PREVIEW OF NEW TV AND RADIO SETS

RADIO & TELEVISION NEWS

SEPTEMBER
1956
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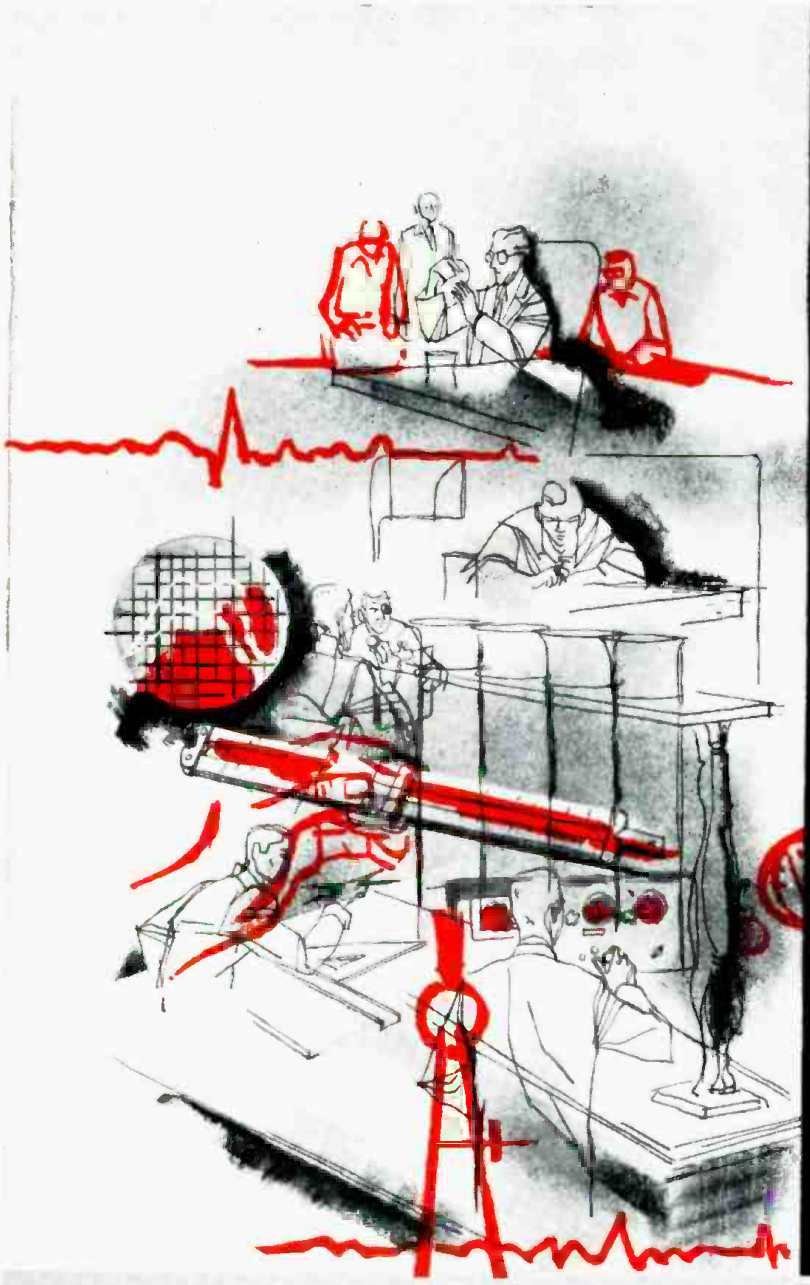
ANC

World's Leading Electronics Magazine

IN THIS ISSUE



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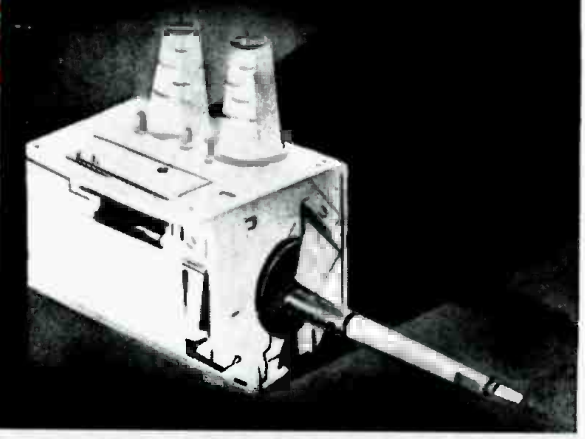

STANDARD factory approved replacement tuners protect servicemen's reputation.

Cut price TV tuners are surplus from a *special* run of a *special design* for one particular model of one particular manufacturer.

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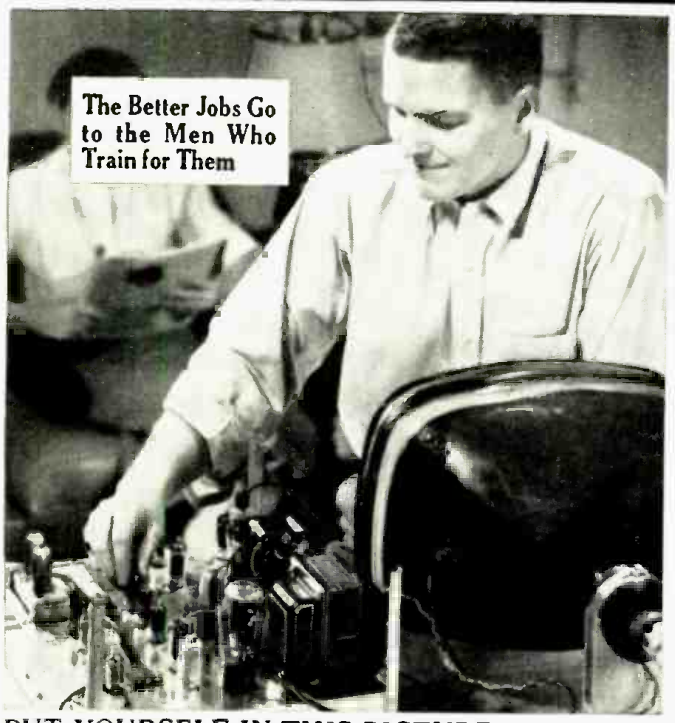
Why Guess? There's a Quick, Sure Way to Find TV Set Troubles



PUT YOURSELF IN THIS PICTURE, experimenting at home with equipment we furnish, getting set to go places in TV servicing. Speed in servicing TV sets means stepped up earnings, greater security for you.

NEW ALL-PRACTICE COURSE Shows How top TV servicemen fix ANY MAKE or model

Home Training includes 17" Picture Tube, components for a TV Receiver, Scope, Signal Generator, HF Probe, all for introductory price under $200 on easy terms.

ACQUIRE SUPERIOR SKILLS AT HOME IN SPARE TIME

TV Servicing . . . real, professional TV Servicing, pays good money to men with specialized knowledge and training. The exciting, expanding TV industry offers more than just good jobs. It offers success, a career to men qualified to render an essential community service.

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ALL LEARN BY DOING

You do more than just build circuits. You get experience aligning TV receivers, isolating complaints from scope patterns, eliminating interference, use geranium crystals to rectify the TV picture signal, adjust the ion trap and dozens of other professional TV Servicing techniques.

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To cash in on the present UHF and the coming Color TV boom you'll need the kind of knowledge and experience this Professional Television Servicing Course gives you. There is no other training like this. Here, condensed into a few months of training at home, is everything that TV servicemen learn in months, even years of bench work. You get practice installing front-end channel selector strips in modern UHF-VHF receivers. You learn UHF servicing problems and their solution. Mail the coupon below. Discover how this new course meets the needs of the man who wants to get ahead in TV Servicing.

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COVER PHOTO: United Air Lines is using small "Minipaks" to speed the loading of cargo and passengers. A unit of this type is shown in use at the Chicago airport where a "Cargo-liner" is being readied for a trip. (Ektachrome by J. E. McWaye, UAL)

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MEN 17-55!

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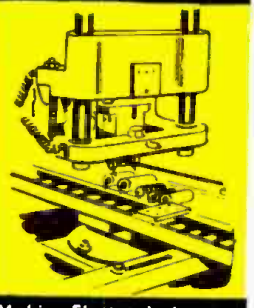
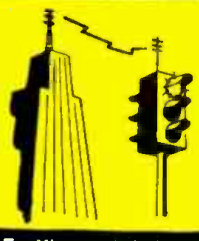


Making Electronic devices

Recording and billing

Anti-aircraft gun control



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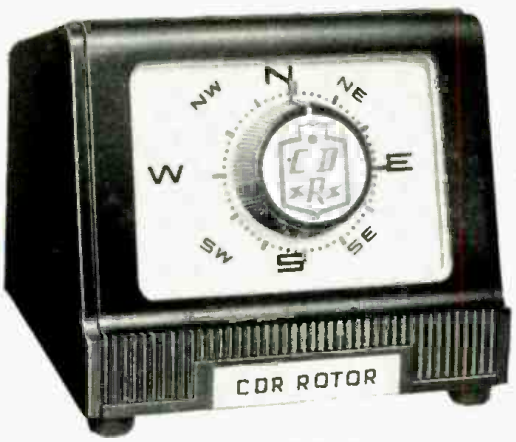

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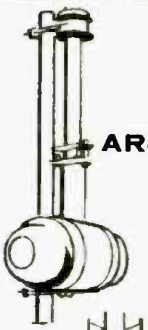

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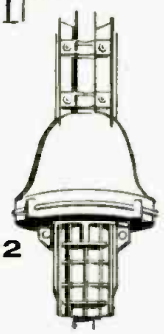

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For the RECORD

DON'T GO BROKE WITH COLOR TV

THERE will be a sizable risk to independent service technicians who, in future months, establish color TV service charges or contract rates that are based on previous monochrome requirements. The very nature of the color television receiver and its behavior is reason enough to anticipate an almost continuous demand for service on a monthly, if not on a weekly, basis for a long period of time.

The widespread public acceptance of color TV has recently been stimulated by a reduction of the list prices on such receivers. This price reduction has caused the public to visit dealers' showrooms in ever increasing numbers.

This cost reduction, unfortunately, is bound to be reflected in the quality of many color television sets reaching the dealers and customers. Because of this inevitable reduction of quality it will create a demand for service never anticipated by this industry—a demand that can be met by only a small minority of service operators who have been specially trained in the maintenance of a particular brand of color set. The leading set manufacturers have trained a substantial number of technicians to maintain the color sets sold by their own distributors. But many other manufacturers have apparently been content to sit back and wait.

Technicians are only kidding themselves if they feel qualified to service color sets using techniques which they themselves have established for black-and-white. New techniques and specially designed test equipment for color is absolutely essential, but even more important is the need for "color know-how."

It is no secret that thousands of color sets will be sold that use a minimum of tubes and circuits. Many will use triple- or quadruple-duty tubes in overworked circuits. Every known shortcut (and a lot of new ones) will be taken to produce sets of minimum standards in an effort to compete and to cut prices.

When these "competitive" color receivers reach the homes of the customers is when the unskilled and unprepared technician will run into real trouble. Most demands for maintenance will simply be "nuisance" calls as a result of aging of components, overloaded tube failures, and the effects of Junior's "skill" with the secondary controls. But there will be many major breakdowns and no longer will the picture tube serve to indicate likely trouble spots (compared to black-and-white).

Antenna requirements will be far more exacting and the orientation more carefully made. New, strange, and precise adjustments will be required on the receiver and a host of new and mysterious circuits will confront the technician.

Customers will be super-critical of their $500 baby and will be quick to heckle the dealer every time that red goes purple or when "Howdy Doody" suddenly turns green. He will soon learn from experience that the performance of the color set can be easily disturbed when the customer decides to play expert. These nuisance calls, and there will be lots of them, will eat up the technician's and dealer's profits at a rate far in excess of those encountered in the maintenance of the monochrome receiver.

Whatever complaints have become routine for monochrome will be multiplied many times in the case of the color set. It is in the interest of the welfare of color technicians of tomorrow that we point to the absolute necessity of anticipating the proportional time requirements for color TV service and to plan and make substantial adjustments when estimating contract requirements and other costs.

If you do not belong to an aggressive Service Association, then we'd like to suggest that you consider the possibility and the advantages of joining. One of the functions of these groups is (or should be) to study and recommend color service charges based on established requirements and the economy of the particular area served by the members. All of the existing service groups should now be giving serious study to the matter of establishing service charges for the maintenance of color TV. It's later than you think!

The most valuable asset of the TV service technician now and in the years to come is the ability to hold and to continually build a trusting clientele. It's taken several years for the average technician to establish a good fundamental relationship with his customers. But when color comes and he is not qualified to maintain a color TV set, he will quickly lose his precious customers to other technicians possessing the "know-how" of color troubleshooting and repair.

Even if color telecasting is not presently available in your area, the technician must prepare now for his future problems. Any service technician not willing to study and who assumes that he can "get by" without knowledge of color circuits is heading towards ultimate failure of his service business. . . . . O. R.

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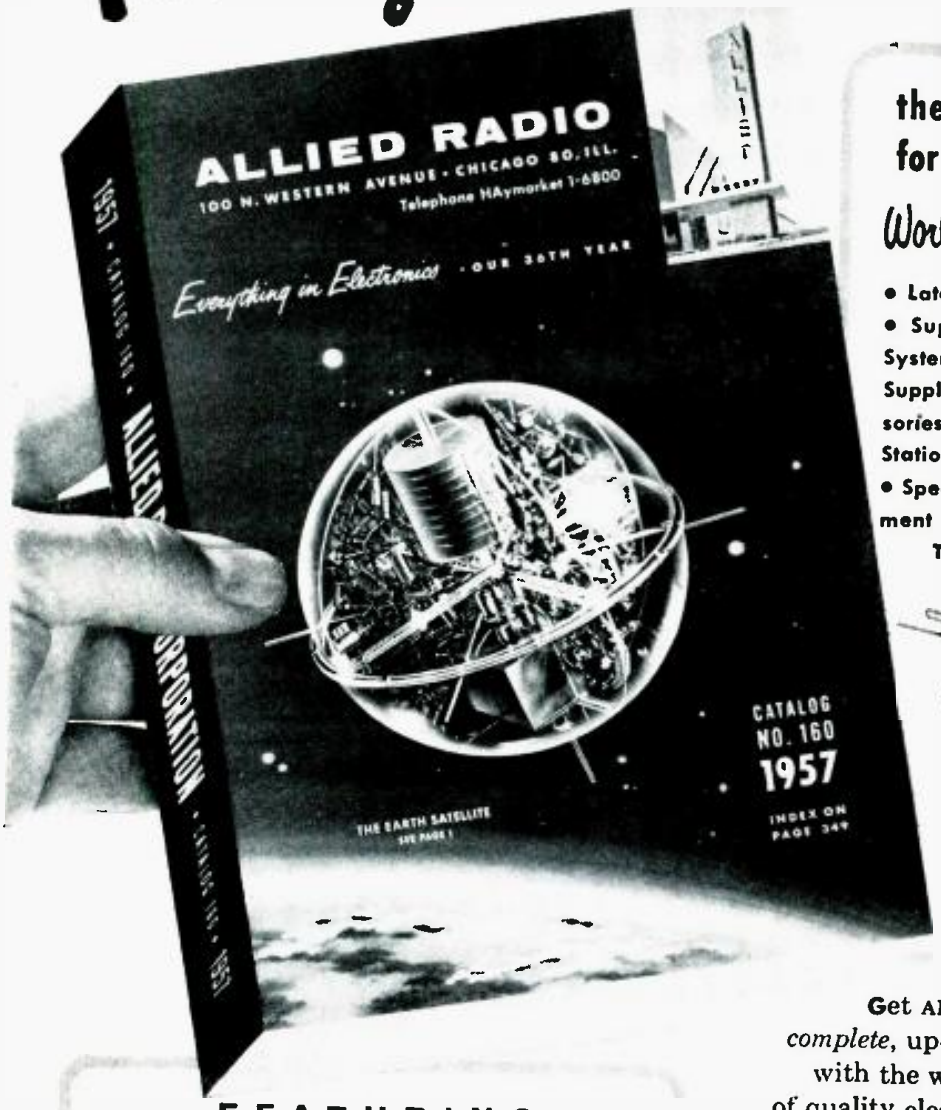

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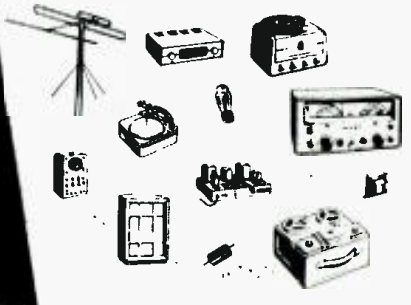

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GAIN CONTROLS: Hi and Lo, 16 db range
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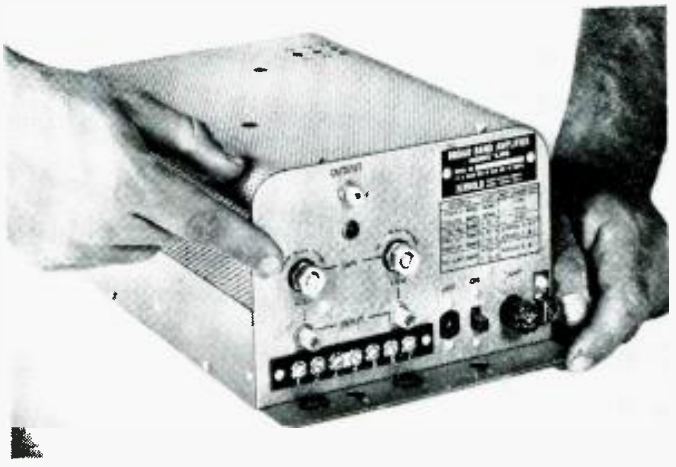
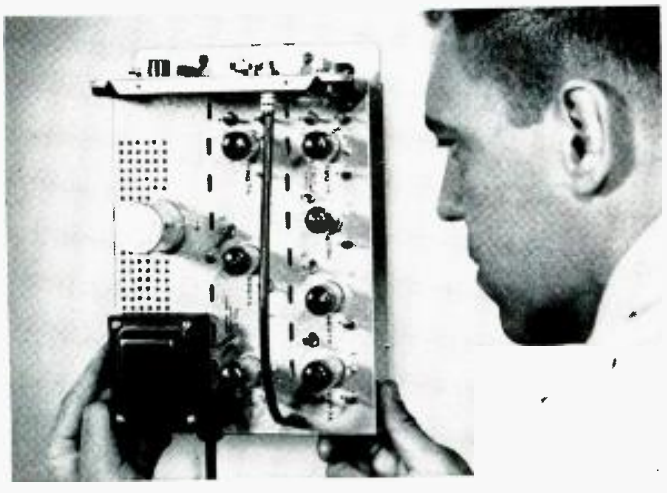
RATED OUTPUT (MAX.): .3v/channel for 9 channel operation
TUBE COMPLEMENT: 4-6BQ7A, 2-12BY7A, 1-6CB6
POWER REQUIREMENTS: 117 volts AC 63 watts

LIST PRICE for MODEL 2300—$164.00
slightly higher west of the Rockies



Universal input circuit permits use of a variety of 72 ohm or 300 ohm antennas—broad band or separate hi-lo arrays. An alignment tilt control (reached through hole in cover) can be adjusted so that the Jerrold Model 2300 will work with various lengths of coax cable without need for external line equalizers. Unit is housed in handsome silver-gray metal housing with perforated cover for ample ventilation.



Model 2300 may be shelf or wall mounted. It may be used singly or in cascade. It has wide application for TV master system use in motels, apartment houses, hotels, schools and for line extenders in community antenna systems.

Jerrold never compromises with quality—that's why Jerrold equipment always means a more consistent and better picture on the TV screen. Yet Jerrold equipment actually costs less to install, is easier to maintain and lasts longer.

For complete information on the Model 2300 broad band amplifier write today for Jerrold Technical Bulletin # 544 or see your nearest Jerrold Distributor.

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Edward Hahn, Illinois. Now an electronics technician with Televisa, Inc. DeVry Tech training helped him prepare for his present position.

Nick Barton, Illinois, a DTI grad, now has his own business and tells us he is "literally snowed with work."

George D. Crouch, California, was a retail store clerk. He took the DeVry Program, and today is in business for himself.

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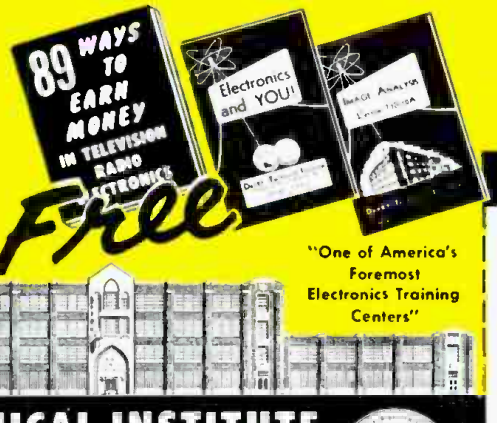

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By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

THE FUTURE OF U.H.F., that it was felt would be firmly resolved by the FCC when its long-awaited new-allocation order was issued, found itself instead surrounded by swirling question marks throughout the ruling. Bluntly, the Commission said that we'll have to see *if* industry can produce a better line of receivers and *if* more efficient transmitters and antennas can be produced.

In the words of one commissioner, industry must launch immediately . . . "an expedited research and development program designed to hasten the day when u.h.f. will be able to assume its proper role in the nationwide television system."

During the first week of October, industry will be asked to submit its official views on the possibilities of the ultra-highs as envisioned by the Commission.

Commenting on the *if* in the new edict, another member of the Commission said that . . . "neither this nor future Commissions will order a move unless there is practical assurance that u.h.f. receiving and transmitting equipment develops a quality of performance equal to v.h.f. It is inconceivable that the present or a future Commission will take any action which would disenfranchise thousands of people now receiving service in the fringe area of a present v.h.f. operation without such assurance.

"Because I have grave doubts as to the eventual feasibility of an all-u.h.f. system," the Commissioner continued, "I consider it to be the sheerest speculation to take steps now which would, for a long time, consign u.h.f. to small and insignificant islands of competition. Even with the best possible improvement of equipment, the best that a u.h.f. operator could show a national or regional advertiser in the future is success in a sheltered harbor. I can see no substantial support forthcoming from the advertisers—the backbone of broadcasting in this country—to a u.h.f. service without proof of competitive ability in a mixed market.

"No petitioner or Commissioner," it was emphasized, "has indicated how this transition from an all-u.h.f. market to a mixed market for v.h.f.'s and u.h.f.'s in the future will be accomplished. . . . At best nothing more is expressed than a hope."

THE VARIETY OF ODD PROBLEMS that surround the electronics program in the forthcoming earth-satellite project, revealed during a recent symposium at the Franklin Institute, have now been compiled into an official report and released by the Institute.

According to the published version, one factor which must be resolved is operational power consumption which, aside from data transmission, depends on size and purpose of the satellite.

Transmission power requirements, it was noted, usually increase with the square of the distance, receiver band-

NEW TV GRANTS SINCE FREEZE LIFT

Continuing the listing of construction permits granted by FCC since lifting of freeze. Additional stations will be carried next month.

STATE	CITY	CALL	CHANNEL	FREQUENCY	POWER*
Minnesota	St. Paul	— — — —	2	54-60	52.2
Virginia	Portsmouth	WAVY-TV	10	192-198	316
Texas	Brownwood	— — — —	19	500-506	.645
NEW CALL LETTER ASSIGNMENTS					
Ohio	Canton	WTLC	29	560-566	
Texas	San Antonio	KONO	12	204-210	
CALL LETTER CHANGES					
Texas	El Paso	KILT (formerly KOKE)	13	210-216	
Oregon	Klamath Falls	KOTI (formerly KFJI-TV)	2	54-60	

*ERP (effective radiated power, kw.)

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Only the Columbia Ⓛⓟ Record Club can make an unprecedented offer like this!

1 Ports of Call
Philadelphia Orchestra, Ormandy, conductor. 6 popular works—*Bolero, Espana, Pavane, Escales,* etc.

2 The Voice
Frank Sinatra in 12 songs that first made him famous — *Lover, Fools Rush In,* etc.

3 King of Swing: Vol. I
Benny Goodman and Original Orch., Trio Quartet. *Riding High, Moonglow*—9 more.

4 My Fair Lady
Percy Faith and his Orchestra play music from this hit show.

5 Mendelssohn: Violin Concerto Tchaikovsky: Violin Concerto
Francescatti, violin; N. Y. Philharmonic, Mitropoulos, conduct.

6 I Love Paris
Michel Legrand and Orch. play *La Vie En Rose, Paris*—12 more.

7 Jazz: Red Hot & Cool
Dave Brubeck Quartet in *Love Walked In, The Duke*—5 more.

8 Levant Plays Gershwin
3 works—Rhapsody In Blue; Concerto in F; An American in Paris.

9 Saturday Night Mood
Dance music by 12 bands—Jimmy Dorsey, Sammy Kaye, etc.

10 Beethoven: Symphony No. 5 Mozart: Symphony No. 40
Philadelphia Orch., Ormandy, conductor.

11 Music of Jerome Kern
Andre Kostelanetz and his Orchestra play 20 Kern favorites.

12 Ambassador Satch
European Concert Recordings by the great Louis Armstrong and his All-Stars.

YES! You may have, FREE, ANY 3 of these best-selling 12" Columbia Ⓛⓟ records. We make this unique offer to introduce you to the money-saving program of the Columbia Ⓛⓟ Record Club . . . a program that selects for you each month the greatest works in every field of music—performed by the worlds finest artists and brilliantly reproduced on Columbia Ⓛⓟ records.

HOW THE CLUB OPERATES

To enjoy the benefits of the Club's program and to receive your 3 records free—mail the coupon, indicating which of the four Club divisions best suits your musical taste: Classical; Jazz; Listening and Dancing; Broadway, Movies, Television and Musical Comedies.

Each month you will receive free the Club Magazine which describes the current selections in all four divisions. You may accept or reject the monthly selection for your division. You may also take records from the other Club divisions. This unique advantage assures you the widest possible choice of recorded entertainment Or you may tell us to send you NO record in any month. Your only obligation is to accept as few as 4 selections from the almost 100 that will be offered during the next 12 months, and you may cancel membership at any time thereafter. The records you want are mailed and billed to you at only $3.98 plus a small mailing charge.

FREE BONUS RECORDS GIVEN REGULARLY

The 3 records sent to you now represent an "advance" of the Club's bonus system—given to you at once. After you have fulfilled your membership obligation by purchasing four records, you will receive an additional free Bonus record of your choice for every two additional Club selections you accept. Bonus records are superb 12" Columbia Ⓛⓟ records—the very best of the world-famous Columbia Ⓛⓟ catalog—just like those shown here. Because you are given a Columbia Ⓛⓟ record free for each two records you purchase from the Club, your membership provides the best buy in records—anywhere.

Indicate on the coupon which 3 records you want free, and the division you prefer. Then mail the coupon at once. You must be delighted with membership or you may cancel without obligation by returning the free records within 10 days.

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Please send me as my FREE gift the 3 records indicated here: (Select the 3 records you want from the list on this page, and circle the corresponding numbers here)

1 2 3 4 5 6 7 8 9 10 11 12

and enroll me in the following Division of the Club. (check one box only)

☐ Classical ☐ Listening and Dancing
☐ Broadway, Movies, Television and Musical Comedies ☐ Jazz

Each month you will send me the Columbia Ⓛⓟ Record Club Magazine which describes the records offered in all four Club divisions. I have the privilege of accepting the monthly selection in the division checked above, or any other selection described, or none at all. My only obligation is to accept a minimum of four records in the next 12 months at the regular list price plus a small mailing charge. After accepting 4 records, I will receive a free Bonus record for every two additional records I purchase. If not delighted with membership, I may cancel within 10 days by returning all records.

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City .... Zone .... State ....

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If you wish to have this membership credited to an established Columbia Records dealer, authorized to accept subscriptions, please fill in the following information:

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Dealer's Address 23

width, and required signal-to-noise ratio in the receiver. A decrease is effected with the square of the transmission frequency and the square of remaining constant, transmission powcordingly, the report says, everything used for pickup and transmission. Ac- the diameter of the parabolic antenna er requirements will increase as the satellites go farther in space.

The use of batteries as auxiliary power supplies was called acceptable, but not dependable for long operational lifetime. The present developmental efforts in the field of solar and nuclear batteries and solar mirror-turbine-generator systems were cited as projects that should produce auxiliary power systems of long operational life, though not necessarily good for severe power drainage.

Elsewhere in the report, in a commentary on antennas and required power output, it was pointed out that for solid earth contact eight symmetrically placed folded dipoles are required. A radiating satellite will require about 12½ watts (average input) to produce 15 watts peak r.f. in each of the eight antennas at 100 mc., it was disclosed. The ratio of low-power input for high-power output can be accomplished, the report continued, by using a radar-type pulse, with a fixed width of about ten microseconds. Pulse spacing, which would be varied by a periodically corrected timing oscillator, would be used to indicate the lapsed time of each orbit period. To produce the required transmitter power, it has been proposed that a nuclear thermopile be used.

THE COMBINATION OF A PHOTOGRAPHER'S idea and the electronic know-how of an engineer have produced a triggering device which will give the Air Force a better pictorial record of its electronic countermeasures tests.

The idea for the electronic trigger has come from John J. Mills, a photographer with the Rome Air Development Center. Assigned to the task of shooting scope photos during electronic countermeasures tests, he noted that improvements could be made over existing mechanical systems. The Mills' plan revolved about the use of a photocell mounted on the scope in such a fashion that the camera's lens would be tripped on each sweep or nod of a radar antenna. To accomplish this, an engineer at the center designed the necessary control box with associated cable and solenoid to complete the triggering setup.

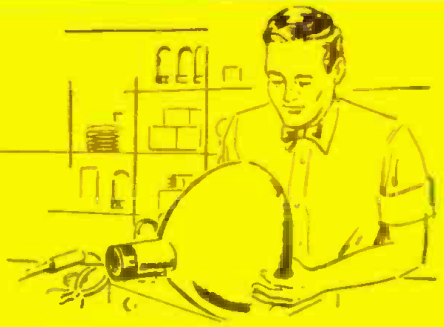
In operation, the photocell, activated by the light from a passing sweep, sends an impulse to the control box. This energy activates the solenoid, which, in turn, closes the shutter, reopens it, and automatically advances the film.

Several improvements and variations have been made on the original camera control. One of these improvements allows two scope cameras to be

(*Continued on page* 175)

WANTED: 200,000 TV SERVICE MEN!

VETERANS
NON-VETERANS



GET IN ON THIS
2 BILLION DOLLAR PLUM!

200,000 — That's how many service men will be needed to handle television-radio-electronics industry requirements in the next few years. That's the figure given by the director of product service for CBS-Columbia — a man in a position to know.

2.7 billion dollars to be spent just for *service* and *installation* of TV sets in American homes by 1957! That's the figure given by one of the top men in the entire industry — the president of Radio Corporation of America.

L. C. Lane, B.S., M.A.
President, Radio-Television Training Association.
Executive Director, Pierce School of Radio & Television.

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Here is a field still in its infancy — New jobs with top pay and a secure future are being created every day — Here is a chance for you to get into a growing field with unlimited opportunity for advancement — Here is your chance to set up your own business and be your own boss — Here is your opportunity to get in on a *2 billion dollar plum* by becoming a Television Technician.

LEARN BY DOING

As part of your training, I give you the equipment you need to set up your own home laboratory and prepare for a BETTER PAY TV JOB. You build and keep an Electromagnetic TV RECEIVER designed and engineered to take any size picture tube up to 21-inch. (10-inch tube furnished. Slight extra cost for larger sizes.) . . also a Super-Het Radio Receiver, AF-RF Signal Generator, Combination Voltmeter-Ammeter-Ohmmeter C-W Telephone Transmitter, Public Address System, AC-DC Power Supply. Everything supplied, including all tubes.

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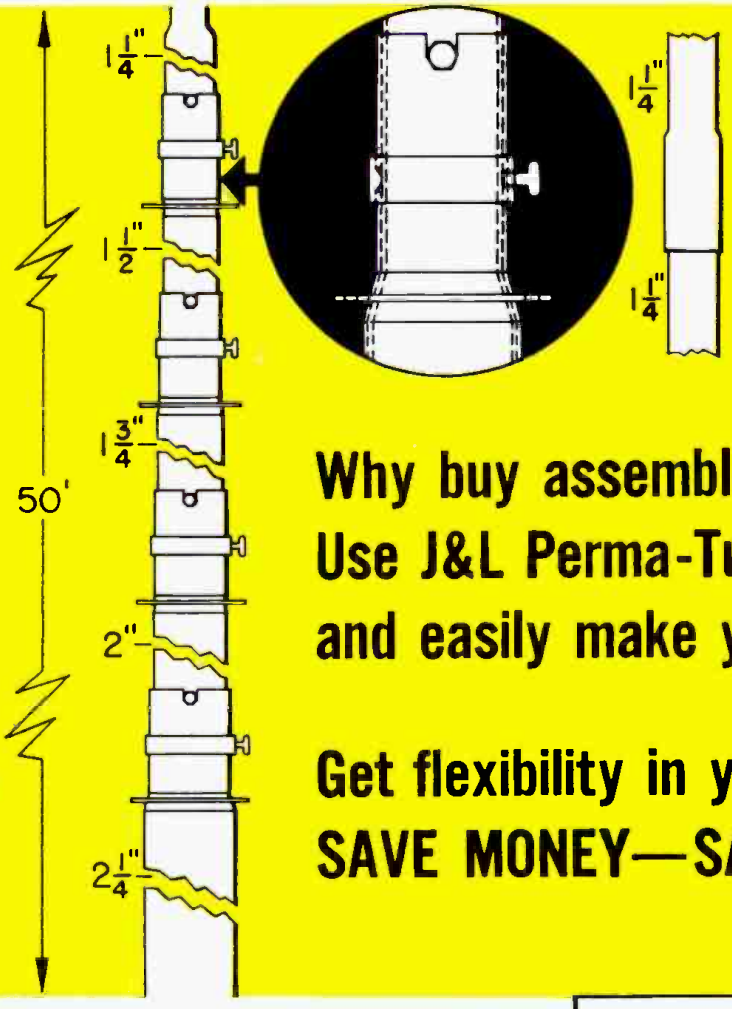

Same 1¼-inch piece of Perma-Tube can be used for telescoping masts or with another 1¼-inch piece to make smaller 2-piece masts.

Why buy assembled telescoping masts? Use J&L Perma-Tube in 10-foot lengths and easily make your own

Get flexibility in your stock SAVE MONEY—SAVE SPACE

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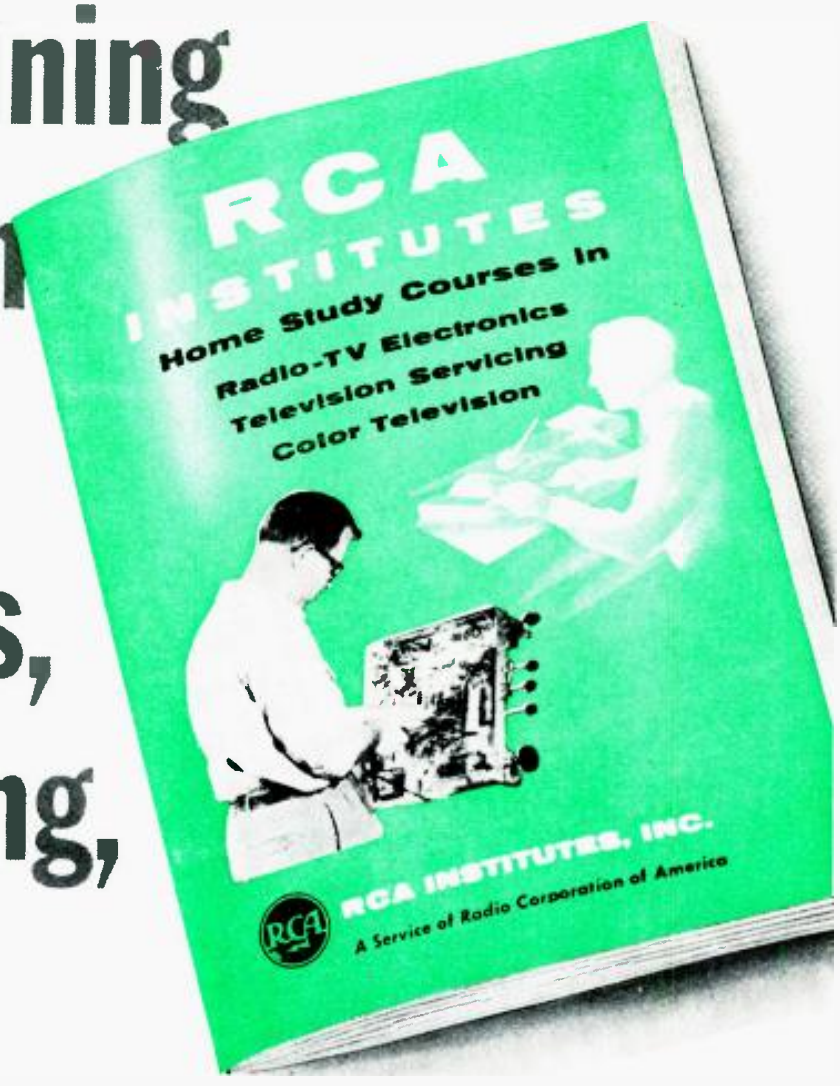

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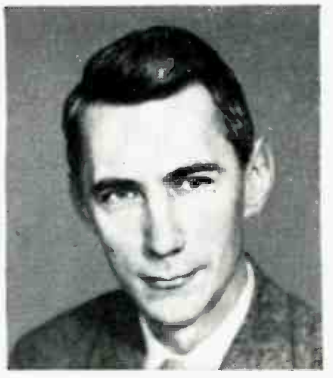
W. G. PFANN. Mathewson Gold Medal, American Institute of Mining and Metallurgical Engineers, for discovery of and pioneering research in zone melting.

H. T. FRIIS. Medal of Honor, Institute of Radio Engineers and Valdemar Poulsen Gold Medal, Danish Academy of Technical Sciences; important work in application of short and ultra-short radio waves.



CLAUDE E. SHANNON. Stuart Ballantine Medal, Franklin Institute of the State of Pennsylvania, for contributions to a comprehensive theory of communication.

AXEL G. JENSEN. David Sarnoff Gold Medal, Society of Motion Picture and Television Engineers, for technical contributions to television; G.A. Hagemann Gold Medal for Industrial Research, Royal Technical College, Copenhagen.

H. F. DODGE. Shewhart Medal, American Society for Quality Control, for original contributions to the art of statisticol quality control.

R. KOMPFNER. Duddell Medal, Physical Society of England, for his original work on the traveling wave tube.

WALTER H. BRATTAIN. Co-winner with Dr. John Bardeen of John Scott Medals, City of Philadelphia, for invention of the transistor.

PIONEERS OF PROGRESS

These are some of our recent medal winners at Bell Laboratories. The awards they have won symbolize recognition for outstanding achievement in the many sciences that bear on telephony. Bell Labs is extremely proud of them—and of the thousands of scientists and engineers who work with them to keep the American telephone system the greatest in the world.

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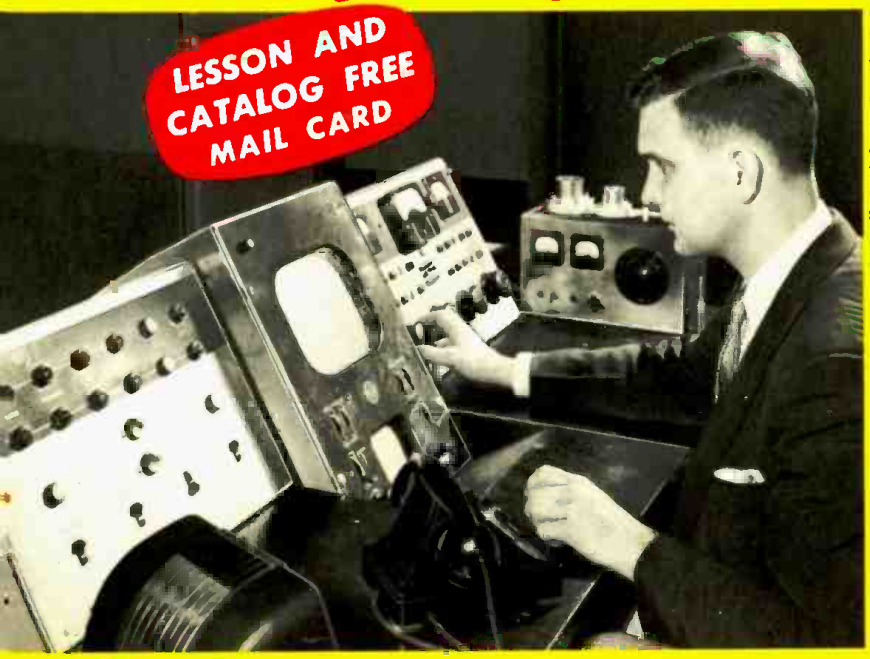
RADIO-TELEVISION

Fast Growing Industry Offers Good Pay, Security, Bright Future



Training PLUS OPPORTUNITY is the ideal combination for success. Today's OPPORTUNITY field is Radio-Television. Over 125 million home Radios plus 30 million sets in cars and 40,000,000 Television sets mean big money, opportunity for trained Radio-Television Technicians. More than 4,000 Radio and TV Broadcasting stations offer interesting and important positions for technicians, operators. Color Television, portable TV sets, Hi-Fi, other developments assure future growth. Radio, Television are both growing. Need for trained technicians is increasing!

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Since 1914—for more than 40 years—N.R.I. has been training ambitious men at home in spare time for Radio-TV. Thousands of successful graduates say N.R.I.'s 50-50 training method is a fast, easy, effective way to higher earnings, desirable jobs. Carefully planned experiments and practice with equipment supplied free of extra charge, bring basic principles, techniques to life right in your own home. Find out what dependable training can do for you.

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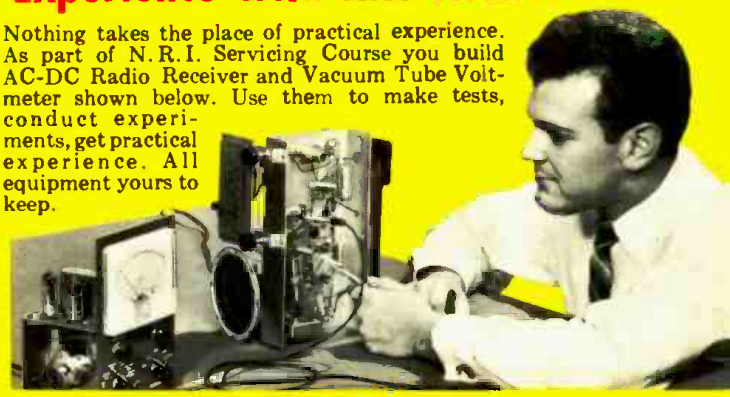

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"I decided to quit my job and do TV work full time. I love my work and am doing all right financially." W. F. KLINE, Cincinnati, Ohio

Engineer with Station WHPE

"I operated a successful Radio repair shop. Then I got a job with WPAQ and now I am an engineer for WHPE." VAN W. WORKMAN, High Point, N. C.

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You build this Signal Generator. Learn how to compensate high frequency amplifiers, practice aligning typical I.F. amplifiers in receiver circuits. Make tests, conduct experiments.

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As part of N.R.I. Communications Course you build this low power Transmitter, learn commercial broadcasting operators' methods, procedures. Train for your FCC Commercial Operator's License.

YOU BUILD Vacuum Tube Voltmeter

Use it to earn extra cash fixing neighbors' sets: bring to life theory you learn from N.R.I.'s easy-to-understand texts.

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"I am Chief Engineer of Station KGCU in Mandan, N. D. I also have my own spare time business servicing high frequency, two-way communications systems." R. BARNETT, Bismarck, N. D.

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"I am doing very well in spare time TV and Radio. Sometimes have three TV jobs waiting and also fix car Radios for garages. I paid for instruments out of earnings." G. F. SEAMAN, New York, N. Y.

Has Own Radio-TV Business

"We have an appliance store with our Radio and TV servicing and get TV repairs. During my Army service, N.R.I. training helped get me a top rated job." W. M. WEIDNER, Fairfax, S. D.

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Here is a line of work that people respect—a vocation where you can advance, win a place for yourself, earn good pay and gain much personal satisfaction in what you are able to do. And you can learn at home in your spare time. Smart fellows everywhere are using their spare time to develop new knowledge, new skills. They know it is the trained man who gets ahead, gets the better job, drives the better car, is respected for what he knows and can do.

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The technical man is looked up to. He should be. He does important work, gets good pay for it. Radio-Television offers that kind of work. There are more than 40 million Televisions, 150 million home and auto Radios. Millions more are sold each year. There are splendid opportunities for the man well trained in Radio-Television Servicing or Broadcasting. Micro-Wave Relay, Aviation and Police Radio, Two-Way Communications for buses, taxis, trucks, etc. are expanding—making more jobs, greater opportunity.

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Keep your job until you're ready for a better one. Learn at home. N.R.I. Courses are planned for men who can study only during spare time. You get many kits to build equipment, get practical experience. You work on circuits common to both Radio and TV. Equipment you build "brings to life" things you learn in N.R.I.'s easy-to-understand texts. Experienced N.R.I. instructors, technicians, specialists devote full time to making sure you get the best and simplest Radio-TV training. Train as fast or as slow as you like.

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N.R.I. Training is practical, thorough. You get the benefit of N.R.I.'s 40 years experience training men for success in Radio-Television. Most successful N.R.I. men start without any knowledge of Radio, many without a high school education. Find out what Radio-Television training can mean to you. Make a decisive move today toward becoming one of that select group—a Radio-TV Technician. Send for Actual Lesson and 64-Page Catalog, both FREE. **NATIONAL RADIO INSTITUTE, Dept. E, Washington, D.C.**

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Seen the new CBS VR Tube Manual? A complete, informative, easy-to-read eight pages. Includes data, theory, and application on voltage regulation and voltage reference. Write for free Bulletin E-267 today.

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WE GUARANTEE YOUR FCC LICENSE

If you fail to pass your Commercial License exam after completing our course, we guarantee to continue your training, without additional cost of any kind, until you successfully obtain your Commercial license.

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Name and Address	License	Time
Walter Eggers, Pacific Grove.....	1st	12 weeks
Paul Reichert, West Salem, Ohio...	2nd	10 weeks
Harold Phipps, LaPorte, Indiana...	1st	28 weeks
John H. Johnson, Boise City, Okla..	2nd	12 weeks
James Faint, Johnstown, Pa.....	1st	26 weeks

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Letter from nationally-known Airlines: "Radio Operators and Radio Mechanics are needed for our company. Periodic wage increase with opportunity for advancement. Both positions include many company benefits such as paid vacations, free flight mileage allowance and group insurance."

Letter from nationally-known manufacturer: "We have a very great need at the present time for radio-electronics technicians and would appreciate any helpful suggestions that you may be able to offer."

These are just a few of the examples of the job offers that come to our office periodically. Some licensed technician filled each of these jobs; it could have been you!

OUR TRAINEES GET JOBS LIKE THESE EVERY MONTH

CHIEF ENGINEER
"Since enrolling with Cleveland Institute I have received my 1st class license, served as a transmitter engineer and am now Chief Engineer of Station WAIN. Also have a Motorola 2-Way Service Station. Thanks to the Institute for making this possible."
Lewis M. Owens, Columbia, Ky.

TEST ENGINEER
"I am pleased to inform you that I recently secured a position as Test Engineer with Melpar, Inc. (Subsidiary of Westinghouse). A substantial salary increase was involved. My Cleveland Institute training played a major role in qualifying me for this position."
Boyd Daugherty, Falls Church, Va.

MAIL COUPON TODAY AND RECEIVE

ALL 3 BOOKLETS FREE!

CARL E. SMITH, Consulting Engineer, President
CLEVELAND INSTITUTE OF RADIO ELECTRONICS
Desk RN-94, 4900 Euclid Bldg., Cleveland 3, Ohio

Member National Home Study Council

Cleveland Institute of Radio Electronics
Desk RN-94, 4900 Euclid Ave., Cleveland 3, O.

Please send Free Booklets prepared to help me get ahead in Electronics. I have had training or experience in Electronics as indicated below:

- ☐ Military
- ☐ Radio-TV Servicing
- ☐ Manufacturing
- ☐ Amateur Radio
- ☐ Broadcasting
- ☐ Home Experimenting
- ☐ Telephone Company
- ☐ Other_____

In what kind of work are you now engaged?_____

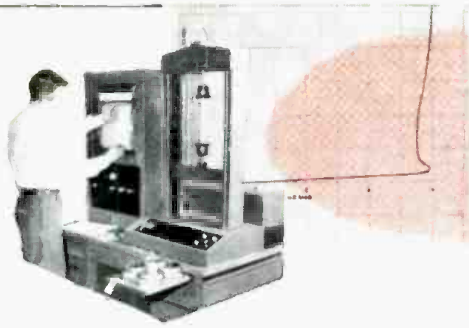
In what branch of Electronics are you interested?_____

Name_____ Age____

Address_____

City_____ Zone____ State_____

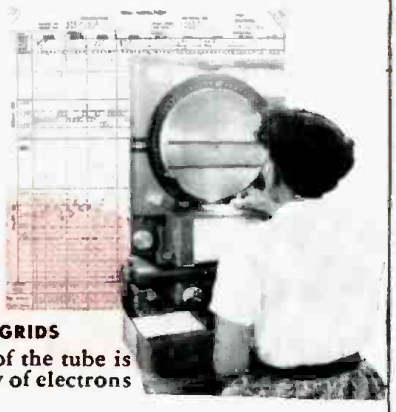
Special Tuition Rates to Members of Armed Forces



INSTRON WIRE TESTING

Testing of grid lateral and filament wire on the Instron Tester for specified physical properties as tensile strength, yield point, breaking point and proportional limit insures better tube quality and uniformity for Raytheon tubes.

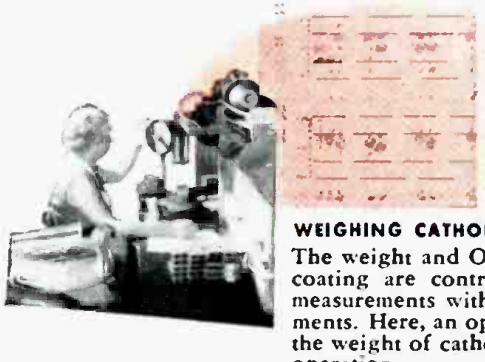
here's why



COMPARATOR INSPECTION OF GRIDS

One of the most critical parts of the tube is the grid which controls the flow of electrons to the plate.

Continuous comparator inspection of critical parts such as the above grid (magnified 20x) *supplies information for better quality control and guards against deviations from Raytheon's high quality standards.*

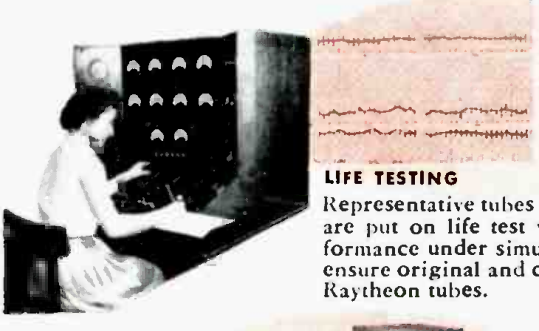


WEIGHING CATHODE COATING

The weight and O.D. of the cathode coating are controlled by periodic measurements with precision instruments. Here, an operator is checking the weight of cathode coating at the operation.

HEATER COATING CHECK

Heater wire must have uniform and closely toleranced coating thickness to insure short and uniform warm-up-time and durability. Raytheon makes continuous inspections of the heater wire coating to make certain of uniformity.



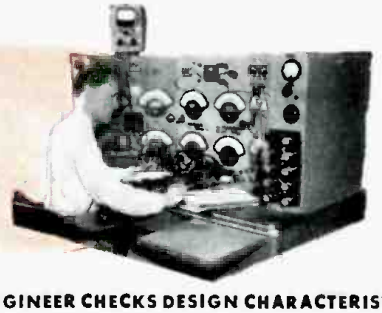
LIFE TESTING

Representative tubes of all tube production lots are put on life test which measures tube performance under simulated actual conditions to ensure original and continuing performance of Raytheon tubes.

1ST FINISHED TUBE TEST

All Raytheon tubes undergo a rigid 100% First Test where they must pass strict requirements on both physical and electrical characteristics.

These girls are testing tubes for excessive noise and microphonics, inoperative tubes, specified electrical characteristics and physical appearance.



ENGINEER CHECKS DESIGN CHARACTERISTICS

Behind all these quality activities stands a large group of experienced, capable engineers whose sole concern is maintaining and developing Raytheon tube quality performance. This engineer is measuring tube design characteristics with the purpose of developing a tube for a customer with special applications.

These and many other vital tests and checks add up to
UNIFORMITY OF CHARACTERISTICS THROUGH RIGID QUALITY CONTROL

RAYTHEON MANUFACTURING COMPANY
Receiving and Cathode Ray Tube Operations
Newton, Mass. • Chicago, Ill. • Atlanta, Ga. • Los Angeles, Calif.

Raytheon makes all these: Receiving and Picture Tubes, Reliable Subminiature and Miniature Tubes, Semiconductor Diodes and Transistors, Nucleonic Tubes, Microwave Tubes.

Within the Industry

DR. W. R. G. BAKER, a *General Electric Company* vice-president and general manager of its Electronics Division at Syracuse, N. Y., has been elected president of the Radio-Electronics - Television Manufacturers Association, succeeding H Leslie Hoffman, president of the *Hoffman Electronic Corp.* of Los Angeles.

The new RETMA president is one of the world's pioneers in the field of electronics with 40 years of experience in telecommunications work. He has been a member of the Board of Directors of the RETMA and director of its engineering department since 1934.

In his latter capacity, Dr. Baker served as chairman of two National Television Systems Committees which developed standards for black-and-white television in 1941 and color television in 1953. He was awarded the RETMA "Medal of Honor" in 1953 for his outstanding contributions to the industry.

* * *

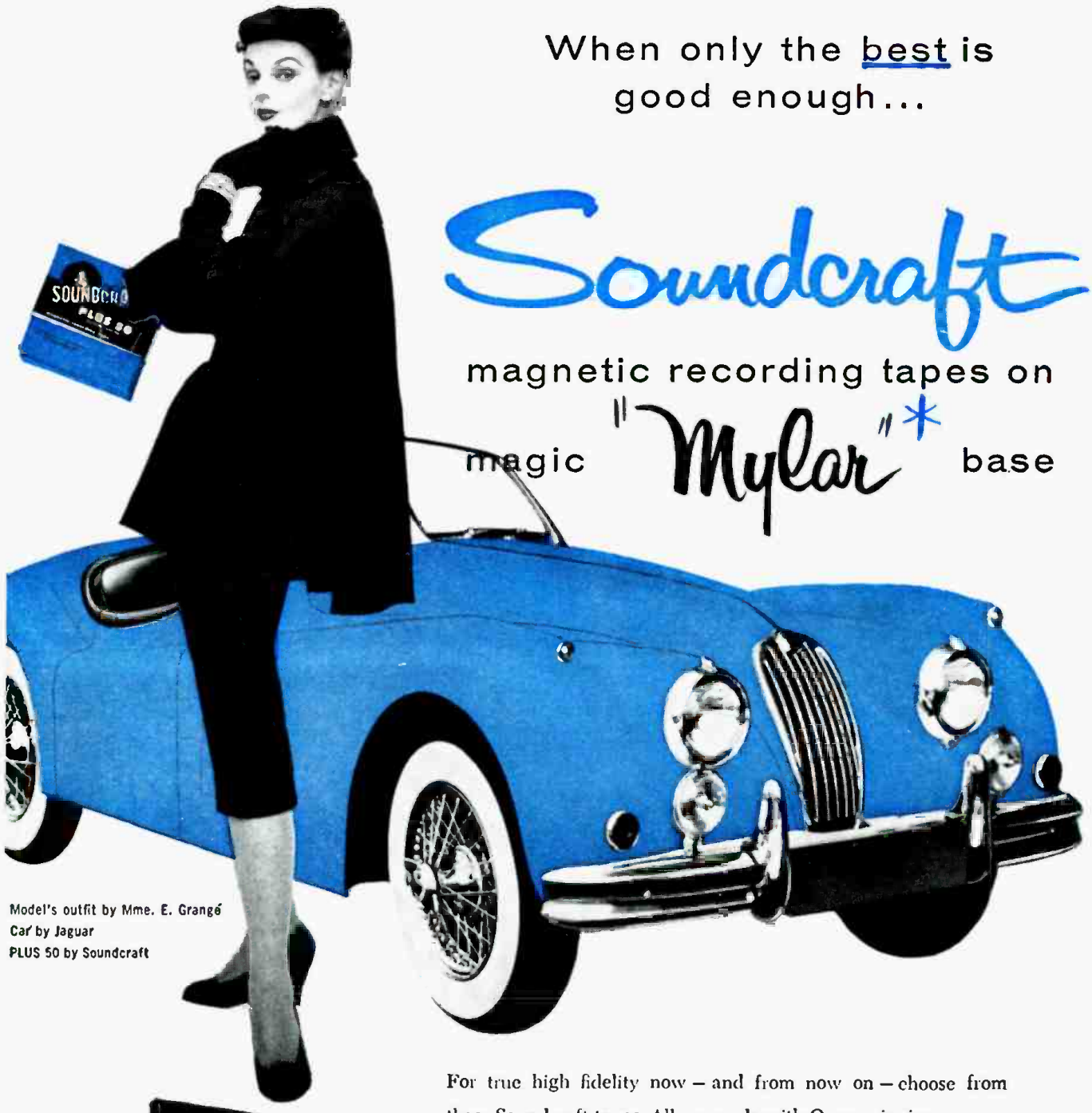
DR. RODOLFO M. SORIA has been named vice-president of engineering by *Amphenol Electronics Corporation* of Chicago. He was formerly director of engineering for the firm . . . **HOBART H. HARTONG** is the new chief engineer of the Joliet, Illinois, plant of *Phillips Control Corp.* . . . The election of **WALTER W. FINKE** as president of *Datamatic Corporation* has been announced by the board of directors. He was formerly vice-president and general manager of the firm . . . *The Cabinart Division of G & H Wood Products Company* has named **LEN BATES** to the post of production manager . . . **SOL SCHNEIDERMAN** has been added to the staff of *Radio Receptor Co., Inc.*, as a senior project engineer . . . **JOHN E. MEADE** has been appointed director of engineering for the Electronics Division of *American Machine & Foundry Company* of Boston . . . *Aerovox Corporation* has appointed **FRANK L. MARSHALL** to the post of vice-president and general manager of its West Coast operation . . . **FRANK A. POOR,** founder and vice-chairman of *Sylvania Electric Products Inc.*, died recently in Wolfeboro, New Hampshire, after a brief illness. He was 76 years old . . . **THOMAS G. FIELDER** has been appointed manager of advertising and sales promotion for the Television Receiver Department of *General Electric Company*. He will make his headquarters in Syracuse . . . **GAIL S. CARTER** is the new sales manager of *Pentron Corporation*, Chicago tape recorder manufacturer . . . **IRA J. KAAR** has been elected vice-president and engineering director for *Hoffman Electronics Corporation*. The post is a new one with the company . . . Appointment of **E. J. NORMAN** as sales manager has been announced by *Hycon Electronics, Inc.*, of Pasadena, California . . . **GEORGE C. ISHAM** has been named general merchandising manager of Electric Products Sales Department of *Sylvania Electric Products Inc.* He has been with the firm since 1936 . . . **MAJOR GENERAL FRANCIS H. LANAHAN,** U.S.A. (Ret.) has been elected executive vice-president of *Federal Electric Corporation* of Lodi, New Jersey, an *I. T. & T.* subsidiary . . . **HAROLD S. GENEEN** has been named executive vice-president of *Raytheon Manufacturing Company*, after resigning his post as vice-president and controller of *Jones & Laughlin Steel Corporation* of Pittsburgh . . . *Howard W. Sams & Co., Inc.*, of Indianapolis has named **JAMES R. RONK** vice-president of engineering to head the firm's new research and product development division and **LESTER H. NELSON** as general manager of production . . . *Chromatic Television Laboratories, Inc.*, has named **ALBERT A. CHESNES** to the post of technical director . . . The distributor sales group of the West Coast Electronic Manufacturers Association has elected **L. W. HOWARD** chairman for the next year.

COLONEL GEORGE P. DIXON, a retired Army Signal Corps veteran of both World Wars, died recently at the Georgetown University Hospital in Washington at the age of 67. Well known in communication and military circles for over four decades, Colonel Dixon is best remembered for his work as Executive Secretary and Executive Vice-President of the Armed Forces Communications Electronics Association and as Editor of the Association's journal "Signal." Upon his retirement from the Signal Corps after World War II, he served as a vice-president of I. T. & T. until his retirement in 1950. He served the AFCA from 1950, and as its vice-president and editor since 1953.

When only the best is good enough...

Soundcraft

magnetic recording tapes on magic "Mylar"* base



Model's outfit by Mme. E. Grangé
Car by Jaguar
PLUS 50 by Soundcraft

*DuPont trademark

For true high fidelity now – and from now on – choose from these Soundcraft tapes. All are made with Oscar-winning Soundcraft oxide on extra-strong "Mylar" base.

PLUS 50 – get 50% longer play
PLUS 100 – twice as much on a reel
"LIFETIME" – guaranteed for life

FOR EVERY SOUND REASON

REEVES SOUNDCRAFT CORP.
10 East 52nd Street, New York 22, N. Y.

He is president of *Triad Transformer Corporation* of Venice, California . . . **REAR ADMIRAL JOSEPH I. TAYLOR,** U.S. Navy (Ret.), has been appointed coordinator of plans and programs for the Government and Industrial Products Division of *The Magnavox Company* . . . **HAROLD A. STRICKLAND, JR.,** has been named general manager of *General Electric Company's* newly established industrial electronics division . . . **DR. HOWARD I. OSHRY** is the new chief research physicist for *Aerovox Corporation* of New Bedford, Mass. He was formerly with *Erie Resistor Corp.* . . . **DONALD J. HUGHES** has been named advertising manager of the Electronic Products Sales Department of *Sylvania Electric Products Inc.* He will make his headquarters at the company's executive offices in New York.

* * *

DOUGLAS H. CARPENTER, formerly chief engineer of *JFD Mfg. Co. Inc.* of Brooklyn, N. Y., has opened a consulting office at 19 West 44th Street, New York, N. Y.

His new firm will deal with various organizations in the electronic and electro-mechanical industries in addition to doing public relations work in association with another New York organization.

Before joining *JFD*, Mr. Carpenter held positions with *McMurdo Silver Co.* of Hartford, Conn., *La Pointe Plascomold Corp.* (*Vee-D-X*) of Rockville, Conn., and *Sommitt Engineering Co.* of Hartford, Conn.

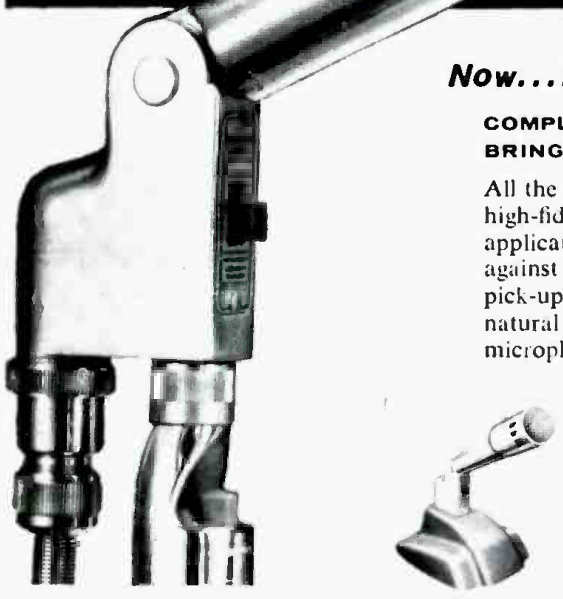
His other industry activities include chairmanship of the executive committee antenna section of the RETMA in addition to holding a similar position as head of RETMA engineering committee 31C.

* * *

TECHNICAL ELECTRONICS CORPORATION of Culver City, California, has been acquired by **CONSOLIDATED ELECTRONICS INDUSTRIES CORPORATION** of New York and will be operated as a West Coast subsidiary of the parent firm's **A. W. HAYDON DIVISION** . . . The **STERLING ENGINEERING DIVISION OF AMF** has been made a subsidiary of **POTTER & BRUMFIELD, INC.,** of Princeton, Indiana, to coordinate production, research and engineering, and marketing of the two companies, both of which manufacture electrical relay switches . . . **BENRUS WATCH COMPANY** has purchased **PIC DESIGN CORP.** of Lynbrook, New York, in a move to diversify its operations. It will operate as a division of the parent firm . . . **NUCLEAR CORPORATION OF AMERICA, INC.** of New York has acquired **CENTRAL SALES & MANUFACTURING CORPORATION** of Denville, N. J., which will be operated as a wholly owned subsidiary of the parent firm under the name **CENTRAL ELECTRONIC MANUFACTURERS, INC.** . . . Management of **CONTINENTAL ELECTRIC CO.** of Geneva, Illinois, has passed

(*Continued on page* 178)

...STOP UNWANTED SOUNDS



Now...Broadcast Performance Designed for Public Address

COMPLETELY NEW ALL-PURPOSE CARDIOID DYNAMIC MICROPHONE BRINGS NEW EFFICIENCY OVER WIDE FREQUENCY RANGE

All the advantages of the E-V Variable D* are now available in the new high-fidelity "664"...for public address, recording, communications and similar applications. Uniform cardioid polar pattern provides high front-to-back discrimination against unwanted sounds, without close-talking boominess. Easily solves sound pick-up and reproduction problems under a great variety of conditions. Gives distinct, natural reproduction of voice and music. Increases working distance from microphone. Gives greater protection against feedback. Especially useful where ambient noise and severe reverberation exist. Pop-proof filter minimizes wind and breath blasts. E-V Acoustalloy diaphragm guarantees smooth wide-range reproduction. Can be used on a floor or desk stand or carried in the hand. No finer microphone for performance and value! *Write for Technical Specification Sheet 664-N69.*

*EV Pat. Pend.

Model 664. Variable D* Super-Cardioid Dynamic Microphone. Uniform response at all frequencies from 40 to 15,000 cps. Output level —55 db. 150 ohm and high impedance. Impedance changed by moving one connection in connector. Line balanced to ground and phased. Acoustalloy diaphragm, shielded from dust and magnetic particles. Alnico V and Armco magnetic iron in non-welded circuit. Swivel permits aiming directly at sound source for most effective pick-up. Pressure cast case. ⅝"—27 thread. Satin chrome finish. 18 ft. cable with MC4M connector. On-Off switch. Size: 1⅞ in. diam. 7⅜ in. long not including stud. Net wt.: 1 lb. 10 oz. List Price **$82.50**

Model 419 Desk Stand. For use with the "664." List Price **$10.00.**

Electro-Voice®

ELECTRO-VOICE, INC. • BUCHANAN, MICH.

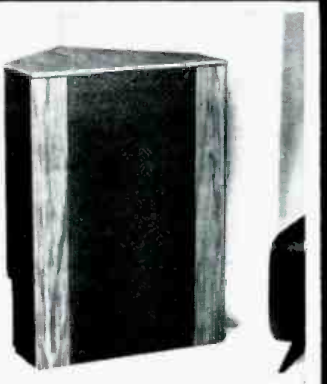
Export: 13 East 40th Street, New York 16, N. Y. U. S. A. Cables: Arlab

HIGH-FIDELITY MICROPHONES • SPEAKER SYSTEMS • PHONO-CARTRIDGES • AND OTHER ELECTRO-ACOUSTIC PRODUCTS

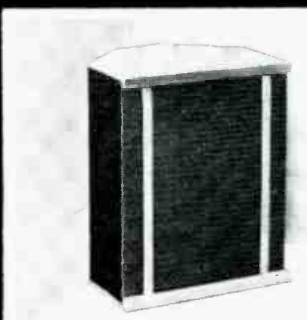
FOR THE FIRST TIME IN HI-FI HISTORY...

cabinart pfk pre-finished Kits!

That's right! Now you can buy a loudspeaker enclosure in kit form whether you are a do-it-yourselfer or a don't-do-it-yourselfer. No more messing with shellac, furniture stain, varnish, wood putty, rags and the rest of the gookum . . . this time you *really* need only a screwdriver to assemble a superb piece of cabinet-work with that supremely professional "CABINART" finish. Each enclosure comes with every outside piece pre-finished in beautiful hand-rubbed korina or mahogany veneers. The assembled kits are absolutely indistinguishable from their world-famous factory-assembled "CABINART" counterparts. Best of all, the money you would otherwise spend on finishing tools and materials more than makes up the price difference between a pre-finished kit and an unfinished kit.

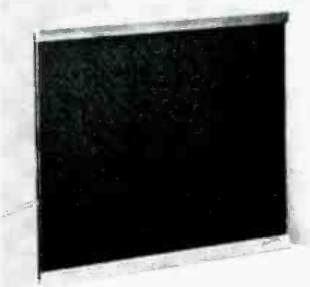


Model PFK-300
(pfK=Pre-Finished Kit)
Pre-finished kit version of the REBEL 3, CABINART's famous Klipsch-designed corner horn for 15" speaker systems. Response down to nearly 30 cps.
Shipping Wt. 61 lbs. **$72.00 net**
Model K-3, unfinished kit version of same.....$49.50 net
Model KR-3, factory-assembled and finished version of same.....$99.00 net



Model PFK-500
(pfK=Pre-Finished Kit)
Pre-finished kit version of the REBEL 5, the extra-compact CABINART corner horn designed by Paul Klipsch for 8" and 12" speaker systems.
Shipping Weight 34 lbs. **$36.00 net**
Model KR-5, factory-assembled and finished version of same.....$48.00 net
Model K-5, unfinished kit version of same.....$24.00 net

Model PFK-120/150
(pfK=Pre-Finished Kit)
Pre-finished kit version of the REBEL 4, Paul Klipsch-designed CABINART corner horn for 12" or 15" speaker systems.
PFK-120, for 12" woofer drivers:
Shipping Weight 42 lbs.....$48.00 net
Model K-12, unfinished kit.....$36.00 net
Model KR-4/12, factory-assembled and finished version of same.....$69.00 net
PFK-150, for 15" woofer drivers:
Shipping Weight 48 lbs.....$58.00 net
Model K-15, unfinished kit.....$42.00 net
Model KR-4/15, factory-assembled and finished version of same.....$87.00 net



Model P-610/630
Pre-finished versions of the CABINART Model 61/63 kits (folded corner horns) for 12" and 15" speakers, respectively.
P-610, for 12" speakers:
Shipping Wt. 39 lbs.....**$25.95 net**
Model 61 unfinished kit version of same.....$19.95 net
P-630, for 15" speakers:
Shipping Wt. 39 lbs.....**$29.95 net**
Model 63, unfinished kit version of same.....$23.95 net

pfK Cabinart

. . . and don't forget—
CABINART can supply you with 16 other hi-fi kits, 29 kinds of equipment cabinets, 4 matched speaker systems and 20 different hi-fi accessories.

Write For Complete cabinart '57 Catalog

cabinart

CABINART FURNITURE IS MANUFACTURED BY G & H WOOD PRODUCTS COMPANY, 99 NORTH 11 ST., BROOKLYN 11, N. Y.

CHANNEL MASTER

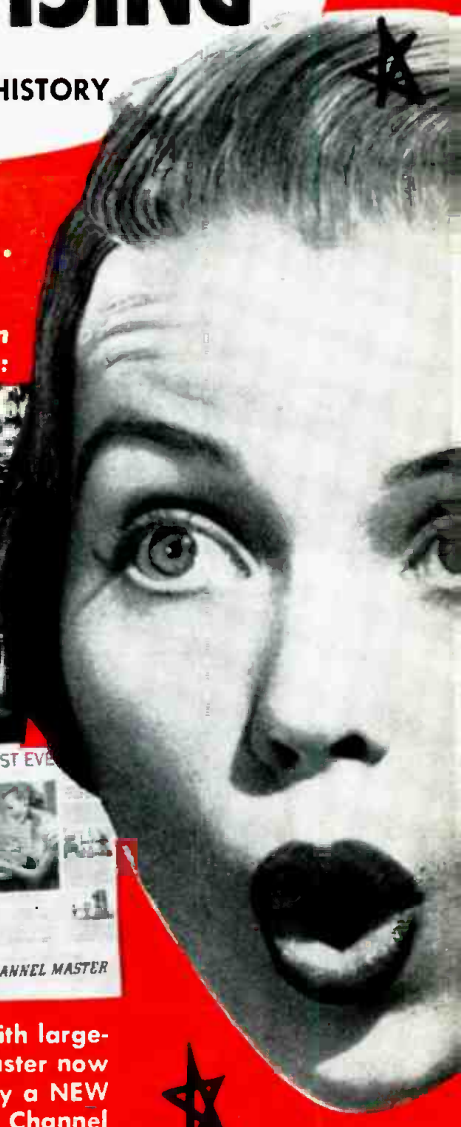
Explodes a Spectacular Campaign of

NATIONAL CONSUMER MAGAZINE ADVERTISING

THE FIRST PROGRAM OF ITS KIND IN TV ANTENNA HISTORY

2-Page Spreads . . . Full-Page Ads . . . Full-Color Ads . . .

reaching into millions of American homes on the pages of these outstanding magazines:

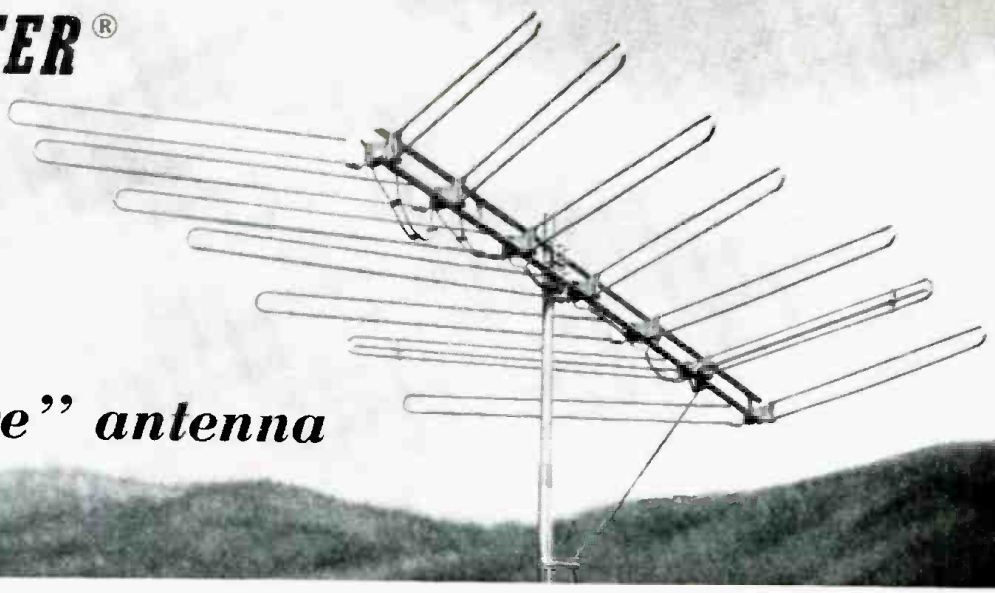


CHANNEL MASTER REVOLUTIONIZES ANTENNA MERCHANDISING! With large-scale national advertising and traffic-building local promotions, Channel Master now places TV antennas on the *same retail level as traffic appliances*. It's actually a NEW WAY for you to sell antennas — and sell *more* of them. Climb aboard the Channel Master brandwagon and tie in with these profit-making promotions. Get details from your Channel Master distributor.

NEW MARKETS . . . NEW CUSTOMERS . . . FOR THESE 2 GREAT NEW ANTENNAS

CHANNEL MASTER®

T-W



the world's first "Travelling Wave" antenna

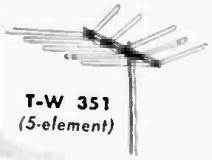
WHAT THE "TRAVELLING WAVE" PRINCIPLE MEANS—

- ideal phase relationships on *all* channels
- optimum impedance matching on *all* channels
- equal flow of current in all dipoles on *all* channels
- fullest use of transmitted energy on *all* channels

IN SHORT — FABULOUS PERFORMANCE ON ALL CHANNELS

SENSATIONAL 3- AND 5-ELEMENT MODELS!

Amazing T-W performance for suburban and near-fringe areas, too! Wonderfully compact and rugged!



T-W 351 *(5-element)*

T-W 352 *(3-element)*

revolutionary new design provides picture quality never before possible

After two years of research—a completely new kind of VHF antenna, operating on revolutionary new electronic principles. The T-W is Channel Master's greatest antenna achievement.

ALL THREE — IN ONE ALL-CHANNEL ANTENNA

1 *HIGHEST GAINS*

Most powerful all-channel antenna ever developed. A single-bay T-W 350 (7-element) actually OUTPERFORMS—

any wide-spaced 5-element Yagi on each low band channel.

any stacked 10-element Yagi on each high band channel.

2 *TOP FRONT-TO-BACK RATIOS*

Low Band:

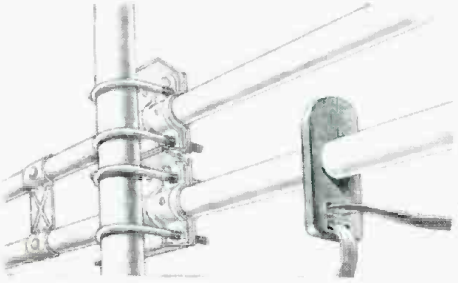
Better than 10:1 on every channel. HIGHER THAN ANY 10-ELEMENT SINGLE CHANNEL YAGI ON ALL CHANNELS!

High Band:

From 5:1 to 12:1. HIGHEST RATIOS OF ANY SINGLE ALL CHANNEL ANTENNA.

3 *GREATEST MECHANICAL STRENGTH*

The most rugged antenna ever built. "Twin Truss" design amplifies the strength of every component. And new mechanical features add still greater durability . . .



"Twin Booms" . . . *Two full-length crossarms—really rugged and rigid.*

2 "Super-Nests" *One heavy-duty mast clamp on each crossboom . A TOTAL OF 4 U-BOLTS! Antenna cannot move.*

"Line-Lok" . . . . . *Twinlead can't possibly tear away from terminals..*

PROOF OF THE SUPERIORITY OF "TWIN-TRUSS" CONSTRUCTION

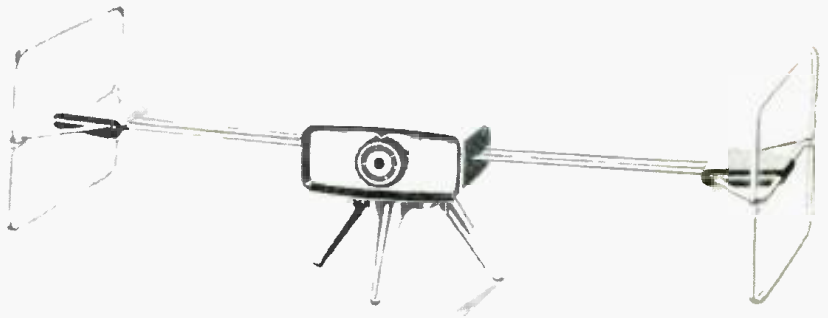
Look at the dramatic result when equal weights are hung on a T-W and a standard 10-element Yagi!

Write for complete technical literature.

®-Trade Mark Reg. U.S. Pat. Off.

CHANNEL MASTER® "Showman"

new "Metro-Dyne" tuning obsoletes "Rabbit-Ears"



the first basic indoor antenna improvement in over 10 years

Channel Master sets an exciting new trend in TV antennas with the Showman. In appearance (so important in the sale of indoor antennas) the Showman is in a dazzling class by itself. Yet, it's a complex electronic instrument—the most powerful indoor antenna yet developed by modern science!

The SHOWMAN is perfect for color reception, tops for black-and-white. And, it provides excellent FM reception, too!

ACTUALLY TUNES OUT "GHOSTS" AND "SNOW"!
MORE EFFECTIVE THAN ANY OTHER INDOOR ANTENNA!

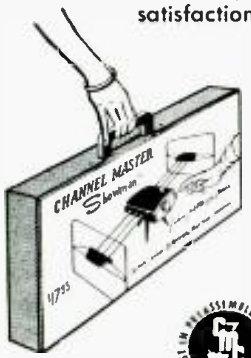
With ordinary indoor antennas

With the Showman

Metropolitan areas, where indoor antennas are most frequently used, are often subject to the most severe "ghosting" problems. Only the SHOWMAN, with its sensational new Metro-Dyne tuning, can overcome this difficulty. You'll be amazed at the job it does on all kinds of interference. Test it for yourself! Demonstrate it for your customers!

Channel Master stands squarely behind every SHOWMAN you sell. An unconditional money-back guarantee assures your customer of complete satisfaction.

UNCONDITIONAL MONEY-BACK GUARANTEE



"High fashion" packaging. Attractive, convenient. Ideal for display.

Available in three "decor designs"—to blend with any setting.

Mahogany and Gold	Blond and Gold	Ebony and Silver
model no. 3900	*model no.* 3901	*model no.* 3902

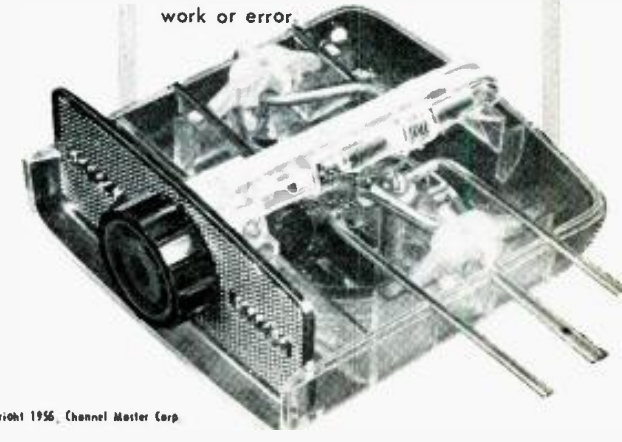
what makes the "Showman" different?

FABULOUS "METRO-DYNE" TUNING!

The Metro-Dyne 12-Channel "Variable Inductance" Tuner

Ordinary switch-type antennas work by connecting various element into different combinations. METRO-DYNE tuning, on the other hand, is "variable inductance" tuning, using the same tuning principles as any TV set. It is the first broad band antenna which can be tuned to a specific channel so that it exhibits the band width characteristics of a single-channel Yagi. This selectivity cuts down tremendously on "electronic noise" and interference. A built-in auto transformer maintains a constant 300 ohm impedance match.

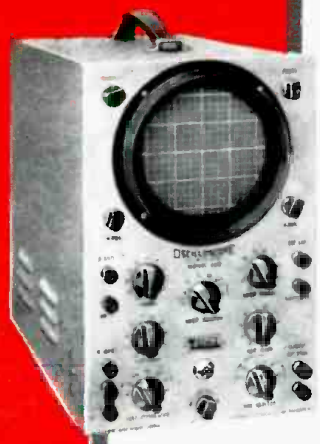
EASY OPERATION: the Showman is calibrated by channels. Just turn it to the same channel number as the TV set. No arms to adjust; no guesswork or error.



CHANNEL MASTER CORP. ELLENVILLE, N. Y.

the world's largest manufacturer of television antennas and accessories

NEW! COLOR and Black-&-White LAB & TV 5" OSCILLOSCOPE #460
KIT $79.95. Wired $129.50



The FINEST professional 5 mc wide-band scope value. Ideal for research, h-f & complex waves, plus Color & Monochrome TV servicing. Flat from DC to 3.58 mc ±1 db (color burst freq.), flat DC to 4.5 mc +1, −3 db. Vert. sens. 25 rms mv/in. Vert. Z 3 megs. Has the following outstanding features not found in scopes up to several times its price, kit or wired:

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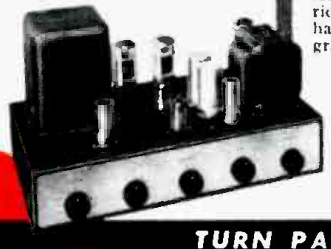

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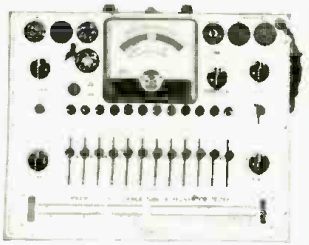

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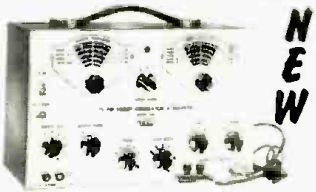

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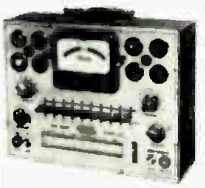

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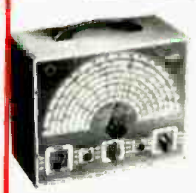

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- fast check all flybacks & yokes in or out of set.
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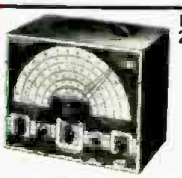

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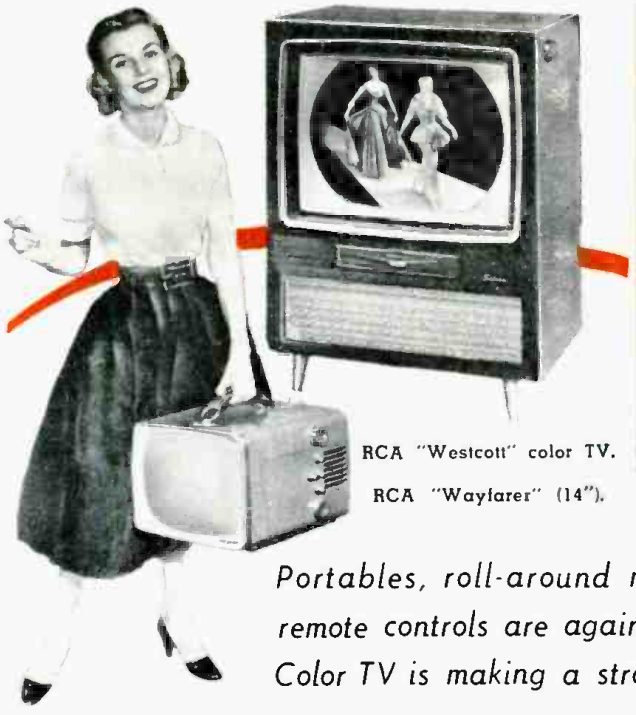


RCA "Westcott" color TV.

RCA "Wayfarer" (14").

Portables, roll-around models, and remote controls are again in the fore. Color TV is making a strong showing.

TELEVISION and radio manufacturers are presenting new models this fall designed for every purpose and pocketbook. Lightweight TV portables are featured and, as a matter of fact, the complete home entertainment center can now be transferred outdoors. The *RCA* "Wayfarer" portable is representative of the 14-inch size. The *Du Mont* "Brewster" 17-inch portable features an accessory roll-about cart. Other popular sizes are 8½ and 10½ inches.

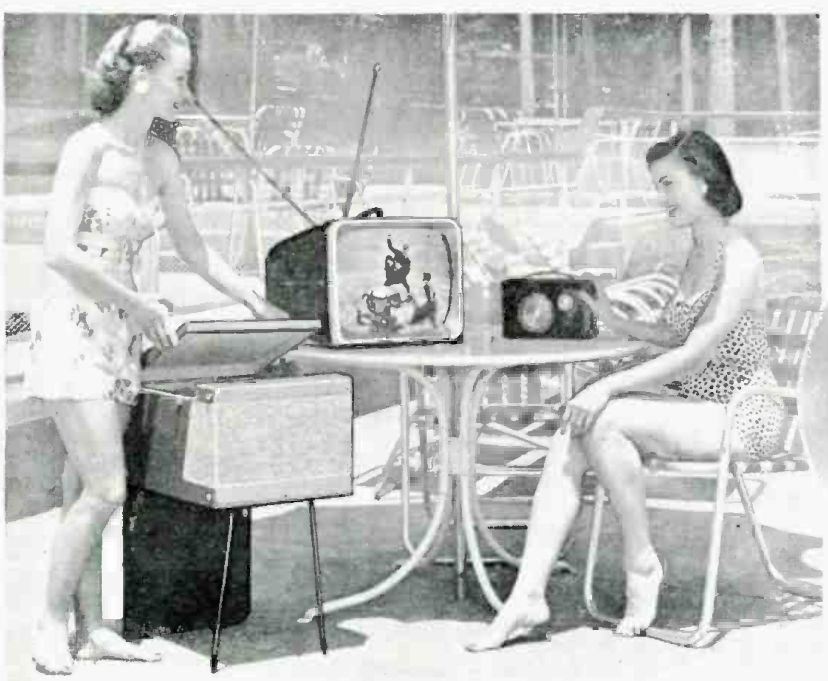
This year also promises to be big news for color television. *RCA* is now offering table model color TV sets at below $500. Part of the 10-model *RCA* color TV line is the "Westcott," selling at the nationally advertised price of $595.

Remote control will be merchandised very heavily this fall. Among the new remote control devices is the *Du Mont* "Dial-O-Matic" unit for $49.95. This unit has a telephone-type dial to select the channel desired; "on-off," volume, and brightness controls are also included.

The three manufacturers whose lines are previewed here are also marketing high-fidelity phonographs. The units manufactured by *Philco* feature the new "Cathedral" electrostatic speaker with a metal-coated plastic sheet stretched over the back of a half-cylinder framework which creates 66 narrow vertical channels, each equivalent to a diminutive speaker.

Typical of the new TV receivers available from *Philco* are the model 4800 mahogany 21-inch console with

The Du Mont "Dial-O-Matic."

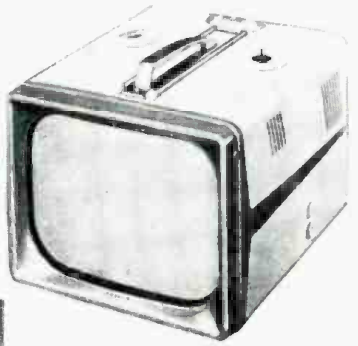


Du Mont "Brewster" a roll-about model.

Above, Philco's "Cathedral" speaker. Left, Trio of Philco portables: hi-fi phono, TV set, and radio receiver.

Three of the new Philco TV models. The 21-inch model 4800 includes a roll-out record player, the 24-inch model 6610T has top-touch tuning, the model 461°G "Runabout" includes snack bar.

Philco model 3034 17" portable.



Philco model 2004G, 14" portable, about 26 pounds.

"Phonorama III" automatic-changer record player with electrostatic speaker and a 15-inch woofer.

Model 818 AM table-model radio with two speakers.

4-speed phonograph, advertised at $259.95; the model 6610T 24-inch at $399.95 with top-touch tuning; and the 21-inch "Runabout" model on wheels and including a snack bar under the lid on top, at $279.95. *Philco* is featuring three 17-inch portable models—the 3034 series, from $159.95 to $169.95. Available accessories include swivel stands and travel covers. Four 14-inch portables are available from $109.95 to $139.95. Among the new radio models is the twin-speaker table model 818 selling for $59.95 and available in mahogany, fruitwood, or blonde finishes. The smartly styled "Phonorama III" is a new *Philco* high-fidelity phonograph using the "Cathedral" electrostatic speaker and a 15-inch woofer. This instrument is available in mahogany at $299.95 and fruitwood at $319.95.

Featured in the *RCA* black-and-white line for 1957 are swivel and roll-around consoles. The "Enfield" with a 261 square-inch screen (21-inch tube) and featuring a swivel stand is nationally advertised at $279.95 in mahogany or walnut and $289.95 in limed oak. The 21-inch "Ardmore" mounted on large rubber-tired wheels, is advertised at $269.95 in a choice of finishes. The "Markham" lowboy console at $269.50 with three speakers and window channel indicator is near the top of the black-and-white line. Close to the bottom of the line is the "Dixon," a 21-inch table model receiver at $199.95. Other table models range from $125 (8½-inch portable) to $229. Two new phonograph models available from *RCA* are the 45 rpm "Mark VIII" with two speakers, at $79.95 in mahogany and $84.95 in maple or oak. The "Mark VII" is a portable 4-speed phonograph with record changer and three speakers at $129.95.

This year, in celebration of its 25th anniversary, *Du Mont* is offering its most complete line of TV receivers, high-fidelity phonographs, and radios. *Du Mont* is again stressing the use of TV receivers in furniture combinations. Available accessories include legs, swivel-top coffee table, and step and tandem tables. Designed for use in this manner is the 24-inch "Derbyshire" advertised for $279.95 in mahogany and $289.95 in limed oak. The 24-inch "Stanford" incorporates four 6-inch speakers and may also be combined with accessory furniture pieces. It is advertised at $349.95 in mahogany and $359.95 in limed oak. One portable receiver, a 14-inch model, is furnished in tweed fabric at $149.95 and in two-tone fabric at $159.95.

Representative of the five new table model radios by *Du Mont* are the "Bel-Air" at $22.95, the "Monoco" at $36.95 and the "Chantilly" clock radio at $29.95 for black and $32.95 for maroon or ivory. One of the three high-fidelity units marketed by *Du Mont* is the "Balladier," a combination 4-speed automatic changer phonograph with AM radio and two extended-range speakers. This unit is furnished in mahogany at $219.95 and limed oak at $229.95.

—30—

RCA

"Markham" lowboy deluxe console, (model 21D750).

"Dixon" (model 21T715) table model.

RCA "Ardmore" TV (model 21D721) mounted on wheel rollers.

"Mark VIII" two-speaker 45 rpm phono.

Four-speed record changer-player, "Mark VII."

"Enfield," (model 21T738), swivels for all-angle viewing.

DU MONT

The "Chantilly" clock radio.

The "Monaco" radio.

"Bel-Air" model AM radio.

Du Mont 14" portable TV in tweed fabric.

The 24-inch "Stanford"

"Balladier" hi-fi phono with AM radio tuner.

"Derbyshire" 24-inch, with removable legs.

New TV TUNER

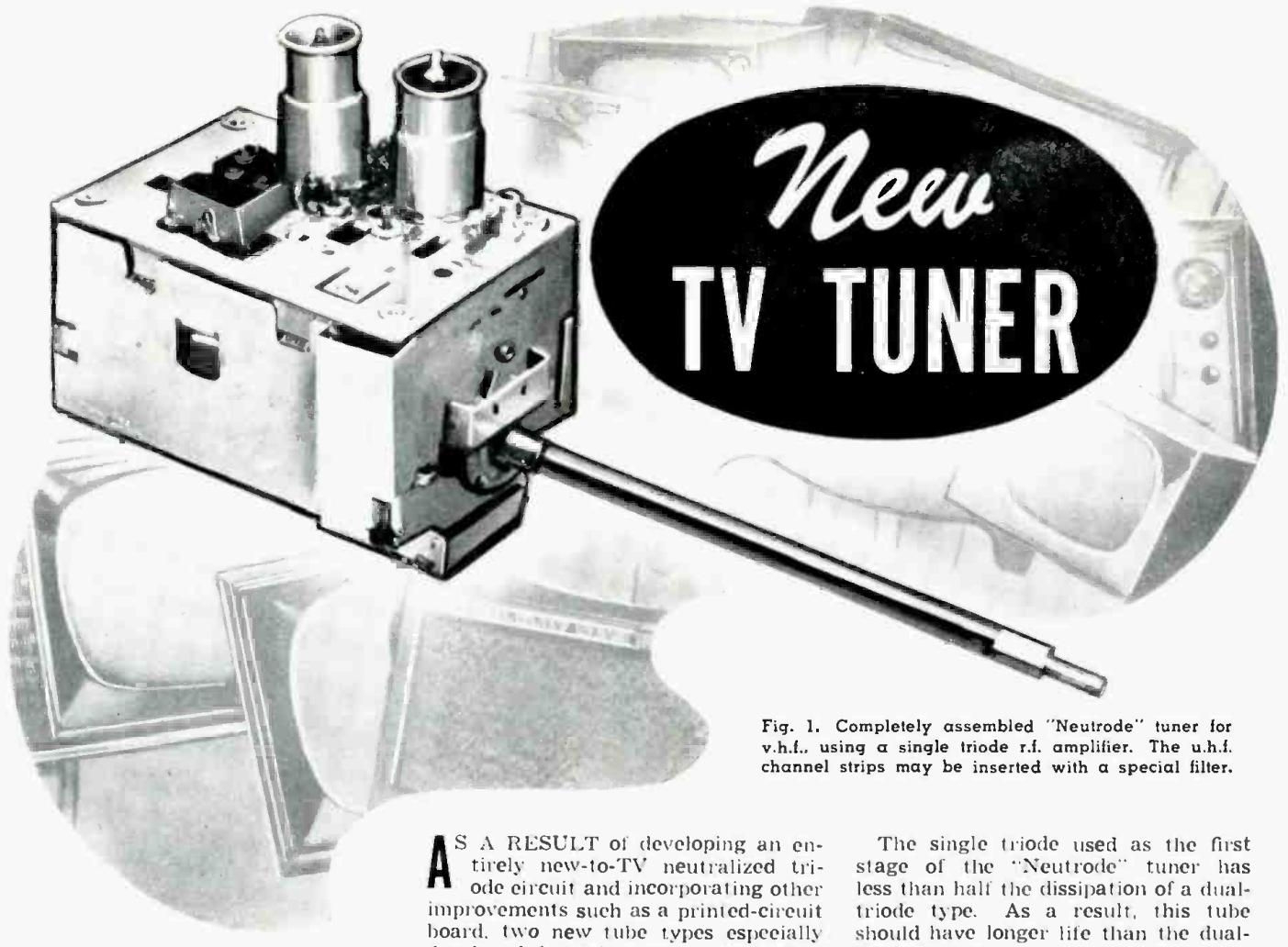
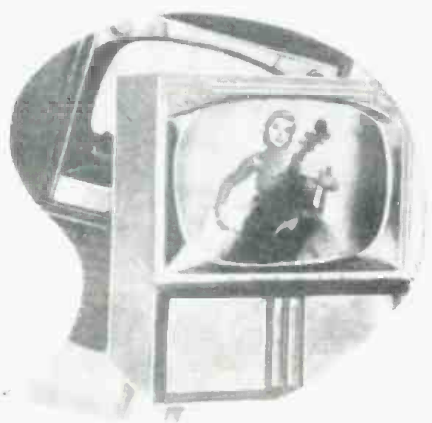


Fig. 1. Completely assembled "Neutrode" tuner for v.h.f., using a single triode r.f. amplifier. The u.h.f. channel strips may be inserted with a special filter.

A simple and inexpensive tuner that compares well with cascode types — it may well become the most popular tuner used in the low priced TV receivers.



AS A RESULT of developing an entirely new-to-TV neutralized triode circuit and incorporating other improvements such as a printed-circuit board, two new tube types especially developed for this purpose, and other innovations, the *Standard Coil Products Co., Inc.*, has been able to introduce a new television tuner, called the "Neutrode." (See Fig. 1.) This unit provides excellent performance and can be produced at a lower price than previous tuners using a cascode circuit.

During recent months, this "Neutrode" tuner has undergone rigorous field tests in all kinds of reception areas—fringe, moderate, and strong signal locations, on both v.h.f. and u.h.f. bands. Typical values established in these tests are more than 32 db gain and less than 7 db noise on channels 2 through 6, more than 28 db gain and less than 8 db noise on channels 7 through 13. This tuner features good stability, improved filter circuits, and improved u.h.f. performance. It operates remarkably well in the presence of overload and noise.

Television receiver manufacturers planning to use the new "Neutrode" tuner have been pleased, not only by the technical advances resulting from this design, but also by the fact that it can be produced at lower cost than previous tuners. There are two major reasons for the lower cost of the "Neutrode": 1. The basic circuit design is simpler and requires fewer components. 2. The use of a printed-circuit board as a major part of the tuner chassis allows for more automation in manufacturing.

The single triode used as the first stage of the "Neutrode" tuner has less than half the dissipation of a dual-triode type. As a result, this tube should have longer life than the dual-triodes used in cascode designs.

Two new tubes have been developed especially for use in this tuner: One is a triode amplifier available in two versions—the 6BN4 for parallel 6.3-volt heater supplies, and the 2BN4 for series-heater models. The second new tube is a pentode-triode used in the mixer-oscillator stage. This tube is also available in two versions, the 6CG8 for parallel heaters, and the 5CG8 for series heaters.

Fig. 2 is the schematic diagram of the new tuner. For v.h.f. operation, the signal is fed through a matching transformer (T_1) and two 41 to 46 mc. i.f. traps to the antenna coil on the channel strip in use. From the antenna coil, L_a, the input signal is fed to the grid of the 6BN4 (or 2BN4 in series-heater receivers). An a.g.c. bias voltage is applied to the same grid through C_5 and R_1.

The cathode of this tube has two leads going to ground to minimize the cathode-to-ground inductance for improved performance on the high channels. The triode plate has a return lead to the grid through capacitors C_7 and C_{12}. Coil L_1 provides 180-degree phase shift of the plate signal as it returns to the grid to neutralize the triode's plate-to-grid capacitance. The amplitude of the plate return signal arriving at the grid is controlled by C_{12}. Thus a neutralizing signal is fed to the grid which is equal in am-

plitude, and 180-degrees opposite in phase, to the plate-to-grid signal voltage. (The use of two grid leads minimizes inductance to the input circuit to the grid.) Without this neutralization the triode amplifier has much lower gain and could not be used successfully as the first stage of a high-performance tuner.

The signal amplified by the neutralized triode is inductively coupled to L_5 and goes from there to the control grid of the mixer section of the 6CG8 (or 5CG8). A test point for r.f. response is provided at the feedthrough capacitor C_6.

The local oscillator circuit of the "Neutrode" tuner is a conventional ultraudion oscillator with "book" fine tuning. The fine tuning stator in the plate circuit is printed on the board. (Rectangular area on right side of board, shown in Fig. 3.) A hinged, silver-plated phosphor bronze plate is separated by insulating tape from this printed stator, and as the fine tuner cam turns, it brings the "book cover" or phosphor bronze plate closer to the stator or farther away from it as desired. This movement of the plate relative to the stator provides capacitive tuning over the v.h.f. band.

The oscillator circuit includes the conventional slug-tuned oscillator coil L_8 on the channel strip. It is adjustable through the front of the tuner.

U.H.F. Reception

As is generally known, there have been two basic approaches to v.h.f.-u.h.f. tuners. One is to substitute a u.h.f. strip on the tuner drum in place of the antenna and oscillator coil boards of an unused v.h.f. channel. This technique, while satisfactory in many cases, has often proved to be a compromise—inexpensive, but not providing the desired quality of reception. The second alternative has been to use a continuous tuner with special u.h.f. circuitry. Such tuners have provided good results but they are more expensive than strip substitution.

The "Neutrode" tuner uses the technique of inserting individual u.h.f. strips for the desired u.h.f. channels, but, in addition, a high-pass filter is included for the u.h.f. signal. This filter is shown on the right in Fig. 4 and is inserted next to mounting block shown on top of the tuner in Fig. 1. Note that this component contains two connection points for direct connection to the u.h.f. antenna lead-in.

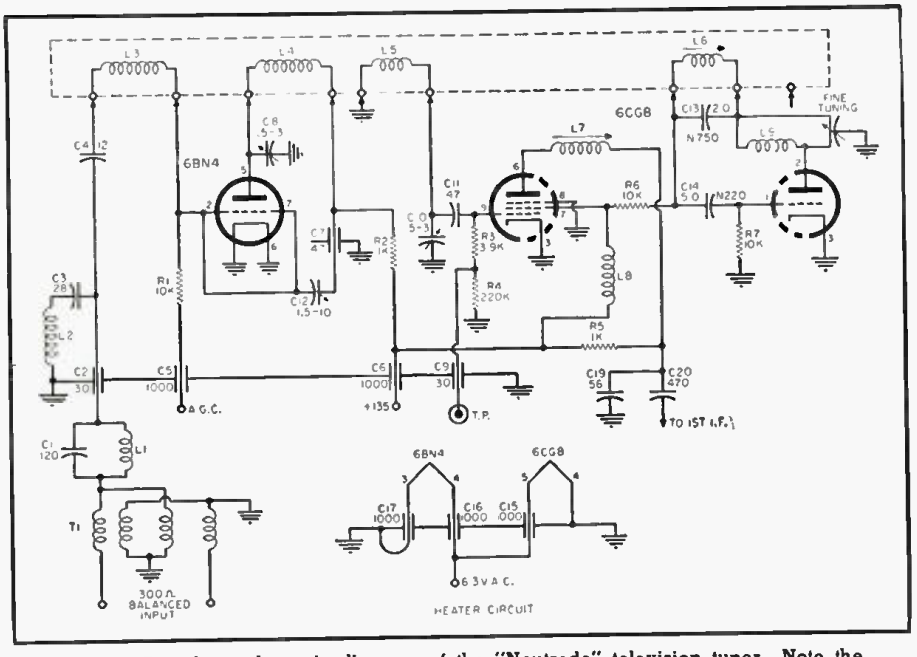


Fig. 2. Complete schematic diagram of the "Neutrode" television tuner. Note the use of a single triode r.f. amplifier. The feedthrough capacitors shown must be replaced when necessary with their equivalent feedthroughs for proper operation.

The u.h.f. strip shown on the left in Fig. 4 contains a germanium mixer crystal which is fed a selected harmonic from the v.h.f. oscillator and, at the same time, the incoming u.h.f. signal.

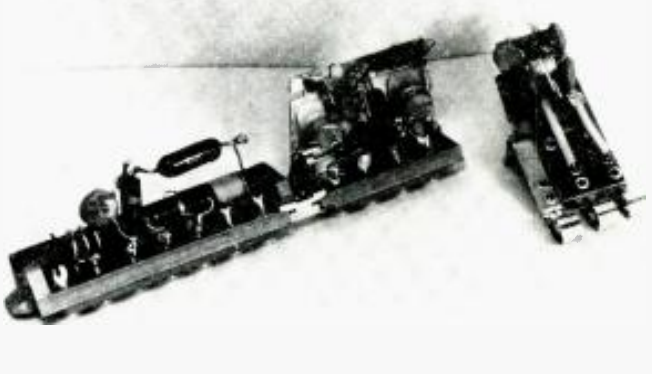
The method of obtaining the correct local oscillator signal to properly operate the mixer is rather unusual. The regular v.h.f. local oscillator is used, and the oscillator coil on the channel strip determines the frequency of oscillation. However, in the case of u.h.f., the frequency chosen is a submultiple of the required frequency. For example, if it is necessary to inject a 600 mc. signal into the germanium mixer to beat against the incoming u.h.f. signal, then the oscillator is made to generate 200 mc. by the u.h.f. strip oscillator coil. The 200 mc. signal is next fed to a crystal harmonic generator, also on the u.h.f. channel strip, and the 600 mc. harmonic is selected from the output of the harmonic generator for injection into the u.h.f. mixer.

The output of the germanium mixer is a 41 mc. i.f. signal. This 41 mc. signal from the germanium mixer is amplified by the 6BN4 neutralized triode and is further amplified by the pentode mixer section of the 6CG8 in the "Neutrode" tuner before it is fed to the receiver i.f. section.

One special servicing consideration is necessary relative to this tuner and that is the matter of feedthrough capacitor replacement. Feedthrough capacitors must be used in this tuner and they must be replaced when necessary with their exact equivalents rather than other types, to assure satisfactory operation. Actually, because this tuner has been designed to operate on relatively low "B+," component life should be prolonged. —30—

Fig. 3. Shown here is the printed-circuit board used in the new TV tuner. All components and tube sockets have already been assembled on the board. The rectangular conductor area on the right is part of fine tuning mechanism.

Fig. 4. Typical u.h.f. strip for the "Neutrode" tuner is on the left and is in most ways similar to the u.h.f. channel strips used with previous turret-type tuners. The special high-pass filter and antenna input bracket is on the right.



An Automatic Tube Tester

Here is a genuinely new idea in tube testers—punched cards are used to set up required switch connections.

Fig. 1. The new automatic tube tester is shown here with a perforated card part of the way in the slot. All switch connections are made by the holes in the card.

By
MURRAY S. RIFKIN
TeleTest Instrument Corp.

THE use of coded cards for storing information and operating computers has been widely applied in industry but not to small, inexpensive test instruments. Yet such a feature could save the instrument operator a good deal of time.

A new tube tester, the "DynaMatic" model DM456 (Fig. 1), manufactured by the *TeleTest Instrument Corp.*, now uses this principle.

In the "DynaMatic" tube tester, perforated plastic cards are used to automatically set up pin connections and test voltages to the three tube sockets on the panel, thereby eliminating most of the switch adjustments usually required. As rapidly as new tube types are used in equipment, additional perforated cards will be supplied, permitting those tubes to be tested. In most cases, however, existing cards will apply to the new tube types introduced. The radical feature of the "DynaMatic" is obviously the use of the perforated cards (called the "Perfo System"), which can be readily adapted to practically any tube tester circuitry.

A proven dynamic mutual conductance measurement circuit is used for the "Good-Replace" G_m test. Suitable bias and a.c. signal voltages are applied between the control grid and cathode of the tube under test. A d.c. voltage with a superimposed a.c. is applied to the plate, and a milliammeter in the plate circuit is calibrated to read the resulting a.c. component of the plate current. The sensitivity of the meter circuit is controlled by a knob on the tube tester panel. The screen grid of the tube under test is connected to a d.c. supply by means of the perforated card; all remaining elements of the tube are connected to the cathode. The tube is, therefore, tested under heavily loaded dynamic conditions.

Multiple section tubes have equivalent elements connected in parallel and are tested as a single composite tube in which the total mutual conductance is the sum of the individual section mutual conductances. Diodes and rectifiers are given a conventional emission test.

Additional tests can be made for inter-element shorts, gas, and "life expectancy." A neon bulb is used to indicate shorts when such are present. For the gas and grid emission tests, the voltage drop across a 10-megohm resistor in the control grid circuit of

(*Continued on page* 180)

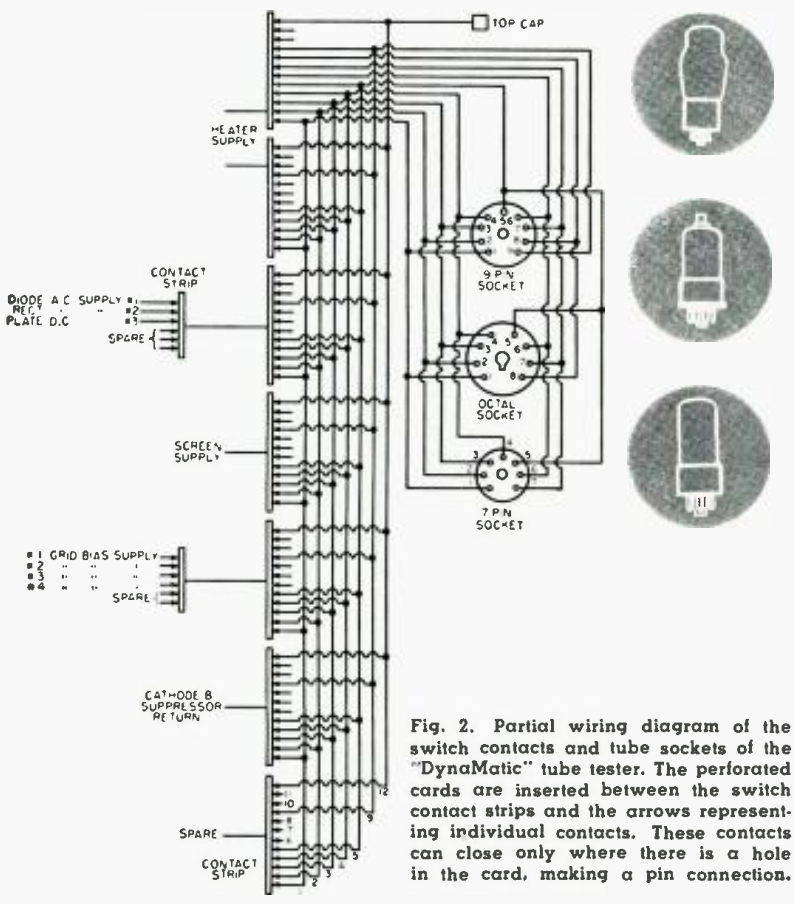
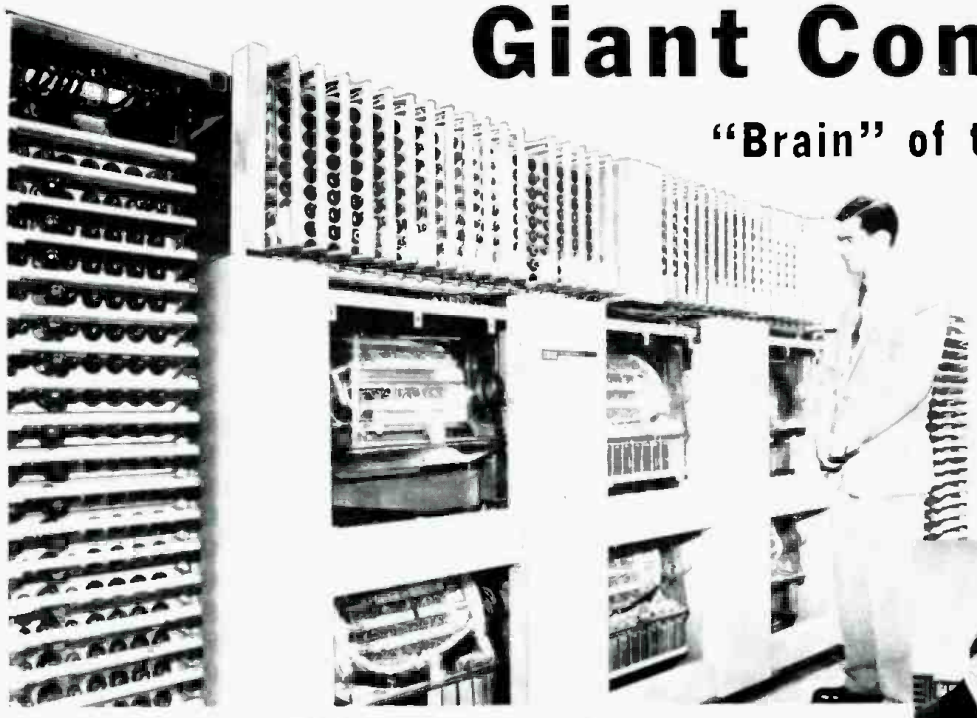


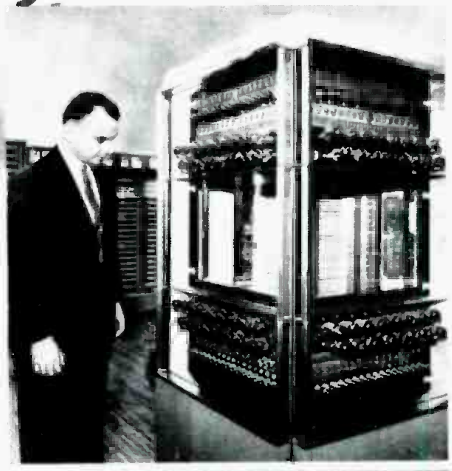
Fig. 2. Partial wiring diagram of the switch contacts and tube sockets of the "DynaMatic" tube tester. The perforated cards are inserted between the switch contact strips and the arrows representing individual contacts. These contacts can close only where there is a hole in the card, making a pin connection.

Giant Computer-

"Brain" of the SAGE System



Main magnetic drums housing frame of giant computer. Six magnetic drum assemblies are shown. These have a total capacity of millions of binary digits (bits). All information processed through the machine is stored on the drums which act as a high-speed buffer storage. The selection control frame in the rear keeps track of and controls the operation of all of the inputs and outputs of the giant unit.



Close-up of one of the magnetic core memory array frames in computer.

Large-scale IBM-built computer plays important part in nation's electronic air defense system.

THE first production model large-scale computer for the nation's vast, new electronic air warning network has recently been shipped to McGuire Air Force Base in New Jersey. This extraordinary "electronic brain" will become the first of the giant computers to fit into the integrated complex of radar, ships, jet aircraft, communications networks, missiles, and people that is rapidly taking shape as the supersensitive continental air defense system.

This immense project is known as the Semi-Automatic Ground Environment (SAGE) system. It combines the abilities of the world's fastest electronic computer to receive information, to memorize, to calculate, and to record answers with the perspective and display talents of radar to present an instantaneous graphic picture of the location, speed, and direction of all planes within radar range. With a knowledge of flight plans of friendly planes available in the computer, hostile planes can be identified immediately and the most effective defense action taken again based on computer information.

The SAGE system starts with a radar ring—on land, on Navy picket ships at sea, on offshore "Texas Towers," and on airborne early warning planes ranging far out over the ocean. These radars are linked by telephone lines or ultra-high-frequency radio directly to the high-speed computer. Information about aircraft anywhere within the radar area is relayed continuously and automatically to the computer. This *IBM*-built equipment, called the AN/FSQ-7, digests all of this information plus Ground Observer reports, flight plans, and weather information as fast as it is received and translates it into an over-all picture of the air situation. These TV-like pictures show the air battle as it develops and provide the basis for the necessary human judgments. Intercepting jets and guided missiles may be controlled directly by the computer.

—30—

The display console presents a picture of the air defense situation to operating personnel. With the aid of the buttons and switches located on the side of the console, Air Force personnel will make tactical decisions which, in turn, will be carried out automatically by the computer. From this location, the operator can request additional information from the computer, can select certain features and exclude all others, can expand his scope picture to look at a smaller area, and can monitor the action of enemy planes and our own jet interceptors and guided missiles.

This console contains the controls for operating the computer. It displays the operating status of the equipment to personnel who monitor the operation of the unit.

ADMIRAL 1957 COLOR SETS

Fig. 1. The Model C322C27 retails in the East for about $719.95. The Model C322C26 is similar in appearance but in mahogany.

Color TV has broken through the $500 barrier with sets from many makers. Here are Admiral's sets and policies.

WITH the introduction of color receivers priced at less than $500, color is here for many; not just a select few. All signs point to an ever-growing production of color receivers and increased color programming. Thus, now is the time to consider the practical aspect of buying, selling, installing, and servicing color receivers if this has not already been done.

As with any new product, color television demands specialized knowledge at all levels of the industry—from manufacturer to consumer. Before and since the adoption of the present NTSC color standards on December 17, 1953, manufacturers have gained their knowledge by producing comparatively small quantities of receivers and watching the results very closely. Field experience gained with these first receivers, combined with extensive research and development programs, has now made it possible to mass-produce practical color receivers with realistic prices.

Admiral's 1956-1957 line of color receivers presently includes Models C322C2, C322C3, C322C16 (Fig. 2), C322C17, C322C26, C322C27 (shown in Fig. 1), LC322C36, LC322C37, and LC322C39. This is in addition to Models C222C6 and C222C7 introduced at the beginning of the year. Models C322C2, C322C3, C322C16 and C322C17 are consolettes with prices starting at $499.95. Equivalent models with built-in all-channel u.h.f. tuners are also available. There are actually four basic models, the other numbers represent cabinet finishes.

The prototype 28Y1 chassis was first produced at the beginning of the year, while the 27Z1 and 29Z1 chassis have only recently been introduced. All three of these chassis are similar, using the three-gun magnetically converged 21AXP22A color picture tube, and triode high-level demodulators.

The use of high-level demodulators allows the color signal to be coupled directly to the picture tube and eliminates the complex and costly circuits (matrix circuits) needed to add the color to the black-and-white signal, the multiple video output amplifiers, and the d.c. restorer circuits required by most low-level color demodulator circuits. Not only is circuitry simplified, but the stability of color balance is improved, for the output of the high level demodulator is practically independent of tube characteristic variations over a wide range and is not affected by changes in color signal strength or power line voltages as much as most low-level demodulator circuits.

The use of high-level demodulators and more dual-function tubes, and intensive development work based on field experience have resulted in receivers that are more efficient, reliable, easier to sell, install, and operate.

There are only six tubes in *Admiral's* new color receiver in addition to those normally used in an equivalent black-and-white receiver. By simply observing the visual symptoms, a trained color service technician can most often eliminate all but one or two of these tubes and their associated circuits as a possible cause of color trouble. Troubles in the balance of the receiver generally produce the same familiar visual symptoms presented by black-and-white receivers.

As many of the installation and service adjustments as possible are mounted on the front of the chassis behind a readily removable cabinet panel beneath the picture tube. This feature allows making convergence adjustments while directly viewing the screen. In the 29Z1 chassis, all convergence controls, including those for

By
FRANK HADRICK*
and
HUGH S. WYETH*
*Service Division, Admiral Corporation

static convergence, are located on the front of the chassis.

Since some stations transmit a color stripe signal during black-and-white programs, a color stripe test point is provided on the rear apron of the chassis. Merely shorting this test point to chassis ground permits the service technician to correctly tune in the color stripe signal and determine if the receiver will pick up a color program, reproduce the picture in correct colors with adequate range of color intensity and hue, and have stable color sync.

All *Admiral* color receivers feature only two additional operating controls for ease of operation. These are the "Color Fidelity" and "Color Intensity" controls. The fidelity control varies the phase of the 3.58 mc. oscillator within the receiver so the desired color hues will be reproduced. The intensity control varies the chroma amplifier gain and thus, as its name implies, the intensity or saturation of the colors.

Additional safety features have been incorporated in models using the later color chassis. Besides the usual a.c. power interlock which disconnects the receiver power supply when the cabinet back is removed, there are two other safety interlocks. One immediately shorts the high voltage supply if the cabinet back is removed, and thus eliminates the shock hazard presented by residual charges in the 25,000-volt supply.

The picture window safety glass is removable from the front for cleaning the glass and the face of the picture tube. Many customers perform this service, so to provide an additional safety factor, an interlock has been added which will disable the horizontal output amplifier, and thus the high voltage, should the picture window be removed with the receiver turned on.

Circuitwise, there are similarities between many of the large-screen color receivers introduced within the past months. These similarities necessarily follow from the widespread common use of a 21-inch, three-gun magnetically converged picture tube and a common trend towards high-level color demodulation of one sort or another.

In black-and-white receivers, the use of aluminized picture tubes, tinted picture tubes and picture windows, and higher video drive, makes it possible to view the black-and-white picture in a very well lighted room. This is *not* true of color receivers which should always be viewed in a room with a low light level to prevent color wash-out. For this reason, greater care must be taken in choosing the installation location for the color receiver.

Moving the receiver will affect color purity and convergence to some extent although not as much as it did previous color receivers. The customer must be made to understand this. Some technicians even go to the extent of marking the floor with strips of masking tape so that the receiver can be returned to its exact position after it has been moved for cleaning purposes.

Don't count on the existing antenna installation being satisfactory for color reception. Chances are that it will be, but even though the customer was satisfied with the black-and-white picture, the antenna may require re-orienting, repair, or replacement, to produce good color pictures.

Admiral's warranty on color receivers to the consumer is the same as for black-and-white receivers; 90 days on parts and one year on the color picture tube. Because of the higher costs of color picture tubes and other color receiver components, this warranty has a considerable monetary value. Thus, the customer should be urged to promptly register his or her receiver with the factory by mailing the postcard packed with each set.

Initially, service costs will be somewhat higher for color receivers. That color receiver service costs are higher follows from the more extensive and complex circuitry, higher costs of picture tubes and other color components, and the additional test equipment investment required of service dealers. Then, too, the very qualities that enhance the value of a color picture also mean that poor operation will be more apparent. For instance, many customers have learned to tolerate minor black-and-white ghosts. Will the same customer be as tolerant of multi-hued ghosts?

To illustrate the color service costs anticipated by at least one large service organization, consider their service contract prices. The cost of a one-year contract providing unlimited service, one-year warranty on all parts including the picture tube, and installation to an *existing* antenna is $99.50. The same service organization offers a service contract providing 90 days of unlimited service and flat-rate service calls at $7.50 each for the next nine months. The cost of this contract, which also provides a one year warranty on all parts including the picture tube, and installation to an existing antenna, is $69.50.

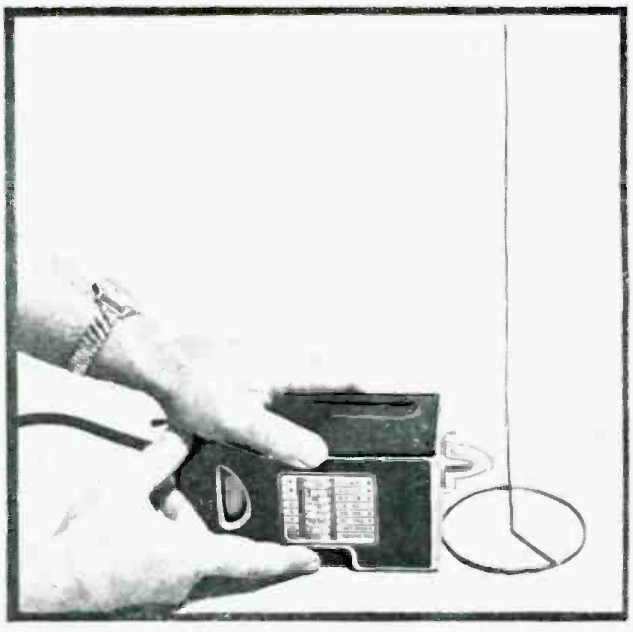
The differences between color and black-and-white offer a challenge not only to the service technician, but to the dealer, dealer salesman, and installation man. The seller must know the aspects of color that affect the customer, for consumer education will minimize potential service problems and increase customer satisfaction. Success in color hinges on the sale being backed with a source of good service by qualified technicians, just as is the case in the automobile industry.

—30—

Fig. 2. This mahogany consolette is the Model C322C16. The Model C322C2, which retails for about $499, is quite similar in appearance to the receiver shown here, however, it has one speaker; the model shown here has two.

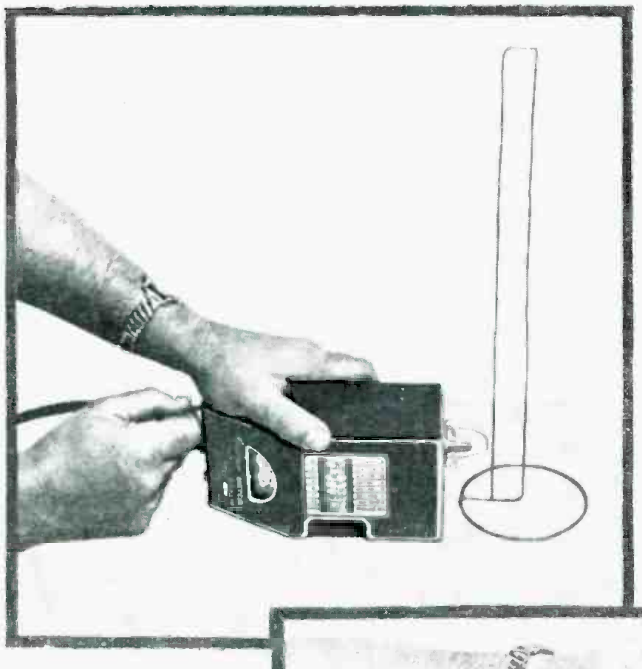
The Case of the Squashed Monopole

By **ELBERT ROBBERSON**

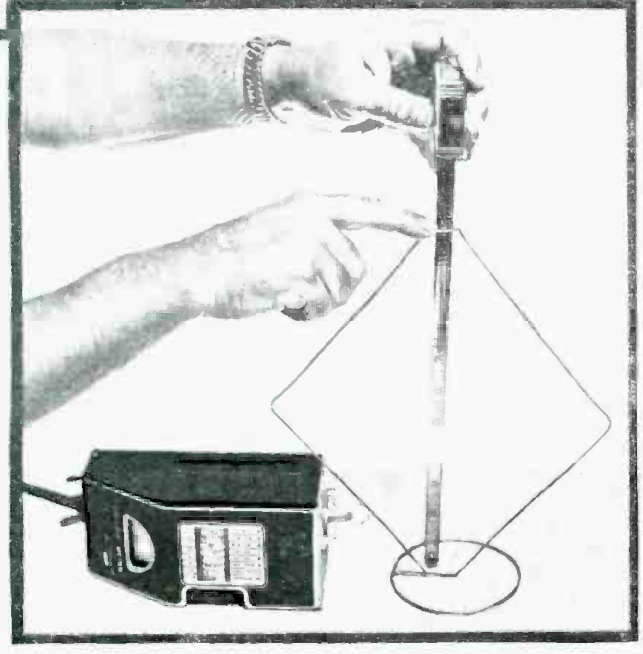


A scale-model Marconi antenna. A vertical antenna, 1-foot long, will resonate at 234 megacycles. The base of the antenna is grounded to a generous-sized piece of window screening. Refer to article for full details on this.

Are you an innocent victim of TVI complaints just because your antenna stands high and in the clear? Here is an easy and simple out.



A hairpin of the same height as the Marconi shown in the photo above will resonate at the same frequency, i.e., 234 megacycles. This is the first step in the development of the "squashed monopole."



Squashing the monopole doesn't materially alter the resonant frequency until it is less than half its original height. If needed, length can be added to the sides to bring resonant frequency back down. Refer to article.

THE events in this story are true. Only the names have been changed to protect the innocent.

I'm an antenna man, see? Freelance, but legitimate. So when this guy knuckles my window I invite him to leave. I know his record. It goes way back.

Seems the neighbors spotted him for a ham about the same time industrial development hit the neighborhood with its arc welders and sparking motors. He made the mistake of putting up a 20-meter beam, and from then on all the noises on the radios were obviously his.

"Can't have anything to do with you," I tell him. "Think I want my phone ringing all night?"

"It's a bum rap," he protests. "All the way down the line. Them key clicks on Amos n' Andy wasn't mine. And about the TV caper I was fingered for—that plaster on the raster was from a plastic press down the street."

This I know to be a fact, but what can I do?

"You got to help me," he said. "My ticket's running out—and every time I show outside with wire under my arm, the neighbors yell for the cops! I've got to get some air time, or take up photography!"

I'm touched. "How about a hair-wire doublet?" I ask.

"The birds make nests out of it," he says. "You know my rig's clean now—give me a break. Can't we cook up a skyhook the neighbors can't see?"

"Fall by in the early dark," I tell him. "We'll see what can be done."

About moon-up, I let him in. "What do you want," I asked. "DX?"

"I'd be satisfied with WN's," he said. "I've got a rig ready for forty. If I could QSO a few guys after work to rack up some time on the log, I'd be happy."

"Care about directivity?" I asked.

"No, anywhere will do, as long as it's out."

"Wife still feels the same?"

"Yeah—she still doesn't want any poles or anything—and besides it's got to be undercover."

"I know. Tomorrow let's case your layout. But you'll have to let the wife in on it."

"Okay," he said. "But not the kids—they wouldn't squeal, but they might leak."

Next day we had a look. We told the kids we were looking for wild canaries. It was an ordinary house—living quarters downstairs, shack in an attic corner, with a conventional peaked roof. There were trees around, but using them as supports was out. "Remember," the wife said, "we don't want any holes anywhere."

The boy said: "Daddy, I think I see a canary."

"Shut up," said Daddy.

We retired to my shack. "I think you have room for a kind of vertical," I told him.

"Thirty-three feet high? The neighbors would nail me for sure!"

"I think we can squash it a little. Maybe no higher than the peak of the roof. And we can feed it with TV twin-lead so it will look real innocent. Let's see."

I got out the grid-dip meter. "The ideal height in feet for a quarter-wave vertical is 234 divided by the frequency in megacycles," I said. "Now, if we make an antenna on the bench 1 foot high, and feed it a 234-megacycle current, we'll have a scale model of a 33-footer at 7 mc."

"Which I can't use," he said.

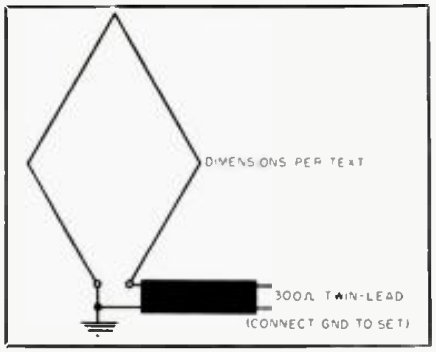
To simulate the ground, we laid a large strip of copper screen on the bench. Then we cut a length of copper wire, and formed a "foot" on the bottom so it would stand unsupported. Coupling the grid-dip meter to the bottom we got a good dip at 234 mc. In fact, the antenna absorbed energy so well we had to move the oscillator slightly away to avoid "suckout."

Next we folded a hairpin loop of the same height in place of the single wire, with the same result.

"What good is this?" he asked.

"A loop we can squash," I told him. "Also in the folded form, the antenna will have a higher feed impedance. Maybe we can match 300-ohm twin-lead before we end up."

We started squashing the "monopole," measuring resonant frequency each time. We found that the resonant frequency remained substantially the same as we pushed antenna height down, to the point where it was half its former height.



Physical details of the "squashed monopole" as discussed in text. Dimensions will vary depending on the band with which it is used.

"Hey," the guy says, "it looks like the height isn't what determines the resonance with a squashed antenna. It looks like the length of the wire in the sides is what counts!"

"Yep," I said. "Looks like we can make a resonant antenna that will be short enough to fit the end of your house. How high is the peak of your roof?"

"Eighteen feet."

"It's a snap. See you in the morning. Have your wire handy."

The next early bright we did the inside work, running a twin-lead from the attic shack under the eaves, then down to a point at the corner of the house. Then we ran it on TV insulators secured to stakes to a point directly under the peak of the roof.

With this point as a base, we stretched #18 stranded copper to one roof corner, up to the peak, down to the other roof corner, and back down to the base. This made a full-size version of our model squashed monopole—a sort of diamond standing on end.

"Now some ground rods," I told him. "A few pieces of pipe will do."

We drove a four-foot pipe in the ground at the antenna base, then a couple more about ten feet away on either side, bonding them together with heavy wire.

One side of the monopole was connected to the ground system, and the other secured to an insulator on a stake.

We dragged over the Antennascope and grid-dip oscillator, and snaked an a.c. extension cord out a window. The antenna feed point showed an impedance close enough to 300 ohms to make us clap each other on the back.

His rig had single-ended output, so we traced out the grounded side of his twin-lead feeder and connected it to the ground system. The other side was tied onto the "floating" side of the antenna. The rig loaded beautifully.

"Now I don't want to hear any more about this," I said. "I don't know from nothing."

The wife came out and had a look. "When are you going to put up the antenna?" she asked.

"Decided against it," he said.

The boy asked, "What were you doing on the roof, Daddy?"

"Go watch Hopalong," Daddy said.

I bid them goodbye.

Next time we met, he told me he'd worked Ohio, and a couple of other places that are fair for the afternoon on forty. And he got his log time. As far as I could tell, he'd done it by pigeon. The neighbors think he's given up radio.

Don't ask me where you can see this antenna. Because if you fall by my place and examine every house on the block you won't spot it. And I don't aim to pass out any pointers. But if you want an antenna the neighbors can't see, feel free to use the idea. Just don't spill the beans to the public.

—30—

While the kids look for "canaries," Dad shows the XYL how the "squashed monopole" will blend in with the corners of the roof. After Mom saw how inconspicuous the antenna turned out, all objections to its installation vanished.

Hi-Fi Equipment

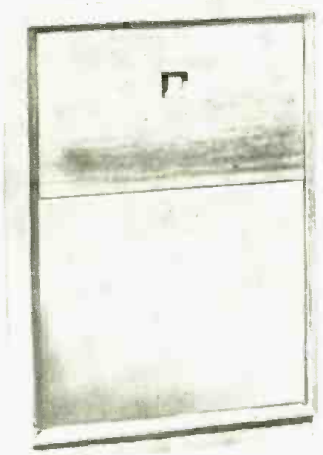
Karlson's equipment table can be assembled with a screwdriver. It measures 20" x 48" x 18". It comes in marble "Karlsonite", blonde, fruitwood, and mahogany finishes. Record player is housed in pull-out drawer, other components on top of table or on shelf below. "Marble" unit is $94.50, rest $104.50.

FOR aesthetic reasons or because of a lack of the requisite woodworking equipment, many audiophiles are actively seeking commercially built housings for their hi-fi equipment.

Luckily, such cabinets are now being produced in ever increasing numbers and the home owner has a wide choice of furniture styles at his disposal. Many cabinets are being offered in three forms—finished, ready-to-finish, and as ready-to-assemble kits.

On these two pages we present a representative selection of nationally distributed equipment cabinets from *Karlson Associates, Inc.* (1610 Neck Road, Brooklyn 29, N. Y.), "Cabinart," *G & H Wood Products Co., Inc.* (99 N. 11th St., Brooklyn, N. Y.), and "River Edge," *British Industries Corp.* (80 Shore Rd., Port Washington, N. Y.)

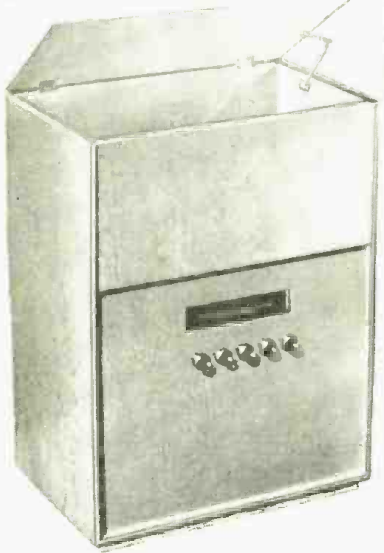
With this plethora of handsome cabinets available, it is no longer necessary to turn the family living room into a "jungle" of wires and unmatched audio equipment chassis. —30—



Model 28 by Cabinart is available in finished, unfinished (Model 28U), and kit form. It measures 35" x 23½" x 17½" and offers two compartments measuring 11⅛" x 22" x 15⅞" and 18½" x 22" x 15¾". Mahogany, walnut, Korina, and black lacquer models are $87.00, the unfinished, sanded birch veneer model is $69.00, the kit (Model 28K) is $51.00. Matching speaker cabinets are available in all versions ($63, $48, $39, respectively).

← Cabinart's Model 21 measures 35" x 23½" x 17½". Compartments measure 18" x 21⅞" x 14⅜" and 10¾" x 21⅞" x 15⅝". Unit comes in mahogany, walnut, Korina, and black lacquer finishes and sells for $117. A matching speaker cabinet, the Model 22, sells for $69.00 and measures 35" x 23½" x 17½" over-all. It comes in same finishes.

Cabinart's Model 11 measures 35" x 35½" x 17½" and provides three compartments. A tuner/amplifier area measures 13⅝" x 16⅝" x 13⅞", record changer space, 13⅝" x 16⅝" x 15⅝". Record storage space of 15⅛" x 34" x 15⅝" is also included. Finishes are mahogany, Korina, walnut, and black lacquer, all priced at $168.00.

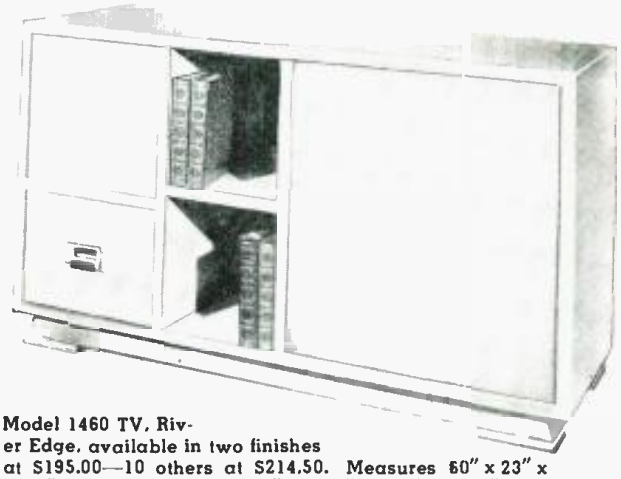


← Model 70 comes ready-to-finish in ⅝" white pine plywood. This Cabinart unit measures 33½" x 23" x 16" and includes two compartments (7½" x 21¾" x 14⅝" and 20" x 21¾" x 15½"). It is Model 80 in kit form. Matching cabinets for either 12" or 15" speakers are available at $27.00 (assembled) and $21.00 (kit). The Model 70 is $36.00 while the Model 80 kit is $24.00.

Cabinart's 16" x 35½" x 16" cabinet which is available with or without legs and finished (Model 50) or unfinished (Model 50U). The compartments measure 14⅜" x 16⅝" x 12½" and 14⅜" x 16⅝" x 14¾". The Model 50 at $72 comes in mahogany, walnut, Korina, black lacquer while sanded birch unit, ready-to-finish, sells for $48.00. Without the wrought-iron legs, each unit sells for $3.00 less than listed price.

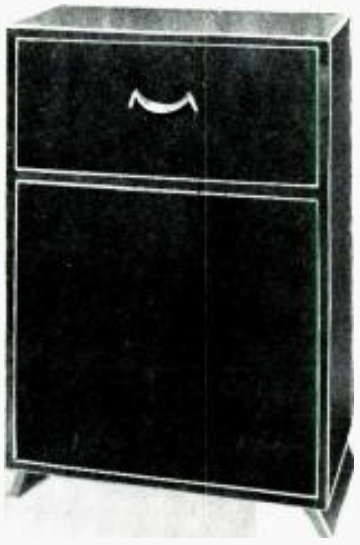
Cabinets

Dress up your hi-fi gear by housing it in one of the many handsome and handy cabinets now on the market.

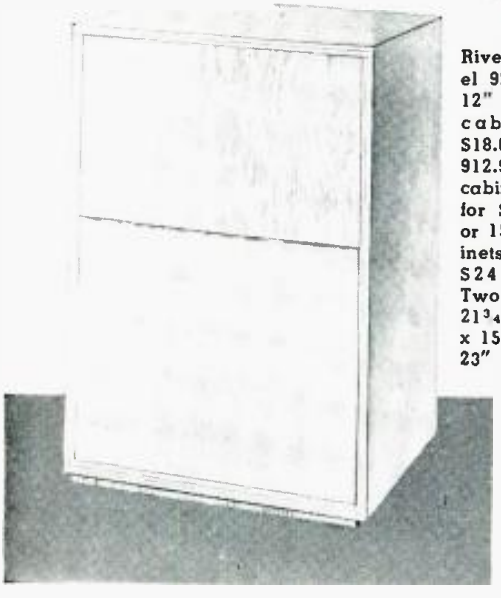


Model 1460 TV, River Edge, available in two finishes at $195.00—10 others at $214.50. Measures 60" x 23" x 33½". Has 4 sections (15¾" x 14¾"; 16¾" x 20½" x 15¼"; 12½"x22"x13¼"; 27½"x22"x28½"). Space to right for TV.

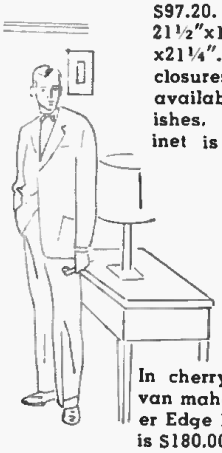
The River Edge Model 2436C is available in fruitwood or maple and is priced at $249.60. It has 3 compartments (record changer drawer, 15¾" x 14¾"; a tuner-preamp-amplifier compartment, 16¾" x 14¾" x 15"; and record storage compartment, 34¼" x14¾"x15¾".) Overall dimensions are 37" x 19¾" x 38¼".



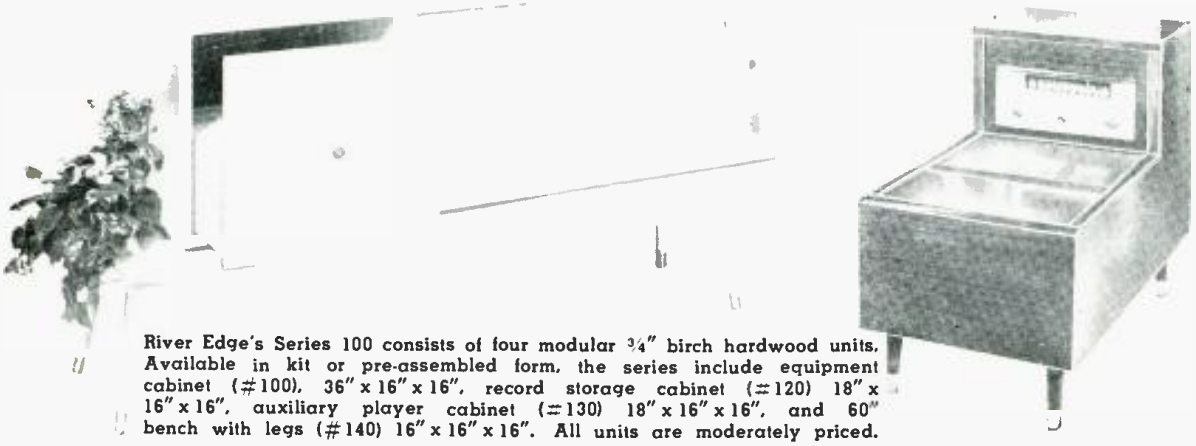
River Edge 5024 "J" in walnut, mahogany, maple, $72; in fruitwood, $79.20. Compartments 15¾"x14¾" and 22¼" x 14¾" x 20¼". Style RK in walnut, blonde, mahogany, maple, $90.; fruitwood, $97.20. Compartments 21½"x14¾"; 22¼"x15" x21¼". Speaker enclosures for 12" or 15" available in all finishes. Equipment cabinet is 24" x 16" x 36".



River Edge kit Model 920 is $26.70. A 12" or 15" speaker cabinet sells for $18.00 each. Models 912.915. Assembled cabinet (970) sells for $35.94 and 12" or 15" speaker cabinets each sell for $24.00 (962,965). Two compartments: 21¾"x14½"; 21¾" x 15¼" x 20". Size: 23" x 16" x 33½".



In cherry or cordovan mahogany, River Edge Model 1636 is $180.00. In blonde mahogany, limed oak, blonde walnut, maple, fruitwood, ebony, African oak or natural birch it is $198.00. Two compartments: 15¾" x 14¾"; 16½"x19½" x 17". The two record compartments are: 12¼" x 21" x 13¾". Over-all 36" x 23" x 36".



River Edge's Series 100 consists of four modular ¾" birch hardwood units. Available in kit or pre-assembled form, the series include equipment cabinet (#100), 36" x 16" x 16", record storage cabinet (#120) 18" x 16" x 16", auxiliary player cabinet (#130) 18" x 16" x 16", and 60" bench with legs (#140) 16" x 16" x 16". All units are moderately priced.

At $89.70 the River Edge Model 420 Style G is available in either cherry or cordovan mahogany. For $98.67 it may be obtained in mahogany, walnut, blonde walnut, limed oak, maple, ebony, African oak, blonde, and natural birch. The over-all dimensions are: 18½" x 32" x 27½". The four compartments are: 17" x 15"; 17" x 10½" x 9½", 17" x 10" x 7¾"; 17" x 7½" x 9¼".

Installing Hoffman COLOR Sets

By
WALTER H. BUCHSBAUM
Television Consultant
RADIO & TELEVISION NEWS

This set uses two unusual circuits which are explained here; also some installation hints.

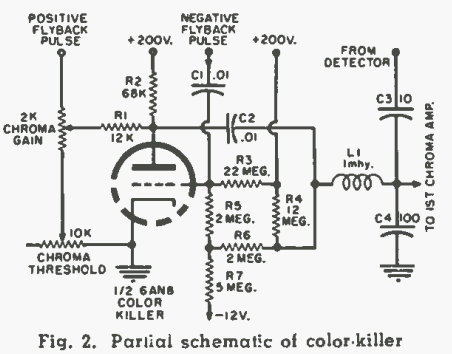


Fig. 2. Partial schematic of color-killer circuit of Hoffman 703 color TV chassis.

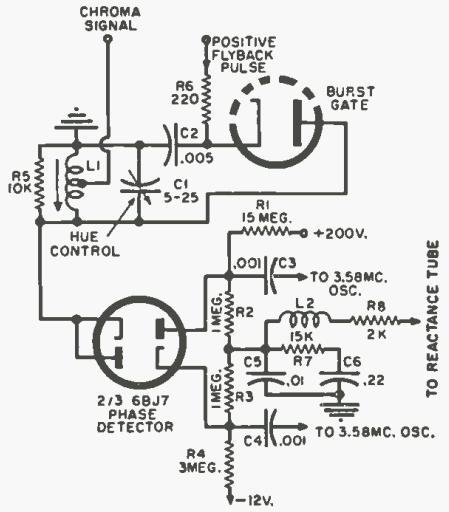
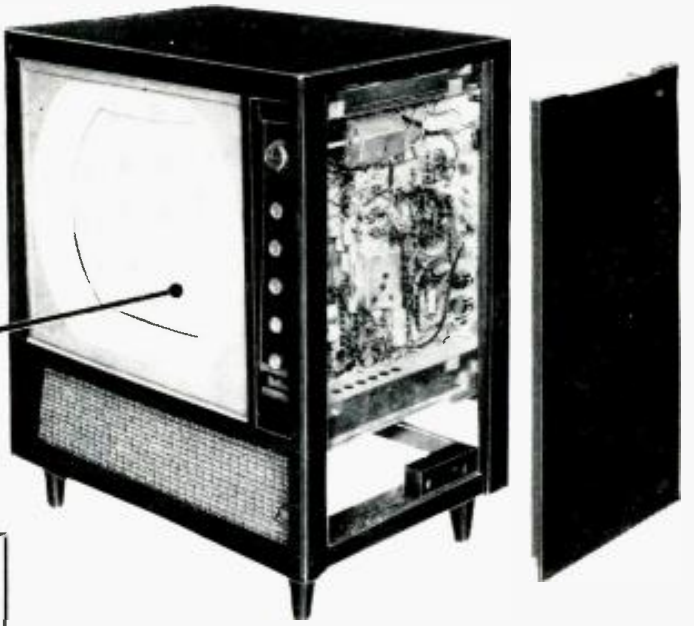


Fig. 3. Burst gate and phase detector.

Fig. 1. Twenty-one inch Hoffman color TV set showing how the side panel is removed for under chassis adjustments.



HOFFMAN "Colorcaster" receivers are shipped with the picture tube in place. Since the entire side panel of the cabinet is removable (Fig. 1), all necessary adjustments can be reached without having to remove the chassis from the cabinet.

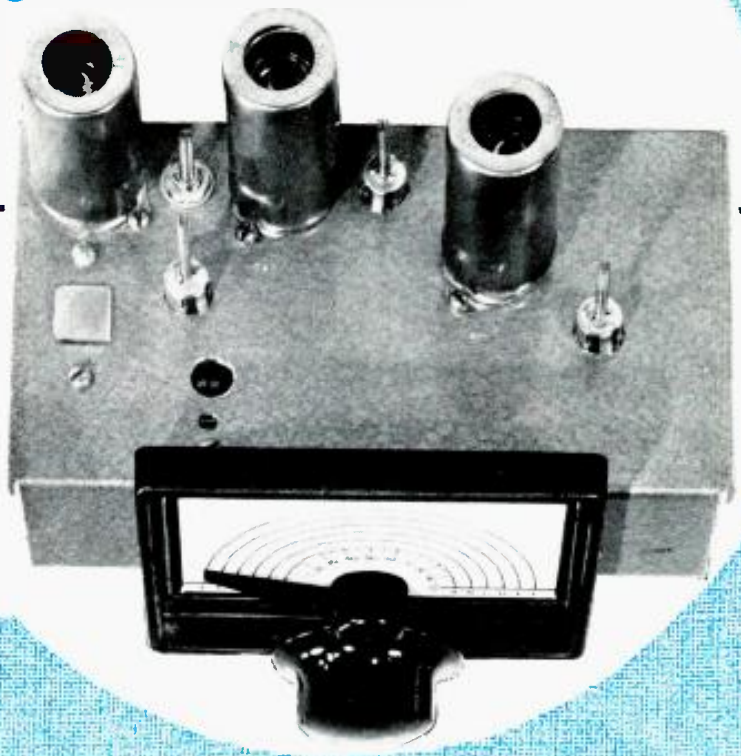
The picture-tube assembly may require some attention during installation or picture-tube replacement. Behind the deflection yoke is the convergence yoke. Each of the three convergence magnet coils contains a small permanent-magnet screw, accessible from the back, which is adjusted for d.c. convergence for each beam. The purity magnet located behind the convergence yoke is adjusted in conjunction with the field neutralizing coil to eliminate color contamination. If only the red electron beam is on, for example, proper purity exists if the entire screen is a uniform red without blotches of yellow or purple. The blue beam positioning magnet, which is just in front of the tube socket, operates in conjunction with the convergence yoke. For detailed adjustment of the purity and convergence system, the manufacturer's data should be consulted.

In many instances when the set performs well on monochrome broadcasts but not color, this is due to the misadjustment of the color-killer circuit. The color burst sent out with each horizontal synchronizing pulse is often slightly attenuated, especially for programs relayed over coaxial cable. As a result, the color-killer circuit does not operate properly.

Fig. 2 shows the vital portions of the color-killer circuit of the 703 chassis. Effectively, the bias on the grid of the first chroma amplifier depends on the amount of flyback pulse amplified by the color-killer stage. During a color telecast, the grid of the color-killer tube receives from the detector the color synchronizing burst which overcomes the effects of the negative pulse at the grid and allows more current to pass. As a result, the bias on the chroma amplifier is such that it conducts. Voltage divider R_4, R_5, and R_7 determines the d.c. potential at the grid of the chroma amplifier; another divider network determines the d.c. voltage on the color-killer tube. Part of the latter is the chroma gain potentiometer located on the front panel. The other potentiometer is called the chroma threshold control because it is adjusted to provide just the right bias so that during a color program, enough of the color burst can get through to reduce the killer bias. For this reason the threshold control should only be adjusted during a color telecast, and care must be taken to see that even if the color signal is weak, the color-killer circuit will allow it to pass.

Among the *Hoffman* color cir- (*Continued on page* 114)

A Low Cost 220-Megacycle Tuner



Over-all view of the author's home-built tuner. When used with a communications receiver, it has a sensitivity of 1 μv. with 3:1 noise ratio. Coils must be hand wound.

An interesting project for the advanced radio amateur which provides worthwhile experience on u.h.f. bands.

By **J. T. GOODE**

THE 220-megacycle band is truly an experimenter's haven. Unlike six and two meters, very little surplus equipment can be easily modified for 220 mc. operation. Most of the equipment used on this band is of the home-constructed type.

Construction of receivers and transmitters for 220 mc. operation is considerably more exacting than for any of the lower frequency bands. Chassis layout and wiring dictate the difference between satisfactory and unsatisfactory results, even though the electrical circuit design is correct.

As a rule, 220 mc. transmitters have low output. The sensitivity of the receiver is an important factor. Receiver sensitivity on the order of one microvolt is highly desirable. The tuner to be described, when used in conjunction with a communications receiver, has a sensitivity of one microvolt with a 3 to 1 noise ratio.

The design of this tuner features the use of low-cost parts. Over-all cost is approximately $18.00 less whatever components the junk box can provide.

This is a broad bandpass tuner, with only the oscillator being tuned. The oscillator frequency is placed on the high-frequency side so the image frequency will not fall inside the channel 13 television band.

The base oscillator operates at 75 mc. and uses a frequency multiplier. This simplifies construction, improves stability, and allows for frequency drift compensation.

The i.f. output circuit uses a cathode follower. This results in more gain from the mixer circuit. Cathode followers, in themselves, have a gain of less than one. The gain realized is a factor of less loss. The cathode follower could be eliminated by using a pickup coil coupling the output of mixer plate coil L_5. L_5 would become a stepdown transformer to obtain the necessary low-impedance output. By using a cathode follower the full voltage output of the mixer plate coil is used, resulting in an increase of 3 to 1 over the pickup coil output, not using the cathode follower.

The r.f. stage is a 6BQ7A cascode amplifier. This is the simple form of cascode amplifier for high-frequency use. The r.f. plate coil is series-connected to the grid of the mixer circuit. This reduces the shunt capacity across the coil, increasing the impedance.

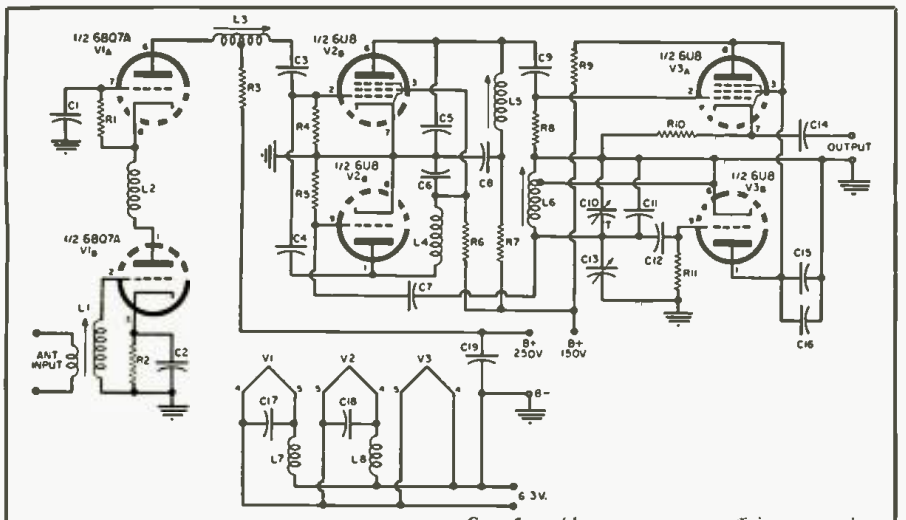
Power requirements are as follows: 6.3 volts, a.c. or d.c., at 1.3 amperes and 250 volts at 10 ma. and 150 volts, regulated, at 35 ma. The power necessary for the tuner can be supplied from the communications receiver power circuit or a separate power supply.

While the use of a voltage-regulated power supply is not absolutely necessary, it is desirable. Any change in oscillator plate voltage will cause drift and the amount of drift may necessitate retuning the dial while listening to a station.

The i.f. frequency of the tuner is 4000 kc. Any receiver that will tune to this frequency and has an antenna coil (no loops) can be used in conjunction with this tuner. Coaxial cable should be used to connect the output of the tuner to the antenna terminals of the receiver. The impedance of the cable is relatively unimportant as long as it is shielded. Stray pickup by this lead will cause interference. Even the lower priced communications receivers will have adequate gain for this tuner.

The operation of the tuner is as follows: L_1 is the antenna coil with C_1 the cathode bypass capacitor shunting the cathode resistor R_2. L_2 is the neutralizing coil which is connected directly at the pin socket connections. R_1 is the grid resistor and C_1 is the grid bypass capacitor. The plate of V_1 is connected to the top contact of coil L_3. R_3 is the "B plus" decoupling resistor.

The mixer grid capacitor is C_3, the mixer grid resistor is R_4, while C_4 is the mixer plate coil bypass. C_5 is the mixer tuning capacitor. C_6 the fre-



R_1, R_3, R_4—470,000 ohm, ½ w. res.
R_2—100 ohm, ½ w. res.
R_5—1000 ohm, ½ w. res.
R_6—220,000 ohm, ½ w. res.
R_8, R_7—10,000 ohm, 1 w. res.
R_9—5600 ohm, ½ w. res.
R_{10}—220 ohm, ½ w. res.
R_{11}—43,000 ohm, ½ w. res.
C_1, C_2, C_6, C_{15}, C_{17}, C_{18}, C_{19}—.001 μfd. ceramic capacitor
C_3, C_9—470 μμfd. ceramic capacitor
C_5—.68 μμfd. ceramic capacitor
C_7—30 μμfd. ceramic capacitor
C_8, C_{12}—20 μμfd. zero temp. coefficient ceramic capacitor
C_{14}, C_{16}—.01 μfd. ceramic capacitor
C_{10}—2.5-6 μμfd. trimmer (Centralab 820-A)
C_{11}—5 μμfd. zero temp. coefficient ceramic capacitor
C_{13}—Two-plate var. capacitor (Bud MC 900. See text)
L_1—3 t. #16 tinned wire, spaced ⅜" on 9/32" o.d. coil form (See text)
L_2, L_3—4 t. #20 en., spaced ⅛", airwound 3/16" i.d.
L_4—5 t. #16 tinned wire, spaced ½" on 9/32" o.d. coil form, center-tapped (See text)
L_5—Miller B-5495-A coil
L_6—6 t. #16 tinned wire, spaced ½" on 9/32" o.d. coil form. Tap 2 t. from bottom (See text)
L_7, L_8—20 t. #24 en., closewound, airwound ⅛" i.d. Cement coil after winding
V_1—6BQ7A tube
V_2, V_3—6U8 tube

Complete schematic of the tuner. The circuit is straightforward but standard u.h.f. wiring procedures must be followed in order to obtain proper operation.

quency multiplier bypass, and R_2 is the multiplier grid resistor. C_1 connects the injection voltage to the grid of the mixer and capacitor C_7 connects the oscillator circuit to the frequency multiplier.

L_1 is the frequency multiplier plate coil. R_4 serves as the "B plus" decoupling resistor for the frequency multiplier plate coil. R_7 is the decoupling resistor for the mixer plate circuit while resistor R_9 is the decoupling resistor for the cathode follower.

C_9 couples the i.f. output to the grid of the cathode follower. R_8 is the cathode follower grid resistor and R_{10} is the cathode follower output resistor. C_{14} serves as the coupling capacitor for the output circuit. L_4 is the plate coil for the mixer circuit.

L_6 is the oscillator coil, while C_{10} is the temperature-compensating trimmer. C_{11} is the oscillator tank capacitor, C_{12} the oscillator grid coupling unit, and C_{13} the oscillator plate bypass capacitor and C_{16} the unit which shunts C_{13}, is the bypass for the plate and screen of the cathode follower. C_{19} serves as the "B plus" bypass. C_{17} and C_{18} are filament bypass capacitors while L_7 and L_8 are filament r.f. chokes.

Capacitor C_{13} is the main tuning unit. This is a *Bud* Type MC900 double-bearing unit. Rotor plates are removed in this application to make it a two-plate capacitor.

Coil Information

L_5 is a standard, commercial unit which requires no modification. L_1, L_3, and L_6 are made by modifying *J. W. Miller* Type 1474 coils. It is not absolutely necessary to use these particular coils but they do have high-frequency cores and the lugs on the coil forms make the winding process easy. The only actual requirement is that the coils tune to the proper frequency without too much reduction in "Q" and are stable.

The modification of these coils should be handled as follows: For L_1 remove the wire from the *Miller* Type 1474 coil. Wind 3 turns of #16 tinned wire, spaced ⅜", connecting either end of the coil to the top and bottom lugs on the coil form. The primary winding consists of one turn wound around the ground end of the coil, using top and bottom lugs on the coil form for connections.

For L_3 wind 5 turns of #16 tinned wire, spaced ½", and center-tap the coil. For L_6 wind 6 turns of #16 tinned wire, spaced ½", tapping 2 turns from the bottom end of the coil. All three of these coils should be wound on *Miller* Type 1474 forms, if possible. After winding the coils, paint the windings with polystyrene cement to secure the winding tightly on the coil form.

L_2 and L_3 consist of 4 turns of #20 enameled wire, spaced ⅜". Use a ⅜" rod to air wind these coils. They should be identical. Coils L_7 and L_8 require 20 turns of #24 enameled wire closewound around a ⅛" diameter rod. Remove the coils from the rod and dip in polystyrene cement. Other forms and cores can be used but it may be necessary to change the number of turns.

Mount the components on the chassis and rotate tube sockets so that the length of the plate and grid leads will be minimum. Socket of V_1 should be turned so that the #2 pin is closest to the grid contact of coil L_4. The mixer socket should be rotated so that pin #2 is as close to coil L_3 as possible. Arrange the V_3 socket so that its pin #2 is as close to pin #6 on the socket of V_2 as you can get it.

A tie-point is located at the rear of the chassis for all of the power connections. First wire in the filament circuits of V_1, V_2, and V_3. Capacitors C_{17} and C_{18} should be wired directly across pins #4 and #5 of the V_1 and V_2 sockets. A ground mounting lug should be placed under the socket mounting screw of V_1. All ground connections for this circuit go to this ground lug.

With #22 copper-tinned wire connect pin #9 (center post of socket) and pin #4 to the ground lug. The ground lead for L_1 connects from the coil to this ground lug. Capacitor C_2 and resistor R_2 connect from the ground lug to pin #3. Coil L_2 is connected from pin #1 to pin #8, with resistor R_1 going from pin #7 to pin #8. C_1 is connected between pin #7 and the center post on the socket. The plate lead from pin #6 is connected to the bottom end of coil L_3.

R_3 should be connected from the center-tap of L_3 to the tie-point on the rear of the chassis. Capacitor C_{19} goes from this tie point to ground at the end of the terminal strip.

Connect C_3 between the top end of L_3 and the #2 pin of V_2, and R_1 from this same pin to the ground lug mounted under the socket mounting screw of V_2. Pin #6 is then connected to the contact of L_5. There is an additional winding on L_5 which is not used but need not be removed.

Capacitor C_5 is connected from pin #6 to the common ground lug of V_2. A piece of #22 copper-tinned wire is used to connect the ground lug to the center post of the V_2 socket. Pins #5, #7, and #8 should be bent over and soldered to this center post. Resistor R_5 goes from pin #9 to the ground lug of V_2. Capacitor C_8 is connected from pin #3 to the common ground lug while C_7 goes from pin #1 to pin #2. Coil L_4 goes from pin #1 to pin #3. R_6 should be connected between pin #3 and the tie point terminal at the rear of the chassis. C_6 goes from the center post of V_2 to coil L_4.

A two-point tie point should be used near the V_3 socket. A lead connects from the "B plus" end of R_6, which is mounted at the rear tie point, to one of the terminals on the tie point located near V_3. R_7 is then connected from L_6 to this tie point. Resistor R_8 also goes from this tie point to pin #6 with pins #6, #3, and #1 strapped together.

A common ground lug is located under the mounting screw of the V_3 socket. R_9 goes from pin #2 to this

ground point. C_9 is connected between pin #6 of V_2 to pin #2 of V_3. R_{10} goes from pin #7 to the common ground point while C_{11} goes from pin #7 to the tie point located near the socket of V_3.

The ground end of L_6 goes to the common ground point while pin #8 of V_3 is connected to the tap on L_6, the oscillator coil. Grid resistor R_{11} goes between pin #9 and the ground point. Capacitor C_{12} connects from pin #9 to the top of the oscillator coil with C_7 going from the same point to pin #9 on the V_2 socket. C_{10} is grounded at the common ground point of the V_3 socket. This connection should be to the movable arm of this trimmer. The other end of the trimmer, C_{10}, is connected to the top of the oscillator coil.

C_{11} should be connected directly across the terminals of C_{10}. The stator of C_{13} is connected to the top of L_6, the oscillator coil, while the ground lug is connected to the common ground point at V_3 by means of #16 bus bar. C_{15} is connected from the center ground post to pin #3 while C_{16} goes from the common ground point of V_3 to pin #6. No. 22 copper-tinned wire should be used to connect the common ground point of V_3 to the center post of the tube. Pin #5 should be bent over and soldered to this center post.

The antenna input connections for the tuner go directly to the contacts on L_1. The output connections are wired directly from the tie point near V_3 to ground.

Tuner Adjustment

Adjustment of this tuner is relatively simple but you will need a grid dip oscillator. With the antenna disconnected from L_1, adjust the iron core until it tunes to 222.5 mc. Next adjust the inductance of L_3 to tune the same frequency. Then adjust L_5 to tune to 4000 kc. and L_1 to 226 mc. The adjustment of this coil consists of pushing the turns closer together or farther apart. You will have to experiment.

Now, close C_{13} and rotate trimmer C_{10} for minimum capacity. Adjust the iron core of L_6 to 74.6 mc. Next open C_{13} for minimum capacity. The frequency of L_6 should be 76.5 mc. or higher. This will provide adequate spread for the 220 mc. band.

The tuner is now ready for operation. Make the necessary connections to the power supply and connect the output terminals of the tuner to the antenna input terminals of the receiver by means of coaxial cable. Hook up the antenna to the antenna terminals of L_1.

The use of a high-frequency signal generator for final adjustments is desirable but other equipment can he used if you don't have access to such h.f. gear. If a low-frequency, service-type signal generator is available, it will do since the harmonics can be employed.

Rotate the tuning capacitor for maximum capacity. The 16th harmonic of 13,750 kc. is 220 mc., the former is in the range of most signal generators. Adjust the signal generator until a signal is heard. If the frequency of the generator is less than 13,750 kc., adjust the iron core of L_6 to bring the received frequency up to 13,750 kc.

Next slowly rotate the dial of the tuner, decreasing the capacity of C_{13} and follow the frequency with the signal generator. The 225 mc. point will be at 14.063 kc. If this frequency is reached before C_{13} reaches minimum capacity, the spread can be adjusted by bending the rotor plate for less capacity. In other words, the bandspread will be determined largely by the bending of the rotor plate of C_{13}. If a high-frequency signal generator is available, use 220 and 225 mc. for adjustment.

In the process of adjusting coils to frequency it may be found that the iron core adjustment still won't give the proper frequency. This can be due to the variation in lead length or the method by which the coils were wound. In either case the turns of the coils can be adjusted so the proper frequency can be obtained.

If, for instance, with the core adjusted for minimum inductance on L_1 the frequency would be 215 mc., spread the turns on the coil form used for L_1. On the other hand, if the inductance, with the core well inside the coil produces a frequency of 230 mc., then bend the turns of the coil closer together which will cause the inductance to increase.

If other coil forms and iron cores are used, it may be necessary to add or subtract as much as a turn on these coils.

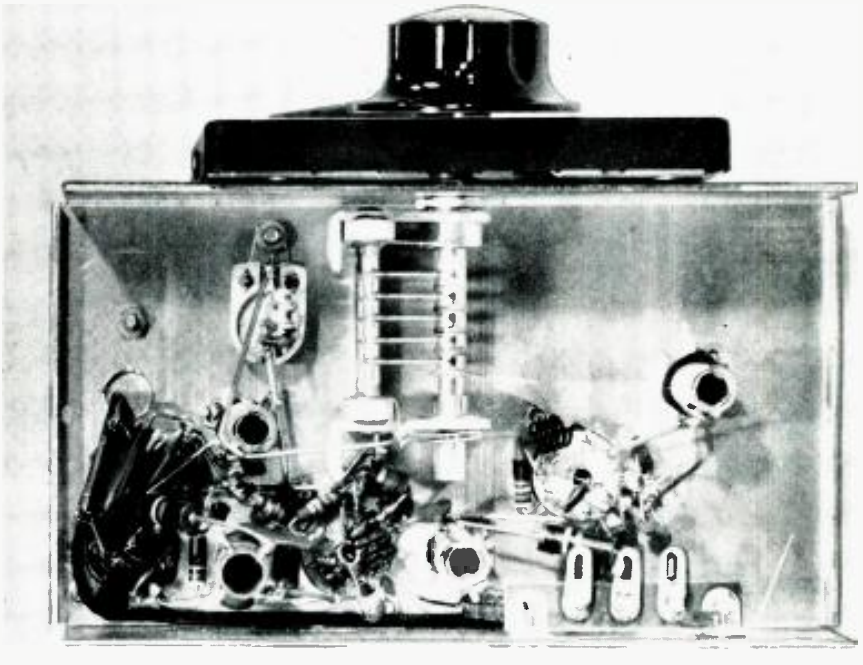
When the tuner is placed in operation, if drift is noticed it can be compensated for as follows: Capacitor C_{10} is a negative coefficient trimmer. As capacity is added by means of this trimmer, the negative drift characteristics will be increased which will compensate for normal drift caused by heat. Rotate capacitor C_{10} slightly and adjust iron core L_6 to bring the frequency back to normal. If the tuner continues to drift, add slightly more capacity with C_{10} and again return the frequency to the original calibration by adjusting the iron core of L_6.

After using the tuner and noticing the drift characteristics, the drift can normally be compensated to the extent that it will no longer be noticeable. Final adjustment of the tuner can be made on received signals.

The core of L_1 is adjusted for maximum signal strength with the tuner receiving signals near the center of the band. L_3 is adjusted for the same characteristics. L_5 is adjusted for maximum output of the i.f. frequencies while L_1 is adjusted slightly on the high-frequency side of the tuning range. If L_1 is adjusted to a higher frequency the sensitivity may be low. On the other hand if L_1 is adjusted inside of the bandpass frequency, 220 to 225 mc., there will be a dip in the sensitivity of the receiver at the exact frequency of L_1.

Since L_2 is the neutralizing coil, if oscillation occurs spread the turns to stop this condition. Adjustment of this coil is not critical. —30—

Under chassis view of the tuner. The capacitor is a standard unit which has been altered for this application. The coils are hand wound with full details in text.



"The Showman" — A New Indoor TV Antenna

Here's an indoor antenna that uses a channel selector control and can be tuned like a television receiver.

Fig. 1. The "Showman" indoor TV antenna. The frames at either end of the antenna provide end loading. The close-up of the interior shows the variable inductors.

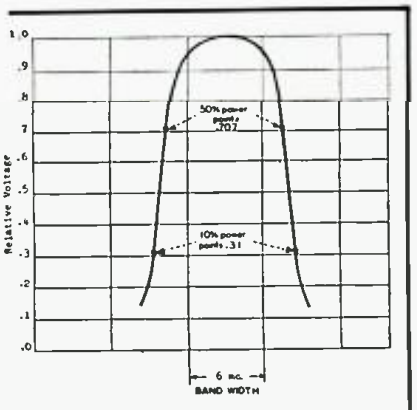


Fig. 2. Typical response curve of the "Showman" when tuned to one channel.

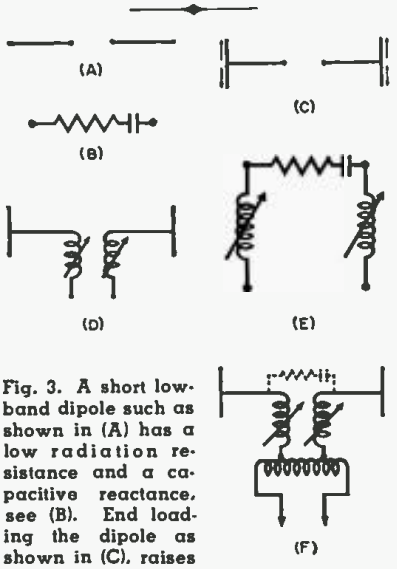


Fig. 3. A short low-band dipole such as shown in (A) has a low radiation resistance and a capacitive reactance, see (B). End loading the dipole as shown in (C), raises the radiation resistance; adding inductance in series as shown in (D), tunes out the capacitive reactance as shown in (E). The autotransformer (F) raises the impedance.

By **HAROLD HARRIS**

Vice-President in Charge of Engineering
Channel Master Corporation

THE indoor television antenna is at the very peak of its popularity in the United States. There are approximately 10 million already in use while another million are being purchased every year!

The reason for the indoor antenna's popularity is easy to understand: they generally cost less, are simple to install, often provide adequate reception in strong signal areas, and they neatly circumvent "landlord restrictions" which often leave the apartment-dwelling TV set-owner no alternative but to use an indoor antenna.

What do people look for in indoor antennas? Surveys to determine consumer attitudes and opinions toward indoor TV antennas show that although good performance is certainly expected, there are other considerations of greater importance to the typical customer: attractive appearance and operating convenience. This becomes obvious when one realizes that an indoor TV antenna usually occupies a prominent spot in the home and that the TV set is used by all members of the family, including young children and old folks.

Major innovations in indoor antenna appearance and performance have been developed by the *Channel Master Corporation*. The new antenna with these features is the "Showman," a device less than 20 inches from tip to tip, consisting of a center nacelle made of plastic containing the tuning mechanism and a wire-formed dipole extending from the nacelle. See Fig. 1. The entire structure pivots on a metallized plastic tripod. It is available in three color combinations, ebony and silver, mahogany and gold, and blonde and gold. The tuning dial is calibrated by channel and the antenna is actually tuned to the channel being viewed.

This antenna is designed for use in locations where indoor antennas are presently being used. However, in field testing the product under favorable conditions such as on points of elevation, reception has been achieved at 75 miles. This antenna is designed for v.h.f. only. Due to the "Metro-Dyne" tuning system used in this unit, gains have been achieved running from minus 2 db on the low band, to slightly above unity on the high band.

Field tests have shown that this antenna has an unusual ability to eliminate "ghosts." "Ghosting" in indoor antennas is frequently caused by the fact that both the antenna and the transmission line pick up signals in areas close to the transmitting station. In these very high-signal areas, the antenna can be tuned off frequency so that it terminates the transmission line properly and, therefore, only one signal is fed to the set. Rotating the antenna on its swivel mount will improve signal-to-noise ratio and sometimes help to eliminate "ghosts."

The "Metro-Dyne" is a new type of tuning system which is, in effect, a 12-channel tuner. It incorporates series compensation on the low band, shunt compensation on the high band, and an autotransformer for correct 300-ohm matching. Possibly the greatest advantage of "Metro-Dyne" tuning is its selectivity. With this tuner, a broadband antenna can be tuned to a specific channel with bandwidth characteristics similar to that of a single-channel yagi. This is shown in Fig. 2. This means, of course, that it rejects all signals on every other channel and, therefore, cuts down tremendously on noise and other interference. The "Metro-Dyne" tuning actually adds to the selectivity of the television set.

Basic to the operation of the "Showman" is the little-known fact that a short dipole (one whose length is considerably less than one-half wavelength) has about the same gain as a half-wave dipole. However, the radiation resistance of a short dipole is down to about 3 or 4 ohms which, at its feed points, appears as a highly capacitive reactance, as shown in Fig. 3B. This situation can be improved somewhat by the familiar technique of end loading. This method, in effect, lengthens the antenna electrically without affecting its tip-to-tip distance physically, as shown in Fig. 3C. Although the current flow in the end-

(*Continued on page* 147)

Voltage Amplifier Distortion

Procedure to follow when designing a driver stage for a power amplifier to obtain minimum distortion.

By LAWRENCE FLEMING

HIGH-FIDELITY amplifiers are generally designed from the output stage back, with the power output and distortion of the last stage taken as the controlling factor. The distortion, at maximum rated output, is published in the tube manuals for all types of power tubes, and from this data, together with performance information on the many amplifiers that have been described in the literature, one can get a pretty good idea of what a given output stage will do.

Not so with the voltage amplifier that precedes the output stage. It is this next-to-last stage that this article is about, the stage which must deliver from 15 to 50 volts or more to the grid of a power tube in class A or AB_1. Except for class AB_2 and class B systems (which are not considered here), there is practically no information on tap as to how much distortion a resistance-coupled amplifier stage will introduce when it is delivering, say, 40 volts to the grid of a 2A3. Tube handbook data gives only voltage output at the 5 per-cent distortion point. Generally we want to be conservative, and select a driver tube and circuit listed in the resistance-coupled amplifier chart as handling about twice the voltage swing we really require. But two questions remain unanswered: how much distortion do we get at half or two-thirds the listed maximum output, and what kind of distortion is it—pure second harmonic, or a sharp mixture of high-order stuff? Moreover, it would be nice to know in a general way what are the best tube types to use for delivering a wide voltage swing, and how critical are the effects of variations in bias resistor, plate load, and plate supply voltage.

By running a few dozen distortion vs voltage output curves on resistance-coupled amplifiers and considering the theory a bit, one can arrive at several handy rules of thumb.

First, among the usual triodes and pentodes there is not a great deal of choice. Among medium-mu triodes, the 6SN7 (or 6J5) and the little 9002 are the best, but the poorest type gives only half again as much distortion at 50 volts output. The high-mu 6SL7 is nearly as good, provided the grid resistor of the next stage is .5 megohm or higher.

Second, the distortion produced by resistance-coupled voltage amplifiers under ordinary operating conditions is nearly all second harmonic, for both triodes and pentodes, provided there is enough bias to keep clear of peak-clipping due to grid current.

Third, the choice of load resistor is not critical within the usual limits, but the plate load resistance should be lower than the following grid resistor, preferably half or less.

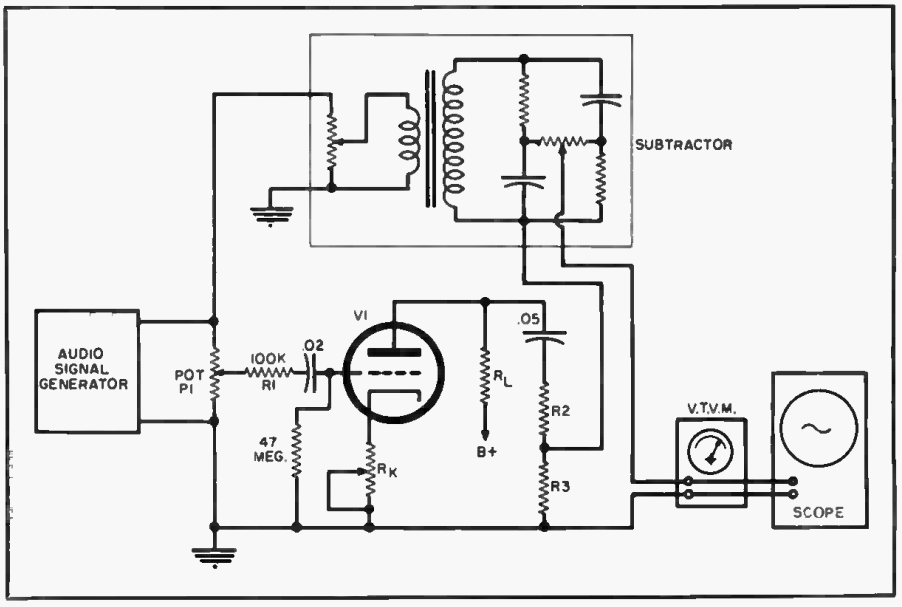
Fourth, the cathode bias resistor is not critical. It should be high enough to avoid grid current at the highest output voltage required, but not very much higher.

Fifth, the way to get high output voltage and/or low distortion is to use a high "B" supply voltage.

Sixth, distortion in most triodes can be cut approximately in half by merely omitting the cathode bypass capacitor. Voltage gain is halved as well.

The reference signal or "subtractor" method of measuring distortion was

Fig. 1. Set-up for use in making voltage amplifier distortion measurements. Tube V_1, R_L, R_K comprise the amplifier circuit under test. The "subtractor" phases out the fundamentals, leaving the harmonics. This is discussed in detail in the article.



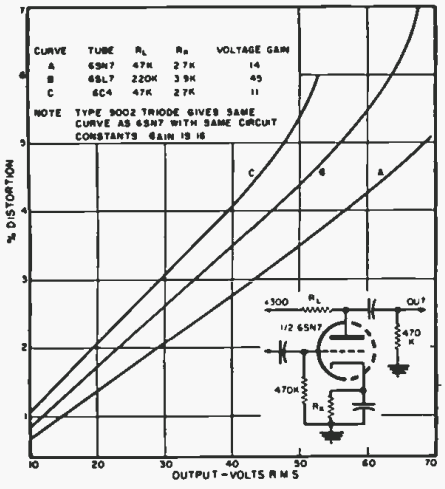


Fig. 2. Distortion vs output for various resistance-capacitance coupled triodes.

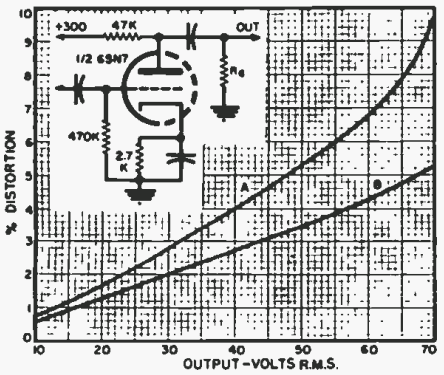


Fig. 3. Effect on distortion of loading by following grid resistor. Curve A is for an R_G of .1 megohm while Curve B is for an R_G of .47 megohm. Refer to the text.

employed, because the equipment needed is simple, inexpensive, and reliable. Fig. 1 shows the experimental set-up in block form. A 500-cycle signal from an ordinary audio oscillator is fed through a volume control P_1 and a grid-current limiting resistor R_1 to the input of the amplifier stage under test, which comprises tube V_1, plate load resistor R_L, and cathode resistor R_K. When R_K is bypassed, a 50-μfd. capacitor was used. The output of tube V_1 goes to a 10:1 voltage divider R_2R_3 of about .47 megohm total resistance, and through the subtractor to a sensitive multi-range a.c. v.t.v.m. and to an oscilloscope. The audio oscillator output is also fed to the subtractor, which is simply an isolating and phasing device. The subtractor output is inserted in series with the input to the v.t.v.m. and the scope. In operation, one merely feeds a signal to the amplifier stage under test, clips the v.t.v.m. input lead to the amplifier output, and sets the signal level to the desired value. Then the v.t.v.m. is hooked into the subtractor circuit, and the subtractor level and phasing controls adjusted until the 500-cycle fundamental is cancelled out. The v.t.v.m. measures the voltage of the harmonics that remain, and the per-cent distortion may be figured by simple division. The order of the harmonics is apparent by inspection of the scope trace.

To keep the amplifier phase shift inside the range of adjustment of the phasing control on the subtractor, it was necessary, at times, to shunt R_1 with a 50 $\mu\mu$fd. capacitor. The output coupling capacitance had to be at least .05 μfd.

Comparison of Triode Types

Curves of distortion percentage *vs* voltage output for four common types of triodes are shown in Fig. 2. The same supply voltage of 300 was used for all cases, and the same plate load of 47,000 ohms for all the medium-mu tubes. For the high-mu 6SL7, a 220,000-ohm load was employed, in keeping with the high plate resistance of that type.

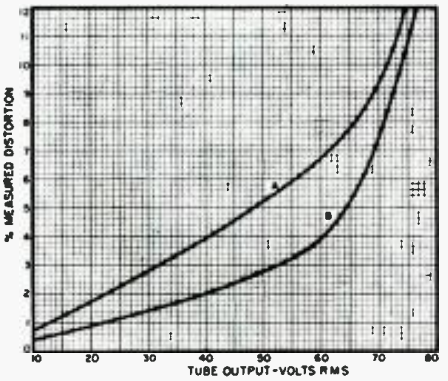
The 6SN7 comes out best, with 1.3 per-cent distortion at 20 volts output (the level needed for driving class A 6L6's), and 3.5 per-cent at 50 volts. Poorest was the miniature 6C4, a tube which shows other signs of poor linearity, as will appear later on. The high-mu 6SL7GT was intermediate.

The 6SL7, however, is not a good tube to use if the grid resistor of the next stage is lower than about 0.5 megohm, because this tube can't produce a large voltage swing across a low impedance, the way that lower-mu tubes can.

The plate voltage swing available from high-mu tubes is inherently less than from low-mu tubes, because the plate current of the high-mu tube is lower at zero bias. Hence the negative side of the plate voltage swing cannot extend as low as with low-mu tubes. This drawback of the high-mu tube is alleviated somewhat by the use of high resistance plate loads, which are necessary anyhow because of the low plate current available and the high plate resistance of the tube. This characteristic of high-mu triodes does not appear to be the controlling factor in high-level distortion, at least not with the 300-volt supply used. At low "B" voltages the handbook shows the 6SL7 becoming definitely inferior to the 6C4.

It was originally thought that low distortion might go hand-in-hand with low amplification factor. Tests were made on three 6AK6 miniature power pentodes in triode connection, with a 47,000-ohm plate load and a 5600-ohm bias resistor, bypassed. Voltage gain was 8. The curve of distortion *vs* output was nearly the same as for the 6SN7, but the gain only half as high. A 6SN7 with unbypassed cathode resistor does much better and gives the same gain. It would seem that distortion characteristics are more a function of the homogeneity of the tube geometry, *i.e.*, to what extent its characteristics are variable-mu. The less so, the better.

Fig. 4. Reduction in distortion due to removal of cathode bypass capacitor. Curve A is distortion vs output for 6SN7 with 47K plate load, 2.7K cathode resistor, 100K following grid leak. Curve B is for same tube with cathode bypass capacitor removed. Gain is halved; feedback cuts distortion in half, except in overload region above 50 volts output. See discussion.



Following Grid Resistor

Amplifier designers often like to operate 6L6's and 6V6's with resistances from grid to ground of 0.1 megohm or 0.05 megohm, for less susceptibility to grid emission and smoother overload characteristics. This definitely loads down the driver stage, although not to a serious extent, when grid swing levels under 40 volts are used. Fig. 3 shows distortion *vs* output curves for a 6SN7 with a 0.47-megohm grid leak following, and with a 0.1 megohm leak. All other conditions are identical. At 20 volts swing, the 0.1 megohm leak arrangement gives some 33 per-cent more distortion, 1.6 per-cent total as compared with 1.2 per-cent for the 0.47 megohm leak. Also the lower grid resistor makes the stage overload sooner, so that at 45 volts output the distortion is 1.5 times higher with 0.1 megohm, and at 70 volts the distortion is double.

The cathode bias resistor was made adjustable throughout these tests. In all cases a check was made to see if improvement in distortion could be obtained by adjusting the value of R_K a bit for each new operating condition. Outside of changing to tubes with radically different characteristics, or changing to different plate loads, the bias resistor proved to be not especially critical.

Omitting Cathode Bypass

Leaving off the cathode bypass capacitor is a kind of negative feedback circuit, and a very cheap one. It works just as it should, reducing the gain and the distortion proportionately. Fig. 4 shows its effect for the same circuit and tube just discussed. Up to 40 or 50 volts output, the distortion for the no-capacitor case is just about half that for the straight amplifier. As we approach overload conditions, feedback does less and less good, until at around 75 volts output it does no good at all, except to make the square waves a little cleaner.

Current feedback of this sort is undesirable in power amplifiers feeding loudspeakers for reasons well known, but that is no reason to avoid this type of feedback in voltage amplifiers which work into a pure resistance load.

The reduction in gain due to an unbypassed cathode resistor is given by the formula

$$A' = \frac{A}{1 + \frac{R_K}{R_L} A}$$

Where: A = gain of stage with cathode resistor bypassed
A' = gain with cathode resistor not bypassed
R_K = cathode bias resistance
R_L = plate load resistance

In practice with triodes, the actual gain reduction due to omitting the bypass across a normal-sized bias resistor is always pretty close to half.

Pentodes

In Fig. 5, three pentode types widely used for voltage amplifiers are compared. The curves do not differ by more than about 1.5 to 1. Distortion characteristics are very much the same as with the triodes, only a little poorer. The distortion was almost pure second harmonic, except when the grid current region was invaded.

Bias resistance, again, was optimized by trial for each tube. Data was not taken for plate load values other than 0.1 megohm, since this condition is listed in the tube manual as giving the highest output.

It has long been the opinion in some engineering circles that the old top-cap 6J7 produces less distortion than any of the newer single-ended and miniature tubes. Thus, *Hewlett-Packard* audio oscillators use 6J7's. The curves bear this out, although the difference is not great. It is a curious fact that, again, one of the early miniature pentodes, type 9001, is almost identical with the best of the other types tried. Anyone having 9001's and 9002's around the place should not overlook them for audio work. Incidentally, the 9001 is interchangeable with the 6AU6 for FM limiter applications.

Phase Inverters

The split-load phase inverter is really the best of all inverter circuits in stability of balance, freedom from parasitic oscillations, and adaptability to negative feedback amplifiers. Its drawback is that only half the voltage swing otherwise available can appear across each of the load resistors. From the distortion *vs* output curve in Fig. 6, it is seen that this drawback is considerably alleviated by the low distortion obtained at low and medium output levels. The heavy degeneration inherent in this circuit keeps the distortion below 1 per-cent up to almost 40 volts output per side, with the constants shown and a 300-volt supply. Above this level the distortion rises very sharply, as is characteristic of heavily degenerative circuits.

With the first stage cathode bypass omitted, the gain from input to either side is 7. The optimum biasing for the inverter triode was such as to produce a drop of 75 volts across each of the 22,000 ohm load resistors, or half the supply voltage for the total load.

Direct coupling of the first stage plate to the inverter grid is not best for high output levels, because one must then compromise between optimum plate potential at the first stage (150 volts) and optimum cathode potential at the inverter (75 volts). However, for signal levels less than 25 volts or so, one can usually get away with direct coupling. Other conventional inverters behave the same as straight amplifiers.

Plate Supply Voltage

Fig. 7 shows distortion *vs* output curves taken with a 6SN7 for various "B" supply voltages. To a pretty fair approximation, the following is true: At a given level of output voltage, the per-cent distortion varies inversely as the "B" supply voltage. Thus at 4 per-cent total distortion, one can get about 25 volts r.m.s. out of the tube with a 150-volt supply and 60 volts out with a 300-volt supply. And at the 30-volt output level, the distortion with a 150-volt supply is around 4.3 per-cent, but with a 300-volt supply, 2 per-cent. The overload point, where distortion begins to rise rapidly, also varies about directly as the "B" voltage.

Choosing Tubes and Circuits

The number of possible combinations of tubes, voltages, and resistances is so large that no practicable investigation of even one of their properties is possible without strictly limiting the number of tube and circuit types tested, and sticking pretty close to standard practice. Standard practice is, after all, the outcome of the work of perhaps hundreds of workers over a period of some twenty years. The measurements reported here were laid out as cross-sections in different directions. That is, various tubes were measured under a single set of conditions, and single tubes were measured under various conditions. The situation is further complicated because two things must often be varied at once to simulate practical conditions.

No two individual tubes are identical. Fortunately, though, amplification factor is a parameter that stays more constant from tube to tube than most others, and this makes the gain of triodes fairly consistent. To get really authoritative data on tube performance requires very large scale measurements, which are out of reason for anyone except a tube manufacturer, on perhaps hundreds of samples of tubes. Naturally, the curves given here are not authoritative in the above sense. The procedure was to try two tubes in each case, and if they gave data the same within about 15 per-cent, to let it go at that. If the divergence was large, another tube or two was tried until two were found that agreed well enough. Actually, agreement was good in all cases except one—an *RCA* 6SJ7GT which was too good. It measured only half the distortion found in the other 6SJ7's. In general there appears to be as much variation between tubes of any one

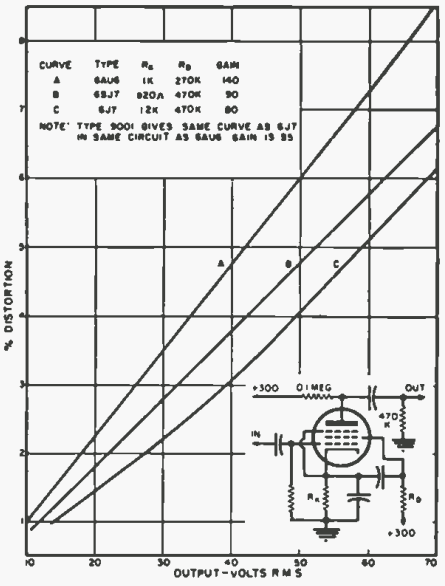


Fig. 5. Distortion of various pentodes.

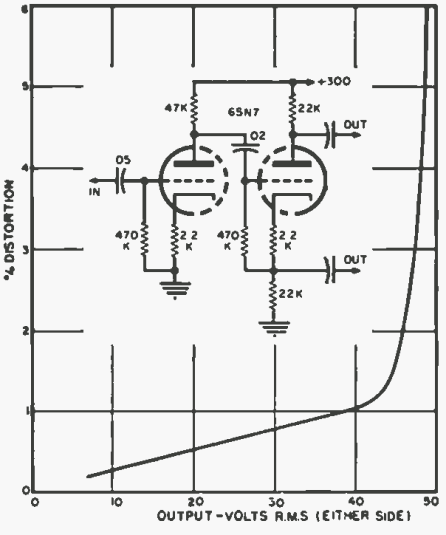
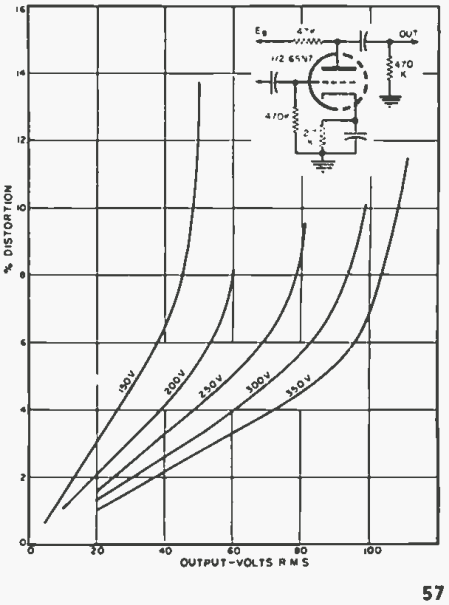


Fig. 6. Split-load phase inverter with preceding triode amplifier stage. Heavy feedback gives low distortion and sharp overload characteristic. Discussed in text.

Fig. 7. Effect of plate supply voltage (150 to 350 volts) on the distortion.



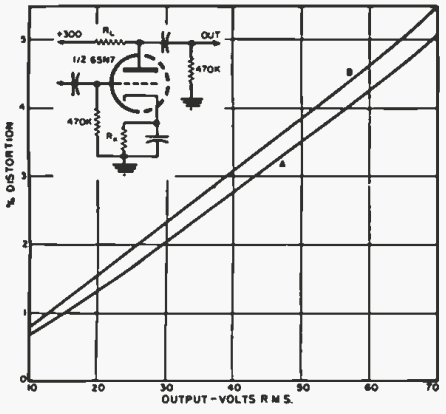


Fig. 8. Load resistor value has little effect on distortion, within usual limits. Curve A shows distortion for 6SN7 with R_L=47K, R_K=2.7K. Curve B for same tube with R_L=220K and R_K=10K. See article.

manufacturer as between samples of different makes, taken at random. This, however, is a complicated statistical problem which would take thousands of tube tests to get a meaningful answer. Then the answer might be wrong, because of changes in manufacturing processes occurring in the meantime.

Load Resistor

Choice of the plate load value in resistance-coupled circuits is a compromise between several conflicting factors, and in the normal range of values it turns out that the value does not make much difference.

The gain is highest and the distortion lowest when the load resistance is high compared to the plate resistance of the tube. The trouble is that when a high resistance is used, we must operate the tube at a lower plate current. At low plate currents the plate resistance of any tube is much higher than at large currents, so most of the advantage is lost.

The mu of triodes drops at low plate current values too, but comparatively slightly; the large increase in R_p is what spoils the fun.

Fig. 8 shows curves taken on a 6SN7 with two widely different load resistances, having optimum grid bias in each case. The lower of the two values, 47,000 ohms, is actually better but the difference is very slight.

To get really high output, impedance coupling is best. The plate choke should have enough inductance to present a reactance to the tube of at least twice the plate resistance at the lowest frequency considered. For a 6J5 going down to 40 cycles, this calls for 64 henrys. For high-quality systems, ordinary chokes are not good enough; few standard units have enough inductance at the current required.

Transformer coupling is capable of large voltages with low distortion, the results depending entirely on the particular transformer. A large unit with plenty of inductance is required for low bass distortion, since core saturation distortion can occur the same as with output transformers. Parallel feed is quite necessary, requiring a large choke for maximum output capacity. A parallel-feed resistor introduces no distortion itself, but limits the plate swing of the tube.

It is always a good idea to use 1-watt resistors for plate loads and screen dropping. Smaller units deteriorate due to the high voltage across them, even when they don't get warm.

Bias

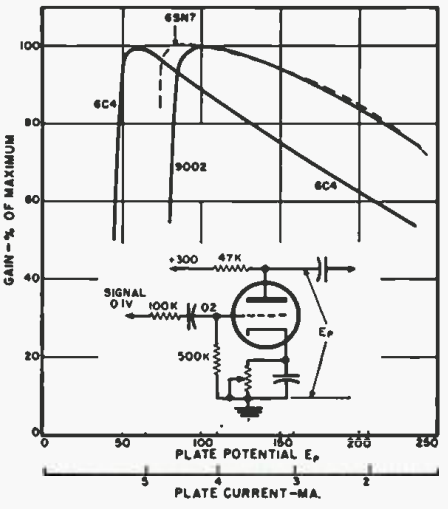
The writer's experience in all this data-taking was that for triodes, the bias resistance is not very critical. With pentodes, the gain drops faster as the bias is increased, and the recommended values should be adhered to within about 30 per-cent. In all cases it is better to err on the high side than the low. Gain drops slowly as the cathode resistor is increased, but with triodes the difference is small within normal ranges. Highest gain is always found at the lowest bias possible without drawing grid current. In fact, if a low-impedance signal source is used, the highest gain will appear at zero bias. Accordingly, in circuit measurements on a single stage it is important to use a resistance of 100,000 ohms or so in series with the grid, to avoid getting fooled.

As bias is increased, the tube becomes capable of putting out larger and larger signals without grid-current limiting. At the same time, the gain drops (only slightly) and the small-signal distortion increases very slightly. Operation of tubes at bias much higher than the middle of the characteristic, *i.e.*, where more than half the supply voltage is dropped across the tube, is undesirable on all counts.

A well-established rule for biasing triodes is to allow half the supply voltage to be lost across the tube, the other half of the d.c. voltage across the load resistance. In the tests reported here, no exceptions were discovered.

Another way to find the best bias for high-level *RC* amplifiers is to keep a watch on the plate current with a d.c. meter (or on the d.c. plate potential, with a v.t.v.m.) while slowly increasing the level of the input audio signal. Near the overload point, the d.c. plate current will start to change. If the bias is too high, the current will increase, and if too low, it will decrease. The optimum bias is midway between these, which about coincides with the point where the first shift in d.c. plate current is delayed until the highest possible signal level is reached.

Fig. 9. Variation in voltage gain of different tube types with bias. Bias resistor was varied and resulting d.c. plate potential plotted as abscissa. Voltage gain was measured at about .1 volt input. Gain of all types varies with operating point; all are "variable-mu" to some extent.



In pentodes operating with high plate load resistances, highest low-level gain is obtained with low bias and low d.c. potentials at the screen and plate. A pentode operating with a 0.47 megohm plate load and a 300-volt "B" supply will deliver maximum gain when the d.c. plate voltage is about 25 to 40 volts, the screen 30 to 50 volts, with a bias of 1 to 1.5 volts. With pentodes, at any given bias voltage there is always a screen voltage which gives maximum gain. The over-all combination producing the highest gain of any is always that with the lowest bias on grid No. 1. Lowest value to be safely clear of grid current is approximately 1.2 volts.

Many handbook values for *RC* coupled triodes are for maximum gain, and the recommended resistor is too low for best high-level performance.

Gain Variation with Bias

All tubes are variable-mu to some extent. Fig. 9 shows variation in small-signal gain with plate current for three triode types. The sharp drop at the left of the curves is due to grid current. The drop starts at a higher plate current value (lower E_p) for the 6C4 because of its lower mu.

As plate current is reduced by biasing up the grids, the small-signal gain drops almost linearly. At around E_p = 150 volts (best operating point), the gain of the 6SN7 and 9002 is down 6 per-cent, and the 6C4 is down 25 per-cent.

A linear variation in gain with bias implies a second order curvature, or parabolic shape, of the transfer characteristic of the tube. This means that it generates second harmonics, as we see it does. The slope of the gain *vs* bias curve is steepest for the 6C4, indicating that it should generate the most distortion, which it does. The similarity of the 6SN7 and 9002 curves indicates that their distortion characteristics should be almost identical, as they have been found to be.

While the measurements detailed above were made on the basis of harmonic distortion, it is of interest that measurements of the same general type have been made on the basis of intermodulation distortion, with generally similar results.

REFERENCES

Fleming, L.; "Distortion Measurements Without Tubes," RADIO & TELEVISION NEWS, *March, 1951.*

Barnard, W. B.; "Distortion in Voltage Amplifiers," Audio Engineering, February, 1953

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Keep Your Customers

By WILLIAM LEONARD

Are you certain that you make a good impression when on a home service call? Be sure, follow these hints.

SINCE good customer relations are the backbone of every successful service business, whether it is a one-man service operation or a multiple-manned organization, the service technician or dealer must make a constant study of his personal strong and weak points in dealing with people. If he cannot establish a clientele of regular customers for the services he has to sell, he has two strikes against him in building his service business. Getting customers to like him is a selling job and every service technician should be a salesman.

The "product" the service dealer has to sell is one the customer does not want to buy. When a TV set goes on the "fritz," the family goes through three stages of emotional disturbance. First, they are irritated because they are deprived of their favorite programs between the time the set goes out and the service technician shows up to fix it. Second, they are disturbed over having to spend money they did not plan to spend on something they already own. Since most people commit most of their earnings for time-payment and charge purchases, it may be a hardship for them to find the cash to pay for servicing the TV set. This prospect does not make for a happy state of mind. Finally, a five-dollar service charge for a technician to call at the home seems to be too much money to the average person.

So, as the technician steps up to the door to render the service the customer does not want to buy, he must be able to overcome these obstacles if he expects to win the friendship of the set owner and keep him as a regular customer.

The service technician's service car or truck is parked in the driveway or in front of the house. What does it look like? Is it reminiscent of the beaten-up cars that were used by itinerant scissors sharpeners as they eked out a door-to-door existence grinding scissors and knives for a mere pittance? People like to deal with successful men and organizations. The appearance of the service car is one tip-off on the technician's efficiency; his appearance is the other—and most important.

A young man who was working his way through college by selling vacuum cleaners door-to-door, made an old car and a "sharp" personal appearance really pay off in sales. He was selling an unadvertised cleaner. In the jargon of salesmen, it was a "cold turkey" deal that required ingenuity to get into the home to demonstrate the cleaner and a persuasive sales pitch to close sales on the first call.

This young fellow turned in so many sales that his supervisor decided to call on a few of his customers to find out their slant on the "magic potion" he was using to close deals. One customer epitomized the secret when he said:

"I heard a noise in our driveway and looked out of the window. The most dilapidated model "T" *Ford* I had ever seen was coming to a grinding stop in our drive. It was a touring car, minus the top, that looked as if it were held together with bailing wire.

"As I watched, an immaculately dressed young man climbed out from the car without opening the door, lifted a case from the back seat, and started for our front door. The marked contrast between the well-dressed young man and the beaten up old car aroused my curiosity. When he asked for permission to demonstrate something new that I had never seen before, I let him in the house. He showed me how I just couldn't get along without the sweeper and have a clean house, so I bought it."

This case history is not given to encourage technicians to buy run-down old cars and dress "sharp." It is intended to illustrate the importance of personal appearance in the eyes of the average housewife with whom the technician must deal.

The service technician rings the bell and the customer comes to the door to see who is there. The technician has observed the first principle of good customer relations by dressing neatly. Does he smile cheerfully and say politely, "I'm from the Jones Television Service!" Or does he say gruffly, "I'm here to fix your set," and start barging in? He can easily make a friend of the customer at the front door, or build a resolve in her mind never to call him again when the set needs servicing.

Pride of Ownership

People are proud of the things they own. Irrespective of what the technician personally thinks about the TV set, the customer was proud of her set when she bought it. If he calls it a "dog" or tells her she bought a "lemon," he is just asking for trouble. Many service shops are doing a good business in repairing and modernizing radio consoles by using the "pride of ownership" theme. Remember this "pride of ownership" factor in dealing with every set owner.

In his article titled "Set-Side Manner," which appeared initially in the *Guild News*, published by the Radio and Television Guild of Long Island, Chris Stratigos offered this sage advice:

"Now as to your attitude . . . many times the customer will knock his set and call it a lemon. Don't be quick to agree with him. He may only be hoping for you to reassure him that this is not so. Question him as to the length of time he has owned the set. Ask him to give you a rough figure on past expenses since he bought it. This will often bring out the pleasing fact that the set isn't as bad as he thought. However, if a set is truly beyond repair at a reasonable price, tell him so without making the customer feel he was 'bilked' on his original purchase. The customer may have had his set for over five years. In that case, point out that he has gotten his use out of it

(*Continued on page* 161)

No Vibrator in New Auto Set

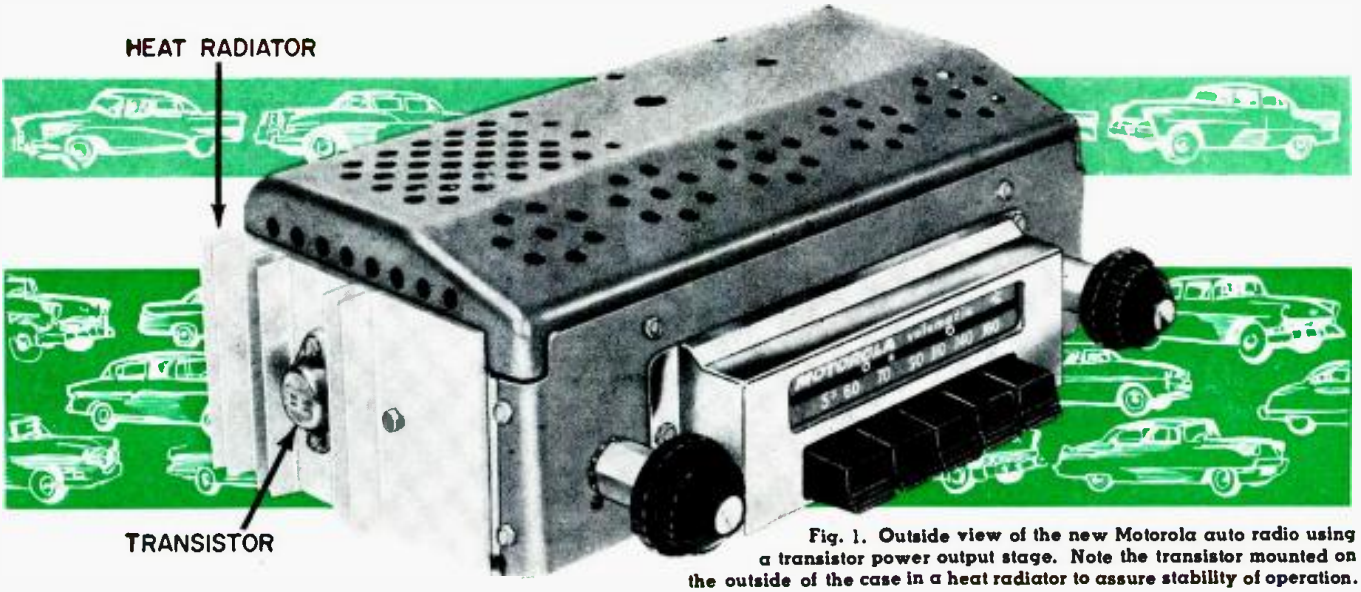


Fig. 1. Outside view of the new Motorola auto radio using a transistor power output stage. Note the transistor mounted on the outside of the case in a heat radiator to assure stability of operation.

By
JOHN S. RUTTER
Service Publications, Motorola Inc.

New auto radio does not use a vibrator, works directly off 12-volt battery, and uses transistor output stage.

MANY of the new automobile models are featuring the recently developed *Motorola* auto radio, the model BKA6T, which combines low "B+" type vacuum tubes with a transistor-powered output stage. This combination eliminates the need for a vibrator type of power supply to increase the battery voltage to a high d.c. value. These radios are now designed to operate off 12-volt auto batteries only.

Because it operates directly from the auto battery, the circuit design is somewhat different than that of conventional radios. The general appearance of the radio is the same as conventional models except that the transistor is mounted together with its heat radiator on the outside of the cabinet. This is shown in Fig. 1.

The antenna input circuit of this radio is conventional except for the use of a high-pass filter, composed of R_1 and C_3 (see Fig. 2). These components function to eliminate 60-cycle noise present in areas of low signal strength and where there are power lines. This network passes the high-frequency radio signals to the grid of the r.f. amplifier but shunts the 60-cycle noise to ground.

The r.f. amplifier stage is fairly conventional, with one exception. The r.f. tube is cut off when the a.v.c. voltage reaches a level of approximately —6 volts. When the r.f. stage is cut off, the incoming signal is fed directly to the grid of the converter stage by means of the interelectrode capacity of the tube. A signal strength of about .1 volt will result in —6 a.v.c. volts. It is necessary to incorporate this feature so as to prevent the converter stage from being overloaded due to the low plate voltage. To insure the tube being cut off at —6 volts, the a.v.c. voltage is applied to the suppressor grid in addition to the input grid of the r.f. amplifier.

The secondary winding of the converter oscillator coil is so connected that the screen current is carried through the winding. This is done to provide stable oscillation even when the car's battery is as low as 9 volts.

The suppressor grid of the i.f. amplifier is grounded through a 560-ohm resistor (R_6) to provide a means of regeneration, which increases the gain of the stage. Gain is important in this stage because the gain of the r.f. stage must be controlled to prevent distortion in the converter stage. It will be noted that the a.v.c. voltage applied to this stage is tapped from the a.v.c. load and is not the full a.v.c. developed.

Table 1. This table indicates the relative resistance between various transistor elements when measured with an ohmmeter.

POSITIVE OHMMETER LEAD CONNECTIONS TO	NEGATIVE OHMMETER LEAD CONNECTIONS TO	RESISTANCE
BASE	EMITTER	HIGH
EMITTER	BASE	LOW
BASE	COLLECTOR	HIGH
COLLECTOR	BASE	LOW
COLLECTOR	EMITTER	HIGH
EMITTER	COLLECTOR	LOW

As the transistor is basically a current amplifying device, the input signal to the transistor should be in the form of a signal current rather than a voltage. To accomplish proper driving of the transistor, a driver stage is used between the detector and transistor stage. This driver utilizes a space charge grid between its cathode and input grid to help accelerate electrons past the control grid. This space charge grid is wired to "B+" through a resistor so as to be less positive than the plate at all times.

Transistor Amplifier

The power amplifier stage incorporates a *Motorola* type 2N176 *p-n-p* junction transistor, wired in a grounded-collector, common-emitter circuit.

A bias is applied to the transistor element which receives the input signal. In this case, since the input signal is in the form of an input current, the bias is in the form of a bias current. The latter is the base current flowing through the transistor and is determined by the difference of voltage between the base and emitter electrodes. The voltage on the emitter is set by the value of the supply voltage, but the voltage on the base is made variable by means of R_{23}. The base current determines the amount of output current that will flow through the output transformer, therefore, whenever the base current is varied the output current will vary in proportion to it.

The input current is provided by the secondary of the driver transformer and is injected into the base circuit. Because it is necessary to bias the transistor, there are two paths which

the input can take; through the base circuit or through the bias network to ground. Any input current that flows to ground is considered a loss. To reduce this possible loss of input signal a tertiary winding is provided on the output transformer. This winding acts as a large choke in the bias network and presents a relatively large impedance to signal currents. The 200 μfd. capacitor from the emitter to the secondary of the driver transformer further insures against signal losses.

The gain of the transistor stage is such that a 1 milliampere change in base current causes an almost 40 milliampere change in the output current.

Servicing the Output Stage

When measuring voltages in the transistor stage care should be taken so as not to accidentally short the base electrode to ground. Doing this will cause the bias of the transistor to be lowered to the point where excessive current will be drawn by the transistor, causing permanent damage.

Field experience has shown that when transistors had to be replaced in this radio it was because of shorts or opens. Checking a transistor with an ohmmeter will disclose these faults. This check measures the ability of the transistor to conduct current in one direction and oppose current flow in the opposite direction. Table 1 shows the relative resistances of the transistor across its electrodes with the ohmmeter leads first connected for conduction and then for nonconduction. The resistance check is similar to that given to a germanium diode. Do not use an ohmmeter scale on which the internal battery voltage exceeds 18 volts. Although this check has been found to be sufficient to detect most defective transistors, a more positive way of determining their condition is to substitute a known good transistor for one that is suspected to be defective.

When a transistor is replaced, and there is a provision made to adjust the operating point of the transistor, this should be done according to manufacturer's recommendations. In this *Motorola* auto receiver, this is done as follows:

1. Connect a low internal resistance milliammeter in series with the emitter electrode, with no signal input.

2. Adjust the variable bias resistor R_{22} until the current reading is 480 milliamperes.

This adjustment is necessary so that the new transistor will operate at approximately the same level as the original unit. The static current which flows through the emitter circuit varies from transistor to transistor. Therefore, it is important that the emitter current be set whenever a transistor is replaced. —30—

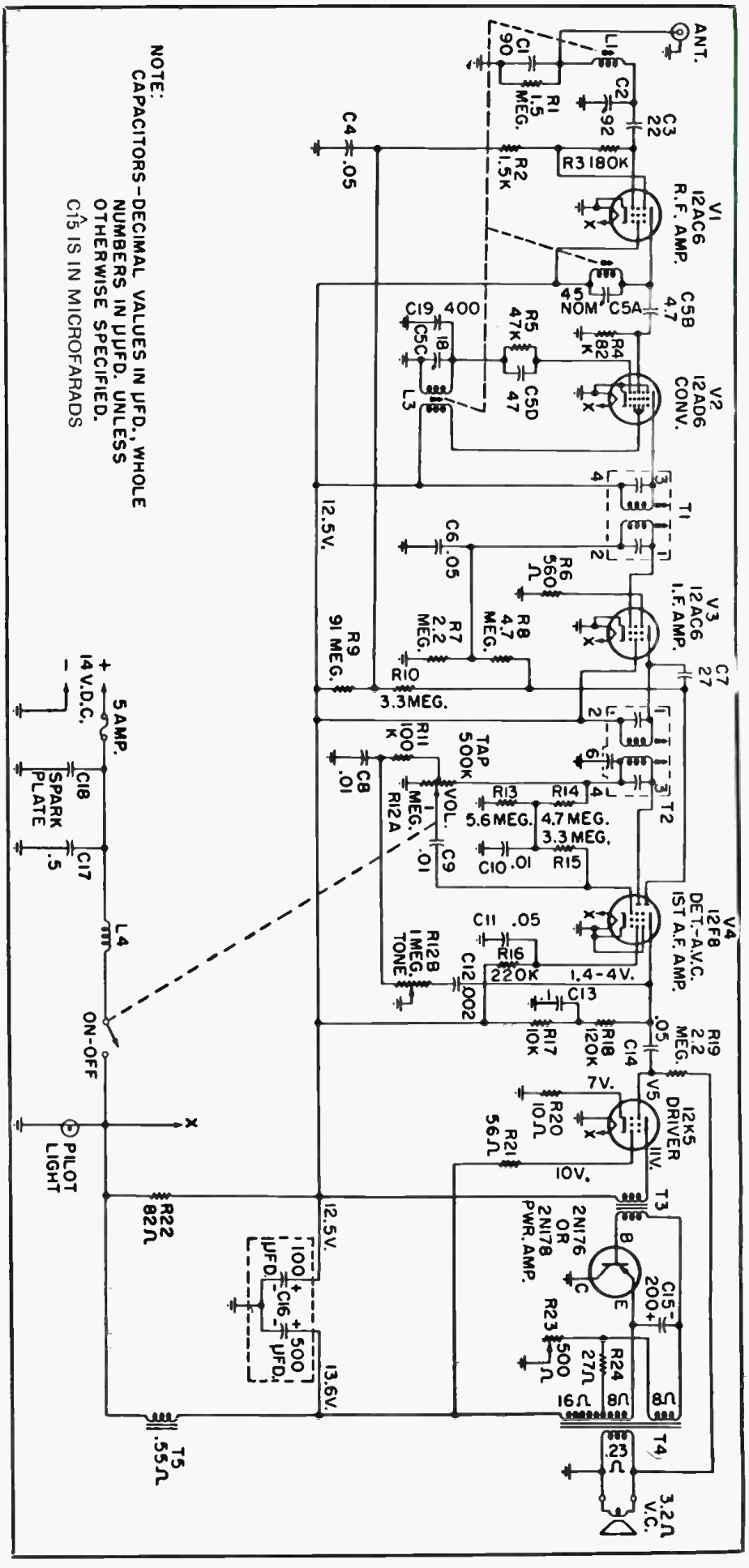


Fig. 2. Complete schematic diagram of the Motorola model BKA6T auto radio. Despite the fact that the set operates directly from the car battery, an input filter is furnished to eliminate noise.

Unusual Test Equipment

These new instruments are each designed to do one or more specific jobs toward making the repair of radio and TV sets faster and easier.

Senco model LC-2 tube and capacitor leakage checker.

ONE facet of electronics which has never run dry of new ideas is the test equipment field. Test instruments are necessary to check the operation and condition of an electronic device, so if a new device or technique is developed or new problem discovered, appropriate and specialized test instruments will be designed.

Some of the new test instruments designed to overcome special problems in the repair of recent types of radio and television receivers are shown here.

A new specialized test instrument designed to make radio repairing faster and more accurate is the *Hickok* crystal-controlled preset AM generator, model 290X. This instrument provides a highly accurate and stable source of r.f., modulated or unmodulated, for alignment of AM broadcast receivers, as well as a 400 cps audio signal for signal tracing the audio section.

The five preset frequencies available *via* a step switch on the front panel are 262 kc., 455 kc., 465 kc., 600 kc., and 1400 kc. In addition, a crystal holder is provided on the front panel for the insertion of a crystal in the frequency range from 500 kc. to 20 mc. The corresponding r.f. output is obtained when the selection switch is set to the "Xtal" position.

Television servicing experience over a period of more than eight years has brought to light certain specific components of the black-and-white television receiver that are consistently more troublesome than others. The flyback transformer and deflection yoke are examples. Attempts have been made to design and market instruments which

Seco model GCT-5 tube and capacitor tester.

Tricraft model 200 tube emission tester.

Precision model SS-10 tube heater tester and pin straightener.

Seco model FB-4 flyback transformer and yoke checker.

Hickok model 290X crystal-controlled signal generator.

could check the flyback circuit without requiring that the transformer be disconnected from its circuit, and some of these have been successful. A new instrument designed to do this is the *Seco* model FB-4 flyback circuit and inductance analyzer. This instrument operates on the "*Q*" meter principle. Although this instrument checks the self-resonant frequency of the complete flyback circuit, the transformer itself may be checked also, but it must be disconnected from its circuit. Using the variable oscillator in the instrument, the self-resonant frequency of the flyback transformer is determined. This frequency will probably fall within the 20 to 50 kc. region, and if the transformer is good, the "*Q*" will be high somewhere in this range, as indicated by a full opening of the electronic eye tube. Shorted turns decrease the "*Q*" and, as a result, the electronic eye will not open fully. The complete flyback circuit can be tested without disconnecting components. A signal of about 50 kc. is injected into the horizontal output tube plate connection. If the flyback circuit resonates between 48 and 68 kc., as it should if it is in good operating condition, the eye will open.

The yoke check is a simple comparison one. Since it is improbable that both halves of a deflection yoke will go bad at the same time, the checker simply compares the inductance of both halves. If the inductances are the same, the yoke is probably good.

The economy model TV receivers that are so popular today are simplified as much as possible. Since most of these sets are designed to operate quite well in fairly strong signal areas, the automatic gain control circuits in these receivers are very important in that they help to prevent troubles due to overload. It is convenient when repairing such TV receivers to have a variable source of d.c. voltage for checking out the a.g.c. circuits. The *Senco* "Align-o-Pak" model BE-3 is a bias supply designed to provide the necessary d.c. voltages.

This unit is a small, selenium rectifier d.c. supply which uses an isolation transformer, so that it may be used on rectifier-type TV chassis without shock hazard. Up to 18 volts d.c. are available. The unit operates from a.c. line voltage.

Many economy model TV receivers have the heaters of most of the tubes in series in either one or more strings. If one of the tubes in a string goes bad, it may require checking each tube in the string to determine which one is at fault. One instrument designed to facilitate such checking is the *Precision* model SS-10. This unit is battery-powered and checks the heater continuity of all tubes used in TV and most of those used in radio receivers. Included are pin straighteners for miniature 7-pin and noval 9-pin tubes.

One of the greatest difficulties in checking r.f. and i.f. tubes in TV sets is that even small grid leakage currents will affect the operation of a tube in the circuit in many cases. Detecting this leakage is quite difficult. Two instruments designed to detect tubes with small leakage currents are the *Seco* model GCT-5 grid circuit tube tester, and the *Senco* model LC-2 leakage checker.

In both models, the grid current of the tube under test is fed to a d.c. amplifier; an electronic eye tube is used as the indicator. Grid-to-cathode leakage resistance of up to 125 megohms will be indicated with these instruments.

The *Seco* unit can be used to check capacitor leakage up to 5000 megohms. The *Senco* unit can also be used to check capacitors using the electronic eye to indicate whether the capacitor charges up correctly or not.

The *Tricraft* model 200 tube analyzer is a quick-check type tube tester which operates on a rather unusual principle. That is that the length of time a tube continues to emit electrons after the current is removed from its heater is proportional to the condition of the heater or cathode. All elements of the tube are isolated from each other and no power is supplied to the heater during the test. A neon bulb glows as long as the cathode emits electrons after the heater current is removed.

The test instruments described here are not the only new and unusual units marketed recently. There are others and these will be brought to the attention of our readers in future issues. —30—

Senco "Align-o-Pak" d.c. bias supply.

By BERT WHYTE

I DON'T know quite how to begin this month's column. Regular readers will recall that in the past two issues I have been promising some sensational news concerning three-channel stereophonic sound. This "scoop" was promised for this, the September issue. Fortunately, the news will be presented this month, but unfortunately it will be nowhere near as detailed a report as I had hoped to bring to you. As I have said in previous issues . . . writing a column two months in advance has its drawbacks and in this case there was many a slip 'twixt the cup and the lip. Don't get me wrong! This will still be one of the most sensational, provocative and industry-shaking announcements in the brief, but spectacular, history of high fidelity! However, I know that if I were not bound by certain restrictions, this report would have had twice the impact. Perhaps, remembering the obstacles and frustrations I encountered during the labor-pains and birth of binaural and two-channel stereo, I have tried to go too far too fast, in an effort to circumvent these difficulties. I guess I'm just a hot-headed Irishman, boiling with enthusiasm for hi-fi in general and stereophonic sound in particular, with a burning desire to help bring this fabulous sound to fruition and make stereo available to everyone! Well, restrictions notwithstanding . . . what I've got is great and a big step forward, so here goes . . . !

You will recall I reported on the 3-channel *Ampex* demonstration with the San Francisco Symphony, and then got up on my soapbox and blithely asked why not 3-channel sound for the home? I acknowledged the multitude of difficulties such an undertaking would entail, daydreamed a little . . . and then got down to the brass tacks of what would be necessary to bring 3-channel stereo to commercial reality. In summation it was concluded that even if there were large numbers of people who could afford the great expense of existing 3-channel tape machines, or even if a relatively inexpensive 3-channel tape playback machine became available, they would all be quite useless without a source of recorded 3-channel stereophonic tapes. Yessir, we were right back at the old bug-a-boo . . . without a continuous source of good recorded tapes the stereo balloon would never get off the ground. I use the words "continuous" and "good" advisedly . . . drawing on the experience with binaural and two-channel stereo, where a good many enthusiasts of the early days rushed out to buy the necessary equipment to play stereo and then were subjected to the frustration of having only the most sporadic trickle of tapes released, and even these were generally of very indifferent quality. Some of the most inane, rankly "gimmick" type repertoire was thrust upon these poor souls with the excuse that it was "stereo" which made everything "all right"! I must insist that this is a ridiculous attitude. Generally, if a person thinks highly enough of his hi-fi to indulge himself in stereo equipment, he is usually a few cuts above the average in musical discrimination and stereo or not . . . he wants either good classical or good jazz material . . . sensibly chosen repertoire, performed reasonably well by professional executants of known reputation, and it goes without saying, the highest degree of technical excellence in the tape he buys. Happily, the days of the "gimmick" releases is about over with 2-channel stereo since the advent of the stereo tapes by *RCA Victor* and other forward looking companies. I think a lot of people have learned a lesson and the buyer of 3-channel stereo will be a more cautious fellow than his 2-channel predecessor, and the same can be said of the recording companies who, as you shall see, will offer tapes of genuine musical substance with the added plus of 3-channel stereo, rather than issue tapes where the stereo "effect" is the thing and the music merely subsidiary.

So, realizing the problem confronting 3-channel stereo for the home was largely a question of recorded tape availability, I decided (without much hope of success I admit) to sniff around the recording companies and ferret out as much information as I could on the possibilities of their producing 3-channel stereophonic tapes. Being a reviewer one naturally gets to know a lot of people in the recording industry, so at least I had the advantage that I wasn't approaching this thing "cold turkey"! My first inquiries were treated about as I expected. . . . Boy, you should have seen the raised eyebrows! I guess most of them figured I had flipped my lid, and I could see the prevailing attitude was that I was strictly for the birds! Not that I blame them very much. While most outfits have been recording 2-channel stereo for some time, few had released any as yet and here I was madly yakking about 3 channels! I must admit things were more than a bit discouraging and I was about to concede that 3-channel stereo was still quite a few years away, when I got the first faint flickering of hope! One of the big record clubs had been recording 3-channel stereo for some time . . . *but not for the purposes of issuing the results in the form of recorded tapes!* They were using a technique which was fairly common with 2-channel machines in making monaural tape masters for subsequent disc transfer . . . that of post-mixing. In other words after the actual recording session, the engineers would play back the 3-channel tape and then, mixing whatever percentage of each channel they wanted, they obtained the desired monaural signal which was recorded on a standard monaural tape machine. It is not my purpose here to debate the pros and cons of this technique, but one fact is of course quite obvious . . . here is a source of 3-channel stereo tape, since there is *no law that says one has to post-mix* and use the 3-channel master for no other purpose!

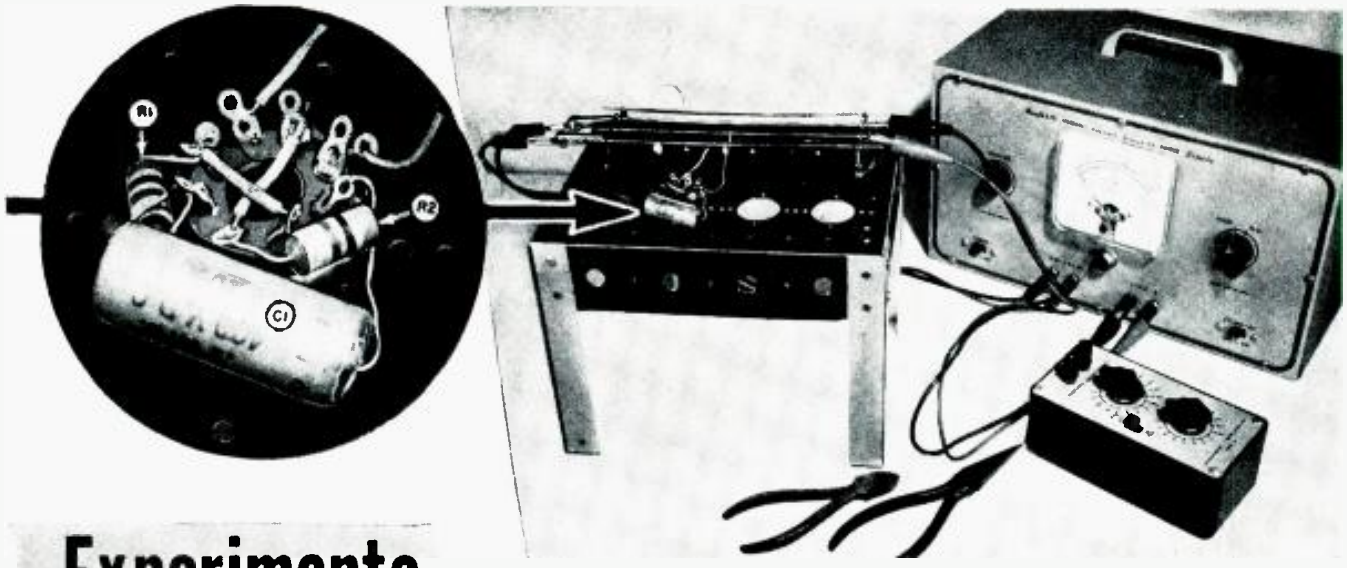
While this certainly was encouraging, it didn't help too much as I drew a blank as far as being able to determine if the release of any 3-channel material was ever contemplated. I would have pursued the matter further (even though my contacts with the clubs are second and third person since I do not review their products), when I got a phone call that changed everything. "Would you care to hear some white labels (test pressings) of some new material tonight?" inquired the feminine voice with the soft Texas drawl. . . . Would I! This is tantamount to offering a man dying of thirst a bucket of ice cold spring water! Naturally, I like to avail myself of every opportunity to observe and hear the work of the professional recordist in his native habitat. The caller was the very charming and talented administrative director of *Mercury Records*, Miss Wilma Cozart. I was to meet her and Mr. Bob Fine, chief engineer of *Mercury* in Studio C in the 5th Avenue, New York headquarters of *Mercury Records*.

That night, I had no sooner stepped through the thick soundproof door of the studio and was shaking hands all around when my eyes riveted themselves on the familiar sight of an *Ampex* 300 tape console with the most unfamiliar addition of oversize tape guides, tape gate, and capstan and capstan roller designed to accommodate the half-inch tape that was threaded through the machine. A wild thought ran through my head and I looked at my hosts who by now were both wearing big grins. "Could this be a 3-channel stereo setup?", I inquired rather warily of Mr. Fine. Both he and Miss Cozart laughed and said that knowing of my interest in stereophonic sound they had rigged up a demonstration that I might find entertaining. By Gadfrey if that wasn't the understatement of the century! Studio C is a room about 35 ft. wide by roughly 60 feet deep and with a nice 20 foot ceiling. Near the entrance is the glass enclosed control booth and at the far end a big curved projection screen that receives its images from the projection booth high in the back end of the room. Behind the screen are three monster *Jim Lansing* theater speaker systems, driven by 3—60 watt *McIntosh* amplifiers! This studio is ordinarily used to score movie films for various types of multi-channel sound, including Mr. Fine's own "Perspecta" sound process. Being obviously all set up and prepared for me, Mr. Fine punched the start button on the *Ampex* and the big reel of half-inch tape began to feed through the tape gate. In a few seconds a slight increase in tape noise over the normal background told me we had reached the "live" portion of the tape and an instant later my astonished ears heard the purest, cleanest, most fabulous sound I have ever encountered as the speakers gave forth with the striking opening bars of "Tabuh-Tabuhan," an exotic work by Colin McPhee . . . a new *Mercury* release featuring the Rochester Symphony Orchestra conducted by Howard Hanson.

The disc is reviewed later in these pages and it is an outstanding recording in every respect . . . but good as it is, it was pallid in comparison to the incredible realism of the 3-channel stereo. I am sincere when I say I was literally stunned with what I was hearing. It was hard to believe the Rochester Symphony Orchestra wasn't there before me on the stage. No, that isn't quite correct really, because in many ways this was far better than the real thing! I mean it . . . it would be a rare seat in a rarer concert hall where all that I heard on this stereo tape could be heard equally as well. The most startling aspect, of course, was the infinitely

(*Continued on page* 153)

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



Close-up of a practical series multivibrator circuit (left) and an experimental laboratory setup for the breadboard testing of the series multivibrator (above).

Experiments with a Series Multivibrator

This type of circuitry offers an infinite variety of practical and experimental possibilities for hobbyists.

By
LOUIS E. GARNER, JR.

MULTIVIBRATOR circuits are widely used in radar, in television, and in military and commercial electronic instruments. In addition, because of the many different waveform patterns that may be obtained with these circuits, they are especially interesting to the serious experimenter and the student. Although a number of refinements are encountered, the majority of commercial multivibrator circuits are but adaptations of either the plate-coupled or the cathode-coupled circuits shown in Figs. 1A and 1B, respectively.

The plate-coupled multivibrator, shown in Fig 1A, is basically a two-stage grounded-cathode resistance-coupled amplifier, with its output coupled back to its input termination. R_1 and R_2 are the plate load resistors, R_3 and R_4 the grid resistors, and C_1 and C_2 the coupling capacitors.

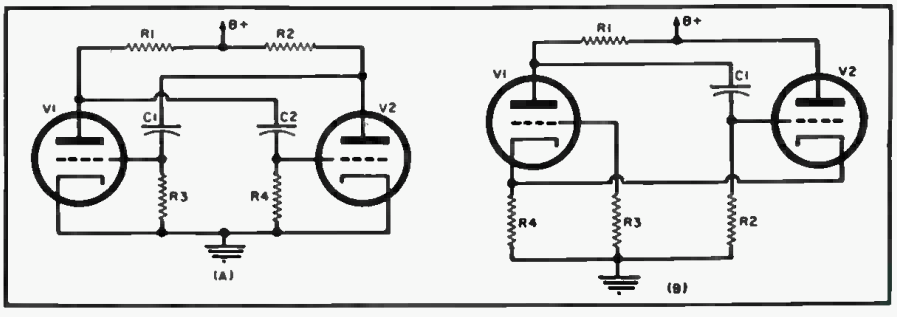
In operation, when "B plus" is applied to the circuit, either V_1 or V_2 will start conducting first. Assuming that V_2 starts conducting first, a voltage drop will develop across plate load resistor R_2, producing a negative-going signal which, transferred through C_1 to the grid of V_1, keeps V_1 in a non-conducting state. Since no current flows through V_1, there is no voltage drop across plate load resistor R_1 and the full "B" voltage appears on the plate of V_1. This is, in effect, a positive-going signal which, applied through coupling capacitor C_2, keeps V_2 in a conducting state. Since the grid of V_2 is driven positive, grid current can flow, and C_2 is charged through the grid-cathode circuit of V_2 and through R_1. When C_2 is fully charged, there is no longer a transfer of a positive-going signal to the grid of V_2 and this tube stops conducting. When V_2 stops conducting, the full "B" voltage appears on the plate of this tube and is transferred, as a positive-going signal, to the grid of V_1 through coupling capacitor C_1, causing this tube to conduct heavily. C_1 is then charged through the grid-cathode circuit of V_1 and R_2 while, at the same time, C_2 is discharged through the plate-cathode circuit of V_1 and R_1. Once C_1 is fully charged and C_2 discharged, the action reverses, with V_1 going back to a non-conducting state and V_2 conducting heavily again. The action continues, with the repetition rate depending on the time constant of the RC circuits involved and hence on the values of R_1, R_2, C_1, C_2, R_3, and R_4.

The cathode-coupled multivibrator, shown in Fig. 1B, is basically a two-stage amplifier consisting of a grounded-cathode stage followed by a grounded-plate (cathode-follower) stage, with the input and output terminations coupled together through a common cathode resistor. R_1 is the plate load resistor of the grounded-cathode stage V_1, with C_1 serving as the coupling capacitor to the cathode-follower stage V_2. Resistors R_2 and R_3 are grid return resistors. R_4 is the common cathode resistor.

In operation, when "B plus" is applied to the circuit, V_2 starts conducting first, building up a heavy bias voltage across the common cathode resistor R_4 which, applied to the grid of V_1 through grid resistor R_3, keeps V_1 in a non-conducting state. This bias is also applied to V_2 through its grid resistor R_2, but is overcome by the positive-going signal applied through C_1. Since V_1 is not conducting, there is no voltage drop across R_1 and the full "B" voltage can be applied through C_1 to the grid of V_2 as a positive-going signal. The grid of V_2 is driven positive and C_1 is charged through R_1, the grid-cathode circuit of V_2, and cathode resistor R_4.

When C_1 is fully charged, there is no longer a positive-going signal delivered to the grid of V_2 to overcome the

Fig. 1. Two conventional multivibrators. (A) plate-coupled, and (B) cathode-coupled.



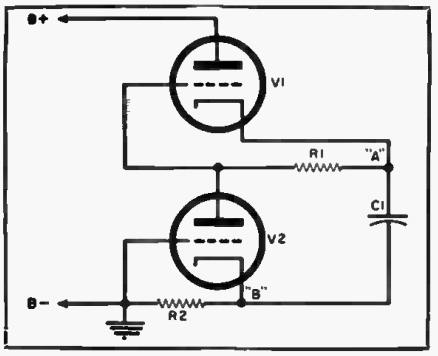


Fig. 2. The basic series multivibrator. The waveforms are shown in photos of Fig. 5.

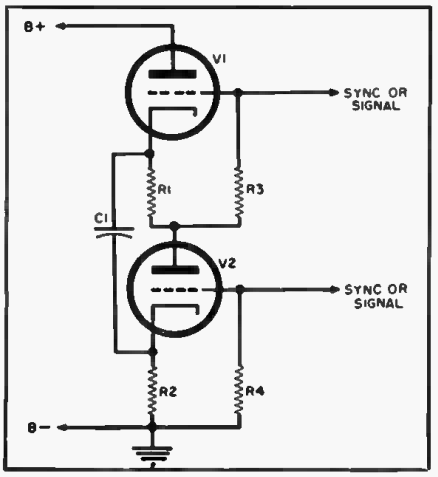


Fig. 3. Techniques for synchronizing, gating, or modulating the basic circuit.

bias developed across R_1 and the plate current through this tube starts to drop. This, in turn, reduces the bias across R_1, acting as a positive-going signal when applied to the grid of V_1 through resistor R_3, and allowing V_1 to conduct. V_2 is rapidly reduced to a non-conducting state and held in this state by the heavy charge on C_1. As V_1 starts to conduct, C_1 is discharged through R_2, cathode resistor R_1 and the plate-cathode circuit of V_1. As soon as the charge on C_1 has dropped sufficiently to permit V_2 to start conducting again, V_1 is again switched back to a non-conducting state and the action is repeated. As in the plate-coupled multi-vibrator, the repetition rate depends on the time constants of the RC circuits.

The Series Multivibrator

The operation of the plate-coupled and cathode-coupled multivibrators has been discussed in detail as background for a discussion of the circuit shown in Fig. 2. Both of the multivibrator circuits shown in Fig. 1 have one common characteristic, the tubes making up each circuit (V_1 and V_2) are essentially in parallel across the "B" supply. In the circuit shown in Fig. 2, on the other hand, the tubes are in series across the "B" voltage source.

Just as the multivibrator circuits shown in Fig. 1 are basically two-stage amplifiers, the series multivibrator of Fig. 2 is basically a cathode-follower capacitively-coupled to a grounded-grid amplifier, with direct-coupling back between the two circuits. V_1 is the cathode-follower and V_2 the grounded-grid amplifier. R_1 serves both as the cathode load resistor for V_1 and as the plate load resistor for the grounded-grid stage V_2. R_2 serves as the cathode input resistor for V_2. C_1 couples the output of the cathode-follower V_1 to the input of the grounded-grid amplifier V_2. The grid of V_1 is connected directly to the output of V_2. Since R_1 serves a dual function and direct-coupling is used between stages, a minimum of components is required for operation.

In operation, when "B" voltage is applied to the circuit, V_1 conducts first, charging C_1 through R_2 and its plate-cathode circuit. But V_2 cannot conduct until C_1 is charged, for there is no plate-cathode voltage applied to this tube until a charge builds up on the capacitor. In addition, while C_1 is charging, the rush of charging current through R_2 develops a heavy bias which keeps V_2 cut off. Once C_1 is fully charged, V_1 stops conducting, for C_1 then acts as an open circuit, removing the plate-cathode voltage of V_1. With the cessation of current flow through R_2, the bias on V_2 drops to zero, permitting this tube to conduct. V_2 then conducts heavily, discharging C_1 through R_1 and its plate-cathode circuit. While V_2 is conducting, V_1 is held cut off by the bias developed across its cathode resistor R_1 as a result of the discharge current flow. Once C_1 is discharged, V_2 stops conducting, for there is no longer plate-cathode voltage applied to this tube. Simultaneously, the cut-off bias applied to V_1 has dropped to zero with the cessation of the discharge current through R_1, and V_1 is free to conduct again, recharging C_1. The action continues in this fashion, with C_1 being charged through V_1 and R_2 and discharged through V_2 and R_1.

The charging time constant depends on the value of R_2 and on the plate-cathode resistance of V_1, along with the value of C_1. The discharge time constant depends on the value of R_1, on the plate-cathode resistance of V_2, and on C_1. The repetition rate depends on all of these values. In general, as R_1, R_2, or C_1 is made smaller, the operating frequency increases and *vice versa*. If R_1 equals R_2, and similar tubes are used for V_1 and V_2, the output signal will be symmetrical, that is, the positive-going and negative-going half cycles of the signal will be of equal time duration. If R_1 and R_2 are not equal, the output signal will be non-symmetrical, and give a series of positive- or negative-going pulses.

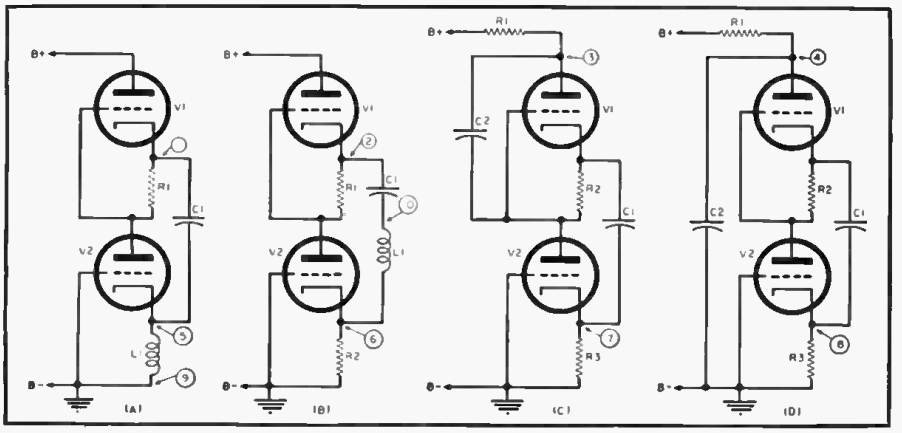
Typical waveform patterns, such as are encountered in practical circuits, are given in Fig. 5, with patterns 1, 2, 3, and 4, showing the waveforms obtained at "A" in Fig. 2 under varying conditions, and patterns 5, 6, 7, and 8 showing the waveforms obtained at "B" (Fig. 2) under similar conditions.

Patterns 1 and 5 were obtained with a 6SN7 tube used for V_1 and V_2, with $R_1 = R_2 = 6800$ ohms, with $C_1 = 0.05$ μfd., and "B plus" at 200 volts. The repetition rate was measured at 330 cps.

Unlike some other types of multivibrator circuits, the series multivibrator operates equally well with gas triodes (thyratrons) as well as high vacuum tubes. The remainder of the patterns shown in Fig. 5 were obtained with type 884 gas triodes substituted for the 6SN7 vacuum tube, with the plate voltage remaining at 200 volts. Patterns 2 and 6 were obtained with the same component values outlined above, but the repetition rate had jumped to 700 cps. Patterns 3 and 7 show the waveforms obtained when R_1 and R_2 are made unequal, with R_1 having the smaller value ($R_1 = 1500$ ohms, $R_2 = 6800$ ohms, $C_1 = 0.05$ μfd.); the repetition rate is 1200 cps. Patterns 4 and 8 show the waveforms obtained when R_2 has the smaller value ($R_1 = 6800$ ohms, $R_2 = 1500$ ohms, $C_1 = 0.05$ μfd.); the repetition frequency was measured at 1050 cps. The difference between the two frequencies obtained as the values of R_1 and R_2 were interchanged is due partially to differences in the tubes used.

The author made no attempt to determine the practical limitations on

Fig. 4. Four modifications of the series multivibrator circuit. (A) to obtain a saw-tooth current, (B) a "two-terminal" oscillator, (C) an RC sine-wave oscillator, and (D) to obtain a saw-tooth voltage. Waveforms are given in Fig. 6.



maximum and minimum frequency of operation. However, the limits appear to be quite wide. Oscillation was obtained from less than 1 cps to several hundred kc, without difficulty, and using standard tubes and components.

Circuit Modifications

The series multivibrator may serve as a basic circuit for an almost infinite variety of modifications, depending on the needs and requirements of the individual designer. The author has personally checked out over thirty modifications of the basic circuit, and sketched at least thirty more for theoretical examination. Obviously, space limitations prevent listing all of the possible variations here. However, four of the more interesting circuit variations are given in Fig. 4, with the corresponding waveform patterns shown in Fig. 6.

In the circuit shown in Fig. 4A, the lower resistance has been replaced with an inductance choke L_1. The small circled numbers show the corresponding waveform patterns in Fig. 6. Pattern 9 is the current waveform through the inductance, not the signal at ground. Circuit values used were as follows: V_1 and V_2— 6SN7GT; R_1—4700 ohms; C_1—0.02 μfd.; L_1—30 mhy.; "B plus"—200 volts; repetition rate— 9 kc.

In the circuit shown in Fig. 4B, the coupling capacitor has been replaced by a series-tuned circuit, L_1-C_1. Again, the small circled numbers show the corresponding waveform patterns in Fig. 6. Circuit values used were as follows: V_1 and V_2—6SN7GT; $R_1 = R_2 = 470$ ohms; C_1— 0.05 μfd.; L_1 30 mhy.; "B plus"—250 volts; repetition rate—12.8 kc.

The circuit shown in Fig. 4C should be extremely interesting to experimenters and designers, for it is one of the simplest *RC* oscillator circuits capable of giving a sine-wave output. Further, it delivers a sine wave from a low impedance source, and produces a sine-wave signal that may be synchronized or "locked-in" with an external signal. More about synchronization later. The sine-wave oscillator differs from the basic series multivibrator by the addition of only two components; plate resistor R_1 in series with V_1, and capacitor C_2, used to couple the two plate circuits together. As before, the small circled numbers given in Fig. 4C correspond to the waveform patterns given in Fig. 6.

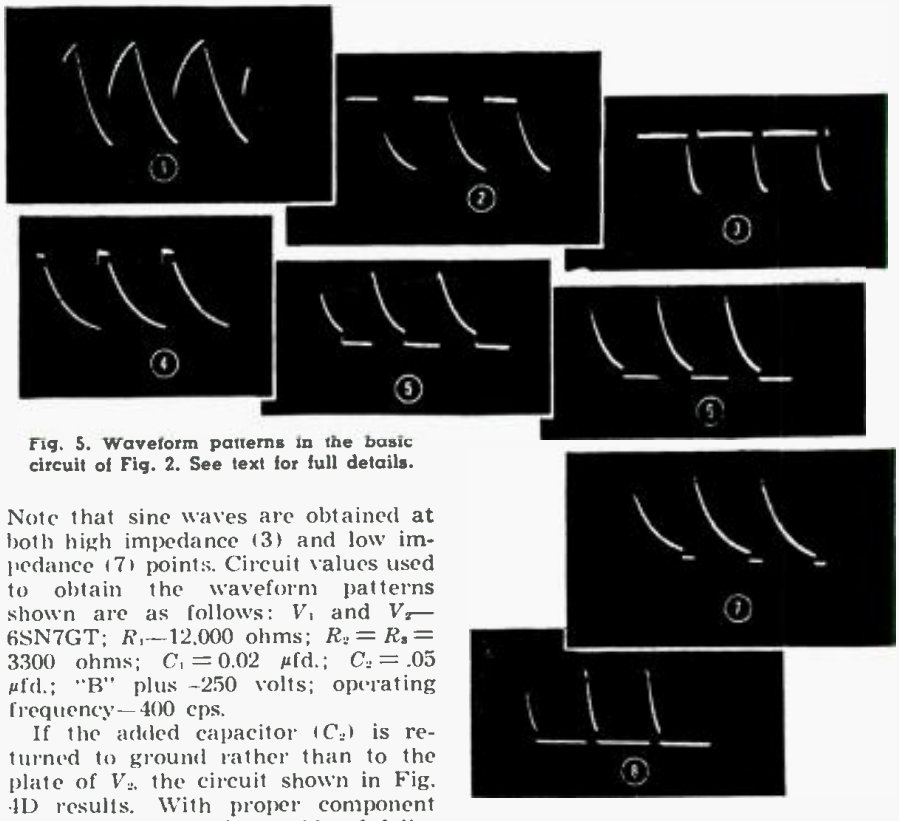


Fig. 5. Waveform patterns in the basic circuit of Fig. 2. See text for full details.

Note that sine waves are obtained at both high impedance (3) and low impedance (7) points. Circuit values used to obtain the waveform patterns shown are as follows: V_1 and V_2— 6SN7GT; R_1—12,000 ohms; $R_2 = R_3 =$ 3300 ohms; $C_1 = 0.02$ μfd.; $C_2 = .05$ μfd.; "B" plus -250 volts; operating frequency—400 cps.

If the added capacitor (C_2) is returned to ground rather than to the plate of V_2, the circuit shown in Fig. 4D results. With proper component values, this circuit is capable of delivering a linear saw-tooth output signal, as shown at (4) in Fig. 6. A narrow positive-going pulse appears across R_3, as shown at (8) in Figs. 4D and 6. The patterns shown were obtained with component values as follows: V_1 and V_2 -6SN7GT; R_1— 47,000 ohms; R_2— 10,000 ohms; R_3—680 ohms; C_1—0.05 μfd.; C_2 -0.1 μfd.; "B plus"—250 volts; operating frequency—620 cps.

Any of the circuits described may be "locked in" or synchronized with an external signal by applying the signal to the grid of either V_1 or V_2. To accomplish this, a grid resistor is inserted as shown in Fig. 3. R_3 and R_4 are the grid resistors. For most applications, only one resistor is used, generally the lower one (R_4). The grids may also be used for many other applications; for inserting one or more modulation signals, for applying a d.c. voltage to obtain monostable operation, for keying, or for general control. Either, or both, grids may be used, depending on the requirements of the individual designer.

The possible applications of the series multivibrator and its modifications, like the modifications themselves, are almost too numerous to mention. The experimenter who wants to try this versatile oscillator in practical circuits will find numerous applications for the circuits shown. The modifications shown in Fig. 4 were deliberately selected with this thought in mind.

Referring again to Fig. 4A, this circuit delivers a saw-tooth current through an inductance coil. A little imagination will show the possibilities of this circuit as a sweep generator for a television receiver, for it is capable of driving a deflection yoke directly without a special output transformer. It may be synchronized with the horizontal or vertical TV sync pulses by applying them to either grid, see Fig. 3. Of course, to be used in this application, the tubes, yoke, and other components must all be chosen with the specific application in mind. A certain amount of engineering will be required. However, it is

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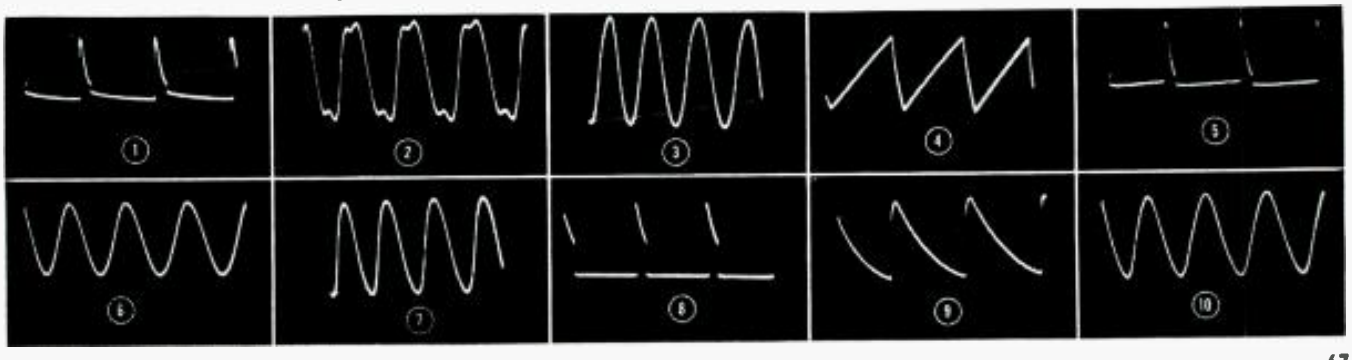
Fig. 6. Waveform patterns in the modified circuits of Fig. 4. Refer to article.



How to match Hi-Fi Components

High quality equipment performance can prove disappointing if the various system components don't work together right.

By HERMAN BURSTEIN

THE purchase of high-fidelity components does not necessarily assure a high-fidelity system. The tuner, cartridge, turntable, preamplifier, amplifier, etc., may, individually, check out excellent with respect to distortion, frequency response, signal-to-noise ratio, and other specifications. But put together improperly, they may produce sound less edifying than a commercial console which winds up in a $10 speaker.

Improper matching of components has brought some audiophiles more frustration than pleasure, and unjustified regrets over their choice of components. Quite possibly, among these audiophiles is the individual who is forever trading in his amplifier, speaker, or other component in a fruitless search for satisfaction.

With proper matching, each unit in a sound chain should drive the following unit hard enough to provide a high signal-to-noise ratio, but not so hard as to cause overload and consequent distortion.

Assume we are dealing with components that have the following specifications:

FM Tuner: Three volts output and 1% IM distortion at full modulation on strong stations.

Tape Recorder: A .5 volt output at 0 reading on the vu meter.

Phono Cartridges: Magnetic, 30 millivolts rated output and ceramic, .5 volt rated output.

Preamplifier: Twenty db gain on tuner input. One per-cent IM distortion at 2 volts output, 2% at 3 volts, 5% at 5 volts, and rising more rapidly thereafter. The preamp may be integrated with the power amplifier in one chassis.

Power Amplifier: Twenty watts output at 1% IM distortion for 1 volt input.

Tuner Input to Preamp

It is obvious that feeding the full tuner output of 3 volts to the first stage of the preamplifier would badly overload it. On the basis of 20 db gain, 3 volts input to the preamp would result in 30 volts output, assuming that the clipping level has not been reached. Distortion would be excessive.

Input level-set potentiometers are a common, though not universal, feature of preamplifiers. If the preamplifier in question has a level set at the tuner jack, its arm should be positioned so that input to the first stage of the preamplifier does not exceed .2 volt if 1% maximum IM distortion is desired. The simplest way of making this adjustment would be to feed in a signal of 3 volts and move the level-set arm until the preamplifier output measures 2 volts. This, of course, assumes that the preamplifier lives up to its distortion specifications. A meticulous high-fidelity installation procedure would first subject the preamplifier to various tests, including one for IM distortion.

If the preamplifier has no input level-set, it would be necessary to use the tuner's volume control to reduce the signal to the point where it does not overload the preamplifier. Once found, the correct position of the control should be marked for future reference. If the tuner possesses fairly low output impedance, nowadays quite commonly provided by a cathode follower, there should be no further problems. However, older or less expensive tuners frequently have a high impedance output, typically a 500,000 ohm or 1 megohm potentiometer. When the pot is somewhere in mid-position, high-frequency losses may occur due to cable and stray capacitance. This is illustrated in Fig. 1, which assumes that the arm is positioned so that the resistance above the arm (R_a) is 300,000 ohms and the resistance below it (R_b) is 200,000 ohms. Thus R_a and C_1 form a frequency-discriminating voltage divider in the audio range when the reactance of C_1 is smaller than the resistance of both R_a and R_b. This condition is met at mid-position settings of the pot if C_1 is not much smaller than 50 $\mu\mu$fd., which is likely to be the case.

One solution to the problem of high-frequency loss is to compensate it by means of the preamp treble control. Another is to keep the tuner gain control at maximum and mount a voltage divider made of two resistors at the preamp tuner jack. The total value of the resistors should be about 500,000 ohms.

Recorder Input to Preamp

As previously stated, the tape recorder is assumed to produce .5 volt when the vu meter reads 0. However, on sharp peaks, where the vu pointer action is relatively slow, the voltage may well be about 10 db higher, or 1.5 volts. To check this, one may monitor tape recorder output on a calibrated scope. If peak output is actually 1.5 volts, the level-set, if any, at the preamp's tape input jack, should

be adjusted so that with a 1.5 volt signal fed into this jack the preamp produces 2 volts output. As in the case of a tuner, if there is no level-set, the volume control of the tape recorder has to be used for signal reduction, and its correct position noted; or else a voltage attenuator may be mounted at the preamp input jack designated for the tape recorder.

Phono Inputs to Preamp

Some, but not all, preamplifiers accommodate high-level as well as low-level magnetic cartridges. Inasmuch as certain magnetic cartridges, like the one assumed for the present discussion, produce as much as 30 to 50 millivolts when played on a disc recorded at "standard level" (explained later), a preamplifier with a magnetic phono input designed for low-level cartridges may easily overload. In fact, overload may take place even with a low-level cartridge if the preamp is not well designed. When the output of a cartridge is stated, it usually has reference to 1000 cycles at the standard recording level, which is that produced by a cutting stylus traveling at peak velocity of 7 centimeters per second. On modern LP discs, however, peak recording level is about 10 db higher than the standard reference level, so that a cartridge rated at 10 millivolts may be turning out 30 millivolts, which in some preamplifiers may cause overload.

To prevent this, the load resistor which should be present at the magnetic phono input, typical values are 27,000 and 47,000 ohms, may be replaced by two resistors having approximately the same total value and forming a properly proportioned voltage divider, as illustrated in Fig. 2.

Recent developments in ceramic and crystal cartridges have brought on the market several brands well suited to high-fidelity use and designed to be fed directly into a high level input, such as one intended for a tuner. No preamplification is required and no equalization is necessary other than use of a correct load resistance on the order of 1 to 3 megohms, depending upon the particular brand of cartridge. Typically, such pickups are rated to produce about .5 volt at the standard reference level. But on peaks these cartridges may turn out about 1.5 volts. Consequently it is necessary to bear in mind an input of 1.5 volts in making any adjustment required to prevent overload. For the particular preamplifier being discussed here, with 20 db gain and an output of 2 volts at 1% IM distortion, it is necessary to reduce input level to .2 volt.

When dealing with ceramic (and crystal) pickups, input level reduction cannot be accomplished by means of the usual 500,000 ohm level-set pot because the required load resistance may be as high as 3 megohms. On the other hand, it is not satisfactory to substitute a 3 megohm pot because at this high resistance, stray capacitance may well produce high-frequency losses as discussed in connection with Fig. 1.

The correct means of reducing signal output from a ceramic (or crystal) pickup is to mount across it a capacitor of suitable value, as shown in Fig. 3. Thus the cartridge capacitance, C_1 is, in effect, one leg of a voltage divider, while C_2 and C_3 form the other leg. At the same time the load resistor, R_1, should be reduced so that the time constant $R_1(C_1 + C_2 + C_3)$ remains the same as when the time constant is composed of just $R_1(C_1 + C_2)$. Cartridge capacitance and required load resistance can be obtained from the manufacturer, and C_2 can be measured or reasonably estimated at about 100 $\mu\mu$fd. When added capacitance is used to reduce output, failure to reduce the load resistor will result in excessive bass response.

Preamp Input to Amplifier

It will be recalled that for illustrative purposes we are dealing with a power amplifier which can be driven to 20 watts by 1 volt input. However, the preamplifier in the illustration is assumed to turn out 2 volts on peaks, which would drive the amplifier uselessly far beyond its rated output. In a power amplifier, distortion usually rises rapidly after rated power has been reached.

Two procedures can be followed to reduce the excessive signal input to the power amplifier: (1) Back down on the preamp input level-set (or other means adopted for reducing input to the preamp); (2) reduce gain at the input to the power amplifier by means of the gain control found in most such amplifiers.

The latter course, backing down on the power amplifier input control, is usually preferable, for it also cuts down the noise from stages that follow the preamp's volume control. In most preamplifiers this control comes after an early stage of amplification. Usually it is not placed at the output because of high-frequency losses due to cable capacitance (although in at least one preamplifier the volume control has been so located without detriment through the use of feedback). Consequently, noise generated after the preamp volume control is reproduced by the power amplifier.

It may be noted that the combination preamplifier-power amplifier often has an advantage over separate units in that it usually places the volume control after those stages which correspond to a preamplifier, as shown in Fig. 4. Thus such a unit may operate with a better signal-to-noise ratio than two separate components if the preamplifier's gain control is at an early stage.

To adjust the power amplifier input level a signal of 2 volts may be fed in, meanwhile measuring output wattage. In most home installations, it will be found that the maximum rated power is well in excess of actual needs. If so, it is advisable to further reduce the power amplifier input level setting so that maximum position of the preamp gain control corresponds to the greatest volume that will ever be desired. This will further reduce any remaining audio noise produced by the preamplifier, as well as protect the ear and speaker from possible damage.

Matching Speakers

Where a two-, three-, or four-way system is used instead of a single speaker, it is important to match the

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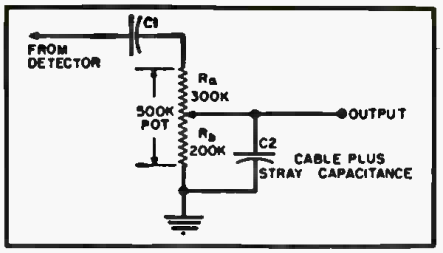


Fig. 1. A frequency-discriminating voltage divider. See discussion in text.

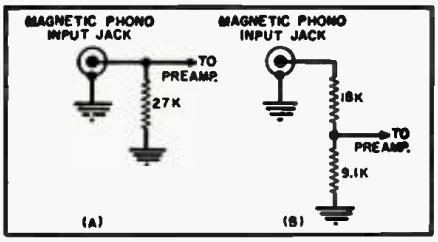


Fig. 2. Attenuation of magnetic cartridge signal, (A) with original load resistor, and (B) with voltage-dividing resistors.

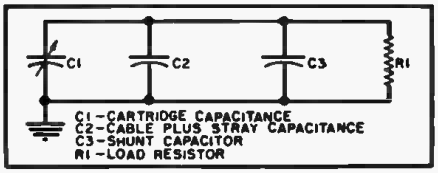
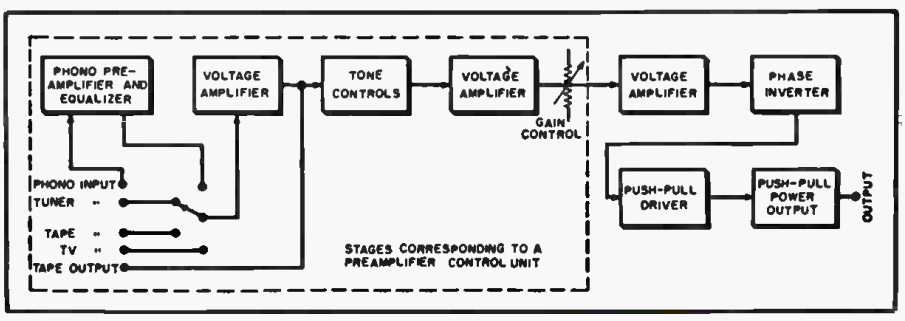


Fig. 3. The electrical load of a piezoelectric cartridge. Refer to the article.

Fig. 4. Block diagram of a typical combination preamp and power amplifier.



Problems in Pulling Chassis

By
ART MARGOLIS

Fig. 1. Unless this set was laid face down, it was an almost impossible job to remove the CRT from the cabinet, unless you happened to have three hands.

Sometimes taking a chassis out of its cabinet is easy, but with some types of chassis, there can be problems.

PULLING an *Admiral* TV chassis is usually easy, but about a month ago I ran into a special case. It was a 14" three-way combination with one symptom—a loud low-frequency hum on all settings of the volume control. The usual tube checking and touch-up adjustments did no good, so I decided to pull the chassis.

By the numbers I proceeded:

1. Pried the knobs off with my fingertips.
2. Pulled off the many-pinned power plug that went from the TV chassis to the radio and phono sections.
3. Took out the two-prong speaker lead.
4. Removed a phono plug that came through the sidewall between the TV and radio, and ended up in front of the audio output tube.
5. Removed the four bolts that secured the chassis to the cabinet floor.

The chassis was ready to emerge. Most *Admiral* TV's are put together in one neat package, chassis and picture tube firmly mounted together. I looked at the speaker to see if I had to pull it too (if there is anything else but a straight PM speaker we take it along). This one, though ten-inch, was just a PM, so I left it.

On the bench, I turned on the set and attached my test speaker. Lo and behold, the hum was gone. I tapped and checked for two days to no avail. I decided that the *Admiral* speaker must be defective, so I went back for it. When I connected this speaker to the TV set, the hum appeared. I ordered a new ten-inch speaker and installed it. My ears then received a shock. The hum sounded off on the new speaker too.

I checked the TV set again and this time I found an open 20 μfd. filter capacitor in the screen circuit of the audio output tube. It was not filtering out 120-cycle hum; a new capacitor filtered out the hum. The 120-cycle hum was reproduced on the ten-inch speaker but my four-inch test speaker wouldn't respond that low. I added a footnote to our rule on pulling PM speakers. "If there is any sound trouble, the speaker must be pulled, no matter what kind it is."

With literally thousands of different makes and models of TV sets, all methods for actually seating a TV chassis in a cabinet have been thought of and done. To set up some definite rules on pulling chassis would be difficult. Fortunately though, TV chassis do fall into some physical patterns. There is the one-piece package, the piecemeal type that has sections of chassis all over the cabinet, the two-part set where only the chassis and CRT are separated, and the newer doughnut type where the chassis is wrapped around the picture tube neck.

Some rules can be set for removing each of these various types of chassis from their cabinets, but you'll still run into new editions of little work stoppers such as: the *Allen*-head securing screws in the knobs of some *Du Mont*, *Stromberg-Carlson*, *Crosley*, *Magnavox*, and *Muntz* sets; the hard-to-see *Sylvania* "Halolight" plug; the loose CRT mounting on some *Muntz*, *Artone*, and *Bendix* sets; and the *Phillips*-head bolt for securing the vertical chassis, hidden behind the channel selector in the newer *Motorola* receivers.

Piecemeal Type

Philco has produced quite a few models that fit into the "piecemeal" category. I'll never forget the first time I ran into one. I entered a lavish home. The 17" TV was sitting in the corner of a big living room on top of lush wall-to-wall carpeting.

Due to a defective CRT, the brightness could not be varied. I decided to change the 17BP4 right there. I laid newspaper down on the area I was going to occupy and went to work:

1. I removed the knobs.
2. I removed the octal yoke plug from atop the high-voltage cage.
3. I removed the 12-pin power plug from the power chassis.
4. I took off the CRT cap plug.
5. I pulled out the five-pin black cable plug from the socket labeled "volume control" in the left hand chassis.
6. I removed the picture tube well plug and touched it to the chassis (Fig. 2).
7. I took the pilot bulb holder out of its spring clip on the cabinet above the channel selector.
8. I removed eight ¼-inch hex-head bolts that fastened the two chassis onto the cabinet floor.

The two chassis slid out easily. I placed them nearby on newspapers and looked at the picture tube mounting. The heavy CRT yoke and focus coil were in one neat assembly that hung from four bolts mounted on the four corners of the picture tube mask and the cabinet. On the neck end of the tube a couple of metal arms ran from the focus coil to the cabinet walls. To free these two arms required the removal of four ¼-inch hex-head

screws. Then, to remove the yoke and focus coil assembly, I laid the cabinet face down onto the newspapers on the thick rug. I removed the four ½-inch nuts from the four corner bolts and lifted the entire CRT assembly up and out.

I then loosened the yoke and focus coil assembly, and slid it off the bad tube and onto the new one, carefully positioning the anode well. Then I retraced my steps one by one. I turned on the set and got the strangest combination of symptoms imaginable.

I checked and double checked all the plugs and connections until I found my error. The "volume control" plug was in the wrong socket. In addition to its own socket, it unfortunately fits perfectly into a nearby video test socket. I plugged it into the correct socket and put a piece of tape over the test socket, so that such a mistake couldn't happen again. From there on, with a few adjustments, the picture came on brilliantly.

The trouble experienced with this set does not mean that such trouble can be expected with all chassis of the piecemeal variety. But, don't be alarmed if you do run into such a situation. Merely make certain that you reconnect all the interconnecting cables correctly.

Two-Part Chassis

The majority of *RCA* receivers use two-part chassis. However, the yoke and focus coil are not part of the CRT assembly as in the *Philco*. The CRT is strapped to the cabinet and then the yoke and focus coil are added by themselves. This system does make for easier chassis pulling, because you can leave the CRT in the cabinet, if you're sure that it's good. But when the picture tube has to come out the job gets messy.

One 21" *RCA* set serviced recently had a classic case of keystoning. Assuming that the yoke was defective, I proceeded to remove it. This entailed the following steps:

1. The back of the set was removed.
2. The tuner antenna lead, which clipped onto the back, was slipped off.
3. The yoke and focus coil assembly is mounted onto the metal strapping holding the CRT with four ¼-inch self-tapping screws. Out they came.
4. The CRT cap came off.
5. The ion trap was removed.
6. The octal yoke plug from the high-voltage cage was unplugged.
7. The yoke and focus coil assembly was slid off the neck of the CRT.
8. The three spring-loaded *Phillips*-head bolts that kept the focus coil attached to the yoke, were taken off.
9. The yoke wing nut was unscrewed and the yoke was free.
10. A new yoke was installed, all steps were retraced, and the picture spread out nicely.

Vertical Chassis

The majority of the doughnut-type vertical chassis are a snap to handle. I serviced a 24" *Muntz* not long ago which had a shrinking picture after a few minutes of ideal performance. Also, the set required a new 25AX4 damper tube every few weeks. I decided to pull it. After removing the back and knobs (located on the side of the chassis), I took out the six bolts which held the bottom lip of the metal cabinet to the floor of the cabinet. The metal cabinet came off the chassis like a box top, and there sat the entire chassis mounted on a wooden board. The set was easy to carry without its cubical covering. In the shop I found that the screen grid resistor of the 12BQ6 had decreased in value. A new resistor restored normal performance. The installation of the chassis was as easy as the pulling.

A few of the vertical chassis receivers, however, are as hard to get at as any of the multi-section sets. For example, try changing a fuse in a 14" *G-E* portable.

I was called out to a golf driving range to repair a 14" *G-E* portable. It had lost everything; sound, picture, and raster. Even though none of the tubes was lit, they all checked good. I looked for the fuse. The tube diagram showed one, but it was on the other side of the vertical chassis, not on the tube side. I had to pull out the chassis to change the fuse. This was not as simple as it may sound. This is what it entailed:

1. The knobs were removed.
2. The *Phillips*-head screw that attached the rear of the portable's handle through the metal cabinet to the chassis was removed.
3. The picture tube cap plug was detached.
4. Two bolts were removed from the cabinet floor, loosening the chassis.
5. The ion trap was taken off the CRT neck.
6. The wing nut holding the brass retainer ring that kept the yoke on tight was removed.
7. The yoke was slid back on the CRT neck.
8. The speaker was taken off its mounting.
9. Then by slipping and scraping, the chassis, yoke, and speaker were moved most of the way out of the cabinet.
10. The high-voltage anode lead was pulled out.
11. The chassis and its various appurtenances were removed from the cabinet.

Now I was able to replace the fuse. Even this was ticklish. The fuse, a pigtail, was soldered flush against its mounting. I had to cut away some of the insulation on a fuse holder to mount it in place with a good fuse. All that was left was to put the chassis back together.

Chassis pulling has its complications but if you take your time and make all of your moves thoughtfully you will avoid any obvious troubles. If you have sound troubles don't leave speakers. If you come across a set that has wires and plugs all over the place, it won't hurt to make a few notes of what goes where, using wire color and plug sizes as designations. Be sure that you have a complete set of the proper tools on hand with you at all times. If you run into a chassis that looks impossible to remove just remember that whatever went into that cabinet must come out. —30—

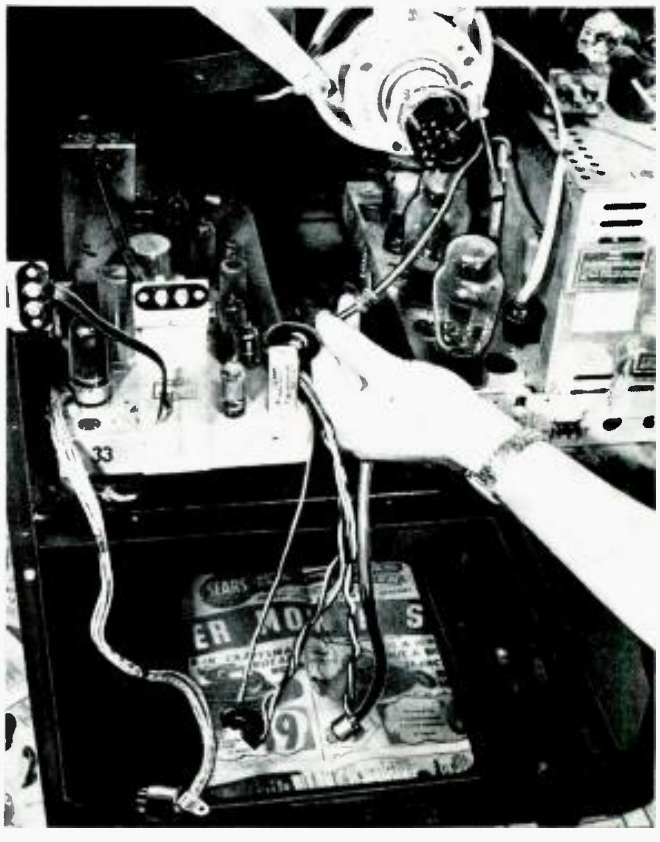
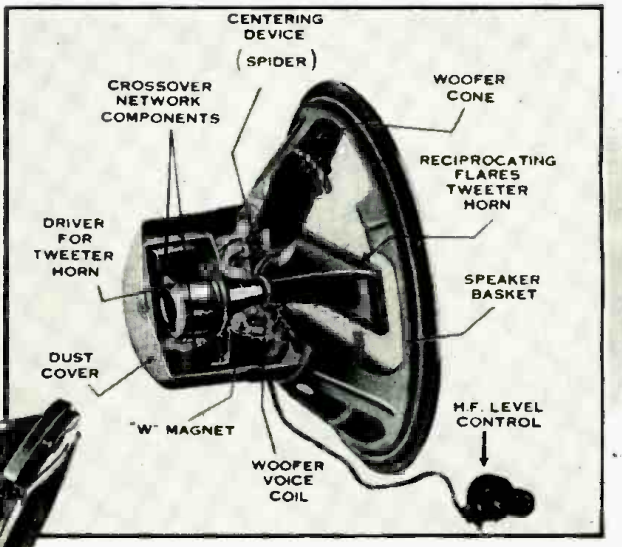
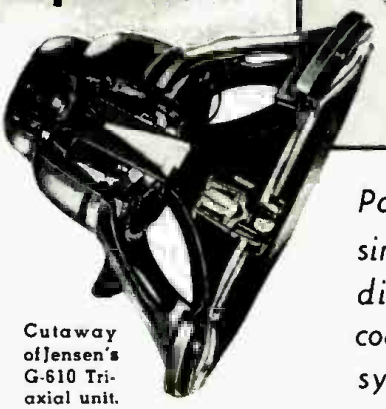


Fig. 2. Six interconnecting cables had to be unplugged before this chassis could be removed from the cabinet and they all had to be plugged back into the correct sockets when the job was finished.

Realistic High Fidelity

Multi-channel Speakers





Cutaway of Jensen's G-610 Tri-axial unit.

Part 6. A leading advocate of the single-cone, wide-range loudspeaker discusses the pros and cons of coaxial units and other multi-channel systems using crossover networks.

By **H. A. HARTLEY**
Audio Consultant

THE term "multi-channel speakers" as I am using it in this article means loudspeaker systems consisting of two or more units whose electrical performances are separated by some sort of filter circuit; the separate units may be entirely separate speakers or mounted in a true or partial coaxial manner. They may be baffle mounted or horn loaded or a mixture of these general types. In an earlier part I have mentioned that one school of thought is opposed to this principle of speakers dealing with only part of the audio spectrum, and it is important that the validity of these objections be considered in an unbiased manner.

First is the case of systems wherein the component speakers are constructed from different materials, such as a woofer with a paper cone and a tweeter with an aluminum cone. It is, of course, well known that materials capable of emitting sounds impart their own particular coloration to the music, such as wooden and metallic wind instruments and organ pipes. It is undesirable for a loudspeaker to impart any coloration to the reproduction at all, since it is a transducer, not an originator of sounds. In the absolute sense, therefore, it is impossible for a speaker with a metallic diaphragm to have exactly the same sound as a speaker with a paper cone and, in practice, it is quite difficult to make two such disparate speakers sound alike at any frequency. The use of the dividing network, which keeps the bass in the woofer and the treble in the tweeter, tends to mask this fundamental difference between the two sorts of coloration, but it certainly does not get rid of it.

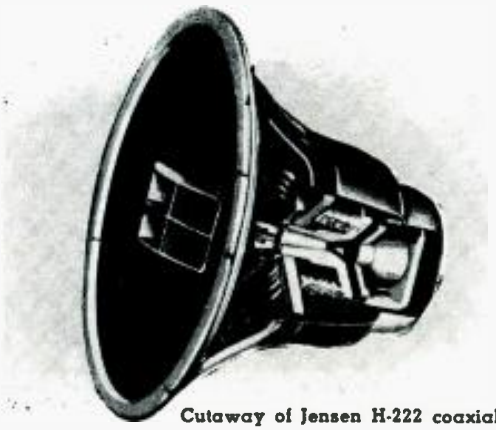
Now, any speaker has over-all coloration of the reproduced music. A musically trained ear can tell at once if what he is hearing is the original performance or a reproduction of it. If there is no measurable distortion in the reproducing equipment, there is still the coloration by the diaphragm material. This need not be a matter of great concern for the human ear is an adaptable sort of device, and within a few minutes will accommodate itself to this subtle distortion and ignore it, but only if it is constant. A two-way speaker system consisting of disparate diaphragms cannot maintain constant coloration over the whole frequency range.

Every musical instrument emits a fundamental frequency and a series of harmonics, ranging from the comparatively simple waveform of the flute to the highly complex acoustic output of the oboe (to take only the woodwind section of the orchestra). Depending on the frequency of the original instrumental note and the crossover frequency of the two-way speaker, the fundamental and the first two or three harmonics will be reproduced by the woofer and the rest of the harmonic range by the tweeter. At a higher frequency perhaps the whole gamut of fundamental and harmonics will be reproduced only by the tweeter. It follows that the characteristics of the reproduced note will vary with frequency, simply due to the different colorations of the woofer and tweeter diaphragms, and a sensitive ear will not like it.

What I have just written cannot be proved in a scientific sense and a convincing argument could, no doubt, be made for a quite different point of view. Why should paper be a better diaphragm material than aluminum? The instruments of the orchestra do not contain either paper or aluminum in their sound producing parts, so a transducer using either of these materials will not reproduce with absolute precision. That I have already admitted. But is there any reason why both units should not be fitted with aluminum diaphragms?

The designer's decision can only be based on what he hears or thinks he hears. If we admit that a speaker cannot be *entirely* designed by mathematics and scientific know-how, then the designer must either be a musical expert himself or get the opinion of some musical expert to listen to his various prototypes and state which one is the nearest approach to the original sound, the original sound being there also for immediate changeover comparison. When I did my basic research many years ago, the considered opinion of the experts I hired was that paper seemed to impart less coloration than other materials. And, as I have pointed out in a previous article, the method of imparting a finish to the paper has an appreciable effect on the quality of reproduction. It must be quite obvious to discriminating listeners that some speakers now on the market must have been designed by, at best, purely technical methods. I have listened to demonstrations when the salesman has stood seemingly lost in rapt wonderment at the sound produced by his wares, when the sound, in a musical sense, was excruciating. When I have ventured to point out that it didn't sound very good, I would be assailed by an avalanche of technical data supposed to prove to me that I didn't know good reproduction when I heard it. On the other hand, a study of the designs of the more esteemed manufacturers shows a certain similarity in method and in this consistency of thought is a reluctance to use metallic diaphragms.

I venture to suggest, therefore, that in a multi-channel speaker system it is logical to assume that the diaphragms should be of similar material and in any event not metallic, which everybody knows has a ringing quality; our diaphragms should be as inert as possible. What is just as important is the spatial relationship of the two or more



Cutaway of Jensen H-222 coaxial.

← The University Model 6201 unit.

diaphragms. If you set up two identical speakers some distance apart and drive them with the same signal you will get quite an impressive imitation of stereophonic reproduction. It is not true stereophony since only one channel is used, but the effect is noticeable as long as you are not equidistant from the two speakers. This effect is most noticeable when, if the two speakers are in the two corners at the ends of one wall, you sit near an adjacent wall.

The effect is due to the sound from one speaker being out-of-phase, to some extent, with respect to the other, since the sound takes a little longer to travel from the more distant speaker. The two outputs are combined in the human hearing mechanism to create an illusion of depth; but the effect will only be obtained if the two speakers each reproduce the whole frequency range. If one of the speakers is a tweeter and the other a woofer, all you hear are the two separate outputs, the treble coming from one corner, the bass from the other, no matter where you are sitting in the room.

It follows, therefore, that a tweeter-woofer combination must be so disposed that the two sound sources are as close together as possible. Ideally they should coincide, which accounts for the development of coaxial speakers. But, as happens over and over again in speaker design, one problem solved leads to another requiring solution, in this case the reaction of one unit on the other. I can illustrate this by referring to some of my early work on two-channel systems. In 1927 I was fully aware of the difficulty of making one dynamic unit cover the whole frequency spectrum and considered methods of propagating the extreme highs from a separate unit; as I also wanted some measure of coaxiality I conceived the possibility of putting the woofer inside the tweeter! This thought was not quite so crazy as it seems, for I had done quite a lot of work on electrostatic speakers and they had very good treble and poor bass. The larger an electrostatic the better it is equipped for radiating sound over a large front, so I mounted my 10-inch dynamic unit on a baffle, and fixed the electrostatic unit on the front of the baffle, with, of course, a hole cut in the center to avoid masking the woofer. At other than small inputs to the speaker I found that the pressure of the sound waves from the woofer deflected the foil of the electrostatic, causing modulation of the highs by the lows from the woofer. This suggests some thought should be given to the relative placing of two speakers of these types now that electrostatics are being re-introduced after a lapse of 30 years.

Any loudspeaker in reverse acts as a microphone. If sound waves emerge from the diaphragm because the voice-coil has been actuated by currents, then if the diaphragm is moved by applied sound waves, movement of the voice-coil in the magnetic gap will create currents in the voice-coil circuit. I found this actually happened when I produced by first commercial tweeter-woofer combination in 1930, which was a 3-inch dynamic tweeter mounted on the same baffle as an 18-inch woofer. I ultimately withdrew it because I didn't like the sound of it, yet quite a number of the hi-fi enthusiasts of those days thought it sounded wonderful.

I believe that the best way of laying out a dual-range speaker is to have each unit horn loaded, so as to avoid interaction between the two units (horns being much more directional at the sound source), and if the tweeter horn can be curved into the mouth of the woofer horn, coaxiality is achieved. Discussion of this, however, is best left until I deal with horn-loaded speakers in general in a later article, so we can resume our discussion of existing coaxial speakers.

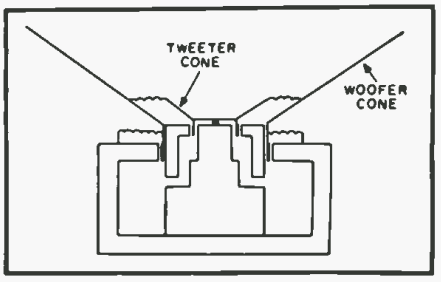
An original and ingenious attempt to resolve the problem of maintaining similarity of cone material with coaxiality is found in the "Duo-Cone" principle of H. F. Olson. Fig. 17 shows a section of the cone assembly and the magnet system. This is a true two-unit assembly, for each cone has its own voice-coil, but the outer suspension of the tweeter cone is cemented to the diaphragm of the bass unit, this providing some measure of independence of movement. It will be obvious, of course, that the movement of the bass cone must be transmitted through the tweeter cone suspension at low frequencies, even if movement of the tweeter cone is not transmitted to the bass cone at high frequencies (the relative mass of the two cones has considerable bearing on this), unless something is done to prevent it. The inventor claims that adequate venting of the air space behind the small cone can reduce this transfer of movement to negligible proportions.

The more popular type of coaxial loudspeaker consists of a small horn-loaded tweeter built into a normal woofer. The *Jensen* ingeniously uses a bored out center pole of the woofer unit as the tweeter horn, the tweeter field magnet being located behind the woofer magnet. The voice-coil of the woofer must necessarily be of fairly large diameter to provide enough magnetic material in the center pole to avoid saturation. The *University* coaxial avoids this difficulty by using a special magnet for the woofer which completely surrounds the tweeter unit. This magnet is an annular casting of U-section, the tips of the "U" being in the same plane; the inner tip applied to its face plate constitutes the center pole; the outer tip with its face plate represents the normal magnet outer pole. It should be realized that it is not of any consequence where the mass of magnet casting is located; the outer casing can be an unmagnetized casting or pressing and the magnet forms part of the center pole, fitted with a separate tip machined to size (since high permeability magnets are so hard that they can only be ground; they are also so brittle that they could not be turned even with a diamond tool). Alternatively, the magnetic material can be cast in the form of a tubular ring, the magnetic circuit being completed by an iron or steel center pole and round plates back and front. The former type of magnet is usually called a slug magnet, the latter a ring magnet; and there is no performance difference between the two types. Since the slug type magnet is virtually screened by the exterior pot, waste of flux through stray fields is less than with the ring type. The *University* magnet is a combination of the slug and ring types. The *Jensen* speaker assumes that the woofer cone forms part of the tweeter horn, since the curvature of the two sections is continuous; the *University* uses a separate horn for the tweeter, and this is recognized as a projection within the woofer cone. Some makes of speakers have this tweeter horn divided into cells to achieve dispersion of the high frequencies.

The two speakers just mentioned show evidence of careful design and manufacture, but it cannot be assumed that any speaker with a small trumpet sticking out in the middle is necessarily a good reproducer. My earlier suggestion that a speaker's performance can be assessed by looking at it does not apply to a coaxial of this type, since there are unseen factors that modify the performance. The woofer can be examined by the methods I have given, but not the horn-loaded tweeter.

I have explained in an earlier article

Fig. 17. How the two cones, suspensions, and magnets are arranged in the Olsen "Duo-Cone" coaxial loudspeaker. See text.



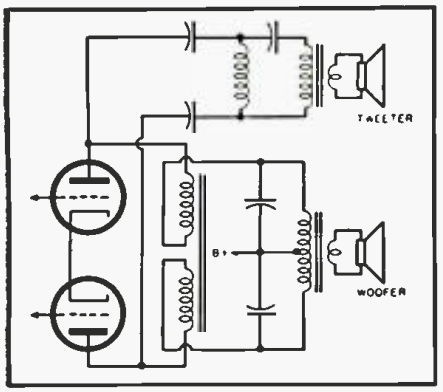


Fig. 18. The Klipsch low-distortion dividing network for use between the output stage and the output transformer. Refer to article for a discussion on network.

that a large cone can reproduce quite high frequencies by "break-up." This term has various usages, so I had better explain what I mean by it. By break-up I mean deformation of the cone at various applied frequencies. A cone is not an infinitely rigid piston and, to put it crudely, it bends in places when actuated by the voice-coil impulses. The cone can node radially and axially, and there is wave transmission along the material of the diaphragm itself. If a light powder, such as lycopodium, is sprinkled on the cone (face up) and the speaker driven by an oscillator feeding an amplifier, patterns will be developed by the powder. These nodal patterns are controlled by the material of the cone, its size and shape, and the applied frequency. The patterns indicate that the cone is bending in varying degrees in different parts, and the three-dimensional shape of the diaphragm at a specific frequency is the "piston" moving the air. For linear response it is obvious that the efficiency of the piston must be constant, but if part of the energy from the voice-coil is dissipated in bending the cone that part is not available for pushing the air. At the same time, small parts of the cone are in motion when other parts are not, hence the propagation of higher frequencies than one would suppose possible. The actual movements of the whole diaphragm are very complex and no hard-and-fast rule can be laid down, but it can be assumed that, in general, it is quite a difficult matter to control the break-up at frequencies higher than about 1500 to 2000 cps.

If a tweeter is not used to get the extreme highs, very special care in design is essential for high-fidelity results. If a tweeter is used, then there is no point in trying to get even medium highs from the large diaphragm. With a tweeter available, the woofer can have its cone size increased to avoid the need for very free suspension at very low frequencies when considerable power is fed into the speaker. This usually calls for a 15 inch cone in a high grade unit. Such a cone will give a very good output up to about 1000 cps, but beyond this figure cone deformation—break-up—is the determining factor and in a large cone this cannot easily be controlled. It was generally agreed in the days before *widespread high fidelity* (and you can put any construction you like on that phrase) that the optimum crossover frequency was in the region 800 to 1000 cps. This opinion was not based only on cone properties but took into account the impedance characteristics of the dividing network.

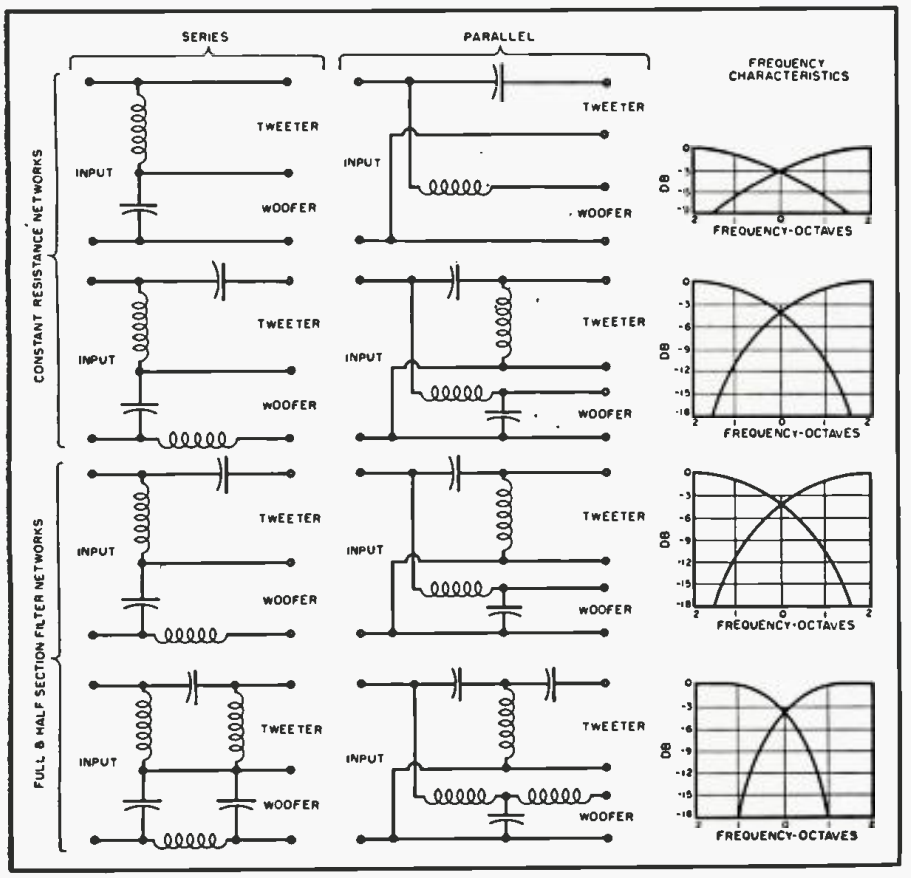
The two frequency bands of the individual speakers should overlap to avoid an abrupt change, and with a crossover frequency of 1000 cps the tweeter must handle the band from about 800 cps to the upper limit. If the tweeter is small, its power handling capacity at even 1000 cps is quite limited, even when horn-loaded, so the power handling capacity of the woofer cannot be used because of the limitations of the tweeter. This undesirable state of affairs has led designers to put the crossover frequency much higher, even as high as 5000 cps. I think it would be fair to say that some designers know quite well that this is not good practice, but are forced by the state of the market to put a limit on what the whole system will cost. If the market demands a dual concentric speaker, the designer can produce it, but it is no criticism of the designer to say that in the opinion of quite a number of qualified engineers the high crossover frequency is not the way to produce the best possible speaker.

The best solution to this problem is to remove it, by introducing a third unit to handle the range from, say, 1000 to 5000 cps. The small tweeter then has no problems of power-handling, for diaphragm movement above 5000 cps is almost microscopic; it can be designed specifically for what it has to do—reproduce the extreme treble. A smallish, say 4 or 5 inch, ordinary dynamic speaker can be used for the range 1000 to 5000 cps, and the woofer looks after the bass. Unfortunately such an intermediate unit is too large to be mounted in a conventional 15-inch woofer, so the three-channel speaker is most frequently met with the intermediate unit mounted by the side of the woofer. Assuming competent design throughout, it can be assumed that a three-channel system is better than a dual system because the disadvantages of a high crossover frequency have been eliminated. Of course, it costs more, but if you want the best you must pay for it.

In any multi-channel system, the efficiency of each channel must be constant, otherwise the whole response will not be linear. It is quite a technical problem to make different types of speakers have equal efficiency, so steps must be taken to attenuate the response of the more efficient unit or units by modification of the dividing network. The only way the potential buyer can satisfy himself on this point is to demand a certified over-all response for a fixed input, unless, of course, his ears are so well trained that he can hear non-linearity.

(*Continued on page* 162)

Fig. 19. Various dividing networks having attenuations of 6, 12, and 18 db per octave. At the crossover frequency, dip in linear response should be between 3 and 4 db.



FOR THE FIRST TIME

A Co-Channel Filter that eliminates "Venetian Blinds"

JERROLD LINE-OUT©

PAT. PENDING

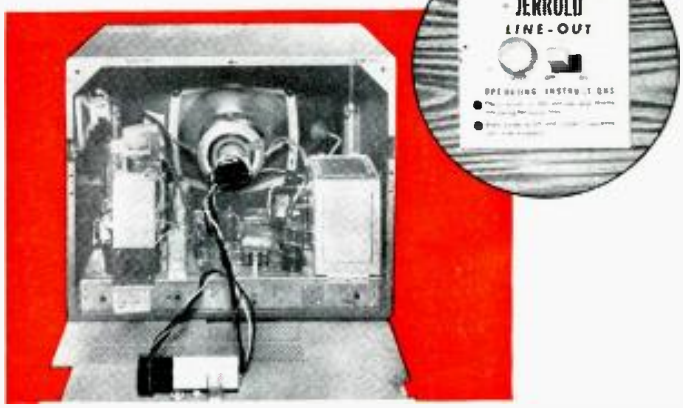
The Jerrold Line-Out is a revolutionary co-channel filter that electronically "erases" TV co-channel "Venetian Blinds".

Its principle of operation is new—but simple. A twenty db filter in the Jerrold Line-Out unit removes the co-channel beat frequency caused by an offset carrier of another TV station on the same channel, thus eliminating "Venetian Blinds" from the TV screen.

Two models are available. Model V10 is designed for use when the carriers of the co-channel stations are offset by 10KC. Model V20 is designed for 20KC offset carriers. The Jerrold Line-Out is not effective if the co-channel interference is so strong that it produces sync instability or picture sliding.

15.95 LIST

The Jerrold Line-Out can be installed in a matter of minutes. No wires to cut—no soldering necessary. Simply remove the plug on kinescope, insert the Line-Out in series and plug back in. Adjust tuner on Line-Out to eliminate "Venetian Blinds"—set it and forget it. The Jerrold Line-Out does not affect reception of any stations when co-channel interference is not present.



The Line-Out is typical of Jerrold's continuing research program to improve TV reception in fringe areas.

See Your Jerrald Distributor Today.

JERROLD *ELECTRONICS CORPORATION* / 23rd & Chestnut Streets Philadelphia 3, Penna.

BY JOHN T. FRYE

HOLDING OUR OWN

BARNEY was working all alone at the service bench, and Barney did not like to work alone. With Mac, his boss, beside him, he could prod around in radio and TV chassis all day long, happy as a chipmunk, even though the two of them did not exchange a dozen sentences an hour; but left strictly to himself, he began to slow down and feel deserted and abused, just as he was doing now.

Mac was up in the front part of the shop cranking postcards through the duplicator, and Matilda was addressing them on her typewriter. Barney watched them chatting gaily back and forth until he could stand it no longer; then he laid his solder gun on the bench and strode into the office part of the shop.

"What are you two doing that is so important?" he demanded testily.

"I guess you might say we're trying to hold our own," Mac replied with a cryptic smile.

Ignoring this answer, Barney picked up one of the cards and began to read aloud:

"Greetings, Valued Customer: For no special reason and on no special occasion, we just want to tell you your steady patronage is deeply appreciated. While we are naturally always eager to secure new business, pleasing our old customers, like yourself, comes first with us; and we intend to do everything in our power to continue to merit your loyalty. Cordially, Mac's Service Shop."

"Well, what do you think?" Mac asked.

"It's OK, I guess, in a kind of corny way," Barney admitted grudgingly; "but it seems to me that you ought to have some sort of business-getter tag on the end, something like, 'If your radio or TV set is not working perfectly, why not give us a call?' "

"Nope!" Mac demurred; "that would ruin the whole idea. I want this card, that is being mailed only to customers who have called us on at least three occasions, to tell them that we appreciate the business they have given us. It is a 'thank you' note, pure and simple, and any solicitation of business would destroy the effect I'm trying to create."

"What brought on all this sweetness and light?"

"Thinking about our service business," Mac said as he perched himself on a corner of Matilda's desk. "All at once it came to me that we spend a lot of time and effort and money trying to secure new customers; but our old customers, who are the real backbone of our business, are more or less taken for granted. Oh sure, we send them a Christmas greeting that is probably overlooked in the shuffle of all the other Christmas mail, and we try to give all our customers the best service we know how to give; but we do not make much of an effort to tell these loyal ones that we appreciate their giving us their electronic repair work year after year. This little card is the opening gun in my campaign to correct that state of affairs."

"That's nice, but looking at the thing purely cold-bloodedly, do you think the result will warrant the expense of the mailing? If they've stuck with us this long, won't they keep right on coming back through sheer habit?"

"It's mighty easy to fall into that mental trap," Mac observed. "To believe it, though, you have to blind yourself to the stiff competition that is rapidly rising in the service game today. It is only necessary to skim through the advertising of our competitors to know that already there are some pretty smart boys—advertising-wise, as well as technically—in the radio and TV service business, and they are getting smarter all the time. Every one of them is out to get new customers, but do you know what a *new* customer is to one of our competitors? It is one of our *old* customers converted!"

"I suppose that's right," Barney said slowly, "although I never thought of it quite like that. Now I know what you meant by saying we are 'trying to hold our own.' But outside of telling an old customer you appreciate his business and seeing to it that he continues to receive good and courteous service, what more can you do to hold him?"

"I've asked myself that question pretty often in the past few weeks," Mac admitted, "and I've concluded that establishing a more personal relationship with our customers will help more than anything else. It is one thing we, as a small independent shop, can provide that a large service organization cannot. And this sort of thing is important to a lot of people. Business and professional relationships in general are becoming more and more impersonal these days, largely because it's believed there's no time to take a personal interest in the customer; but many customers, consciously or unconsciously, miss the personal touch.

"To confess the truth, I do myself. I can remember nostalgically when the druggist took a deep personal interest in my case of poison ivy. We discussed exactly how I got it and the pro's and con's of treatment for a good quarter of an hour before he finally mixed up his own super-duper prescription for me. Now when I go in he is so busy selling sun glasses, flashlight bulbs, and comic books that he barely has time to take my money and hand me a prepared lotion from the shelf. It's the same way with my garage mechanic. A few years back I had a car that would fail to start about one time in twenty. The mechanic became so interested in locating the trouble that he used to call me up every morning to see if the car started all right that day. Now when I have something like that, he shrugs his shoulders and says about all he can suggest is that I let it go until the condition becomes worse and so will be easier to find. I no longer have any urge to go to that particular drug store or that particular garage. I can get the same kind of 'impersonal' service they provide anywhere."

"How are we going about creating this personal relationship with our customers?"

"Mostly by taking a genuine interest in the customer and his problems. Before going out on a call, make sure you look in the card file and make yourself thoroughly familiar with the history of our work done for him. Being able to mention casually, 'The last time I was here you had picture but no sound, didn't you?' will establish in his mind that you remember *his* set and its symptoms. That's a little thing, but you'd be surprised how important it seems to some people. Also we are going to make it an inflexible practice to check by telephone or postcard on every service job a few days after it has been completed to see if everything is satisfactory. Finally, we are going to listen sympathetically to every one of those hardship stories—you know the one about the set belonging to a kid they are trying to keep in bed with the

(*Continued on page* 174)

New "Plastic" Magnetic Material Developed by Westinghouse

Manganese-bismuth magnets resist demagnetization. Can be cut with penknife.

SCIENTISTS of the Westinghouse Electric Corp. have perfected a magnetic material that promises to yield more powerful new permanent magnets. The material is virtually 100 per-cent pure manganese-bismuth—or "MnBi."

Perhaps the greatest advantage of MnBi magnets is their unusual resistance to demagnetization. Such magnets are said to be at least ten times better in this respect than most commercial magnets available today. This high resistance to demagnetization, or high coercive force, results in a magnet that would not be adversely affected by external magnetic fields. This would make them especially promising for use in electric meters, where "stray" magnetism from large electrical equipment is likely to be encountered.

Magnets of manganese-bismuth derive many of their unusual properties from being powder-type magnets. Each individual MnBi particle is itself a tiny magnet. The particles are insulated from one another by imbedding them in a plastic binder, or matrix, which forms the body of the magnet and keeps the particles separated.

Such "plastic" magnets can be easily drilled, tapped, and cut—even with a penknife if a suitable plastic binder is selected. This means that expensive machining operations can be eliminated; magnets can be cast or molded, possibly even extruded, into any shape desired. What is more, because the plastic binder is an electrical insulator, manganese-bismuth magnets are nonconductors of electricity. —30—

Highly purified manganese-bismuth bursts into fiery "waterfall" when scattered in air. Since it catches fire on exposure to air, the finely ground powder must be prepared and processed in inert atmosphere.

New

MODEL O-11
Shpg. Wt. 21 Lbs.

$69.50

* *An improved model of what was already an outstanding instrument.*

* *Performance is unmatched in this price range.*

* *Incorporates the extra features required for color TV servicing.*

HEATHKIT ETCHED CIRCUIT, PUSH-PULL

5" Oscilloscope Kit

COLOR TV

The previous Heathkit oscilloscope (Model O-10) which was already a most remarkable instrument, has been improved even further with the release of the Heathkit Model O-11. It incorporates all the outstanding features of the preceding model, *plus* improved vertical linearity, better sync stability, especially at low frequencies, and much-improved over-all stability of operation, including less vertical bounce with changes in level. These improvements in the Model O-11 circuit make it even more ideally suited for color TV servicing, and for critical observations in the electronic laboratory. Vertical response extends from 2 CPS to 5 MC without extra switching. Response only down 1½ DB at 3.58 MC. The 11-tube circuit features a 5UP1 cathode-ray tube. Sync circuit functions effectively from 20 CPS to better than 500 kc in five steps. Modern etched circuit boards employed in the oscilloscope circuit cut assembly time almost in half, permit a level of circuit stability never before achieved in an oscilloscope of this type, and insure against errors in assembly. Both vertical and horizontal output amplifiers are push-pull. Built-in peak-to-peak calibrating source — step-attenuated input — plastic molded capacitors and top-quality parts throughout — pre-formed and cabled wiring harness — and numerous other "extra" features. A professional instrument for the serviceshop or laboratory. Compare its specifications with those of scopes selling in much higher price brackets. You can't beat it!

Extra!

A FULL YEAR TO PAY

SEND FOR DETAILS OF HEATH TIME-PAYMENT PLAN.

1 FEWER DOLLARS BRING MORE REAL QUALITY.

- Factory-to-you sales eliminate extra profit margin.
- "Build-it-yourself" eliminates labor charge.
- Heath purchasing power cuts component costs.

2 PERSONAL SERVICE ASSURES CUSTOMER SATISFACTION.

- You deal directly with the manufacturer.
- We are interested in you before and after sale.

5 BIG REASONS WHY

Heathkits®

ARE YOUR BEST BUY...

3 PROVEN DESIGNS MEAN RELIABLE PERFORMANCE.

- Research and development efforts concentrated on kits only.
- All kits guaranteed to meet advertised specifications.

4 EVERY KIT BACKED BY WORLD-WIDE REPUTATION.

- The world's largest manufacturer of electronic equipment in kit form.
- Producer of more than a million electronic kits for the home workshop and industry.

5 EASY TIME-PAYMENT PLAN TO FIT YOUR BUDGET.

HEATH COMPANY

A SUBSIDIARY OF DAYSTROM, INC.

BENTON HARBOR 15, MICH.

GREATEST SELECTION . . .

Whether your particular special interest is in servicing, ham-radio, high-fidelity, or just experimenting—there are Heathkits to fill your needs. You can equip an entire service shop or lab, buy a complete ham station or high-fidelity system, or set up a really deluxe home workshop, by choosing from the more than 70 different "do-it-yourself" electronic kits by Heath. Just glance through the kits displayed in this ad, and you will get some idea of the tremendous array of low-priced, high-quality electronic equipment available.

New **HEATHKIT ETCHED CIRCUIT**

5" Oscilloscope Kit

- *Brand new model with improved performance specifications.*
- *Full 5" scope for service work at a remarkably low price.*
- *Attractively styled front panel in charcoal gray with sharp white lettering.*
- *Easy to build from step-by-step instructions and large pictorials. Not necessary to read schematic.*

This new and improved oscilloscope retains all the outstanding features of the preceding model, but provides wider vertical frequency response, extended sweep-generator coverage, and increased stability. A new tube complement and improvements in the circuit make these new features possible. Vertical frequency response is essentially flat to over 1 mc, and down only 1½ DB at 500 kc. The sweep generator multivibrator functions reliably from 30 to 200,000 CPS, almost twice the coverage provided by the previous model. Deflection amplifiers are push-pull, and modern etched circuits are employed in critical parts of the design. A 5BP1 cathode-ray tube is used. The scope features external or internal sweep and sync, one volt peak-to-peak reference voltage, 3-position step-attenuated input, adjustable spot-shape control, and many other "extras" not expected at this price level. A calibrated grid screen is also provided for the face of the CRT, allowing more precise observation of wave shapes displayed. The new Model OM-2 is designed for general application wherever a reliable instrument with good response characteristics may be required. Complete step-by-step instructions and large pictorial diagrams assure easy assembly.

MODEL OM-2

$42.50

Shpg. Wt. 21 Lbs.

HEATHKIT LOW CAPACITY PROBE KIT

Oscilloscope investigation of high frequency, high impedance, or broad bandwidth circuits encountered in television requires the use of a low-capacity probe to prevent loss of gain, circuit loading, or waveform distortion. The Heathkit low-capacity probe may be used with your oscilloscope to eliminate these effects. It features a variable capacitor, to provide correct instrument impedance match. Also, the ratio of attenuation can be varied.

No. 342

$3.50

Shpg. Wt. 1 Lb

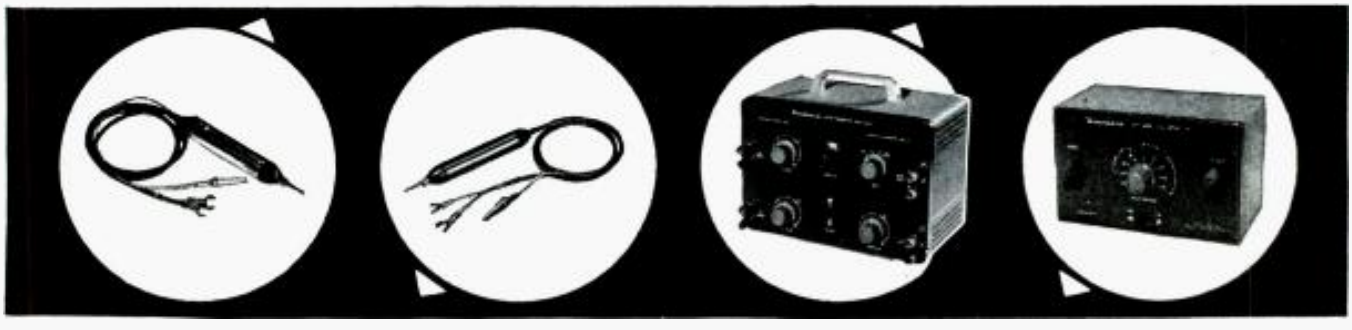
HEATHKIT ELECTRONIC SWITCH KIT

This handy device allows simultaneous oscilloscope observation of two signals by producing both signals, alternately, at its output. It features an all-electronic switching circuit, with no moving parts. Four switching rates are selected by a panel switch. Provides actual gain for input signals, and has a frequency response of ± 1 DB from 0 to 100 kc. Sync output provided to control and stabilize scope sweep. Will function at signal levels as low as 0.1 volt. This modern device finds many applications in the laboratory and service shop. It employs an entirely new circuit, and yet is priced lower than its predecessor.

MODEL S-3

$21.95

Shpg. Wt. 8 Lbs.



HEATHKIT SCOPE DEMODULATOR PROBE KIT

Extend the usefulness of your oscilloscope by employing this probe. Makes it possible to observe modulation of RF or IF carriers found in TV and radio receivers. Functions much like an AM detector to pass only modulation of signal, and not the signal itself. Among other uses, it will be helpful in alignment work, as a signal tracer, and for determining relative gain. Applied voltage limits are 30 volts (RMS) and 500 volts DC. It uses an etched circuit board to simplify assembly.

NO. 337-C

$3.50

Shpg. Wt. 1 Lb.

HEATHKIT VOLTAGE CALIBRATOR KIT

This entirely new voltage calibrator produces near-perfect square wave signals of known amplitude. Precision 1% attenuator resistors assure accurate output amplitude, and multivibrator circuit guarantees good, sharp square waves, as distinguished from clipped sine waves. Output frequency is approximately 1000 CPS. Fixed outputs selected by panel switch are; .03, 0.1, 0.3, 1.0, 3.0, 10, 30, and 100 volts peak-to-peak., Allows measurement of unknown signal amplitudes by comparing to known peak-to-peak output of VC-3 on an oscilloscope. Will also double as a square wave generator at 1000 cycles for determining gain, frequency response, or phase-shift characteristics of audio amplifiers. Equally valuable in the laboratory or in radio and TV service shops.

MODEL VC-3

$12.50

Shpg. Wt. 4 Lbs.

HEATHKIT ETCHED CIRCUIT VACUUM TUBE

Voltmeter Kit

$24.50

Shpg. Wt. 7 lbs.

The fact that this instrument is the world's largest-selling VTVM says a great deal about its accuracy, reliability, and overall quality. The V-7A is equally popular in the laboratory or service shop, and represents an unbelievable test equipment bargain, without a corresponding sacrifice in quality. Its appearance reflects the performance of which it is capable. A large 4½" panel meter is used for indication, with clear, sharp calibrations for all ranges. Front panel controls consist of a rotary function switch and a rotary range selector switch, zero-adjust, and ohms-adjust controls. Precision 1% resistors are used in the voltage divider circuits and etched circuits are employed for most of the circuitry. This makes the kit much easier to build, eliminates the possibility of wiring errors, and assures duplication of laboratory instrument performance. This multi-function VTVM will measure AC voltage (rms), AC voltage (peak-to-peak), DC voltage, and resistance. There are 7 AC (rms) and DC voltage ranges of 0-1.5, 5, 15, 50, 150, 500, and 1500. In addition, there are 7 peak-to-peak AC ranges of 0-4, 14, 40, 140, 400, 1400, and 4000. 7 ohmmeter ranges provide multiplying factors of X1, X10, X100, X1000, X10K, X100K, and X1 megohm. Center-scale resistance readings are 10, 100, 1000, 10K, 100K ohms, 1 megohm, and 10 megohms. A DB scale is also provided. The precision and quality of the components used in this VTVM cannot be duplicated at this price through any other source. Model V-7A is the kind of instrument you will be proud to own and use.

- *Easy to build — a pleasure to use.*
- *1% precision resistors employed for high accuracy.*
- *Etched circuit board cuts assembly time in half.*

HEATHKIT Etched Circuit RF PROBE KIT

This RF probe extends the frequency response of any 11-megohm VTVM so that it will measure RF up to 250 megacycles within ± 10%. Employs printed circuits for increased stability and ease of assembly. Ideal for extending service and laboratory applications of your Heathkit VTVM.

No. 309-C

$3.50

Shpg. Wt. 1 lb.

HEATHKIT SCOPE DEMODULATOR PROBE KIT

This probe functions like an AM detector to pass only modulation of signal and not signal itself. Permits observation of modulation from RF or IF carriers in TV and radio receivers. Extends usefulness of your oscilloscope. Voltage limits are 30 V. rms, and 500 V. DC. Very valuable in service or laboratory applications.

No. 337-C

$3.50

Shpg. Wt. 1 lb.

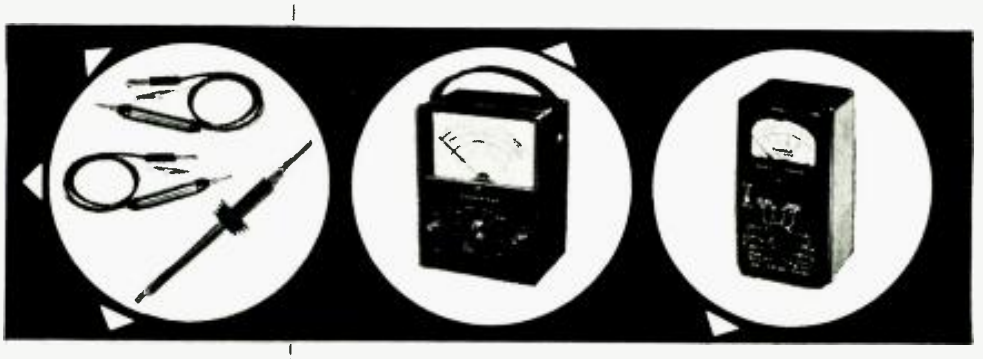
HEATHKIT 20,000 OHMS/VOLT VOM KIT

Sensitivity of this instrument is 20,000 ohms-per-volt DC and 5,000 ohms-per-volt AC. Measuring ranges are 0-1.5, 5, 50, 150, 500, 1500, and 5000 volts for both AC and DC. Also measures current in the ranges of 0-150 microamperes, 15 ma, 150 ma, 500 ma, and 15 a. Resistance ranges provide multipliers of X1, X100, and X10,000, resulting in center scale readings of 15, 15,000, and 150,000 ohms. DB ranges cover from −10 db to +65 db. Housed in attractive black bakelite case with plastic carrying handle, this fine instrument provides a total of 25 meter ranges on its two-color scale. It employs a sensitive 50 microampere, 4½" meter and features all 1% precision multiplier resistors. Requires no external power, and is, therefore, valuable in portable applications where no AC power is available.

MODEL MM-1

$29.50

Shpg. Wt. 6 lbs.



HEATHKIT 30,000 VOLT DC HIGH VOLTAGE PROBE KIT

This probe provides a multiplication factor of 100 on the DC ranges of the Heathkit 11-megohm VTVM. Precision multiplier resistor mounted inside the two-color plastic probe body. Plenty of insulation for completely safe operation, even at highest TV potentials. Designed especially for TV service work.

No. 336

$4.50

Shpg. Wt. 2 lbs.

HEATHKIT HANDITESTER KIT

The Model M-1 measures AC or DC voltage at 0-10, 30, 300, 1000, and 5000 volts. Direct current ranges are 0-10 ma, and 0-100 ma. Ohmmeter ranges are 0-3000 (30 ohm center scale) and 0-300,000 ohms (3,000 ohms center scale). Uses a 400 microampere meter for sensitivity of 1000 ohms-per-volt. A very popular test device for the home experimeter, electricians, and appliance repairmen, and for use as an "extra" instrument in the service shop. Its small size and rugged construction make it perfect for any portable application. Easily slips into your tool box, glove compartment, coat pocket, or desk drawer. Top quality, precision components employed throughout.

MODEL M-1

$14.50

Shpg. Wt. 3 lbs.

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BENTON HARBOR 15, MICH.

CONTROLLED QUALITY . . .

Incoming parts inspection, and inspection of material coming off of our own production line assures you of the finest "build-it-yourself" kit that money can buy. Each kit contains all the components you need for assembly—and you can have confidence in the quality of the parts themselves. In addition to this inspection procedure, an extensive proof-building program for each new kit guarantees easy-to-follow instructions and reliable performance.

HEATHKIT NEW AUDIO VACUUM TUBE

Voltmeter Kit

- *Brand new circuit for extended frequency response and added stability.*
- *Ten accurate ranges from 0-.01 to 0-300 volts.*
- *Modern, functional panel styling. "On-off" switch at both extreme ends of range switch.*

This brand new AC vacuum tube voltmeter emphasizes stability, broad frequency response, and sensitivity. It is designed especially for audio measurements, and low-level AC measurements in power supply filters, etc. Employs a cascode amplifier circuit with cathode-follower isolation between the input and the amplifier, and between the output stage and the preceeding stages. An extremely stable circuit with high input impedance (1 megohm at 1000 CPS). Response of the AV-3 is essentially flat from 10 CPS to 200 kc, and is usable for tests even beyond these frequency limits. Increased damping in the meter circuit stabilizes the meter for low frequency tests. Nylon insulating bushings at the input terminals reduce leakage, and permit the use of the 5-way Heath binding post.

The extremely wide voltage range covered by the AV-3 makes it especially valuable not only in high-fidelity and service work, but also in experimental laboratories. AC (RMS) voltage ranges are 0-.01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 V. Decibel ranges cover −52 DB to +52 DB. An entirely new circuit as compared to the previous model. Employs 1% precision multiplier resistors for maximum accuracy. Handles AC measurements from a low value of one millivolt to a maximum of 300 volts.

MODEL AV-3

$29.50

Shpg. Wt. 5 Lbs.

HEATHKIT AUDIO WATTMETER KIT

This instrument measures audio power directly at 4, 8, 16, or 600 ohms. Load resistors are built in. Covers 0-5 MW, 50 MW, 500 MW, 5 W, and 50 W full scale. Provides 5 switch-selected DB ranges covering from −10 DB to +30 DB. Large 4½" 200 microampere meter and precision multiplier resistors insure accuracy. Frequency response is ± 1 DB from 10 CPS to 250 kc. Functions from AC power line. Use in the audio laboratory or in home workshop.

MODEL AW-1

$29.50

Shpg. Wt. 6 Lbs.

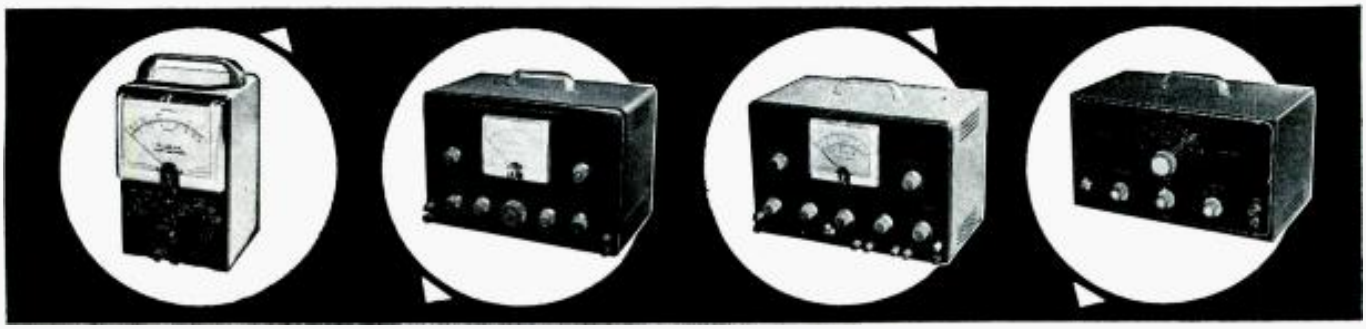
HEATHKIT AUDIO ANALYZER KIT

This multi-function instrument combines an AC VTVM, an audio wattmeter, and an intermodulation analyzer into one case, with combined input and output terminals and built-in high and low frequency oscillators. The VTVM ranges are .01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 volts (RMS). Wattmeter ranges are .15 MW, 1.5 MW, 15 MW, 150 MW, 1.5 W, 15 W, 150 W. IM scales are 1%, 3%, 10%, 30%, and 100%. Provides internal load resistors of 4, 8, 16, or 600 ohms. A valuable instrument for the engineer or serious audiophile.

MODEL AA-1

$59.50

Shpg. Wt. 13 Lbs.



HEATHKIT HARMONIC DISTORTION METER KIT

The HD-1 is equally valuable for the audio engineer or the serious audiophile. Used with a low-distortion audio signal generator, this instrument will measure the harmonic content of various amplifiers under a variety of conditions. Functions between 20 and 20,000 CPS, and reads distortion directly on the panel meter in ranges of 0-1, 3, 10, 30, and 100 percent full scale. Built-in VTVM for initial reference settings and final distortion readings has voltage ranges of 0-1, 3, 10, and 30 volts. 1% precision resistors employed for maximum accuracy. Features voltage regulation and other "extras". Meter calibrated in volts (RMS), percent distortion, and DB.

MODEL HD-1

$49.50

Shpg. Wt. 13 Lbs.

HEATHKIT AUDIO OSCILLATOR KIT

Producing both sine waves and square waves, the Model AO-1 covers a frequency range of 20 to 20,000 CPS in three ranges. An extra feature is thermistor regulation of output for flat response through the entire frequency range. AF output is provided at low impedance, and with low distortion. Produces good sine waves, and good, clean square waves with a rise time of only two micro-seconds for checking square wave response of audio amplifiers, etc. Designed especially for the serviceman and high-fidelity enthusiast. A real dollar value in test equipment.

MODEL AO-1

$24.50

Shpg. Wt. 10 Lbs.

HEATHKIT

Audio Generator Kit

$34.50

Shpg. Wt. 8 Lbs.

This particular audio generator is "made to order" for high fidelity applications. It provides quick and accurate selection of low-distortion signals throughout the audio range. Three rotary selector switches on the front panel allow selection of two significant figures and a multiplier for determining audio frequency. In addition, it incorporates a step-type output attenuator and a continuously variable attenuator. Output is indicated on a large 4½" panel meter calibrated in volts and in db. Attenuator system operates in steps of 10 db, corresponding with the meter calibration. Output ranges are 0-.003, .01, .03, .1, .3, 1, 3, and 10 volts rms. A "load" switch provides for the use of a built-in 600 ohm load or an external load of higher impedance when required. Output and frequency indicators accurate to within ± 5%. Distortion is less than .1 of 1% between 20 cps and 20,000 cps. Total range is 10 cps to 100 kc. New engineering details combine to provide the user with an unusually high degree of operating efficiency. Oscillator frequency selected entirely by the switch method means that accurate resetability is provided. Comparable to units costing many dollars more, and ideal for use in critical high fidelity applications. Shop and compare, and you will appreciate the genuine value of this professional instrument.

* *Less than 0.1% distortion — ideal for hi fi work.*
* *Large 4½" meter indicates output.*
* *Step-type tuning for maximum convenience.*

HEATHKIT RESISTANCE SUBSTITUTION BOX KIT

The RS-1 contains 36 10% 1-watt resistors ranging from 15 ohms to 10 megohms in standard RETMA values. All values are switch-selected for use in determining desirable resistance values in experimental circuits. Many applications in radio and TV service work.

MODEL RS-1

$5.50

Shpg. Wt. 2 Lbs.

HEATHKIT CONDENSER SUBSTITUTION BOX KIT

This kit contains 18 RETMA standard condenser values that can be selected by a rotary switch. Values range from 0.00001 mfd to 0.22 mfd. All capacitors rated at 400 volts or higher. Capacitors are either silver-mica, or plastic molded.

MODEL CS-1

$5.50

Shpg. Wt. 2 Lbs.

HEATHKIT AUDIO GENERATOR KIT

The Model AG-8 is a low cost, high performance unit for use in service shop, or home workshop. It covers the frequency range of 20 cps to 1 mc in five ranges. Output is 600 ohms, and overall distortion will be less than .4 of 1% from 100 cps through the audible range. Output is available up to 10 volts, under no load conditions, and output remains constant within ±1 db from 20 cps to 400 kc. A five-step attenuator provides control of the output. Precision resistors are employed in the frequency determining network.

MODEL AG-8

$29.50

Shpg. Wt. 11 Lbs.

HEATHKIT DECADE CONDENSER KIT

Precision, 1% silver-mica capacitors are employed in the Model DC-1 in such a way that a selection of precision capacitor values is provided ranging from 100 mmf (.0001 mfd) to 0.11 mfd (110,000 mmf) in 100 mmf steps. Extremely valuable in all types of design and development work. Switches are ceramic wafer types.

MODEL DC-1

$16.50

Shpg. Wt. 3 Lbs.

HEATHKIT DECADE RESISTANCE KIT

The Model DR-1 incorporates twenty 1% precision resistors arranged around five rugged switches so that various combinations of switch positions will provide a total range of 1 ohm to 99,999 ohms in 1-ohm steps. Switches are labeled "units," "tens," "hundreds," "thousands," and "ten thousands." Use it for ohm-meter calibration in bridge circuits as test values in multiplier circuits, etc.

MODEL DR-1

$19.50

Shpg. Wt. 4 Lbs.

HEATHKIT VARIABLE VOLTAGE REGULATED POWER SUPPLY KIT

This power supply is regulated for stability, and the amount of DC output available from the power supply can be controlled manually from zero to 500 volts. Will provide regulated output at 450 volts up to 10 ma, or up to 130 ma at 200 volts output. In addition to furnishing B-plus, the power supply provides 6 volts AC at 4 amperes for filaments. Both the B-plus output and the filament output are isolated from ground. Ideal power supply for use in experimental work in the laboratory, the home workshop, or the ham shack. Large 4½" panel meter indicates output voltage or current.

MODEL PS-3

$35.50

Shpg. Wt. 17 Lbs.

HEATH COMPANY
A Subsidiary of Daystrom, Inc.
BENTON HARBOR 15, MICH.

BONUS PERFORMANCE . . .

If a single word had to be selected to describe Heath Company advertising policy, it would be "conservative." By this we mean that the performance specifications and features are not exaggerated, and that the descriptions are accurate. We specify performance on the conservative side so you can be sure of equaling or exceeding our specifications. In almost every instance our kits will do more than we claim. Extra care in construction, and calibration against an accurate standard can extend performance well beyond advertised levels.

HEATHKIT

Signal Generator Kit

- *No calibration required with pre-aligned coils.*
- *Modulated or unmodulated RF output.*
- *110 mc to 220 mc frequency coverage.*

MODEL SG-8

$19.50 *Shpg. Wt. 8 Lbs.*

Here is an RF signal generator for alignment applications in the service shop or the home workshop. Thousands of these units are in use in service shops all over the country. Produces RF signals from 160 kc to 110 mc on fundamentals on five bands. Also covers from 110 mc to 220 mc on calibrated harmonics. RF output is in excess of 100,000 microvolts at low impedance. Output is controllable with a step-type and a continuously variable attenuator. Front panel controls provide selection of either unmodulated RF output or RF modulated at 400 cps. In addition, two to three volts of audio at approximately 400 cps are available at the output terminals for testing AF circuits. Employs a 12AU7 and a 6C4 tube. Built-in power supply uses a selenium rectifier.

One of the most outstanding features about the Model SG-8 is the fact that it can be built in just a few hours, even by one not thoroughly experienced in electronics work. Complete step-by-step instructions combined with large pictorial diagrams assure successful assembly. Pre-aligned coils make calibration from an external source unnecessary.

HEATHKIT LABORATORY GENERATOR KIT

This laboratory RF signal generator covers from 100 kc to 30 mc on fundamentals in five bands. The output signal may be pure RF, or may be modulated at 400 cycles from 0 to 50%. Provision for external modulation has been made. RF output available up to 100,000 microvolts. Output controlled by a fixed step and a variable attenuator. Output impedance is 50 ohms. Panel meter reads RF output or percentage of modulation. Incorporates voltage regulated B+ supply, double shielding of oscillator circuits, copper plated chassis, and other "extras."

MODEL LG-1

$39.50

Shpg. Wt. 16 Lbs.

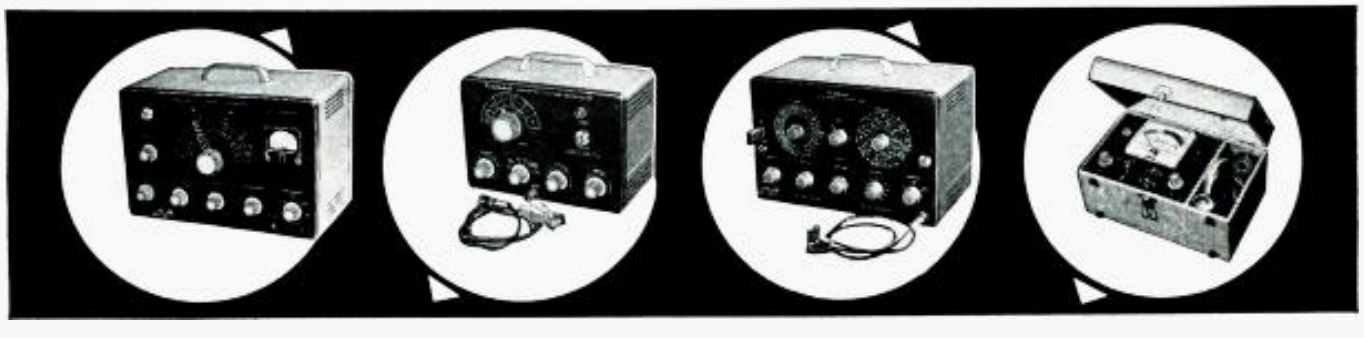
HEATHKIT TV ALIGNMENT GENERATOR KIT

This improved sweep generator model provides essential stability and flexibility for work on FM, monochrome TV, or color TV sets. Covers 3.6 mc to 220 mc in four bands. Provides usable output even on harmonics. Sweep deviation from 0-42 mc, depending on base frequency. All-electronic sweep circuit eliminates unwieldy mechanical arrangements. Includes built-in crystal marker generator providing output at 4.5 mc and multiples thereof, and variable marker covering 19 to 60 mc on fundamentals and from 57 to 180 mc on harmonics. Effective two-way blanking.

MODEL TS-4A

$49.50

Shpg. Wt. 16 Lbs.



HEATHKIT LINEARITY PATTERN GENERATOR KIT

This instrument supplies information for white dots, cross-hatch pattern, horizontal bar pattern, or vertical bar pattern. It feeds video and sync signals to the set under test, with completely controlled gain, and unusual stability. Covering channels 2 to 13, the LP-2 will produce 5 to 6 vertical bars and 4 to 5 horizontal bars. The dot pattern presentation is a *must* for the setting of color convergence controls in the color TV set. Panel provision made for external sync if desired. Use for adjustment of vertical and horizontal linearity, picture size, aspect ratio, and focus. Power supply is regulated for added stability. Essential in the up-to-date TV service shop.

MODEL LP-2

$22.50

Shpg. Wt. 7 Lbs.

HEATHKIT CATHODE RAY TUBE CHECKER KIT

This instrument checks cathode emission, beam current, shorted elements, and leakage between elements in electro-magnetic picture tube types. It eliminates all doubt for the TV serviceman, and even more important, for the customer. Features its own self-contained power supply, transformer operated to furnish normal test voltages for the CRT. Employs spring-loaded switches for maximum operator protection. Large 4½" meter indicates CRT condition on "good-bad" scale. Luggage-type portable case ideal for home service calls. Special "shadowgraph" test permits projection of light spot on screen. Also gives relative check of picture tube screen coating.

MODEL CC-1

$22.50

Shpg. Wt. 10 Lbs.

HEATHKIT

Tube Checker Kit

$29.50

Shpg. Wt. 12 Lbs.

This fine piece of test gear checks tubes for quality, emission, shorted elements, open elements, and filament continuity. Will test all tube types normally encountered in radio and TV service work. Sockets provided for 4, 5, 6, and 7-pin large, rectangular, and miniature types, octal and loctal types, the Hytron 9-pin miniatures, and pilot lamps. Condition of tubes indicated on a large 4½" meter with multi-color "good-bad" scale. An illuminated roll chart is built right in, providing test data for various tube types. This tester provides switch selection of 14 different filament voltage values from 0.75 volts to 117 volts. Individual switches control each tube element. Close tolerance resistors employed in critical test circuits for maximum accuracy. A professional instrument both in appearance and performance.

The Model TC-2 is very simple to build, even for a beginner. It employs a color-coded cable harness for neat, professional under-chassis wiring. Comes with attractive counter style cabinet, and portable cabinet is available separately. At this price, even the part-time serviceman can afford his own tube checker for maximum efficiency in service work.

- *Attractive counter-style cabinet.*
- *Wiring-harness simplifies assembly.*
- *Large 4½" meter with two-color "good-bad" scale.*
- *Separate tube element switches prevent obsolescence.*

HEATHKIT TV PICTURE TUBE TEST ADAPTER

Designed especially for use with the Model TC-2 tube checker. Use it to test TV picture tubes for emission, shorts, etc. Consists of 12-pin TV tube socket, 4 ft. cable, octal connector, and necessary technical data. Not a kit.

MODEL 355

$4.50

Shpg. Wt. 1 Lb.

HEATHKIT PORTABLE TUBE CHECKER KIT

This portable tube checker is identical, electrically, with the Model TC-2. However, it is housed in an attractive and practical carrying case, finished in proxylin impregnated material. The cover is detachable, and the hardware is brass plated. This rugged unit is ideal for home service calls or any portable application.

MODEL TC-2P

$34.50 Shpg. Wt. 15 Lbs.

HEATHKIT VISUAL-AURAL SIGNAL TRACER KIT

Although designed primarily for radio receiver work, this valuable instrument finds extensive application in FM and TV servicing as well. Features a high-gain channel with demodulator probe, and a low-gain channel with audio probe. Will trace signals in all sections of a radio receiver and in many sections of a FM set or TV receiver. Uses built-in speaker and electron beam eye tube for indication. Also features built-in wattmeter and a noise locater circuit. Provision for patching speaker and/or output transformer into external set.

MODEL T-3

$23.50

Shpg. Wt. 9 Lbs.

HEATHKIT DIRECT READING CAPACITY METER KIT

Operation of this instrument is simplicity itself. One has only to connect a capacitor to the terminals, select the proper range, and read the capacity value directly on the large 4½" meter calibrated in mmf and mfd. Ranges are 0 to 100 mmf, 1,000 mmf, 0.01 mfd, and 0.1 mfd full scale. Precision calibrating capacitors supplied. Not susceptible to hand capacity effects. Residual capacity less than 1 mmf. Especially valuable in production line checking, or in quality control.

MODEL CM-1

$29.50

Shpg. Wt. 7 Lbs.

HEATHKIT CONDENSER CHECKER KIT

The Model C-3 consists of an AC powered bridge for both capacitive and resistive measurements. Bridge balance is indicated on electron beam eye tube, and capacity or resistance value is indicated on front panel calibrations. Measures capacity in four ranges from .00001 mfd to .005 mfd, .001 mfd to .5 mfd, .1 mfd to 50 mfd, and 20 mfd to 1000 mfd. Measures resistance in two ranges, from 100 ohms to 50,000 ohms, and from 10,000 ohms to 5 megohms. Selection of five different polarizing voltages for checking capacitors, from 25 volts DC to 450 volts DC. Checks paper, mica, ceramic, and electrolytic capacitors. Indicates power factor of electrolytic condensers.

MODEL C-3

$19.50

Shpg. Wt. 7 Lbs.

HEATH COMPANY

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BENTON HARBOR 15, MICH.

PIONEER DESIGN . . .

New and unique approaches to instrument and equipment designs are a Heath Company tradition. We concentrate all our development efforts on kit projects, since this is our prime activity—and not just a sideline. This logically results in more efficient, more reliable circuit designs—and you benefit from this constant engineering progress. Buying from the undisputed leader in the electronic kit field assures you of completely modern equipment, with outstanding advanced design features.

HEATHKIT

Impedance Bridge Kit

- *½% precision resistors and silver-mica capacitors.*
- *Battery-type tubes, no warm-up required.*
- *Built-in phase shift generator and amplifier.*

The Model IB-2 is a completely self-contained unit. It has a built-in power supply, a built-in 1000 cycle generator, and a built-in vacuum tube detector. Provision has been made on the panel for connection to an external detector, an external signal generator, or an external power supply. A 100-0-100 microampere meter on the front panel provides for null indications. Measures resistance from 0.1 ohm to 10 megohms, capacitance from 10 mmf to 100 mfd, inductance from 10 mh to 100 h, dissipation factor (D) from 0.002 to 1, and storage factor (Q) from 0.1 to 1000. ½ of 1% decade resistors employed for maximum accuracy. Typical accuracy figures are: resistance, ±3T; capacitance ±3%; inductance, ±10%; dissipation factor, ±20%; storage factor, ±20%. Employs a Wheatstone bridge, a Capacity Comparison bridge, a Maxwell bridge, and a Hay bridge. Special two-section CRL dial provides maximum convenience in operation. Use the Model IB-2 for determining values of unmarked components, checking production or design samples, etc. A real professional instrument.

MODEL IB-2

$59.50 Shpg. Wt. 12 Lbs.

HEATHKIT "Q" METER KIT

The Q Meter permits measurement of inductance from 1 microhenry to 10 millihenries, "W" on a scale calibrated up to 250 full scale, with multiplying factors of 1 or 2, and capacitance from 40 mmf to 450 mmf, ±3 mmf. Built-in variable oscillator permits testing components from 150 kc to 18 mc. Large 4½" panel-mounted meter is features. Very handy for checking peaking coils, chokes, etc. Use to determine values of unknown condensers, both variable and fixed. Compile data for coil winding purposes, or measure RF resistance. Distributed capacity, and Q of coils.

MODEL QM-1

$44.50

Shpg. Wt. 14 Lbs.

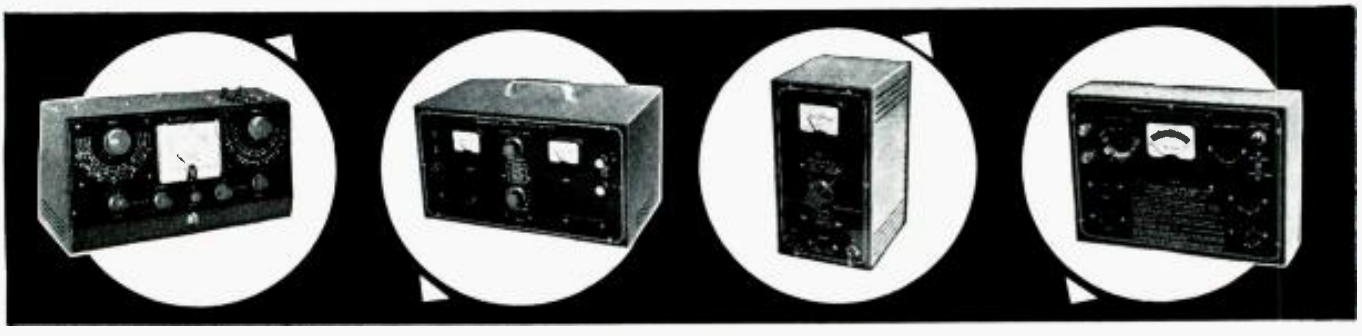
HEATHKIT ISOLATION TRANSFORMER KIT

This device isolates equipment under test from the power line. It is rated at 100 volt-amperes continously, or 200 volt-amperes intermittently. AC-DC sets may be plugged directly into the IT-1 without the chassis becoming "hot." Additionally, since the IT-1 is fused, it is ideal for use as a buffer between the power line and a questionable receiver, or a new piece of equipment. Protects main fuses. Features voltage control, allowing control of the output from 90 volts to 130 volts. Panel meter monitors output voltage. A very handy device at an extremely low price.

MODEL IT-1

$16.50

Shpg. Wt. 9 Lbs.



HEATHKIT 6-12 VOLT BATTERY ELIMINATOR KIT

This completely modern battery eliminator will supply DC output in two ranges for both 6-volt and 12-volt automobile radios. The output is variable for each range, so that operating voltage can be raised or lowered to determine how the receiver functions under adverse conditions. Range is 0-8 volts DC or 0-16 volts DC. Will supply up to 15 amperes on the 6-volt range, or up to 7 amperes on the 12-volt range. Two 10,000 microfarad output filter capacitors insure smooth DC output. Two separate panel meters indicate output voltage or output current. Makes it possible to test automobile radios inside at the workbench. Will also double as a battery charger.

MODEL BE-4

$31.50

Shpg. Wt. 17 Lbs.

HEATHKIT 6-VOLT VIBRATOR TESTER KIT

This instrument functions very much like a tube checker, to test auto radio vibrators. Vibrator condition is indicated on a simple "good-bad" scale. Tests for proper starting and overall quality of operation, of both interrupter and self-rectifier types of 6-volt vibrators. The model VT-1 is designed to operate from any battery eliminator capable of delivering continuously variable output from 4 to 6 volts DC at 4 amperes or more. It is an ideal companion unit for the Heathkit Model BE-4 battery eliminator. The construction book for the VT-1 contains vibrator test chart for popular 6-volt vibrator types. A real time saver!

MODEL VT-1

$14.50

Shpg. Wt. 6 Lbs.

HEATHKIT DX-100 PHONE AND CW

Transmitter Kit

MODEL DX-100
Shpg. Wt. 107 Lbs.

$189.50

Shipped motor freight unless otherwise specified.
$50.00 deposit required on c.o.d. orders.

The Heathkit DX-100 transmitter is in a class by itself in that if offers features far beyond those normally received at this price level. It takes very little listening on the bands to discover how many of these transmitters are in operation today. A truly amazing piece of amateur gear. The DX-100 features a built-in VFO and a built-in modulator. It is TVI suppressed, and uses pi network interstage coupling and output coupling. Will match antenna impedances from approximately 50 to 600 ohms. Extensive shielding is employed, and all incoming and outgoing circuits are filtered. The cabinet features interlocking seams for simplified assembly and minimum RF radiation outside of the cabinet. Provides a clean strong signal on either phone or CW, with RF output in excess of 100 watts on phone, and 120 watts on CW. Completely bandswitching from 160 through 10 meters. A pair of 1625 tubes are used in push-pull for the modulator, and the final consists of a pair of 6146 tubes in parallel. The VFO dial and meter face are illuminated, and all front panel controls are located for maximum convenience. Panel meter reads driver plate I, final grid I, final plate I, final plate voltage, and modulator current. The chassis is constructed of heavy #16 gauge copper-plated steel. Other high-quality components include potted transformers, ceramic switch and variable capacitor insulation, silver-plated or solid-silver switch terminals, etc. All coils are pre-wound, and the main wiring cable is pre-harnessed. The kit can be built by a beginner from the comprehensive step-by-step instructions supplied. It is a proven, trouble-free rig, that will insure many hours of "on-the-air" enjoyment in your ham shack.

- *Phone or CW on 160, 80, 40, 20, 15, 11 and 10 meters.*
- *Built-in VFO, modulator, and power supplies.*
- *High quality components used throughout for reliable performance.*
- *Features 5-point TVI suppression.*

HEATHKIT COMMUNICATIONS TYPE ALL BAND RECEIVER KIT

This receiver covers 550 kc to 30 mc in four bands, and is ideal for the short-wave listener or beginning amateur. It provides good sensitivity and selectivity, combined with good image rejection. Amateur bands clearly marked on illuminated dial scale. Employs transformer type power supply—electrical bandspread—antenna trimmer—separate RF and AF gain controls—noise limiter—headphone jacks—and automatic gain control. Has built-in VFO for CW reception.

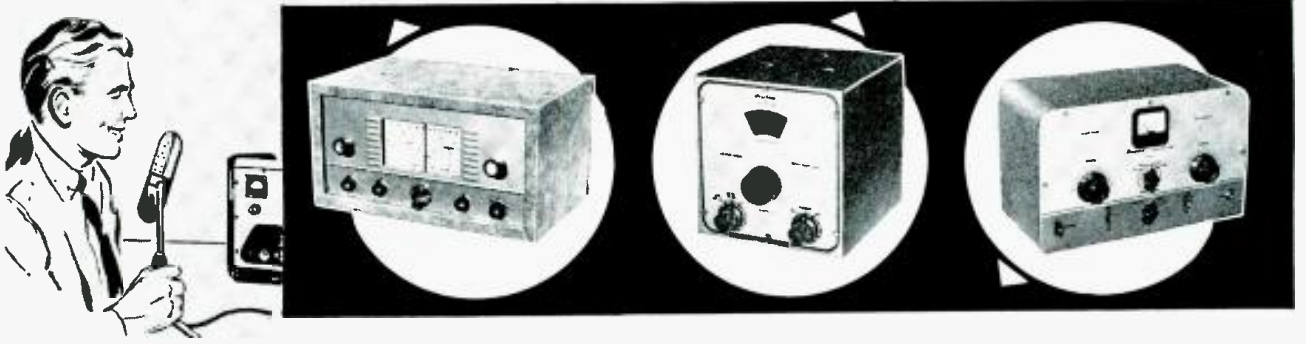
MODEL AR-3
$30.75
INCLUDING NEW EXCISE TAX‡
(Less Cabinet)
Shpg. Wt. 12 Lbs.

CABINET: Fabric covered cabinet with aluminum panel as shown. Part 91-15A. Shipping weight 5 Lbs. $4.95‡

HEATHKIT VFO KIT

You can go VFO for less than you might expect. Here is a variable frequency oscillator that covers 160, 80, 40, 20, 15, 11, and 10 meters with three basic oscillator frequencies, that sells for less than $20. Provides better than 10 volt average RF output on fundamentals. Plenty of drive for most modern transmitters. Requires a power source of only 250 VDC at 15 to 20 ma. and 6.3 VAC at 0.45A. Incorporates a regulator tube for stability. Illuminated frequency dial reads frequency directly on the band being employed. Temperature-compensated capacitors offset coil heating.

MODEL VF-1
$19.50
Shpg. Wt. 7 Lbs.



EASY ON THE BUDGET!

You can buy Heathkits on an easy time-payment plan that provides a full year to pay. Write for complete details and special order blank.

HEATHKIT CW TRANSMITTER KIT

This is the original low-priced Heathkit CW transmitter. Its reliable performance has been proven time and time again on the CW bands. Designed for crystal control, the Model AT-1 covers 80, 40, 20, 15, 11, and 10 meters. May be excited from external VFO. Plate power input up to 30 watts. Power supply built in. Panel meter indicates grid current or plate current for final. Incorporates pre-wound coils, copper-plated chassis, built-in line filter, profuse shielding, and top-quality parts throughout. Crystal socket and key jack on front panel. Built-in key-click filter, and single-knob bandswitching. 52-ohm coaxial output. Uses 6AG7 oscillator-multiplier, 6L6 power amplifier-doubler, and 5U4G rectifier.

MODEL AT-1
$29.50
Shpg. Wt. 15 Lbs.

HEATH COMPANY
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BENTON HARBOR 15, MICH.

DOLLAR-SAVING ECONOMY . . .

There would be no particular achievement in selling inexpensive merchandise at a low price—although it is being done every day. However, there is something to crow about when, through tremendous purchasing power and factory-to-you distribution, Heath Company can offer top-quality equipment, using name-brand components, at such low prices. This is real economy, as opposed to the so-called "bargains". Needless to say, there is a big difference.

HEATHKIT PHONE AND CW

Transmitter Kit

* *6146 final amplifier for full 65-watt plate power input*
* *Phone and CW operation on 80, 40, 20, 15, 11, and 10 meters. Pi network output coupling.*
* *Switch selection of three crystals — provision for external VFO excitation.*

MODEL DX-35

$56.95 *Shpg. Wt. 24 Lbs.*

The DX-35 features a 6146 final amplifier to provide 65 watts plate power input on CW, with controlled carrier modulation peaks up to 50 watts on phone. In addition, it is a most attractive transmitter. Modulator and power supplies are built-in, and the rig covers 80, 40, 20, 15, 11, and 10 meters with a single band-change switch. Pi network output coupling provided for matching various antenna impedances. A 12BY7 buffer stage provided ahead of the final amplifier for plenty of drive on all bands. 12BY7 oscillator and 12AU7 modulator. Provision for switch selection of three different crystals. Crystals reached through access door at rear. Front panel controls marked "off—CW—stand-by—phone", "final tuning", "antenna coupling", "drive level control", and "band change switch". Panel meter indicates final grid current or final plate current. A perfect low-power transmitter both for the novice, and for the more experienced operator. A remarkable power package for the price. Incidentally, the price includes tubes, and all other components necessary for assembly. As with all Heathkits, comprehensive instruction manual assures successful assembly.

HEATHKIT ANTENNA IMPEDANCE METER KIT

This instrument employs a 100 microampere panel meter and covers the impedance range of 0-600 ohms for RF tests. Functions up to 150 mc. Used in conjunction with signal source, such as the Heathkit Model GD-1B grid dip meter, the Model AM-1 will determine antenna resistance and resonance, match transmission lines for minimum standing wave ratio, determine receiver input impedance, etc. Will also double as a phone monitor. A very valuable device for many uses in the ham shack.

MODEL AM-1

$14.50

Shpg. Wt. 2 Lbs.

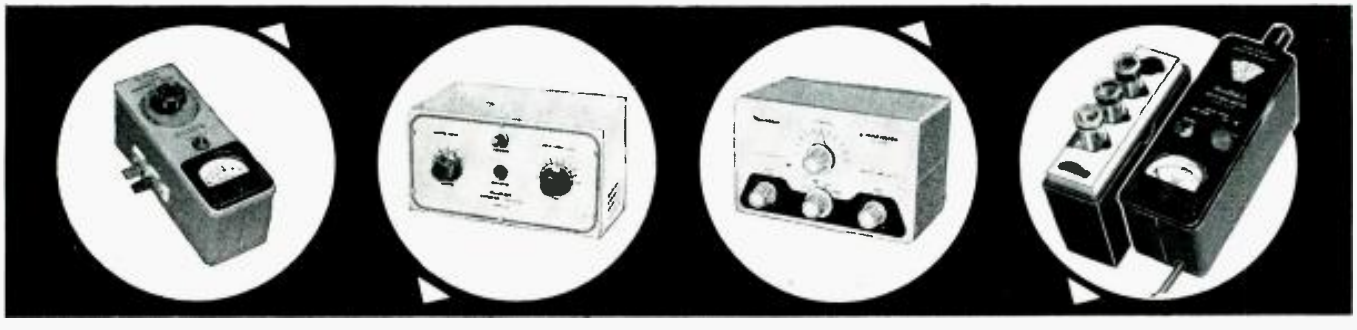
HEATHKIT "Q" MULTIPLIER KIT

The QF-1 functions with any receiver with an IF frequency between 450 and 460 kc that is not AC-DC type. Operates from the receiver power supply, requiring only 6.3 VAC at 300 ma. and 150 to 250 VDC at 2 ma. Simple to connect with cable and plugs supplied. Provides additional selectivity for separating two signals, or will reject one signal and eliminate heterodyne. A big help on crowded bands. Provides an effective Q of approximately 4,000 for sharp "peak" or "null". Tunes to any signal within the IF bandpass of the receiver, without changing main receiver tuning dial.

MODEL QF-1

$9.95

Shpg. Wt 3 Lbs.



HEATHKIT ANTENNA COUPLER KIT

This device is designed to match the Model AT-1 transmitter to a long-wire antenna. In addition to impedance matching, this unit incorporates an L-type filter which attenuates signals above 36 megacycles, thereby reducing TVI. Designed for 52 ohm coaxial input. Handles power up to 75 watts, 10 through 80 meters. Uses a tapped inductor and variable capacitor. Neon RF indicator on front panel. Copper-plated chassis—high quality components throughout—simple to build. Eliminates waste of valuable communications power due to improper matching. A "natural" for all AT-1 transmitter owners.

MODEL AC-1

$14.50

Shpg. Wt. 4 Lbs.

HEATHKIT GRID DIP METER KIT

The grid dip meter was originally designed for the ham shack. However, its use has been extended into the service shop and laboratory. Continuous frequency coverage from 2 mc to 250 mc with pre-wound coils. 500 microampere panel meter employed for indication. Use for locating parasitics, neutralizing, determining RF circuit resonant frequencies, etc. Coils are included with kit, as is a coil rack. Front panel controls include sensitivity control for meter, and phone jack for listening to zero-beat. Will also double as an absorbtion-type wavemeter.

MODEL GB-1B

$19.50

Shpg. Wt. 4 Lbs.

HEATHKIT BROADCAST BAND

Receiver Kit

MODEL BR-2
(Less Cabinet)
Shpg. Wt. 10 Lbs.

$19.95
INCLUDING NEW EXCISE TAX*

You need no previous experience in electronics to build this table-model radio. The Model BR-2 receiver covers 550 kc to 1620 kc and features good sensitivity and selectivity over the entire band. A 5½" PM speaker is employed, along with high gain miniature tubes and a new rod-type built-in antenna. Provision has been made in the design of this receiver for its use as a phonograph amplifier. The phono jack is located on the back chassis apron. A transformer operated power supply is featured for safety of operation, as opposed to the usual AC-DC supply commonly found in "economy radio kits." Don't let the low Heathkit price deceive you. This is the kind of set you will want to show off to your family and friends after you have finished building it.

Construction of this radio kit is very simple. Giant size pictorial diagrams and detailed step-by-step instructions assure your success. The construction manual also includes an explanation of basic receiver circuit theory so you can "learn by doing" as the receiver is built. The manual even provides information on resistor and capacitor color codes, soldering techniques, use of tools, etc. If you have ever had the urge to build your own radio receiver, the outstanding features of this popular Heathkit deserve your attention.

ATTENTION BEGINNERS . . .

This kit is an ideal "first project" if you have never built a Heathkit before. A good chance to "learn by doing."

- *Miniature tubes and high-gain IF transformer.*
- *Rod-type built-in antenna. Good sensitivity and selectivity.*
- *5½-inch PM speaker.*
- *Provision for phono jack.*
- *Transformer - operated power supply.*

CABINET: Proxylin impregnated fabric covered plywood cabinet available for the BR-2 receiver as shown. Complete with aluminum panel, reinforced speaker grill, and protective rubber feet. Shipping weight 5 lbs., part No. 91-9A.....$4.95*

HEATHKIT PROFESSIONAL RADIATION COUNTER KIT

This sensitive and reliable instrument has already found extensive application in prospecting, and also in medical and industrial laboratories. It offers outstanding performance at a reasonable price. Front-panel meter indicates radiation level, and oral indication produced by panel-mounted speaker. Meter ranges are 0-100, 600, 6,000 and 60,000 counts per minute, and 0—.02, .1, 1 and 10 milliroentgens per hour. The probe, with expansion cord, employs type 6306 bismuth counter tube, sensitive to both beta and gamma radiation. It is simple to build, even for a beginner.

MODEL RC-1
$79.95
Shpg. Wt. 8 Lbs.

HEATHKIT CRYSTAL RECEIVER KIT

The crystal radio of Dad's day is back again, but with big improvements! The Model CR-1 employs a sealed germanium diode, eliminating the critical "cat's whisker" adjustment. It is housed in a compact plastic box, and features two Hi-Q tank circuits, employing ferrite core coils and variable air tuning capacitors. The CR-1 covers the standard broadcast band from 540 kc to 1600 kc, and no external power is required for operation. Could prove valuable for emergency signal reception. This easy-to-build kit is a real "learn by doing" experience for the beginner, and makes an interesting project for all ages.

MODEL CR-1
$8.75
INCLUDING NEW EXCISE TAX*
Shpg. Wt. 3 Lbs.

- *Amazing new circuit for high efficiency.*
- *Compact, portable and rugged.*
- *Stable circuit requires only one 67½ volt "B" battery and two 1½ volt "A" batteries.*

HEATHKIT ENLARGER TIMER KIT

The Model ET-1 is an easy-to-build device for use by amateur or professional photographers in controlling the timing cycle of an enlarger. It covers the range of 0 to 1 minute with a continuously variable, clearly calibrated scale. The timing period is pre-set, and the timing cycle is initiated by depressing the spring-return switch to the "print" position. Front panel provision is made for plugging in the enlarger and a safelight. The safelight is automatically turned "on" when the enlarger is "off". Handles up to 350 watts. The timing cycle is controlled electronically for maximum accuracy and reliability. Very simple to build in only one evening, even by a beginner.

MODEL ET-1
$11.50
Shpg. Wt. 3 Lbs.

HEATH COMPANY
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BENTON HARBOR 15, MICH.

COMPREHENSIVE INSTRUCTIONS . . .

The step-by-step assembly instructions provided with each Heathkit are the finest available anywhere. Each manual begins at the beginning, and assumes no previous training or experience on the part of the kit builder. This means that our kits can be built successfully by anyone who can follow instructions. As a matter of fact, new manuals are tested by having the kit built by someone in our office who has had no previous experience in electronics. This is your guorantee of complete and thorough instruction material.

HEATHKIT HIGH FIDELITY

Preamplifier Kit

- *5 switch-selected inputs, each with its own level control.*
- *Equalization for LP, RIAA, AES, and Early 78's.*
- *Separate bass and treble tone controls, and special hum control.*
- *Clean, modern lines and satin-gold enamel finish.*

Literally thousands of these preamplifiers are in use today, because the kit meets or exceeds specifications for the most rigorous high-fidelity applications, and will do justice to the finest available program sources. Provides a total of 5 inputs, each with individual level controls (three high-level and two low-level). Frequency response is within 1 DB from 25 CPS to 30,000 CPS, or within 1½ DB from 15 CPS to 35,000 CPS. Hum and noise are extremely low, with special balance control for absolute minimum hum level. Tone control provides 18 DB boost and 12 DB cut at 50 CPS, and 15 DB boost and 20 DB cut at 15,000 CPS. Cabinet measures only 12-9/16" W. x 3⅜" H. x 4⅞" D, and it is finished in beautiful satin-gold enamel. 4-position turnover and 4 position roll-off controls provide "LP," "RIAA," "AES," and "early 78" equalization, and 8, 12, 16, and 1 flat position for roll-off. Derives operating power from the main amplifier, requiring only 6.3 VAC at 1 ampere and 300 VDC at 10 MA. Easy to construct from step-by-step instructions and pictorial diagrams provided.

MODEL WA-P2 (With Cabinet) Shpg. Wt. 7 Lbs.

$21.75 INCLUDING NEW EXCISE TAX*

HEATHKIT HIGH FIDELITY FM TUNER KIT

- *Illuminated slide-rule dial covers 88 to 108 MC.*
- *Modern circuit emphasizes sensitivity and stability.*
- *Housed in attractive satin-gold cabinet to match WA-P2 and BC-1.*

This amazing new FM tuner can provide you with real high-fidelity performance at an unbelievably low price level. Covering 88 to 108 MC, the modern circuit features a stabilized, temperature-compensated, oscillator, A.G.C., broadbanded IF circuits, and better than 10 UV sensitivity for 20 DB of quieting. A high gain, cascaded, RF amplifier is used ahead of the mixer to increase overall gain and reduce oscillator leakage. It employs a ratio detector for high efficiency without sacrifice in high-fidelity performance. IF and ratio transformers are pre-aligned, as is the front end tuning unit. This means the kit can be constructed by a beginner, without elaborate test and alignment equipment. The FM-3A is designed to match the WA-P2 preamplifier and the BC-1 AM tuner. An illuminated slide-rule dial is employed for frequency indication. Step-by-step instructions and large pictorial diagrams assure success.

MODEL FM-3A

$26.95*

INCLUDING NEW EXCISE TAX*

(With Cabinet)

Shpg. Wt. 7 Lbs.

HEATHKIT BROADBAND AM TUNER KIT

This AM tuner has been designed especially for high-fidelity applications. It incorporates a low-distortion detector, a broadband IF, and other features essential to usefulness in high-fidelity. Special voltage-doubler detector employs crystal diodes for low distortion. Sensitivity and selectivity are excellent. Audio response is ± 1 DB from 20 CPS to 2 kc, with 5 DB of pre-emphasis at 10 kc to compensate for station roll-off. Covers the standard broadcast band from 550 to 1600 kc. Incorporates a 10 kc whistle-filter and provides a 6 DB signal-to-noise ratio at 2.5 UV. RF and IF coils are pre-aligned, and power supply is built-in. Incorporates AVC, two outputs, and two antenna inputs.

MODEL BC-1

$26.95

INCLUDING NEW EXCISE TAX*

(With Cabinet)

Shpg. Wt. 8 Lbs.

HEATHKIT ELECTRONIC CROSS-OVER KIT

This unusual device functions to separate low frequencies and high frequencies so that they may be fed to separate amplifiers and to separate speakers. This eliminates the need for conventional cross-over circuits, since the Model XO-1 does the complete job electronically. Cross-over frequencies of 100, 200, 400, 700, 1,200, 2,000 and 35,000 CPS are selectable with front panel controls on the XO-1, and a separate level control is provided for each channel. Minimizes intermodulation distortion problems. Handles unlimited power, since frequency division is accomplished ahead of the power stage. Attenuation is 12 DB per octave, with sharp "knee" at cut-off frequency.

MODEL XO-1

$18.95

Shpg. Wt. 6 Lbs.

HEATHKIT ADVANCED-DESIGN

HIGH FIDELITY

Amplifier Kit

$59.75

This 25 watt unit is our finest high-fidelity amplifier. Using a special design peerless output transformer, and KT-66 output tubes by Genalex, the Model W-5M provides performance characteristics unsurpassed at this price level. Frequency response is ± 1 DB from 5 to 160,000 CPS at 1 watt. Harmonic distortion is less than 1% at 25 watts and IM distortion is less than 1% at 20 watts (60 and 3,000 CPS, 4 to 1). Hum and noise are 99 DB below 25 watts. Damping factor is 40 to 1. Input voltage for 5 watts output is 1 volt. Tubes employed are a pair of 12AU7's, a pair of KT-66's and a 5R4GY rectifier. Measures 13-3/32" W. x 8½" D. x 8¼" H. Output impedance is 4, 8, or 16 ohms. Featured, also, is the "tweeter saver" which suppresses high frequency oscillation, and a new type balancing circuit requiring only a voltmeter for indication. This balance is easier to adjust, and results in a closer "dynamic" balance between output tubes. The Model W-5M provides improved phase shift characteristics, reduced IM and harmonic distortion, and improved frequency response. Conservatively rated high-quality components are used throughout to insure years of trouble-free operation. No technical background or training is required for assembly. Step-by-step instructions are provided for every stage of construction, and large pictorial diagrams illustrate exactly where each wire and component is to be placed. An amplifier for music lovers who can appreciate subtle differences in performance. Just ask the audiofile who owns one!

MODEL W-5‡

Consists of Model W-5M *plus* Model WA-P2 preamplifier.

Shpg. Wt. 38 lbs.
Express only.... $81.50‡

- *Full 25 watt output with KT-66 output tubes.*
- *All connectors brought out to front chassis apron.*
- *Protective cover over all above-chassis components.*

HEATHKIT DUAL-CHASSIS—WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

This 20-watt high-fidelity amplifier employs the famous Acrosound Model TO-300 "ultra-linear" output transformer and uses 5881 output tubes. The power supply is built on a separate chassis, and the two chassis are inter-connected with a power cable. This provides additional flexibility in mounting. Frequency response is ± 1 DB from 6 CPS to 150 kc at 1 watt. Harmonic distortion is only 1% at 21 watts, and IM distortion is only 1.3% at 20 watts. (60 and 3,000 CPS). Output impedance is 4, 8, or 16 ohms. Hum and noise are 88 DB below 20 watts. A very popular high-fidelity unit employing top-quality components throughout.

MODEL W-3M: Shpg. Wt. 29 lbs. Express only..... $49.75

MODEL W-3: Consists of Model W-3M *plus* Model WA-P2 preamplifier. Shpg. Wt. 37 lbs. Express only..... $71.50‡

HEATHKIT SINGLE CHASSIS—WILLIAMSON TYPE HIGH FIDELITY AMPLIFIER KIT

The 20-watt Model W-4AM Williamson type amplifier is a tremendous high-fidelity bargain. Combining the power supply and main amplifier on one chassis, and using a special-design output transformer by Chicago Standard brings you savings without a sacrifice in quality. Employing 5881 output tubes, the frequency response of the W-4AM is ± 1 DB from 10 CPS to 100 kc at 1 watt. Harmonic distortion is only 2.7% at this same level. Output impedance is 4, 8, or 16 ohms. Hum and noise are 95 DB below 20 watts.

MODEL W-4AM: Shpg. Wt. 28 lbs. Express only..... $39.75

MODEL W-4A: Consists of Model W-4AM *plus* Model WA-P2 preamplifier. Shpg. Wt. 35 lbs. Express only..... $61.50‡

HEATHKIT 7-WATT AMPLIFIER KIT

This amplifier is more limited in power than other Heathkit models, but it still qualifies as a high-fidelity unit, and its performance definitely exceeds that of many so-called "high-fidelity" phonograph amplifiers. Using a tapped-screen output transformer of new design, the Model A-7D provides a frequency response of ± 1½ DB from 20 to 20,000 CPS. Total distortion is held to a surprisingly low level. Output stage is push pull, and separate bass and treble tone controls are provided. Shpg. Wt. 10 lbs.

MODEL A-7D
$18.65
INCLUDING NEW EXCISE TAX‡

MODEL A-7E: Similar to the A-7D, except that a 12SL7 tube has been added for preamplification. Two inputs, RIAA compensation, and extra gain. $20.35‡

HEATHKIT 20-WATT HIGH FIDELITY AMPLIFIER KIT

This high-fidelity amplifier features full 20-watt output using push pull 6L6 tubes. Built-in preamplifier provides 4 separate inputs, selected by a panel-mounted switch. It has separate bass and treble tone controls, each offering 15 DB boost and cut. Output transformer is tapped at 4, 8, 16, and 500 ohms. Designed primarily for home installations, but also used extensively for public address applications. True high-fidelity performance with frequency reponse of ± 1 DB from 20 CPS to 20,000 CPS. Total harmonic distortion only 1% (at 3 DB below rated output).

MODEL A-9B
$35.50
Shpg. Wt. 23 Lbs.

HEATH COMPANY
A Subsidiary of Daystrom, Inc.
BENTON HARBOR 15, MICH.

All prices marked with a ‡ include a 10% federal excise tax that now applies to receivers, tuners and some amplifiers, even though they may be in kit form. Since the tax is in effect as of July 5, 1956, we have no choice but to reflect it in our kit prices. This note is just to let you know we are not increasing our prices on some kits, but merely including this new tax in them.

Thank you,
HEATH COMPANY

HEATHKIT HIGH FIDELITY

Range Extending
SPEAKER SYSTEM KIT

* *High quality speakers of special design — 15" woofer and compression-type super-tweeter.*
* *Easy-to-assemble cabinet of furniture-grade plywood.*
* *Attractively styled to fit into any living room. Matches Model SS-1.*

MODEL SS-1B

$99.95

Shpg. Wt. 80 Lbs.

This range extending unit is designed especially for use with the Model SS-1 speaker system. It consists of a 15" woofer, providing output between 35 and 600 CPS, and a compression-type super-tweeter that provides output between 4,000 and 16,000 CPS. Cross-over frequencies are 600, 1,600, and 4,000 CPS. The SS-1 provides the mid-range, and the SS-1B extends the coverage at both ends of the spectrum. Together, the two speaker systems provide output from 35 to 16,000 CPS within ± 5 DB. This easy-to-assemble speaker enclosure kit is made of top-quality furniture-grade plywood. All parts are pre-cut and pre-drilled, ready for assembly and the finish of your choice. Complete step-by-step instructions are provided for quick assembly by one not necessarily experienced in woodworking. Coils and capacitors for proper cross-over network are included, as is a balance control for super-tweeter output level. The SS-1 and SS-1B can provide you with unbelievably rich audio reproduction, and yet these units are priced reasonably. The SS-1B measures 29" H. x 23" W. x 17½" D. The speakers are both special-design Jensens, and the power rating is 35 watts. Impedance is 16 ohms.

HEATHKIT HIGH FIDELITY **SPEAKER SYSTEM KIT**

MODEL SS-1

$39.95

Shpg. Wt. 30 Lbs.

* *Special design ducted-port, bass-reflex enclosure.*
* *Two separate speakers for high and low frequencies.*
* *Kit includes all parts and complete instructions for assembly.*

This speaker system is a fine reproducer in its own right, covering 50 to 12,000 CPS within ± 5 DB. However, the story does not end there. Should you desire to expand the system later, the SS-1 is designed to work with the SS-1B range extending unit — providing additional frequency coverage at both ends of the spectrum. It can fulfill your present needs, and still provide for the future. The SS-1 uses two Jensen speakers; an 8" midrange-woofer, and a compression-type tweeter. Cross-over frequency is 1,600 CPS, and the system is rated at 25 watts. Nominal impedance is 16 ohms. The cabinet is a ducted-port bass-reflex type. Attractively styled, the Model SS-1 features a broad "picture-frame" molding that will blend with any room decorating scheme. Pre-cut and pre-drilled wood parts are of furniture grade plywood. The kit is easy-to-build, and all component parts are included, along with complete step-by-step instructions for assembly. Can be built in just one evening, and will provide you with many years of listening enjoyment thereafter.

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QUANTITY	ITEM	MODEL NO.	PRICE

THE ADDITIVE Tone Control

By JACOB H. RUBENSTEIN
United Radio

A simple three-channel system which adds the bass and treble boost to original signal in any desired amount.

MANY tone controls are simply passive *RC* networks. Some use *RC* networks combined with negative feedback but here, also, with or without negative feedback, the bass is obtained by attenuating the highs. It is true that these tone control circuits provide bass and treble attenuation and boost and, with a given setting of the control knobs, a flat top frequency response can be had. But from the writer's point of view, these results can be had by less involved methods by *adding* the bass and treble boost to the original signal in any desired amount, and with the tone volume controls at zero position the original signal is left unmodified. The circuit evolved is shown in Fig. 1.

This tone control is composed of three triode sections. First V_{1A} is a simple "pass-through" stage which allows the original signal to pass from point "I" (input) to point "O" (output) without any modification except for an over-all attenuation of about 3 db. This triode section has a flat-top characteristic. So far we have not altered the incoming signal except to slightly decrease its amplitude.

Second is V_{1B}, which is the bass-boost section. The filter network in the plate circuit of this triode allows only the frequencies below 1000 cycles to be added to the signal of the pass-through stage, the amount of amplitude added to V_{1A} is controlled by the volume control in the grid circuit of V_{1B}.

Third is V_{2A}, which is the treble-boost section. The input and output coupling capacitors of this triode filter out the low-frequency notes so that only the highs are added to the pass-through stage at point "O." The outputs of V_{1B} and V_{2A} are added to V_{1A} at point "O" in phase with V_{1A}.

With the volume control in the grid circuit of V_{2A} set for minimum signal, the fixed 80,000-ohm resistor in series with this control allows V_{2A} to amplify just enough highs to compensate for the loss of highs in V_{1A} through the filter network in the plate circuit of V_{1B}. The over-all result is a flat-top response of this entire circuit, from point "I" to point "O" when both volume controls are at zero setting.

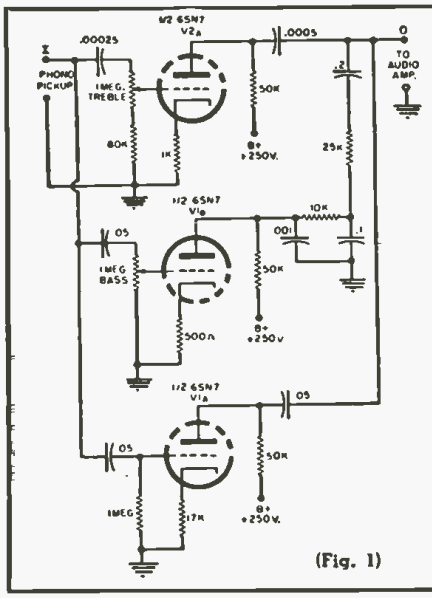
For best results, this tone control unit should be connected in a low-level volume point, such as, between the phono pickup and audio amplifier; for radio operation it should be connected between the first audio coupling capacitor and the adjacent grid.

The output amplitude of both the bass and treble at maximum volume (see Fig. 2) may be sufficient to overload the input tube of the following amplifier. Therefore, the boost controls are not then operated at their maximum settings. Due to the high amplitude of the low frequencies passed on by the bass boost section of the tone control, the accompanying amplifier may have a tendency to motorboat as the bass volume control is advanced. This motorboating may be stopped by decreasing the value of the grid resistance of one or more tube circuits in the audio amplifier and, if necessary, inserting decoupling networks in the plate circuits of the same stages.

The writer has also developed a condensed version of this tone control using a dual-triode tube, the circuit of which is shown in Fig. 3. This condensed circuit was built into a car radio and connected in series with the first audio coupling capacitor and adjacent grid. The listening response seems much improved over the original circuit.

In this single-tube circuit, one triode boosts the lows and the other triode boosts the highs. No attempt is made to amplify the middle frequencies. However, speaker attenuation smooths out the tone response so that the extremes of the tone range are present in good proportion to the middle frequencies.

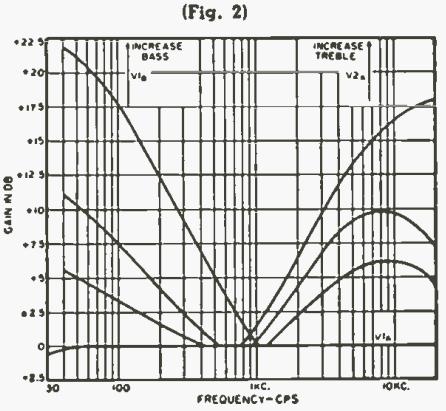
An audio amplifier system with a comparatively low priced speaker may be greatly improved by the addition of this tone circuit, because, even though the amplifier may have a flat frequency response, speaker attenuation will cause a falling characteristic at the extremes of the frequency range. This may be compensated, to a great degree, with boost of the audio at the extremes of the range. —30—

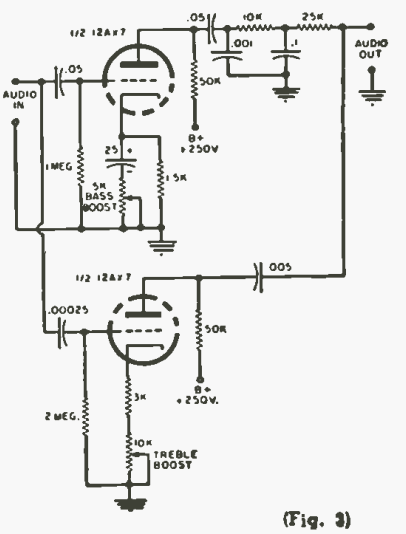


(Fig. 1)

Fig. 1. The additive tone control. Fig. 2. Output amplitude of both bass and treble at maximum volume. Fig. 3. One-tube version.

(Fig. 2)





(Fig. 3)

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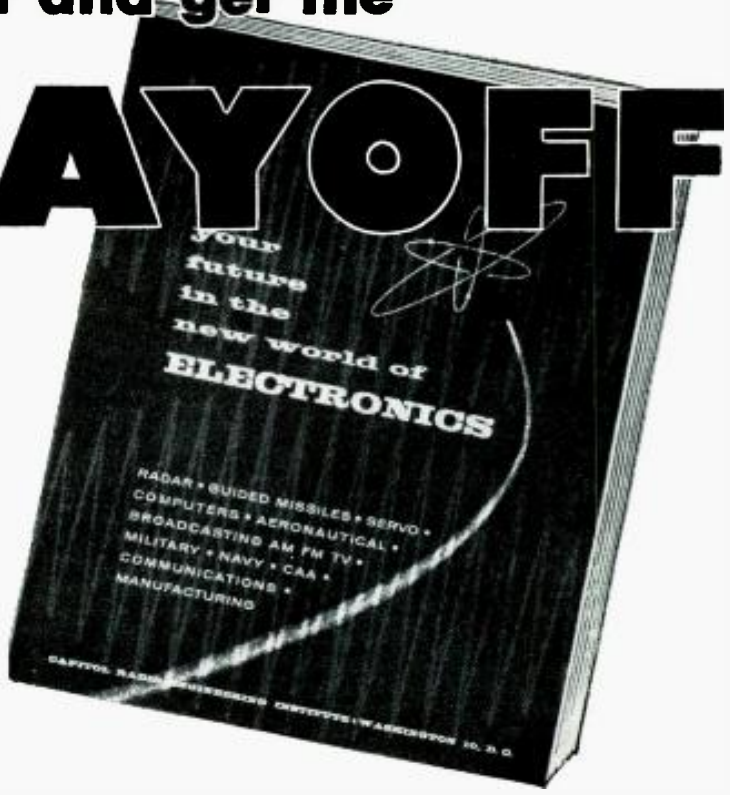

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who murdered the serviceman?

OR at least the serviceman's confidence in tube testers. LOOK at the FACTS —A serviceman trusts his VTVM (like the Precise 9071 or 909); his signal generator (like the Precise 610 or 630 or 635); his oscilloscopes (like the famous 300 or 308 or 315).

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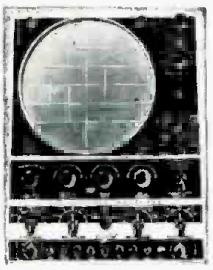
Precise engineers recognize him as a logical, intelligent fellow. They knew he had good reasons and they looked into the matter with him in mind. Our electronic sleuths found that some manufacturers used an Em (emission) test, some a Gm (mutual transconductance), some a so-called combination, and some a sort of OUIJA board. Some manufactured tube testers that were fast—some slow—some tied almost all the elements together. In some you could cut off pins and the tube merrily read "good." Some didn't even connect all the pins. NO wonder our serviceman's confidence was being murdered!

What then has Precise done to prevent this mayhem. We went directly to the tube manufacturers before offering the serviceman a tube tester. We found out how the tube manufacturer gets the kind of check a serviceman wants . . . a 100% test! We wanted to offer a tube tester that simulates operating conditions in a set. WE HAVE DONE THIS. We added a lot of other requirements . . . A SHORT CHECK, GAS CHECK, Gm, Em, LIFE, FILAMENT CURRENT for 600 mil tubes, BIAS, NOISE and other checks.

RESULT, a tube tester with built in confidence . . . you can even see the tube characteristic curve on an oscilloscope. What's more you can operate this tube tester as simply as the ordinary testers. The Precise 111 has about the same number of controls . . . Remember! it uses rotary switches instead of lever type, because the rotary gives over twice the protection against becoming obsolete. Furthermore, several tests are listed for each tube (an Em and a Gm) with the 100% test starred.

NOW YOU CAN TEST YOUR TUBES *COMPLETELY*. FOR PROOF OF WHAT WE OFFER SEE THE RESULTS OF AN INDEPENDENT SURVEY.



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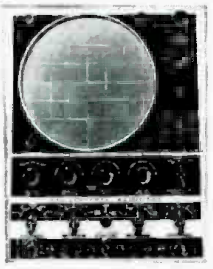

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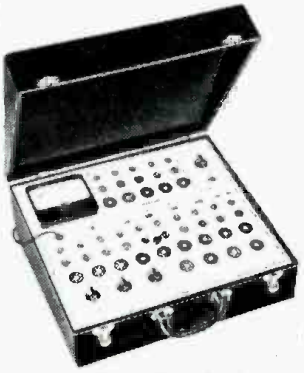

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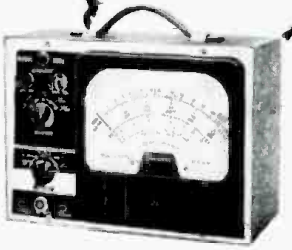

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COVER STORY

Two-Way Communications Speed Ground Operations . . .

One of the prime users of two-way radio in the past, the airlines are now adopting "earthbound" communications gear to step up ground operations to match air age speed.

AIRLINES have relied on radio in the skies for many years but only in recent months have they begun to use it for improved communications on the ground.

Leading in this "new" application is *United Air Lines*, which has portable sets in operation at Seattle, Portland, San Francisco, Los Angeles, Denver, Omaha, Chicago, and Cleveland. The installations consist of a transmitter-receiver in the office of *UAL*'s station coordinators. Supervisors, moving about the ramp, carry eight-pound "Minipak" sender-receivers.

Two-way radio enables the coordinators to remain in constant communication with the supervisors. It assures flexibility and precision in handling the flow of passengers, baggage, cargo, food supplies, fuel, and other items required in servicing aircraft. Loading stands, baggage carts, lift forks, and belt conveyors can be shifted from plane to plane with maximum efficiency.

United has developed valuable side uses for ground radio. When a traveler arrives at the check-in counter within moments of take-off, the supervisor in charge of "buttoning up" the aircraft can be instantly informed to hold up for the latecomer. When passengers fail to appear at departure time, the coordinator can radio the ramp supervisor to load air freight equal to the weight of the "no shows."

At Chicago, where *United*'s cargo volume is particularly heavy, the base station in the coordinator's office is supplemented by a transmitter-receiver in the air freight office. The latter is used exclusively for "on and off" loading of cargo. R. L. Mangold, manager of cargo sales, reports that radio has increased the utilization of "Cargoliner" space. The handling of last-minute acceptances, for example, is simplified and weight-change information can be disseminated without delay.

At San Francisco, where *United* has its maintenance base, two-way radios are mounted in the tractors which tow aircraft between the base and the airport terminal, a round-trip distance of one mile. This method saves substantial quantities of fuel which the big engines would consume in taxiing under their own power. It also keeps the engines in better condition since they are designed to operate at high speed.

When the tractor driver receives an assignment to tow an airplane from the base to the terminal, he contacts the airport control tower by radio, requesting permission to proceed. Having received clearance, he crosses the field to the loading ramp where passengers are boarded.

Use of tractors and two-way radio at San Francisco saves *United* an estimated $17,000 annually in gasoline costs. In taxiing between the airport terminal and the maintenance base, a DC-6 "Mainliner" would use approximately 30 gallons of expensive aviation gasoline. In contrast, the tow tractor consumes less than half a gallon of standard automobile fuel.

All of *United*'s portable radio units are leased from local telephone companies which install and maintain the equipment. The "Minipaks" shown in use on the cover are manufactured by the *Radio Specialties Company* of Portland, Ore. —30—

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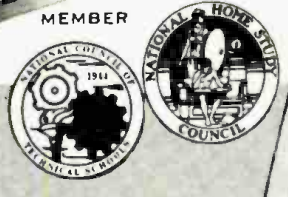

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New Transistor Circuits

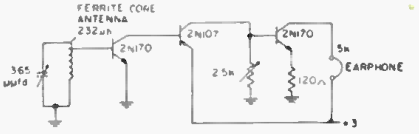
Two of the new G-E 2N170 rate-grown "n-p-n" high-frequency transistors which are intended for low power and low voltage.

Inexpensive high-frequency transistor puts simple circuits within easy reach. Preamp for reluctance cartridge is shown.

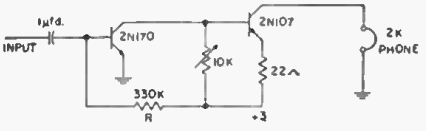
A NEW high-frequency transistor for radio hobbyists and do-it-yourself devotees, priced about the same as its nearest comparable electron tube, was announced recently by the General Electric Co. Designated 2N170, the new transistor is an "n-p-n" type produced by the rate-grown process.

Included in possible applications for the recently released transistor are an inexpensive vest-pocket super-regenerative broadcast radio receiver, a direct-coupled audio amplifier, a compensated preamplifier for a variable reluctance phono cartridge, a phonograph oscillator, and a wireless microphone. The 2N170 can be used in any of the many published circuits for "p-n-p" transistors where a low-voltage, high-frequency transistor is required. To do this it is only necessary to change the connections to the power supply as shown below.

In a typical common-emitter circuit the 2N170 has a power gain of 22 db at 455 kc., thus allowing it to be used in i.f. circuits. Maximum frequency cut-off with usable gain is 4 mc. The transistor is hermetically sealed in an all-metal case for reliability. —30—

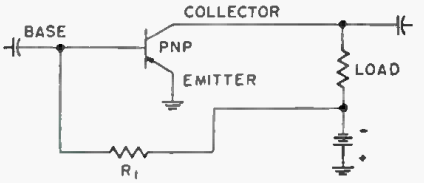


Direct-coupled vest pocket radio.

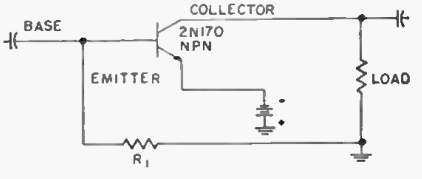


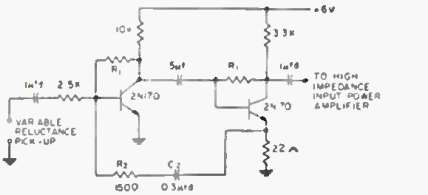
R SHOULD BE ADJUSTED FOR OPTIMUM RESULTS

Direct-coupled battery-saver amplifier using "n-p-n" and "p-n-p" transistors.



Basic "p-n-p" circuit (above) is easily converted to "n-p-n" circuit (below).



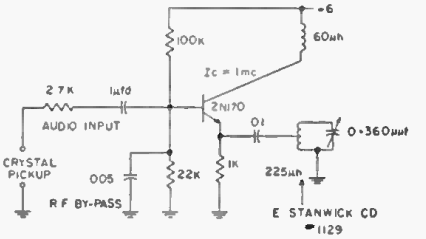


R1 (130K - 500K) SHOULD BE CHOSEN TO MAKE COLLECTOR VOLTAGE 2.5 TO 3.5 VOLTS

CHANGING C2 AND R2 WILL VARY COMPENSATION CURVE VALUES SHOWN GIVE APPROXIMATE COMPENSATION FOR R I A A RECORDING CHARACTERISTICS

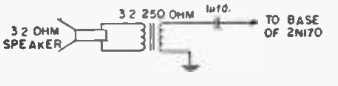
Compensated preamp for variable reluctance phonograph cartridge.

Wireless broadcast-band phono oscillator. Mike input may also be used.



RANGE 6 - 20 FEET

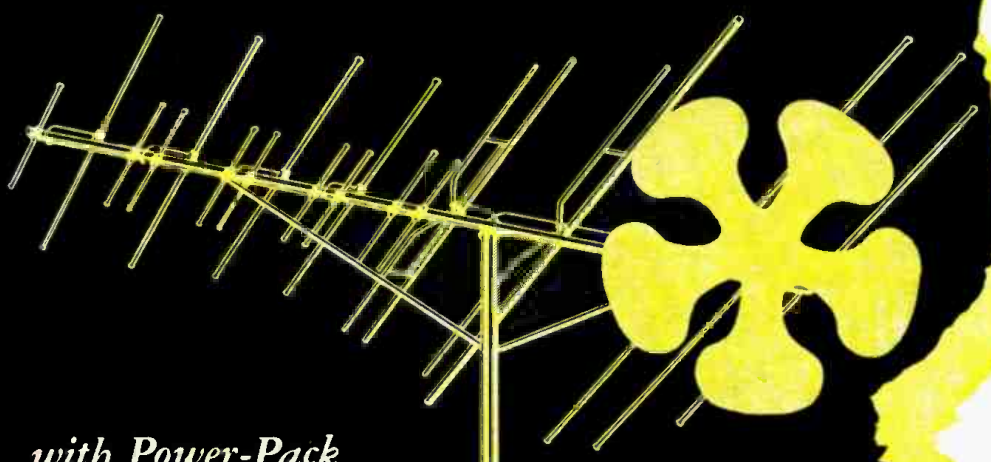
NOTE FOR "MIKE" INPUT USE FOLLOWING CIRCUIT IN PLACE OF CRYSTAL PICKUP AND RESISTOR



designed expressly for color . . .
it's way ahead for Black and White

Color 'Ceptor

18 element high gain yagi for all channels 2 through 13



with Power-Pack shows up to

47%

more gain than the famous Winegard Interceptor

WINEGARD

COMPANY *Burlington, Iowa*

You can sell the Color 'Ceptor 2 ways

CL4
(11 element Color 'Ceptor)
$29.95

+

PK
(7 element Power-Pack)
$14.95

=

CL4X
Ultra Sensitive 18 element Color 'Ceptor
~~$44.90~~

John Winegard says:

You can have a "Color 'Ceptor" absolutely free. Why? So you can demonstrate your color TV sets successfully. Our future—yours and mine — depends on color. To sell color sets, you have to show people they work.

The Color 'Ceptor is the one antenna that guarantees successful color set demonstration every time on any VHF channel from 2 through 13.

The fact that the antenna you are now using gives satisfactory results on black and white—is absolutely no guarantee . . . that this same antenna will give equally good color reception on all 12 VHF channels, particularly if you are in a low signal area. When a color picture is off—it's way off. Most often it's the fault of the antenna.

With this in mind, and mindful that the higher gain necessary for color automatically guarantees better black and white pictures, we have engineered the first all VHF channel yagi designed expressly for color reception . . . our brand new, ultra sensitive, 18-element "Color 'Ceptor" antenna, model CL-4X with "Power-Pack."

The "Power-Pack" is an ingenious new idea developed in our laboratories that increases the gain of the "Color 'Ceptor" . . . up to 47% over our world famous Interceptor, and at the same time, more than doubles the front to back ratio—really knocks out co-channel interference!

I know the "cobbler's children" are usually the ones that don't have shoes—and even though you sell "Color 'Ceptors," you might not get around to installing one on your own set for a long time—so to make sure you do, I am giving you a free CL-4X with your first purchase of 6 Color 'Ceptors—naturally this offer is limited.

Every Winegard jobber has my authorization to redeem 12 "Color 'Ceptor" box tops (2 from each box) for a gleaming gold anodized "Color 'Ceptor" with "Power-Pack" absolutely free.

Not only can you brag that you have the best color picture in town, but the bright, shining gold "Color 'Ceptor" on your roof will cause much comment . . . advertising you!

John R. Winegard

For further information, see your jobber or write

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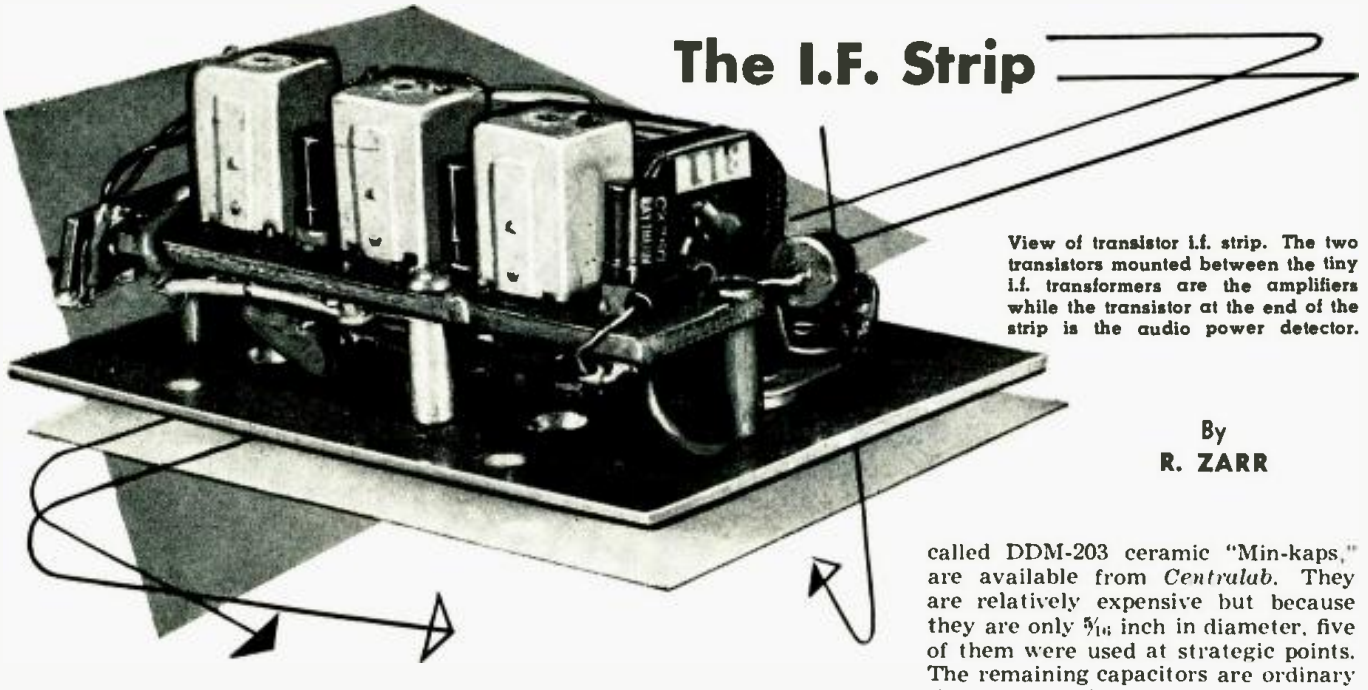
Burlington, Iowa

Burton Browne Advertising

An All-Transistor Superhet Tuner

The I.F. Strip



View of transistor i.f. strip. The two transistors mounted between the tiny i.f. transformers are the amplifiers while the transistor at the end of the strip is the audio power detector.

By
R. ZARR

Part 1. A 455-kc. i.f. strip and detector for an all-transistor broadcast tuner, occupying a space of only 3 x 1.5 x .75 inches with a 60-db voltage gain.

HERE is an all-transistor superhet broadcast tuner that may be connected to any audio amplifier or used with headphones to provide excellent volume. It may also be used as a signal source for tape recording where its reduced sideband-cutting provides better fidelity than many high-gain tube tuners. It has the advantages of extreme portability and very long battery life. The tuner is also a natural for emergency use when the a.c. power fails.

The construction of the tuner is divided into two parts. The construction of the compact i.f. amplifier and detector will be covered in this article while a subsequent article will deal with the mixer-oscillator front end section of the tuner.

How small can a modern high-gain i.f. amplifier strip get? Here is one that occupies a space only 3 x 1½ x ¾ inches, yet it boasts a gain of about 60 db, and provides good selectivity. The circuit of this unusual amplifier is shown in Fig. 1. It includes two stages of i.f. and a power detector. The high gain is due to new type r.f. junction transistors by *Raytheon*, known as 2N112's (formerly CK760). In a correctly designed stage, the gain may be as high as 30 db. They require a collector supply of 6 volts at a drain of less than 1 ma.

The 455 kc. i.f. transformers are *Miller* type 2041, designed especially for transistor applications. Note the compactness of these units as shown in the photo. Each measures only ½ inch wide and ¾ inch high. Only one type is available, there being no "input" or "output" transformers as for tube circuits. Each transformer has 5 terminals, with a tap on the primary to maintain a high "Q." The tapped portion matches the output of a transistor (25,000 ohms). The secondary is a low-impedance winding which matches 600 ohms. Only the primary is tuned (by a slug on the bottom of the transformer).

In several respects the design and construction of a transistor i.f. strip differs from that of a conventional tube circuit. Here are some important pointers to watch.

As most readers know, transistor circuits require relatively large capacitance for coupling and bypassing. This holds true for i.f. just as it does at a.f. For example, tube circuits often require .005 μfd. bypass capacitors for i.f. amplifying stages. With transistors, the recommended value is .1 μfd. at 455 kc. This capacitance makes a unit that is enormous in size as compared with transistor components and transistors themselves. Therefore, a value of .02 μfd. was adopted in this circuit. This is the largest capacitance available in the disc type at a reasonable price. Tests show that there is negligible drop in gain or filtering when using this value of capacitance.

Extra-small-sized .02 μfd. capacitors, called DDM-203 ceramic "Min-kaps," are available from *Centralab*. They are relatively expensive but because they are only 5/16 inch in diameter, five of them were used at strategic points. The remaining capacitors are ordinary sized discs which are not so costly.

An i.f. triode transistor requires neutralization. Fortunately, neutralizing is not too complicated a procedure. It may be done as follows by cut-and-try methods.

Connect headphones across the output terminals and a 0-1 v. voltmeter across R_{10}. Remove V_1 and connect a variable 100-μμfd. capacitor temporarily between the bases of V_2 and V_3 with as short leads as practicable. Now as the variable capacitor is rotated near its maximum or its minimum settings, the voltmeter reading will be large, perhaps 1 volt or so. Near intermediate settings, perhaps 50 to 80 μμfd., the indication drops to a minimum, approximately .15 volt. The low reading shows correct neutralization, and the larger indications show oscillation. Estimate or measure the correct setting of the variable capacitor, and obtain a small ceramic capacitor of this size. This is the correct neutralizing capacitor for the circuit.

An alternate method is to feed in a modulated 455-kc. i.f. signal to V_2 and listen in on the headphones. If the tone sounds distorted, the amplifier is oscillating and is not correctly neutralized. Rotate the variable capacitor for undistorted tone. Actually, the correct neutralization point is not critical or sharp. The stage will stay neutralized over a considerable range of the variable capacitor. Of course, choose a capacitance well within this range. For example, if the stage stays neutralized with anywhere from 50 to 80 μμfd., the correct value to use is approximately 65 μμfd.

After having neutralized this stage, replace V_1 and follow the same procedure to find the correct value for the first neutralizing capacitor.

All this sounds much more complicated than it actually is. The neutralizing capacitor is far from critical. Perhaps this is best shown by the following fact. *Raytheon*, *Miller*, and *Automatic Mfg. Corp.* show nearly identical i.f. circuits in their data sheets covering the 2N112. *Raytheon* recommends 80 μμfd., *Miller* shows 30 μμfd., and *Automatic* includes no neutralizing capacitor at all in its test circuit. In this particular circuit, a value of 56 μμfd. was found to work best.

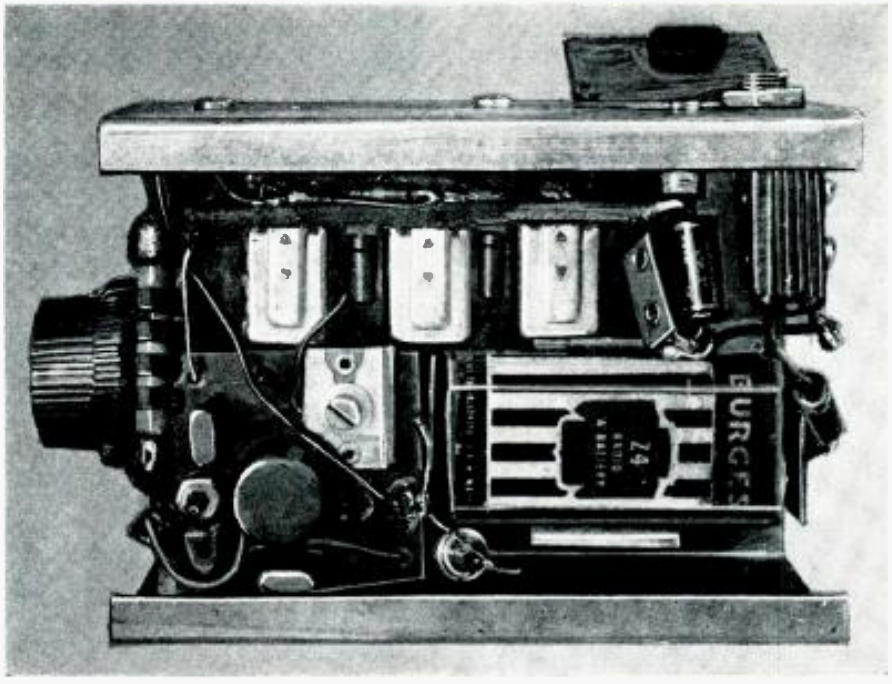
When the i.f. strip is completed, you may test it by feeding it with the output from any converter such as from an a.c.-d.c. set. Still better, a 455-kc. signal generator may be used as the source. Alignment may be done either visually or audibly.

If the signal source is unmodulated, check with a 0-1 v. voltmeter across R_{10} as described previously. This meter shows the strength of signal carrier. With no signal fed in (assuming good neutralization) there should be little or no output from the i.f. strip. The voltmeter will show only about .15 volt. A strong signal will send it to 1 volt or even slightly higher. If a modulated signal is used, the set can be aligned by listening in on headphones across the output.

Fig. 2 shows a typical over-all response curve of an i.f. strip using 2N112 transistors. Bandwidth is 8 kc. at 3 db down, and 12 kc. at 6 db down.

In wiring and soldering this circuit, special care must be taken. It is easy to damage the tiny components if too much heat is applied or too much mechanical strain is placed on them. If possible use a thin soldering tip and don't overheat any part.

As in any very compact device, it will not be easy to correct errors in wiring or substitute defective components. Work slowly and double-check each connection after it is made. If possible test each component before connecting.



Underside of all-transistor broadcast tuner showing i.f. strip in place along the top flange of the chassis. The transistor front end is at the lower left corner.

Use as short leads as possible and lay out the parts with this in mind. The photo shows a good arrangement, with transistors between the transformers. Identify the transistor sockets, perhaps by a red dot painted on the collector side, so that transistors will be replaced correctly after removal.

This sensitive amplifier makes a good spare or emergency replacement. It will operate for long periods of time from four tiny penlite cells, since the total drain is approximately 3 ma. A *Burgess* type Z4 (or equivalent) 6-volt battery may also be employed as shown in the photograph.

Next month Part 2 of this article will describe a transistor front end for the i.f. strip covered herein.

(To be continued)

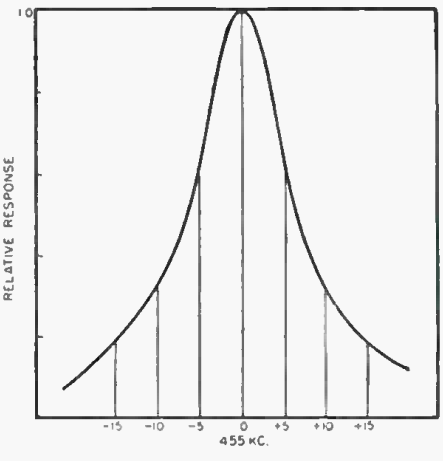
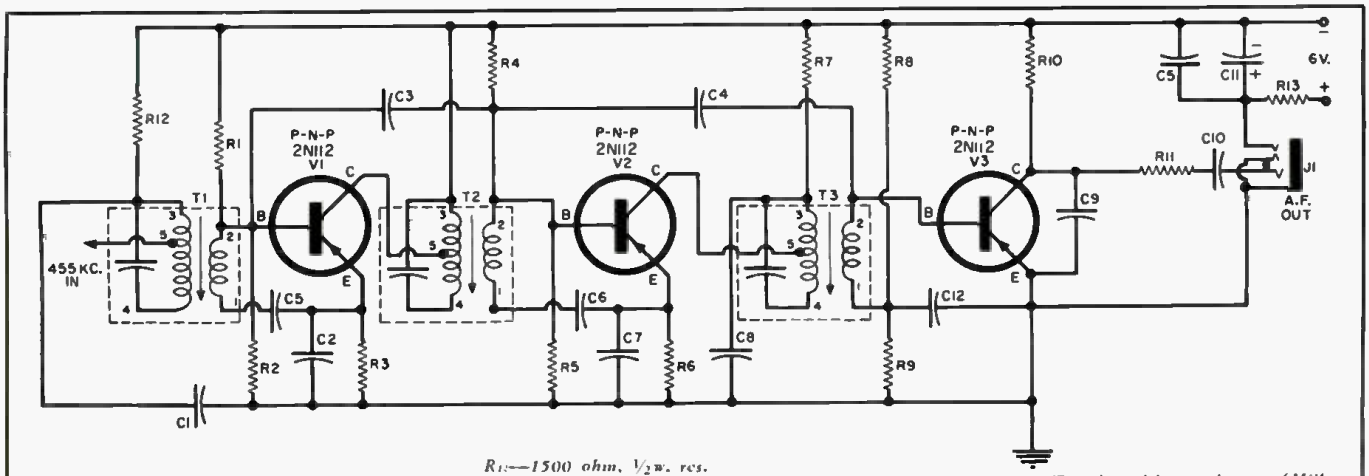


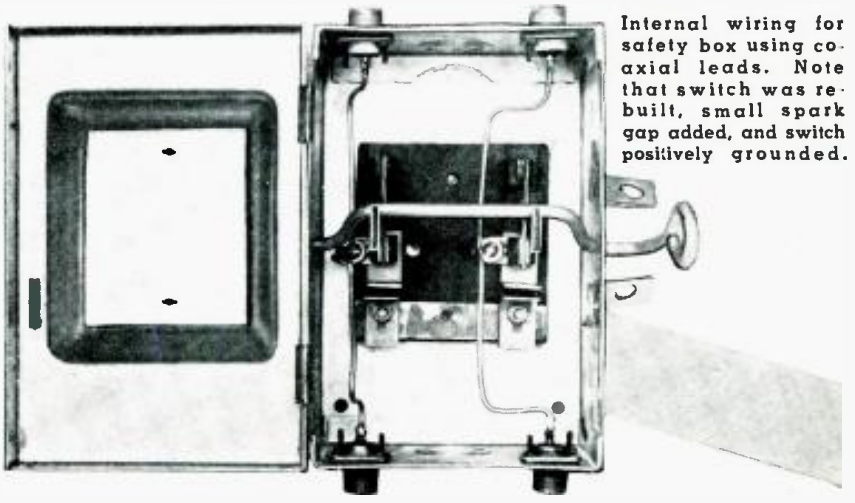
Fig. 2. Over-all i.f. response curve of transistorized i.f. amplifier strip.

Fig. 1. Complete schematic diagram of transistor i.f. strip and audio detector employing three "p-n-p" transistors.



R_1—15,000 ohm, ½ w. res.
R_2, R_3—2000 ohm, ½ w. res.
R_5, R_6, R_7, R_9, R_{10}—1000 ohm, ½ w. res.
R_8—10,000 ohm, ½ w. res.
R_{11}—39,000 ohm, ½ w. res.
R_{12}—220 ohm, ½ w. res.
R_{13}—1500 ohm, ½ w. res.
R_{14}—240 ohm, ½ w. res.
C_1, C_2, C_3, C_4, C_7, C_8, C_9, C_{12}—.02 μfd. ceramic capacitor (see text)
C_5, C_6—56 μμfd. ceramic capacitor
C_{10}—.1 μfd. paper capacitor
C_{11}—25 μfd., 12 v. elec. capacitor
T_1, T_2, T_3—Transistor i.f. transformer (Miller 2041 or equiv.)
J_1—2-circuit jack
V_1, V_2, V_3—"p-n-p" junction transistor (Raytheon 2N112)
Batteries—See text

Ground that Antenna



Internal wiring for safety box using coaxial leads. Note that switch was rebuilt, small spark gap added, and switch positively grounded.

By **WALTER S. ROGERS, W1DFS**

Be safe—not sorry. Get that antenna fixed up so autumn thunderstorms pose no threat to your home.

NOW that we are in the midst of the autumn storm season, it is a good time to take a look at lightning protection as well as general communication equipment grounding protection.

Most of us have been very lucky. Not often, due more to luck than sense, do we learn of a direct hit or a near miss that induces enough surge to do a pile of damage. This applies to radio receivers, transmitters, TV receivers, and other gear that might be exposed to lightning. It is a relief to know, on leaving the house, that basic precautions have been taken and that we can expect to see the house intact upon our return.

All communications antennas, which run outside the house, are fed with RG-8/U coaxial cable. The 75-80 meter dipole and the two- and ten-meter antennas clear the local house area with these leads. This minimizes noise from the lead-in, radiation in nearby receivers and, with the permanent grounding of the shield, gives one a good start in the right direction.

The National Board of Fire Underwriters has set the standards and we will be making no mistake if we exceed these minimum requirements. Under "General Communication Circuits, Section 8041," it is stated that the grounding conductor on communication circuits shall not be less than 18 gauge copper wire, leads should be as straight as practicable and protected from mechanical injury, and a waterpipe used as the preferred ground.

Under "Lightning, General 8151," it is indicated that the lead must be corrosion-resistant, no insulation is required, support should be given with mechanical protection (*not in conduit* on the advice of the author as high frequency, including surges, travels on the surface or outer conductor so r.f. grounding must not be in thin-wall or standard steel conduit to be effective) and, finally, a nearby waterpipe is the preferred ground.

With transmitters and down leads of any size, one must have the ground lead size equal or greater than the down lead, unless coaxial cable is used and properly grounded. Where 300-ohm twin-lead is used, a suitable lightning arrester, approved by the national code, should be used.

Among the author's old "wireless" souvenirs is a 600-volt, 100 ampere double-throw, single-blade knife switch with "electrose" insulation. Old Marconi antennas and counterpoises required these immense switches to drain the surges imposed.

As an added precaution at W1DFS, the inner lead of the coaxial cable is grounded by a modified power switch of the above type (see photograph). All equipment has ground leads. The transmitter uses a three-wire twist lock power cable of ample size with the third lead grounding the metal-enclosed rack before connection to the a.c. lines. This lead comes from a nearby 117-volt safety switch, which has lighter fuses than at the main fuse box, and which is used just for the transmitter circuit.

The suggestions made by the author are not intended to be copied exactly but are rather designed to point up the need for lightning and communication equipment protection. There are many ways of insuring this safety —the point is that something should be done and before it is too late. —30—

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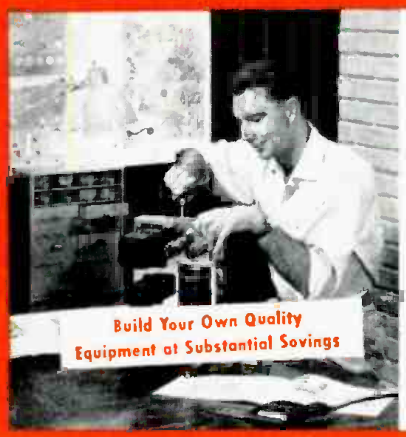

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1000 OHMS/VOLT VOM KIT

Exceptional accuracy and versatility at amazing low cost. Ideal for service shop, lab and Amateur use. Uses 4½" meter (400 microamp movement) with separate scales for AC voltage and current, DC voltage and current, decibels and resistance. 38 ranges include: AC, DC and output volts, 0-1-5-10-50-100-500-5000 (1000 ohms/volt sensitivity); Resistance, 0-1000-100,000 ohms and 0-1 meg.; Current, AC or DC, 0-1-10-100 ma and 0-1 amps; Decibels, —20 to +69 in 6 ranges. *Uses 1% precision resistors.* 3-position function switch and 12-position range switch. Complete kit with bakelite case, (6¾ x 5¼ x 3¾"), battery, pre-cut wire, solder and test leads. Shpg. wt., 2½ lbs.

Model F-128. 1,000 ohms/volt VOM Kit. Net only. **$16.95**

Model F-140 **$29.50**

knight-kit

20,000 OHMS/VOLT VOM KIT

Outstanding quality and performance at extremely low cost. Features 32 ranges; full vision 4½" meter; accuracy ±2% of full scale; 50 microampere sensitivity for 20,000 ohms/volt input resistance on DC; front panel "zero adjust" Single switch selects function and range. Range: AC, DC and output volts, 0-2.5, 10-50-250-1000-5000; Resistance, 0-2000-200,000 ohms and 0-20 meg.; DC ma, 0-.1-10-100; DC amps, 0-1-10; Decibels, —30 to +63 in 6 ranges. Uses precision 1% multipliers. Moisture-resistant film-type resistors. Complete kit with bakelite case (6¾ x 5¼ x 3¾"), batteries. pre-cut wire, solder and test leads. Shpg. wt., 5 lbs.

Model F-140. 20,000 ohms/volt VOM Kit.
Net only **$29.50**

knight-kit VTVM KIT with Printed Circuit Board

Model F-125 **$24.95** An extremely stable, and highly accurate VTVM. Greatly simplified wiring—entire chassis is a printed circuit board. Maximum convenience in arrangement of scales; 3X AC and DC scale design permits utilization of best portion of each scale for most accurate readings. Also measures peak-to-peak for FM and TV work. Ranges: AC P-P volts, 0-4-14-40-140-400-1400-4000; AC rms volts and DC volts, 0-1.5-5-15-50-150-500-1500; resistance, 0-1000-10K-100K ohms and 0-1-10-100-1000 megohms; db scale, —10 to +5. AC response, 30 cycles to 3 mc. Low-leakage switches and 1% precision resistors. Balanced-bridge circuit. 4½" meter, 200 microamp movement. Polarity reversing switch. Input res., 11 megs. Shpg. wt., 6 lbs.

Model F-125 Printed Circuit VTVM Kit. Net only. . **$24.95**
F-126. Hi-Voltage Probe; extends DC to 50,000 Volts **$4.75**
F-127. Hi-Frequency Probe; extends AC to 250 mc. . **$3.45**

PORTABLE MODEL

knight-kit RESISTOR-CAPACITOR TESTER KIT

Model F-124 **$19.50** Measures capacitance and resistance by accurate bridge method; checks for opens and shorts in paper, mica and ceramic capacitors; shows power factor of electrolytics. Large dial shows capacitance and resistance at a glance; balanced-bridge circuit with "magic eye" null indicator measures power factor from 0-50%. Tests capacitors with rated voltages applied. 5 test voltages: 50, 150, 250, 350, 450. Capacity ranges: 10 mmf to 1000 mfd in 5 ranges. Resistance ranges: 100 to 50,000 ohms and 10,000 ohms to 5 megs. Accuracy, ±10%. Automatic discharge feature prevents after-test shock. Blue-finished steel case, 5 x 3 x 2". With tubes and all parts. Shpg. wt., 8 lbs.

Model F-124. Resistor-Capacitor Tester Kit. Net only **$19.50**

Model F-143 **$29.75**

knight-kit LOW-COST TUBE TESTER KIT

Offers high accuracy, top versatility and convenience at lowest cost. Tests 4, 5, 6 and 7-pin large, regular and miniature types, octals, loctals, 9-pin miniatures and pilot lamps. *Features test for new 600 ma series string tubes.* Tests for open, short, leakage, heater continuity and quality (by amount of cathode emission). 4½" square meter with clear "GOOD-?-REPLACE" scale. With line-voltage indicator and line-adjust control. Choice of 14 filament voltages from .63 to 117 volts. Blank socket for future type tubes. Universal-type selector switches for any combination of pin connections. *Single-unit, 10-lever function switch.* Entire switch assembly is installed as a single unit—saves time and greatly simplifies construction. Illuminated roll chart lists over 600 tube types. Shpg. wt., 14 lbs.

Model F-143. Counter Model Tube Tester Kit. Net only . . **$29.75**
Model F-142. Portable Model Tube Tester Kit. Net only. . . . **$34.75**
F-141. TV Picture Tube Adapter for above. Net only **$3.75**

NEW knight-kit TRANSISTOR & DIODE CHECKER KIT

Model F-149 **$8.50** Checks leakage-to-gain ratio and noise level of all junction, point contact and barrier transistors. Also checks diodes. forward and reverse current conduction of selenium rectifiers; useful for continuity and short checks. Easy-to-read meter. Features: spring-return leakage gain switch; calibration control; separate sockets for PNP and NPN transistors. Headphones or signal tracer may be used with checker for noise measurements. Case, 5 x 3 x 2". With 22½ volt battery. 2½ lbs.

Model F-149. Transistor Checker Kit. Net. **$8.50**

Model F-119 **$12.50**

knight-kit LOW-COST "IN-CIRCUIT" CAPACITOR CHECKER KIT

Tests capacitors while they ore still wired in the circuit! Saves time and bother; an essential instrument for the service technician. Just press a button and the "magic eye" instantly shows opens and shorts (not leakage). Tests opens and shorts on any capacitor of 20 mmf or greater capacity, even if it is in parallel with a resistance as low as 50 ohms. Tests for shorts may be made on any capacitor even when it is shunted by as low as 20 ohms. Blue-finish steel case, 7¾ x 5¼ x 5". With tubes, all parts, wire and solder. Easy to assemble. Shpg. wt., 5 lbs.

Model F-119. Cap. Checker Kit. . . . **$12.50**

EASY PAYMENT TERMS: If your total KNIGHT-KIT order is over $45, take advantage of our liberal Time Payment Plan —only 10% down. Write for application blank.

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ALLIED'S *own MONEY-SAVING* knight-kits

FAMOUS knight-kits FOR HOBBYISTS & EXPERIMENTERS...FASCINATING, INSTRUCTIVE...

knight-kit
"SPACE SPANNER"
BAND SWITCHING
RECEIVER KIT

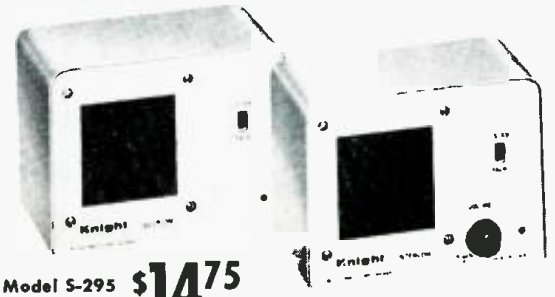
Model S-243 **$15.95**

Thrilling Short Wave and Broadcast

Famous 2-band AC-DC receiver in easy-to-build kit form at a very low price. Pulls in thrilling short-wave (6 to 17 mc) and standard broadcast. It's fun listening to amateur, aircraft, police and marine radio. Features highly sensitive regenerative circuit. Bandswitch selects broadcast or short wave. Has 4" PM speaker and beam-power output tube for plenty of volume; headphone connectors for weak signal listening; slide switch cuts out speaker. Uses 12AT7 regenerative detector and audio amplifier, 50C5 power output, 35W4 rectifier. Six controls: Bandspread; Main Tuning; Antenna Trimmer; Bandswitch; Regeneration; Audio Gain. Includes tubes and all parts. 7 x 10½ x 6". Shpg. wt. 4½ lbs.

Model S-243. "Space Spanner" Receiver Kit. Net only **$15.95**

S-247. Matching Cabinet for above. 2 lbs. Net **$2.90**



Model S-295 **$14.75**

NEW knight-kit TWO-WAY INTERCOM KIT

New low-cost, easy to build intercom system kit. Ideal for use in home or office. Consists of Master unit and Remote unit, each with press-to-talk switch. Remote unit may be left "open" for answering calls from a distance, for "baby-sitting", etc. Remote may also be connected for "private" operation—cannot be "listened-in" on, but it can be called and can originate calls. Master unit includes high-gain 2-stage amplifier; each unit has 4" PM dynamic speaker. Complete with Antique White cabinets (4¾ x 6½ x 4⅜"), all parts, tubes and 50 feet of cable (up to 200 feet of cable can be added). For AC or DC. Shpg. wt., 7 lbs.

Model S-295. Two-Way Intercom Kit. Net only.. **$14.75**

Model S-740 **$11.75**

knight-kit

"OCEAN HOPPER" RECEIVER KIT

Tops for exciting broadcast, long wave and short wave reception. Highly sensitive regenerative-type circuit. Excellent headphone reception; can be used with 3-4 ohm PM speaker on strong broadcast band stations. Supplied with plug-in coil for standard broadcast; covers long wave and popular short wave bands with coils below. Pulls in thrilling foreign broadcasts, police, amateurs and aircraft. Controls: Main Tuning, Bandspread, Antenna Tuning. Off-On-Regeneration. With all parts and tubes (less extra coils and headset). AC or DC. Shpg. wt., 5 lbs.

Model S-740. "Ocean Hopper" Kit..... **$11.75**

EXTRA PLUG-IN COILS

S-741. Long Wave, 155-470 kc. Net ..... 79¢

S-742. Short Wave, 1.65-470 kc. } Net

S-743. Short Wave, 2.9-7.3 mc. } each ..... 65¢

S-745. Short Wave, 7-17.5 mc. } each ..... 65¢

S-744. Short Wave, 15.5-35 mc. } each ..... 65¢

Model S-735 **$17.25**

knight-kit

"RANGER II" SUPERHET RADIO KIT

Thousands have built and enjoyed the "Ranger" Broadcast Band Receiver. Carefully engineered for easy construction and powerful, sensitive performance. Latest Superhet circuit; tunes 540 to 1680 kc; covers entire broadcast band and exciting police calls. Features automatic volume control, built-in preformed loop antenna, ball-bearing tuning condenser. Develops excellent tone quality from Alnico V PM dynamic speaker. Supplied with following tubes: 12SA7GT converter; 12SK7GT IF amp.; 12SQ7GT det.-AVC-audio; 50L6GT audio output; 35Z5GT rect. Complete with handsome brown plastic cabinet (6 x 9 x 5) tubes, speaker, all parts, and instruction manual. AC or DC operation. Shpg. wt., 8 lbs.

Model S-735. "Ranger II" Superhet Radio Kit. Net only **$17.25**

Model S-730 **$19.95**

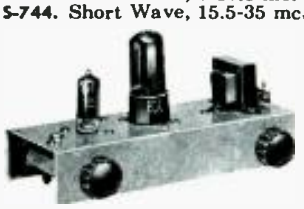
knight-kit

3-WAY PORTABLE RADIO KIT

A low-cost portable radio covering the full standard broadcast band from 535 kc to 1650 kc. Delivers excellent reception on AC or DC current or from self-contained batteries. Sensitive Superhet circuit features automatic volume control, economical operation. Includes powerful 5" Alnico PM dynamic speaker, efficient ferrite loop-stick antenna. Supplied with following tubes: 1R5 converter; 1U4 IF amplifier; 1U5 detector-AVC-audio; 3V4 audio output. Complete with attractive portable case (7⅝ x 10 x 5¼"), tubes, speaker, all parts and instruction manual. Shpg. wt., 6 lbs.

Model S-730. 3-Way Portable Radio Kit (less batteries). Net. **$19.95**

J-651. Battery Kit for above..... **$2.50**



Model S-790 **$8.95**

knight-kit LOW COST PHONO AMPLIFIER KIT

It's easy to build this fine-performing, low-cost compact phono amplifier. Ideal for use in a portable phonograph—simply add any record player and a 3 to 4-ohm speaker. Amplifier works with crystal or ceramic cartridges. Inverse feedback circuit for rich, clean tone quality. Delivers full 1½-watt output with less than .25 volt input. Includes efficient tone control; has AC outlet, controlled from amplifier switch. Complete with tubes and all parts. Size only 4½ x 7 x 4"—fits into almost any portable phono case. Shpg. wt., 3 lbs.

Model S-790. Phono Amplifier Kit. Net only..... **$8.95**

FAMOUS knight-kit CRYSTAL SET KIT

Model S-261 **$2.15**

Thousands of beginners have started in radio and electronics by building the KNIGHT-KIT crystal set. This feature-packed set delivers loud, clear reception of local broadcast stations. A germanium crystal diode detector assures high sensitivity and simple operation—no crystal adjustment required. "Hi-Q" coil boosts sensitivity. Ball-bearing variable capacitor for easy tuning. With all parts and simple-to-follow instructions. Shpg. wt., 1 lb.

Model S-261. Crystal Set Kit. Net only..... **$2.15**

S-267. Accessory Kit. 2000-ohm headphones and all parts for outdoor antenna..... **$2.95**

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finest quality electronic equipment in lowest-cost kit form

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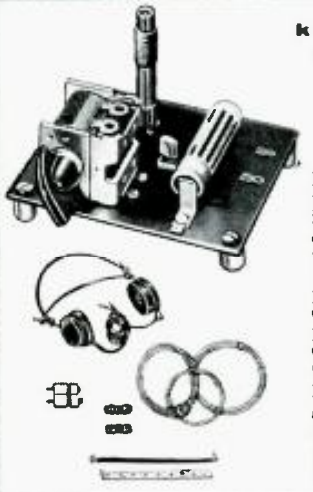
NEW knight-kit ELECTRONIC PHOTOFLASH KIT

Model S-244 **$28.50**

New feature-packed photoflash kit—designed for top quality dependability—available at a money-saving low price. Ideal for black and white or color photography. Xenon-filled reflector-bulb assembly gives over 10,000 flashes at less than ½¢ each! 1/700-second flash freezes the fastest action. Has 50 watt-second output. Provides light approximating daylight in spectral quality; permits the use of outdoor-type film indoors. Film guide number for color (ASA10) is 45. Designed for "X" or "O" shutters only. Requires sync cable (available from any photo supply dealer) and either battery or AC supply listed below. Complete outfit with battery weighs only 3½ lbs. Kit includes all parts, carrying case and easy-to-follow instructions. Shpg. wt., 3 lbs.

Model S-244. Electronic Photoflash Kit. Net.... **$28.50**
S-246. AC Power Supply Kit. Easy to assemble.... **$3.75**
J-626. Battery for above (Burgess U-200)..... **$8.47**



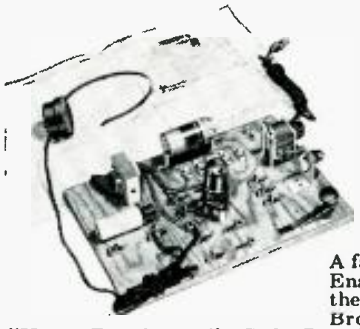
knight-kit TRANSISTOR RADIO KIT

Printed Wiring • Works from Penlight Cell

Model S-765 **$4.35** Smooth Variable Capacitor Tuning

Experiment with the marvel of transistors! Printed circuit requires no wiring—just assemble with a few solder connections and enjoy excellent reception over the full AM broadcast band. No tubes to burn out—no crystal. Compact—fits in the palm of your hand—operates for months from a single penlight cell. Transistor provides plenty of power for strong headphone reception. Complete with all parts, transistor and penlight cell. Shpg. wt., 8 oz.

Model S-765. Transistor Radio Kit **$4.35**
S-266. Accessory Kit. 4000-ohm headphones and all parts for outdoor antenna..... **$3.15**



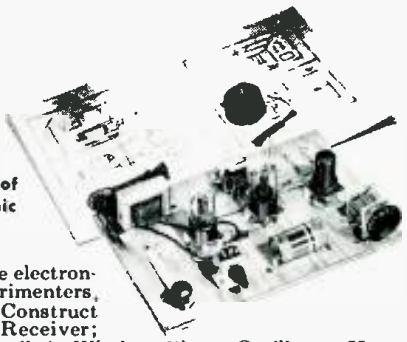
FAMOUS knight-kit LAB KITS

6-IN-1 RADIO LAB KIT

Model S-770 **$7.95** Build Any of 6 Electronic Projects

A fascinating and instructive kit. Enables you to build any one of the following projects: Standard Broadcast Receiver; Wireless "Home Broadcaster"; Code Practice Oscillator; Code Practice Broadcaster; Signal Tracer; Sine Wave Generator. Perfect for beginners. Once basic wiring is completed, circuits may be changed without soldering. Safe to build and operate; only tools needed are screwdriver, pliers and soldering iron. The ideal kit for students and beginners in electronics. Kit includes mounting board, tube, all parts and easy-to-follow instruction manual. Less headphone (also serves as mike). Shpg. wt., 6 lbs.

Model S-770. "6-in-1" Lab Kit. Net only..... **$7.95**
J-112. Single 1000-ohm headphone for above..... **$1.05**
C-100. Antenna kit for above..... **$1.05**



10-IN-1 LAB KIT

Model S-265 **$12.65** Build Any of 10 Electronic Projects

A wonderfully instructive electronics kit. Ideal for experimenters, beginners—fun to build. Construct a sensitive Broadcast Receiver; Amplifier (for phono or mike); Wireless Phono Oscillator; Home "Broadcast Station"; Code Practice Oscillator; Capacity-Operated Relay, or any one of *four* other fascinating projects. Low voltages; safe to build and operate. Only tools needed are soldering iron, screwdriver and pliers. Perfect for self-instruction in circuit fundamentals, and packed with practical applications. Kit includes mounting board, tubes, all parts, hardware, microphone, and 12-page builders' manual. Shpg. wt., 10 lbs.

Model S-265. "10-in-1" Lab Kit. Net only..... **$12.65**
J-112. Single 1000-ohm headphone for above..... **$1.05**
C-100. Antenna Kit for above..... **$1.05**

knight-kit WIRELESS BROADCASTER KIT

Model S-705 **$9.50**

This fascinating unit makes it possible to "broadcast" witn phonograph or microphone through any standard radio receiver up to 50 feet away—without any connection to the set. May be used with crystal or magnetic cartridge, or with microphone. Broadcasts a clear, full-toned signal. High-gain stage permits using magnetic cartridge without need for external preamp. Complete with all parts, tubes, wire and solder (less microphone). 4½ x 5 x 6". Easy to assemble. Shpg. wt., 3 lbs.

Model S-705. Wireless Broadcaster Kit. Net only..... **$9.50**
S-556. Microphone for above with 5-ft. cable..... **$3.95**

knight-kit PHONO OSCILLATOR KIT

Model S-760 **$5.85**

This low-cost phono oscillator may be used with any crystal phonograph for "broadcasting" recorded music through any standard radio receiver up to 50 feet away. Requires no direct connection to radio set. Operates on any frequency between 600 and 800 kc. Has controls for adjustment of modulation level and selection of clear frequency on radio receiver. Uses 50L6GT tube and 35Z5GT rectifier. Complete with all parts, tubes and instructions. 4¼ x 4¼ x 4½". Shpg. wt., 1 lb.

Model S-760. Phono Oscillator Kit. Net only..... **$5.85**

ALL PRICES NET F.O.B. CHICAGO

knight-kit CODE PRACTICE OSCILLATOR KIT

Model S-239 **$3.95** Transistor Circuit—Powered by Penlight Cell

An ideal code practice oscillator. Uses transistor circuit. Extremely low current consumption—powered by single penlight battery. Provides crisp, clear tone (400 to 600 cps). Has input jack for earphone; screw-type terminal strip for key. In compact bakelite case (2⅜ x 3¾ x 1½") with anodized aluminum panel. Complete with all parts, transistor, battery and easy-to-follow instructions. Shpg. wt., 1 lb.

Model S-239. Code Practice Kit.... **$3.95**

See Next Page for Amateur Kits

ALLIED'S *own* knight-kits *give you the most for your money*

BUILD YOUR OWN QUALITY HI-FI AMPLIFIER!

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BASIC 25-WATT LINEAR-DELUXE HI-FI AMPLIFIER KIT

Model S-755

$44.50

Williamson-Type Circuit
Printed Circuit Board
Chrome-Plated Chassis

This super-quality hi-fi basic amplifier is designed to satisfy the most critical listener. Intended for use with tuners incorporating built-in preamp or with separate preamp. Incorporates latest Williamson-type circuit and has potted matched transformers. Delivers maximum output of 45 watts. Frequency response is: ±0.5 db, 10 cps to 120 kc, *measured at 20 watts*. Harmonic distortion is only .15% right up to 30 watts. Intermodulation distortion is only .27% at 10 watts and only .4% at 20 watts, using 60 cps and 7 kc, 1:4 ratio. Hum level is —85 db below full rated output. Output impedance, 4, 8, 16 ohms. Input voltage for 25-watt output is 1.8 volts. Uses two 12AU7's, two 5881's, and a 5V4. Etched circuit is utilized in voltage amplifier and phase inverter stages to speed assembly. Has output tube balancing control, variable damping control, and on-off switch. Handsome chrome-plated chassis, 14 x 9 x 2". Overall height, 7". A deluxe true hi-fi amplifier equal in performance to amplifiers selling at over twice the price. Complete with all parts and tubes. Easy to assemble. Shpg. wt., 27 lbs.

Model S-755. Basic 25 Watt Hi-Fi Amplifier Kit. Net only..... **$44.50**
S-759. Metal enclosure for above; black finish. 3 lbs. Net..... **$4.25**

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10-WATT HI-FI AMPLIFIER KIT

Model S-753 — Chrome-Plated Chassis

$23.50

Famous for wide response and smooth reproduction at low cost. Only 0.5 volt drives amplifier to full output. Frequency response: ±1 db, 30-20,000 cps at 10 watts. Harmonic distortion less than 0.5% at 10 watts. Intermod. distortion less than 1.5% at full output. Controls: on-off-volume, bass, treble. Input for crystal phono or tuner. Chromed chassis; punched to accommodate magnetic cartridge preamp. Matches 8 ohm speakers. Shpg. wt., 14 lbs.

Model S-753. Amplifier Kit. Net... **$23.50**
Model S-235. Preamp Kit for above ... **$3.10**
S-757. Metal Enclosure. 3 lbs..... **$3.95**

knight-kit

20-WATT HI-FI AMPLIFIER KIT

Model S-750 — Chrome-Plated Chassis

$35.75

True hi-fi for less! Frequency response, ±1 db, 20-20,000 cps at 20 watts. Distortion, 1% at 20 watts. Hum and noise level: tuner input, 90 db below 20 watts; phono 72 db below 20 watts. 4 inputs: magnetic phono, microphone, crystal phono or recorder, and tuner. Controls: Bass, Treble, Volume, Selector. With compensation positions for 78 and LP records. Built-in Preamp. Outputs: 4, 8, 16 and 500 ohms. 23 lbs.

Model S-750. 20-Watt Kit. Net **$35.75**
S-758. Metal Enclosure. 3 lbs..... **$4.15**
S-752. Chrome-plated escutcheon for cabinet installation of amplifier. Net..... **$1.40**

LOW-COST TOP QUALITY KITS FOR THE HAM

knight-kit

50-WATT CW TRANSMITTER KIT

Model S-255

$43.75

Built-in Pi-Type Antenna Coupler

Check the features packed into this new transmitter kit and you'll see why it's one of the greatest Amateur values ever offered. Compact and versatile, it is the perfect low-power rig for the beginning Novice or seasoned veteran. Features: 50 watts input to 807 final; high-efficiency 6AG7 modified-Pierce oscillator takes crystal or VFO without circuit changes; bandswitching coverage of 80, 40, 20, 15, 11-10 meters; pi-section antenna output matches line impedances from 50 to 1200 ohms —permits use with any type of antenna; no separate antenna tuner required. Crisp, clean, cathode keying of oscillator and final. Power take-off plug supplies filament and B-plus voltages for other equipment. Copper-finished chassis and cabinet interior, filtering, shielding, bypassing, and coaxial SO-239 antenna connector provide excellent TVI suppression. Meter reads either plate or grid current of final. Jacks for VFO, crystal and key. Supplied with all parts and tubes. Less crystal and key. 8¾ x 11¾ x 8¾". Shpg. wt., 18 lbs.

Model S-255. 50-Watt Transmitter Kit. Net... **$43.75**

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SELF-POWERED VFO KIT

Model S-725

$28.50

Complete with built-in power supply! Careful design and voltage regulation assure high stability. Excellent oscillator keying characteristics for fast break-in without clicks or chirps. Full TVI suppression. Has plenty of bandspread: separate calibrated scales for 80, 40, 20, 15, 11 and 10 meters; vernier drive mechanism. 2-chassis construction keeps heat from frequency determining circuits. Output cable plugs into crystal socket of transmitter. Output on 80 and 40 meters. With Spot-Off-Transmit switch for "no swish" tuning. Extra switch contacts for operating relays and other equipment. With all parts and tubes. 8 lbs.

Model S-725. Self-Powered VFO Kit. Net..... **$28.50**

NEW knight-kit AMATEUR RF "Z" BRIDGE KIT

Model S-253

$5.85

Measures standing wave ratio (SWR) and impedance of antenna systems; also for adjusting antenna networks for optimum results. Any VOM may be used for null indicator. High accuracy with 20,000 ohm/v VOM. Correction factor info supplied for other VOM's. With coax input and output connectors. Meters both input and bridge voltage. Calibrated dial gives direct impedance reading; includes 1% precision resistor for precise calibration adjustment. With all parts and handy plasticized SWR chart. 1½ lbs.

Model S-253. "Z" Bridge Kit. Net only **$5.85**

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DON'T TINKER WITH TV

By **S. L. TERRY**

A "do-it-yourself" fan relates what happened when he tried to fix a defective condition in his set.

I FEEL that I should pass along a soul-searing experience which I, a simple chemist, recently suffered at the hands of an electronic device, namely, a limed oak, 21-inch, almost-paid-for television receiver. Those who probe professionally into television circuits may not consider my experience to be unique, but it was a revelation to me.

By way of making this tale of frustrations as complete as possible, let us start at the beginning, which was, I believe, when the picture began to narrow, leaving a black streak on both sides of the picture screen. A couple of weeks elapsed and the picture became narrower. I was not really concerned, for a modest genius such as I, this would be easy to fix—probably a weak tube down in the horizontal section or something.

A few days later I was stretched out energetically on the divan watching a somewhat narrow TV program, when the wavy-haired pianist and his brother lost another horizontal inch and dissolved in a dark, distorted, low voltage mess. All channels were the same. As the picture failed, a little static appeared in the audio, but otherwise the sound was normal. The set was switched off and after five seconds elapsed it was switched on again and a full screen picture returned but narrowed down and failed after two minutes. If the power was kept off longer, the picture would remain on as long as five minutes after the set was switched on.

I sent the oldest child for tools and the cord to my electric razor, while I made myself a salami on rye and unfolded the circuit diagram. When the back was removed from the set and the razor cord was in place, I peeped inside and located the horizontal sweep generator, a 6SN7, and the horizontal damper, a 6W4. They were lit up and nothing happened when I pecked on them lightly with the handle of the screwdriver (the one with part of the blade burned off). Replacement tubes were not available, but a borrowed tube tester showed that these tubes were good.

The 1B3 high voltage rectifier and the flyback transformer are in a metal box to protect them from dust, screwdrivers, and such. This box can, however, be easily opened with a ¼-inch "Spintite," even by people who have no business in there. I found nothing loose or melted in that section and, since the hour was late, I withdrew forces for the evening.

The next evening I replaced, one by one, each tube in the horizontal section with new tubes. No results.

I am pretty much of a hot-tube, loose-wire man, myself, but I have a a couple of friends who actually understand some phases of electronics. One has a nice knack for this type of project and also is equipped with a "Voltohmyst" and one of those clever little *Waterman* "Pocketscopes." I brewed a pot of coffee and gave him a ring. He arrived, eager as a bird dog, but seemed disappointed when I demonstrated the symptoms.

"It's just a gassy old 6BQ6," he said. I handed him the new tube and a Swiss on rye. He plugged in the new tube and reached for the mustard. When the picture narrowed down and failed he brightened up considerably and reckoned we might have an enjoyable evening after all.

We eased the chassis out on a chair, propped it up with a motor repair manual (we will work on anything) and checked a few voltages. The plate of the horizontal amplifier was cherry red and the cathode of the damper tube had 440 volts instead of the 500 volts needed for normal operation. We plugged in the new 6BQ6 and found the same readings.

Ah, how familiar we became with those circuits during the next two evenings. No capacitor remained unchecked, no voltage unmeasured. The saw-tooth on the horizontal amplifier grid was there but a little low, so we decided that we had a fault which lowered the impedance in the plate circuit of that tube. Several circuit elements were suspected but when located and checked, proved to be OK. One ground connection on the diagram looked oddly out of place but after closer scrutiny we determined that it was a small spot of mustard.

We even took the 6BQ6 over to my friend's house and put it in his set right in the middle of "Dragnet." The set worked perfectly, so we took our tube and returned to our low voltage and black coffee. Time 11:50 p.m. We knocked off for the day.

The next evening, my first friend was tied up but another came over and we ran through his repertoire of places to look for trouble when logical places do not pay off. We rechecked cathode bypass capacitors, the a.c. voltage on the 6W4 cathode, and other pertinent points. As a matter of fact, we even checked the 320 volt "B+" to ground. My friend coupled in from right index

finger to left elbow. It was wonderful. His eyeballs lit up like a pair of thyratrons and a low sixty-cycle rattle with a profane side tone built up in the region of his Adam's apple. A few steps of "Mambo" later, he got loose but it took a full five minutes for the oscillations to die down.

Some parts of a television receiver I have always held inviolate but not my friend. He suggested we check the capacitors in the horizontal deflection coils, which are contained in the yoke at the neck of the picture tube. We took the yoke apart, removed the capacitors, and checked them. All to no avail, the capacitors checked OK and were soldered back. I kept suggesting a shorted flyback transformer, but was told that everyone but a chemist knew that shorts involving such voltages were not a gradual condition and to look in his tool box and see if he had brought another 6BQ6. There was a new tube there and just because we had run out of something sensible to do we plugged it in. This last 6BQ6 warmed up and with all jumpers in place, the picture came on and remained in full screen splendor.

I looked at my friend and his face got as red as a snooker ball. Everybody in that end of town knew we had spent three nights working on my set, all because of a sour 6BQ6 (and a sour new 6BQ6) both good enough to work in another set which probably has less load on this tube.

If there is a moral to this story it is—call a service technician! —30—

VIKING MODIFICATION

By R. E. FRANKLIN, W2EUF

THE Viking series of transmitters are good performers but the noise made when cranking the rotary inductor final sounds like an Indian war dance.

Several months ago the noise was traced to the wheel riding the coil turns and comes from the friction of the wheel on the axle rod. Since the Yale locks in the house had just been dosed with graphite powder, it was tried on the inductor and completely eliminated all of the screeching noise.

The treatment consists of first dusting off the coil turns and the rod with a brush or some soft material wound around a pencil or cuticle stick. Then, squirt the powdered graphite on scrap paper and wrap "Kleenex" or cloth on the cuticle stick to make an applicator. Pipe cleaners or "Q-Tips," especially, are almost perfect.

Dirty the soft applicator in the graphite pile and drag it up and down the rod. Generally, one trip back and forth will cure the noise.

To be safe, blow off the coil form after lubricating the rod and never squirt the powder directly on the rod from the tube or it will imbed in the ceramic form and produce losses.

The powder sells for 15 cents for a cigar-shaped plastic tube in the dime stores. The graphite is a conductor and lubricator and no evidence of overheating or pitting is visible after several months. It is a pleasure to have the inductor silent since it permits the OM to operate at all hours. —30—

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Model FP-1 is Midget circuit tester, Measuring Ranges as follows: (An attractive blue bakelite cabinet)
DC Volt: 15v/150v/750v
AC Volt: 15v/150v/750v
DC Current: 1~150mA
Resistance: 0~100KΩ
Accuracy:
Rated D.C. Voltage and Electric Current within ± 4%
Rated A.C. Voltage within ± 4%
Rated Resistance within ± 10%
Inner Resistance 1000Ω/V

$7.95

MODEL LP-3 POCKET TESTER

An attractive Black Bakelite cabinet.
Response: 170μA
AC Volt: 10v 50v 250v 500v 1000v (500μA V/2000Ω)
DC Volt: 10v 50v 250v 1000v (250μA V/4000Ω)
DC Current: 250μA 10mA 250mA
Resistance: 0~1MgΩ 0~10KΩ
Decibels: —20db~+22db (at AC 10v Range) +20db~+36db (at AC 50v Range) (0db—0.775v—600Ω)

$6.50

MODEL FP-4 CIRCUIT TESTER

Model FP-4 is handy and popular pocket size circuit tester with an attractive gray color cabinet, having a high sensitivity.
DC Volt: 10v 50v 250v 500v 1000v
AC Volt: 10v 50v 250v 500v 1000v
DC Current: 1~250mA
Resistance: 0~1MΩ 0~10KΩ 10KΩ 100Ω (1.5v Battery×2)
Decibels: —20~+22db At AC 10 Volts range —20~+36db At AC50 Volts range (0db 0.775v 600Ω)

$6.50

MODEL FP-2 CIRCUIT TESTER

Model FP-2 is a handy pocket size circuit tester with an attractive every kinds color plastic panel, having a high sensitivity 180μA full scale.
DC Volt: 10v 50v 250v 500v 2500v
AC Volt: 10v 50v 250v 500v 2500v
DC Current: 0.5mA 50mA 500mA
Resistance: 0~10KΩ 0~1MΩ
Decibels: —20~+22db +5~+36db

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MODEL A-3Y CIRCUIT TESTER

Model A-3Y is a portable circuit tester with a 150μA high sensitivity meter or an attractive black bakelite panel and the tester has a black bakelite cover. The tester has 18 ranges in total.
DC Volt: 5v 10v 100v 250v 500v 1000v
AC Volt: 5v 10v 100v 250v 500v 1000v
DC Current: 250μA 100mA
Resistance: 0~1KΩ 0~10KΩ 0~100KΩ 0~1MΩ
Decibels: —10~+16db —5~22db (0db 0.775v 600Ω)

$8.95

MODEL LP-6 CIRCUIT TESTER

A handy pocket size Circuit Tester with a rotary control switch. Excellent product with *measuring device of 1200v, Currency, Voltage and Capacity of Condenser.* Fine Black Bakelite cabinet.
Response: 140μA
AC.DC Volt: 6v 12v 60v 300v 1200v (300μA v/2000Ω)
DC Current: 300μA 3mA 300mA
Resistance: 0~1MgΩ 0~10KΩ
Decibels: —20db~+17db
Capacity: 0.01μF~250PF
To measure Capacity of Condenser, use OUT (—) and (+) sockets and connect the Condenser with exact A.C. 100v in series, keeping Center switch at AC 60v Range.

$14.50

MODEL L-30 FUJI TESTER

The latest model we have succeeded to enable *simple reading of resistance up to 10MΩ with 22.5v battery inside.*
The most luxurious looking with Gray Plastic Panel and Cabinet.
Response: 160μA
AC Volt: 10v 50v 250v 500v 1000v (500μA V/2000Ω)
DC Volt: 10v 50v 250v 500v 1000v (250μA V/4000Ω)
DC Current: 250μA 2.5mA 25mA 500mA
Resistance: 0~10KΩ 0~100KΩ, 0~1MgΩ 0~10MgΩ (By 25.5v internal battery)
Decibels: —20db~+22db (at AC 10v Range) +20db~+36db (at AC 50v Range)

$11.95

MODEL L-18 FUJI TESTER

An excellent medium size Tester of high sensitivity, enjoying good reputation of *its simplicity for professional use.* The best Black Bakelite Cabinet.
Response: 160μA
AC Volt: 10v 50v 250v 500v 1000v (500μA V/2000Ω)
DC Volt: 10v 50v 250v 500v 1000v (250μA V/4000Ω)
DC Current: 250μA 2.5mA 25mA 250mA
Resistance: 0~10KΩ 0~100KΩ 0~1MgΩ (By 3v internal battery) 0~10MgΩ (By 22.5v exterior battery)
Decibels: —20db~+22db. (at AC 10v Range) +20db~+36db. (at AC 50v Range)

$8.45

MODEL FP-3 CIRCUIT TESTER

Model FP-3 is Pocket circuit tester, Measuring Ranges as follows: (An attractive Black & Gray bakelite cabinet)
DC Volt: 10/250/500/1000V.
AC Volt: 10/250/500/1000V
DC Current: 1/10/100mA
Resistance: 0~100KΩ
Accuracy:
Rated DC Voltage and Electric Current within ± 4%
Rated AC Voltage within ± 4%
Rated Resistance within ± 10%
Inner Resistance 1000Ω/V

$14.95

MODEL 290-F CIRCUIT TESTER

Model 290-F is a standard size circuit tester with a 120μA high sensitivity with an attractive black bakelite panel. The tester is appreciated among the professional circle for its simplicity.
DC Volt: 10v 50v 250v 500v 1000v 5000v
AC Volt: 10v 50v 250v 500v 1000v 5000v
DC Current: 250μA 10mA 100mA 500mA
Resistance: 0~1KΩ 0~10KΩ 0~100KΩ 0~1MΩ
Decibels: —20~+5db (0db 0.775v 600Ω) —10~+20db (0db 0.775v 7KΩUP)

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Service Industry News

THE fourth annual Texas Electronics Association's "Electronic Fair and Clinic" may well become the most successful event to date promoted and managed by an electronic service association. With the members of the Texas Electronics Technicians Association, Inc. of Houston serving as hosts, the southwestern service dealers who attend the affair will hear some of the industry's outstanding speakers during the three-day clinic sessions. More than a thousand dealers and service operators registered in advance for the meetings on August 24, 25, and 26 at the Rice Hotel in Houston, Texas.

Van J. Roark, president of the Texas Electronics Association and William A. Galbreath, Sr., clinic chairman, started to publicize the 1956 annual convention immediately after their election to office in December 1955. The intense rivalry between the associations in the four larger Texas cities that rotate the sponsorship is practical insurance for a steadily increasing attendance.

The TEA clinics have assumed such a degree of industry importance that top-level industry executives are delighted to accept invitations to speak at the clinic sessions. In order to cover the extensive range of subjects and to accommodate all of the speakers, the clinic this year will start on Friday afternoon, August 24th, with a "kick-off" speech of William A. Galbreath, Sr., clinic chairman. He will introduce the speakers at the Friday afternoon sessions who will include J. T. McMurphys, sales manager of the accessories division of *Philco Corp.;* Paul H. Wendel, editor of "Service Management" magazine; Dorman Israel, executive vice-president of the *Emerson Radio & Phonograph Corp.;* and Ray Yeranko, national sales manager for *The Magnavox Company.*

The clinic on Saturday, August 25th, will start with a breakfast session and, during the morning, talks will be given by Joe Bannon, national sales manager of the television division, *RCA-Victor;* Arthur L. Chapman, vice-president in charge of operations for the *Sylvania Electric Products Inc.;* Henry T. Paiste, vice-president in charge of service for the *Philco Corp.;* and Al Robertson, the "Will Rogers" of the TV-appliance retail sales industry. Speakers at the Saturday afternoon session will include W. L. Parkinson, manager of products for the *General Electric Company;* William Kalbfus, national television sales manager for *Westinghouse Electric;* Russ Weber, national sales training director for *The Magnavox Company;* Forrest L. Baker, president, and C. D. "Jack" Hughes, executive secretary of the American Electronic Council; and J. B. "Kip" Anger, national TV sales manager for *Motorola Inc.*

At the annual banquet which will be held in the Rice Hotel on Saturday night, the keynote address will be delivered by Dr. Allen B. DuMont, chairman of the board of *Allen B. DuMont Laboratories, Inc.,* and one of the industry's outstanding engineers and executives. The "pièce de resistance" of the convention is the panel discussion which will be held on Saturday morning. Manufacturer sales and service executives who serve on these panels freely answer questions put to them by dealers and service operators, but their answers are strictly "off the record." John F. Rider, president of *John F. Rider Publisher, Inc.,* will act as moderator, serving on a panel made up of leading sales and service executives.

New Michigan Group

Approximately 500 technicians and service dealers at-

tended a recent meeting of the Television Service Association of Michigan to get clarification from TSA officials of the recently enacted television licensing ordinance in Detroit. They also heard how TSA plans to become a strong voice in the promotion of the independent service branch in television. The new technicians group is to be sponsored by TSA and will be known as the Television Technicians Guild. It will be made up of all full-time electronic technicians. The group will not be controlled by TSA as the plan calls for election of its own officers and directors from its technician membership. TSA will furnish the use of its offices, club rooms, and office secretary.

Following the presentation of the plan for the Television Technicians Guild, Jack Barton, past president of TSA, gave an outline of the technical training program that will be presented weekly for members of the Guild. Mr. Barton made it clear that the entire program would be keyed to the practical aspects of television servicing. Harold Chase, editor of "TSA News," outlined the plan for the business management training program that the association is preparing for TSA members.

The Television Radio Association of Alameda County, Inc., Oakland, California, recently launched a two-pronged program to focus the spotlight of publicity on the two most serious facets of competition for the independent service industry. The first of these is a parts distributors' shopping program to learn which of the distributors are actually parts retailers and not wholesalers. The results of each month's shopping tours are published in the TRAAC house organ, the "TV Flashes."

Guild to Sponsor Fair

The Radio Television Guild of Long Island recently announced that a full working committee had been selected to handle the arrangements for an "Electronics Fair" scheduled for three days in the early part of December. The Long Island State Agricultural Institute, where the fair will be held, has pledged its full support.

The "Long Island Electronics Fair" will be conducted as a non-profit activity. A complete exhibit of products and equipment of interest to electronic technicians and service dealers is planned along with a program of lectures.

Shortly after the announcement of the fair was made, considerable interest developed among service associations on the eastern seaboard over the prospects of holding a conference of eastern associations in connection with the fair. Many of the top television service companies in the metropolitan New York area feel that the growing promotion of consumer service business by factory service depots poses a serious threat to the entire independent electronics service industry. They feel that a conference of service associations would pave the way for cooperative action among independent businesses to combat this competition.

The statements recently made by Dr. Allen DuMont and Paul Galvin that only six to eight manufacturers will remain in the television receiver manufacturing business after the present economic readjustments are completed, makes the future of independent television service businesses rather gloomy in the eyes of many service operators. The plans announced by eastern banks that they will provide 36-month financing for color TV set sales including the cost of the service contracts, paves the way for the channeling of the color TV service business into manufacturers' service depots.

Service Labor Pricing

The problem of adjusting labor charges to conform to the actual costs of operating is of deep concern to every service association and ethically managed service business.

The Television & Radio Electronics Institute of Washington recently published schedules of charges for television and radio service in the State of Washington. These schedules are based upon an exhaustive survey of operating costs in the Pacific Northwest. They show that the minimum charge for either TV or radio home service calls should be $6.00 in that section. This charge allows for one half hour of labor in the customer's home. After the first half hour, operating costs require a charge of $1.50 for each additional 15 minutes or fraction thereof. -30-

Hoffman Color Sets
(*Continued from page 50*)

cuits is one which is quite unfamiliar. This is the combination burst gate and color phase detector, shown in simplified form in Fig. 3. Two diodes of a 6BJ7 are connected as a phase detector which compares the local 3.58 mc. signal to the received color sync burst. The phase error voltage, just as in many horizontal sync circuits, is derived from the center of the two balancing resistors R_2 and R_3 and applied to the grid of the reactance tube which controls the local 3.58 mc. oscillator. The color sync burst is taken from the output of the second chroma amplifier and has considerable amplitude.

The burst is only part of the horizontal blanking pulse so, to make the phase detector operate only during the period of the color sync burst, it is necessary to shut the circuit off and turn it on only during the proper period.

The third diode of the 6BJ7 is effectively shunted across the tapped resonant circuit L_1-C_1 and will normally prevent any signals from affecting the phase detector. During the horizontal retrace time, a pulse derived from the flyback section is applied to the cathode of the gating diode. This pulse is so shaped that its effective peak occurs exactly during the instant when the color sync burst appears. The amplitude of the gating pulse is about 145 volts, making the cathode more positive than the plate of the diode, and preventing any current flow. The shunting effect of the diode is therefore removed from the circuit during the color sync burst and the phase detector can function.

Since the error voltage, if any, is derived only during a very small portion of the horizontal scan time, it must have a filter with a long time constant to properly control the reactance tube.

Accurate horizontal synchronization is required since, if the gating pulse is out of step, the phase detector cannot function properly. Weak horizontal sweep will also result in a weak gating signal and color synchronization may therefore be lost entirely. In troubleshooting color defects, it is paramount to make sure that horizontal sync and flyback sections work perfectly since any defect there will affect not only the color burst gate, but also the color-killer circuit. —30—

FREE SERVICE COURSES

FREE courses in radio and television servicing will be offered by the Queens Evening Trade School to qualified residents of New York City. The school is located at 47th Avenue and 37th Street in Long Island City, New York. Registration for all classes will take place at the school on September 10 and 11, from 7 p.m. to 9 p.m. Both fundamental and advanced courses are offered. —30—

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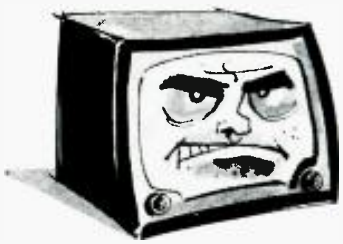

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New! SICO Streamlined TUBE TESTERS

Superior's New Model TC-55

FOR { The Experimenter or Part-time Serviceman, who has delayed purchasing a higher priced Tube Tester.
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• **You can't insert a tube in wrong socket.** Separate sockets are used, one for each type of tube base. • **"Free-point" element switching system** Any pin may be used as a filament pin and the voltage applied between that pin and any other pin, or even the "top-cap". • **Checks for shorts and leakages between all elements.** Provides a super sensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals. Continuity between various sections is individually indicated. • **Elemental switches are numbered in strict accordance with R.M.A. specification.** The 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system.

Speedy, yet efficient operation is accomplished by: Elimination of old style sockets used for testing obsolete tubes (26, 27, 57, 59, etc.) and providing sockets and circuits for efficiently testing the new Noval and Sub-Minar types.

Model TC-55 comes complete with operating instructions and charts and streamlined carrying case.

$26.95 NET

PICTURE TUBE TESTER

Superior's New Model TV-40

- **Tests all magnetically deflected tubes . . . in the set . . . out of the set . . . in the carton!!**
- **A complete picture tube tester for little more than the price of a "make-shift" adapter!!**

The Model TV-40 is absolutely complete! Self-contained, including built-in power supply, it tests picture tubes in the only practical way to efficiently test such tubes; that is by the use of a separate instrument which is designed exclusively to test the ever increasing number of picture tubes!

SPECIFICATIONS

Tests all magnetically deflected picture tubes from 7 inch to 30 inch types. • Tests for quality by the well established emission method. All readings on "Good-Bad" scale. • Tests for inter-element shorts and leakages up to 5 megohms. • Test for open elements.

Model TV-40 comes absolutely complete — nothing else to buy. Housed in round cornered, molded bakelite case. Only . . .

$15.85 NET

Superior's New Model TV-11
Standard Professional

TUBE TESTER

- ★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin-number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary.
- ★ The Model TV-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket.
- ★ Free-moving built-in roll chart provides complete data for all tubes.
- ★ NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

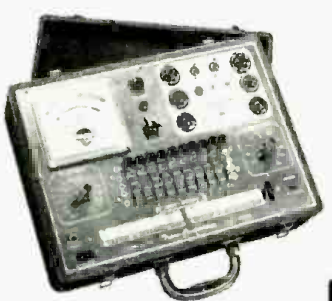
EXTRA SERVICE — The Model TV-11 may be used as an extremely sensitive Condenser Leakage Checker. A relaxation type oscillator incorporated in this model will detect leakages even when the frequency is one per minute.

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

$47.50 NET

TRANS-CONDUCTANCE TUBE TESTER

Superior's New Model TV-12



TESTING TUBES

★ **Employs improved TRANS-CONDUCTANCE circuit.** An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured. This provides the most suitable method of simulating the manner in which tubes actually operate in Radio & TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading.

★ **NEW LINE VOLTAGE ADJUSTING SYSTEM.** A tapped transformer makes it possible to compensate for line voltage variations to a tolerance of better than 2%.

★ **SAFETY BUTTON**—protects both the tube under test and the instrument meter against damage due to overload or other form of improper switching.

★ **NEWLY DESIGNED FIVE POSITION LEVER SWITCH ASSEMBLY.** Permits application of separate voltages as required for both plate and grid of tube under test, resulting in improved Trans-Conductance circuit.

TESTING TRANSISTORS

A transistor can be safely and adequately tested only under dynamic conditions. The Model TV-12 will test all transistors in that approved manner, and quality is read directly on a special "transistor only" meter scale.

Model TV-12 housed in handsome rugged portable cabinet sells for only

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New! SICO 20,000 OHMS PER VOLT ALLMETER

Superior's New Model TV-60

Includes services never before provided by an instrument of this type. Read and compare features and specifications below!

SPECIFICATIONS

8 D.C. VOLTAGE RANGES (At a sensitivity of 20,000 Ohms per Volt) 0 to 15/75/150/300/750/1500/7500/30,000 Volts.
7 A.C. VOLTAGE RANGES: (At a sensitivity of 5,000 Ohms per Volt) 0 to 15/75/150/300/750/1500/7500 Volts.
3 RESISTANCE RANGES: 0 to 2,000/200,000 Ohms, 0-20 Megohms.
2 CAPACITY RANGES: .00025 Mfd. to 30 Mfd.
5 D.C. CURRENT RANGES: 0-75 Microamperes, 0 to 7.5/75/750 Milliamperes, 0 to 15 Amperes.
3 DECIBEL RANGES:—6 db to + 58 db.

R.F. SIGNAL TRACER SERVICE: Enables following the R.F. signal from the antenna to speaker of any radio or TV receiver and using that signal as a basis of measurement to first isolate the faulty stage and finally the component or circuit condition causing the trouble.
AUDIO SIGNAL TRACER SERVICE: Functions in the same manner as the R.F. Signal Tracing service specified above except that it is used for the location of cause of trouble in all audio and amplifier systems.

FEATURES

★ Giant recessed 6½ inch 40 Microampere meter with mirrored scale.
★ Built-in Isolation Transformer.
★ Use of the latest type printed circuit and 1% multipliers assure unchanging accurate readings.

Model TV-60 comes complete with book of instructions; pair of standard test leads; high-voltage probe; detachable line cord; R.F. Signal Tracer Probe and Audio Signal Tracer Probe. Pliofilm bag for all above accessories is also included. Price complete. Nothing else to buy. ONLY

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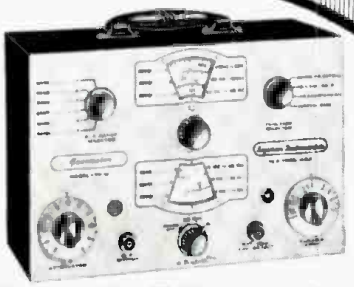

Superior's New Model TV-50

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R. F. SIGNAL GENERATOR: Provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics. • **VARIABLE AUDIO FREQUENCY GENERATOR:** In addition to a fixed 400 cycle sine-wave audio, the Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal. • **BAR GENERATOR:** Projects an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars. • **CROSS HATCH GENERATOR:** Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting horizontal and vertical lines interlaced to provide a stable cross-hatch effect. • **DOT PATTERN GENERATOR (FOR COLOR TV):** The Dot Pattern projected on any color TV Receiver tube by the Model TV-50 will enable you to adjust for proper color convergence. • **MARKER GENERATOR:** The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc., (3579 Kc. is the color burst frequency.)

MODEL TV-50 comes absolutely complete with shielded leads and operating instructions.

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of the instruments on this or on the facing page, for 10 days before you buy. If completely satisfied *then* send down payment and pay balance as indicated on coupon. ***No Interest or Finance Charges Added!*** If not completely satisfied return unit to us, no explanation necessary.

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- ☐ Model TC-55 ..... Total Price $26.95 $6.95 within 10 days. Balance $5.00 monthly for 4 months.
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- ☐ Model TV-40 ..... Total Price $15.85 $3.85 within 10 days. Balance $1.00 monthly for 3 months.
- ☐ Model TV-50 ..... Total Price $47.50 $11.50 within 10 days. Balance $6.00 monthly for 6 months.

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New Hi-Fi-Audio Equipment

FM-AM TUNER

Sherwood Electronic Laboratories, Inc., 2802 W. Cullom Avenue, Chicago 18, Illinois has recently introduced an FM-AM tuner, the Model S-2000.

The tuner is characterized by an FM sensitivity of 1.2 microvolts for 20

db quieting. This is accomplished by using the new 6BS8 input amplifier tube along with a specially designed, highly efficient, balanced input transformer.

IM distortion is at a minimum because of the special circuitry which includes a.g.c. and newly designed, highly stable coils. An automatic frequency control with 16 db correction simplifies tuning and holds stations accurately in tune.

The Model S-2000 has flywheel tuning and a directable ferrite rod AM antenna. It is remarkably compact, measuring only 14" x 10½" x 4". The tuner comes in a variety of attractively styled cabinets to match the company's 20-watt amplifier.

"BUDGET-PRICED" AMPLIFIER

Stromberg-Carlson, a division of *General Dynamics Corporation*, Rochester 3, New York has added a budget-priced amplifier to its line of audio components.

The Model AR-411 is a 10-watt unit with a peak power-handling capacity of 15 watts. Frequency response is 15 to 25,000 cps. Hum and noise level is 80 db below the rated output with the controls at a listening level. A bass control provides 15 db boost and 15

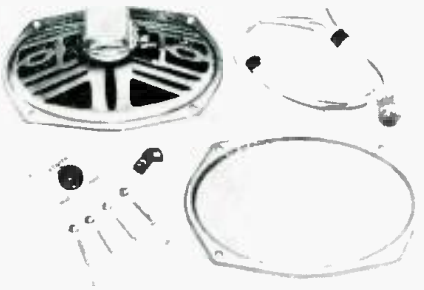
db droop at 50 cps. The treble control provides 10 db boost and 15 db cut at 10,000 cps.

There are four inputs on the unit to handle magnetic phono, radio tuner, tape, and auxiliary applications. There are output taps for 4, 8, and 16 ohms. The entire unit is housed in a cabinet measuring 13" wide, 7" deep, and 3½" high.

REAR SEAT SPEAKER

The *United Motor Service Division* of *General Motors Corporation*, Detroit 2, Michigan is now offering a new *GM-Delco* automobile rear seat radio speaker kit which is designed to boost profits and increase sales for electronic dealers.

The new speaker package is designed for simple installation and priced to overcome customer cost objections. The package features a speaker with a one-inch voice coil, a three-position selector switch for dashboard installation, and an attractive one-



piece grille. The selector switch allows for rear speaker operation, front speaker operation, or both.

A dealer bulletin, entitled "How to Make Big Profits Selling Rear Seat Speakers," is available from the company or its distributors.

NEW UNIVERSITY SPEAKERS

University Loudspeakers Inc., 80 South Kensico Ave., White Plains, New York has added three new units to its "Diffaxial" line of high-quality, full-range loudspeakers.

The new units are the Model UXC-123, 12" 3-way "Diffaxial"; the Model UXC-122, 12" 2-way "Diffaxial"; and the "Diffusicone-15," 15" 2-way "Diffaxial." The "Diffaxial Family" of speakers are unitary assemblies containing two or three radiators integrated to give two- or three-way performance. The split-range performance of the 2-way unit is obtained through the mechanical parameters designed into the woofer and patented "Diffusicone" sections to achieve mechano-acoustical crossover characteristics.

In the 3-way unit, the added element is a top-range compression driver tweeter coupled to a reciprocating flare horn. Employing through-the-axis construction, the wide-angle horn is mounted through the center of the

"They think I'm going instead of coming!"

Trade-ins are not always what they seem, either. That's why it will pay you, as it has thousands of others, to rely on the one and only "Surprise" trade-in policy popularized by Walter Ashe. For real satisfaction and money saving trade used (factory-built) test or communication equipment today. Wire, write, phone or use the handy coupon.

NATIONAL NC-300 RECEIVER

The "Dream Receiver" with super selectivity and sensitivity. For all bands 160 thru 1¼ meters (6, 2, and 1¼ meters with plug-in converters). Less speaker. Net.....$ 399.00

Johnson Viking

"VALIANT"

275 watts input CW, SSB (P.E.P. with SSB exciter), 200 watts input on AM. Built-in VFO. 160 thru 10 meters. Complete kit with tubes. Net $349.50 Wired and tested. Net.....$ 439.50

"PACEMAKER"

SSB transmitter-exciter. 90 watts P.E.P. input SSB, CW, 35 AM. Upper and lower sideband selection. Built-in VFO. 80 thru 10 meters. With tubes. Wired, tested only. Net $495.00

NEW HAMMARLUND HQ-150

Continuously tunable from 540 kc to 31 mc. Separate calibrated bandspread dial for 80, 40, 20, 15, and 10 meter bands. Built-in 100 kc crystal calibrator. Crystal filter and Q-multiplier for unsurpassed reception on SSB, CW, and AM. Improved "S" meter. 13 tubes including rectifier and VR tube. With tubes, less speaker. Net..... $ 294.00

B&W 5100-B TRANSMITTER

Bandswitching, VFO or crystal controlled. All bands 80 thru 10 meters. 180 watts input on CW, 140 watts AM, 180 watts SSB when used with 51SB-B SSB generator. TVI suppressed. Net.....$ 475.00

HALLICRAFTERS SX-100 RECEIVER

Features selectable sideband operation. Covers 540 kc to 34 mc. Bandspread for all bands 80 thru 10 meters. 100 kc crystal calibrator. "Tee-Notch" filter. 12 tubes plus rect. and VR. Net.....$ 295.00

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woofer assembly so that full exponential expansion is used for highest conversion efficiency and uniform wide-angle dispersion. The tweeter is electrically meshed to the 2-way cone system through a built-in *LC* dividing network.

$295 STEREO TAPE PLAYER

The *RCA Victor and "Victrola" Division, Radio Corporation of America*, has developed a portable stereophonic tape player which will retail for $295.00, with a consolette version marketed at $350.00.

Either version comprises a complete stereophonic tape reproducing system which includes two amplifiers, two speaker systems, a stereo-tape player, and 30 feet of connecting cable. The tape transport system will be available separately for those already owning three of the company's "New Orthophonic" hi-fi instruments which were designed to be adaptable to the stereo mode of operation.

The system consists of two matching cases, one of which contains the tape player which will play either dual or single track tapes at 7½ ips; a pair of 2.5 watt amplifiers, and a "Panoramic" sound system consisting of two 3½-inch and one 6½-inch speakers. The second case houses an identical speaker system and storage space for tapes.

The "portable" version is housed in matching luggage-type cases in two-tone brown and tan simulated leather while the "consolette" is housed in cabinets similar to the company's Mark VI "New Orthophonic" high-fidelity "*Victrola*" phonograph.

The new tape players will be ready for distribution early this Fall.

ELECTROSTATIC SPEAKERS

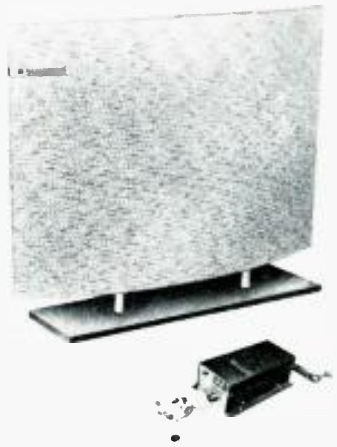
Pickering and Company, Inc., Oceanside, Long Island, New York is currently marketing two new electrostatic speakers which propagate sound in-phase over the entire surface of a curved, virtually massless diaphragm.

Unlike conventional cone speakers which drive only small amounts of air at high velocities, the "Isophase" speaker re-introduces the original sound into the air at a low velocity closely approximating the unit-area energy of the sound at the microphone in a concert hall or studio.

Harmonic and IM distortion are at a fraction of one per-cent, making them comparable to the best amplifiers in this respect, because of the in-

herent linearity of the push-pull electrostatic design, according to the company.

Two models are currently available, the "580" for frequencies from 1000 to 20,000 cps and the "581" for frequencies from 400 to 20,000 cps. The Model 401-D divider is supplied with each speaker to provide polarizing voltage for the speaker and divide the output from the 16-ohm secondary of any output transformer to send the proper signals to the speaker and to the woofer used with it.



NEW MODEL "NOISERASER"

The *Burbank Division* of *Librascope, Inc.*, 133 E. Santa Anita Street, Burbank, California is now marketing a new, small-sized "Noiseraser," another unit in the firm's series of bulk magnetic tape degaussers.

The N-HF, which is especially designed for the audiophile, contains a powerful magnetic circuit which removes recorded and undesirable signals from entire reels of tape in a matter of seconds, 4-6 db below standard erase head levels of demagnetization. It is recommended for ¼" magnetic tape, on reels up to 10½" in diameter and operates from the ordinary a.c. power outlet.

Over-all size of the "Noiseraser" is 7¾" x 4¾" x 3¼". It weighs 8 pounds.

EICO PREAMPLIFIER

Electronic Instrument Co., Inc., 84 Withers Street, Brooklyn 11, New York has developed and is offering a new preamplifier unit which can be used with any high-quality power amplifier.

The Model HF61 (with power supply) and the Model HF61A (without power supply) feature five, all-feedback equalization positions for *Col.*

LP, *London*, RIAA, American 78's, and European 78's; high- and low-end feedback filter circuits, effective on all inputs; variable turnover, low-distortion feedback tone controls which do not affect volume or mid-frequencies; a *Centralab* printed circuit "Senior Compentrol" loudness control which provides

adjustable Fletcher-Munson compensation or no compensation, as desired; two magnetic cartridge inputs, for turntable and changer; four high-level switched inputs and three low-level inputs; a hum balance control; and frequency range ±1 db from 8 to 100,000 cps and ±.3 db from 12 to 50,000 cps.

This new *Eico* unit is available in kit or factory-wired form. In kit form, the preamp comes complete with wiring and operational instructions.

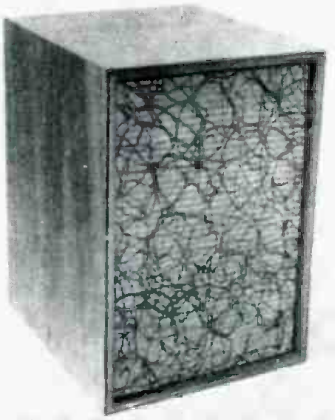
NEW CUE DISC

Reeves Soundcraft Corp., 10 East 52nd Street, New York 22, New York has announced the availability of a new cueing disc designed especially for radio disc jockeys.

The new unit is 16 inches in diameter and becomes a permanent top for the turntable. It handles all sizes of records and preloads 45 rpm discs without the need for a 45 adapter. Minimum finger pressure holds the cue disc in place and upon release of this pressure, the correct turntable speed is instantly restored.

ELEKTRA SPEAKER SYSTEM

The Elektra Corporation, 361 Bleecker Street, New York 14, New York has developed a small, high-performance speaker system consisting of a speaker



and enclosure designed to operate in conjunction with each other.

The unit has a specially plasticized cone edge which lowers the resonant frequency of the cone to provide fuller bass. There is direct radiation of the highs and complete use of backwave as a means of higher efficiency. The lengthened air column simulates big-speaker performance.

Response is 45 to 15,000 cps with extremely low distortion. Impedance is 4 to 8 ohms, power rating is 16 watts. The cabinet measures 15" high, 10½" wide, and 12¼" deep. It is available finished in walnut or blonde woods or in unfinished wood, smooth sanded, ready to be finished at the discretion of the buyer. A data sheet on this speaker system is available on request.

FISHER 55-WATT AMPLIFIER

Fisher Radio Corporation, 21-21 44th Drive, Long Island City 1, New York has announced the availability of its new Model 55-A, a 55-watt laboratory standard amplifier.

The new unit, engineered primarily for the laboratory yet suitable for home use, delivers 55 watts at less

than 1% distortion and handles power peaks of 110 watts. All-triode in design, the Model 55-A will reproduce the most complex transient passages without coloration or clipping and drives even the lowest efficiency loudspeaker system to full output without amplifier overload.

Complete specifications on the Model 55-A are available on request from the company. Over-all size is 14½" wide, 9¾" deep, 8¾6" high. It weighs 50 pounds.

BINAURAL TAPE PLAYBACK

V-M Corporation, 280 Park Street, Benton Harbor, Michigan is in production on a new furniture-styled table-model tape recorder which will be marketed as the "Celeste," Model 750.

It is a monaural recording and play-

back unit which also plays binaural recorded tapes when teamed with any other amplifier-speaker combination. Available in blonde or mahogany cabinet finishes, the "Celeste" has a frequency response of 40 to 12,000 cps, plus or minus 5 db and 5-watt output

at maximum 2½% distortion. The speaker system consists of two 8" woofers and a 3½" tweeter. It has external amplifier and speaker jacks, plus a jack for a 12-foot "Stere-o-matic" binaural sound cord, furnished with the unit. Power cord, patch cord, microphone, a 7" reel of tape, and empty tape reel are also included. The cabinet includes storage space for a dozen tape reels.

"SPEAK-CHECK"

Century Electronics Co., Inc., 111 Roosevelt Ave., Mineola, N. Y. has developed a new and specialized item of test equipment for the service technician.

Known as the "Speak-Check," Model SC-1, this unit is not only a universal substitute for all speakers, but also a multi-purpose signal tracer and volt-

age checker. Besides checking and substituting for any speaker or output transformer in use today, the instrument will also substitute for speakers using field coils, signal trace all audio and video circuits by signal injection, check for vertical and horizontal sweep voltages, check and measure "B+" voltages, as well as substitute power supply bleeder resistances.

ELECTRONIC CROSSOVER KIT

Heath Company of Benton Harbor, Michigan has just released a new electronic crossover system which is designed to operate ahead of the main power amplifier instead of between the amplifier and the speakers.

The crossover system consists of two independent electronic filters, one

high-pass and one low-pass, each with a rotary switch for selecting the cut-off frequency. A single input is divided so that high- and low-frequency portions of the spectrum are available at the outputs to feed separate amplifiers.

Known as the Model XO-1, the new unit will handle unlimited power because frequency division is performed ahead of the power stage. No audio power is consumed by the crossover itself. It eliminates unstable loading conditions and matching problems. It will not affect amplifier damping factor.

Crossover frequencies are 100, 200, 400, 700, 1200, 2000, and 3500 cps. Attenuation is 12 db per octave with sharp "knee" at the cut-off frequency, instead of a rounded slope as obtained with the usual *RC* filter.

AUDIO CATALOGUES

AIREX HI-FI LINES

Airex Radio Corp., which recently opened a modern hi-fi salon at 64 Cortlandt Street, New York 7, N. Y., has issued a 70-page catalogue and audio equipment guide covering an extensive line of amplifiers, tuners, receivers, speakers, enclosures, transcription turntables, arms, cartridges, tape recorders, and hi-fi accessories.

The distributor carries audio products made by over fifty well-known manufacturers and each of the items are pictured and described in some detail in this handy manual. Audiophiles unable to visit the hi-fi salon can order any of the catalogue items by mail.

Write M. Hockey, in care of the company, for a free copy of this catalogue.

"MAGNELOOP" DATA

Amplifier Corp. of America, 398 Broadway, New York 13, N. Y. is now offering a four-page folder which describes its "Magneloop" series of variable- and fixed-speed continuous loop magnetic tape recorders-reproducers which incorporate an unusual tape drive.

The brochure completely describes features of 21 models which are available in single- or dual-speed as well as in single-, dual-, and triple-channels. Recording characteristics are tabulated for easy reference.

Specialized uses and technical applications of all "Magneloops" are suggested. Mechanical and electrical features are fully explained along with complete technical specifications, recommended accessories, and direct factory prices. The brochure is free on request.

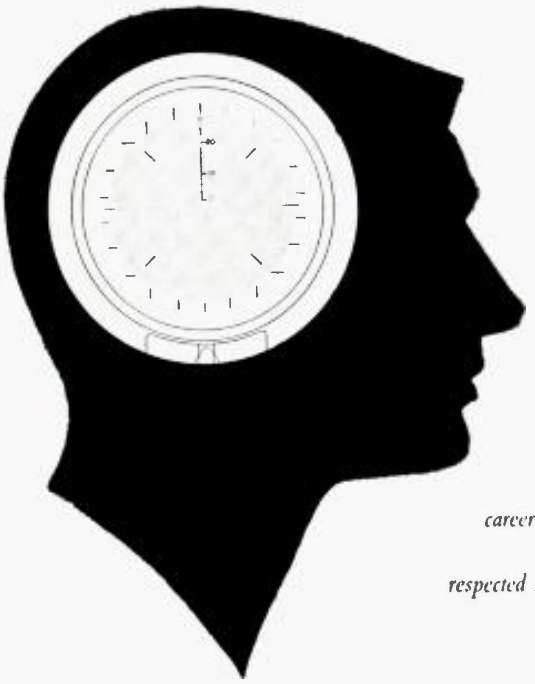
TUBES FOR AUDIO

Amperex Electronic Corporation, 230 Duffy Ave., Hicksville, Long Island, N. Y. has issued an eight-page brochure covering its complete series of tubes for high-fidelity audio equipment applications.

Included are complete characteristics and typical operation condition data on the EF86, ECC83, EL84, 6CA7, EZ81, and GZ34. Performance graphs for two 6CA7's in push-pull and two EL84's in class AB push-pull are also included.

Copies of this publication are available without charge upon request to the manufacturer. —30—

Systems Career: a laboratory for learning



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As a Field Engineer at Hughes, through training and assignment you will become familiar with the entire systems involved, including the most advanced electronic computers. With this knowledge you will be ideally situated to broaden your experience and learning for future application in either the military or commercial field.

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Training at full salary for 3 months before assignment.

Generous moving and travel allowance between present location and Southern California (Culver City).

Additional compensation plus complete travel and moving on assignments away from Culver City.

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AMERICA'S FINEST VALUES IN "LOW COST" HIGH FIDELITY

ECONOMY 20 WATT AMPLIFIER $22.95 — IMPERIAL 30 WATT AMPLIFIER $29.95

Model HF-20

NEW 1957 MODEL

Push-Pull 6L6 Output Tubes
Response 30-15,000 CPS
Bass and Treble Tone Controls
Input for Xtal or Dynamic Mike
Input for Xtal or V.R. Phono

With CU-14Y, 12" Coax Speaker...$32.95
With P15-CR, 15" Coax Speaker...$42.95
With Imperial IV System.....$39.95
With Imperial VI.....$48.95 With HF-33GE $69.95

A tremendous High Fidelity amplifier value. Response 30 to 15,000 cps. Electronic bass and treble boost by separate tone controls. Use this amplifier with any record changer having crystal or variable reluctance cartridge, radio tuner or high impedance crystal or dynamic microphone. 20 watts power output. Use with any 4 or 8 ohm speaker or 250 ohm line. Chassis size, 7 3/8 x 10 1/2 x 7 1/8 high. Complete with tubes: 2—6L6, 2—6C4, 12AX7 and 5U4G. This is a terrific value. A ready to use high fidelity amplifier at less than the cost of a kit. Ship. wt. 17 lbs. Model HF-20, 20 watt Hi-Fi amplifier. McGee's sale price, $22.95.

NEW 1957 MODEL

Push-Pull 6L6 Output Tubes
Response 15-20,000 CPS
Bass and Treble Tone Controls
Compensated Gain for G.E. Cart.
Input for Xtal or Dynamic Mike

With CU-14Y, 12" Coax Speaker .$39.95
With P15-CR, 15" Coax Speaker..$49.95
With Imperial IV Speaker System.$46.95
With Imperial VI.....$55.95 With HF-33GE $76.95

Model IMP-30

New 1957 model 7 tube Imperial 30 watt High Fidelity audio amplifier. A $100.00 list value for only $29.95. Features a heavy 4 lb., specially wound high fidelity output transformer with 15% inverse feed-back; push-pull 6L6 output tubes and frequency response from 15 to 20,000 cps. Matches 8 or 16 ohm speakers. You can center your entire custom music system around this low cost 30 watt amplifier. This Imperial 30, 30 watt amplifier may be used with any radio tuner or record player. It will drive any speaker system that you may have. Use from one to ten 8 speakers or any 12" or 15" coaxial speaker or any 3-way speaker system. Tone compensated input for either a crystal phono pickup or a General Electric variable reluctance pickup. Also, has input for crystal or high impedance dynamic microphone, 4 controls are: mike gain, phono gain, treble tone and bass boost tone control. This amplifier weighs 21 lbs. net. Full size transformer components would cost you up to $15.00 if purchased separately. Gold color chassis is 12 1/4 x 7 3/4" x 7 1/4" high. Complete with tubes: 6AT6, 12AU7, 6C4, 12AU7, 2—6L6GA, plus 5U4G rectifier. Stock No. IMP-30. 30 watt Imperial High-Fidelity amplifier complete with tubes and diagram. Ship. wt. 23 lbs., Sale price only $29.95.

NEW "LOW-BOY" 3-WAY SPEAKER SYSTEM

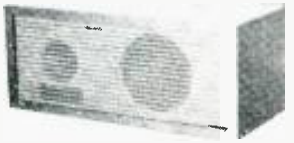
15" COAXIAL SPEAKER
6" SPEAKER-CROSSOVER
30 to 17,000 CPS
CHOICE OF BLOND OR MAHOGANY

SALE PRICE **$29.95**

Low-Boy, 3-way High Fidelity speaker system. Designed expressly for apartment size high fidelity. Features choice of blond or mahogany cabinet. Use with any high fidelity amplifier. Matches 8 ohm impedance. Equipped with a top quality 15" coaxial speaker and a 6" speaker on one side for augmented mid-range audio dispersion. Size, approx. 29" high, 24" wide and 21" front to back. A tremendous high fidelity speaker system with response from 30 to 17,000 cps. Stock No. GM-415. Ship. wt. 40 lbs. McGee's sale price, $29.95. (Specify cabinet finish desired when ordering.)

NEW IMPERIAL SPEAKER SYSTEMS

Imperial IV with 8" G.E. High Fidelity Speaker
$19.95



3-Way Imperial VI with 12" G.E. Speaker
$29.95

New 1957 Model IMPERIAL IV, High fidelity speaker system with General Electric 8" speaker. Housed in a high quality leatherette covered plywood cabinet 10" x 10" x 24" long. Fully enclosed; covered on all sides except back. Use as an auxiliary speaker or with any high fidelity radio, amplifier or home music system. The IMPERIAL IV contains a General Electric Model 850 extended range high fidelity 8" PM speaker with 6.8 oz. Alnico V magnet and curvelinear cone with 8 ohm voice coil and a 5" tweeter. Response 50 to 15,000 cps. Model IV Imperial $19.95.

1957 Model Imperial VI, 3-way speaker system. Baffle is of heavy wood, leatherette covered. Similar in appearance to the Imperial IV pictured above, except 4" taller and 1" deeper. Equipped with 3 matched speakers. A 12" G.E. Model 1203 with 9 oz. Alnico V magnet, plus 5 1/4" PM for middle range and 3" tweeter. Simple to connect to any high fidelity amplifier. (8 ohms impedance). Stock No. IMP-VI. Sale Price, $29.95. Ideal for use with HF-20 and IMP-30 amplifiers described above.

BLOND OAK 3-WAY HI-FI SPEAKER SYSTEM

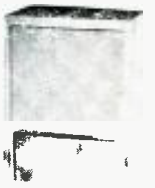
HEAVY ELECTRO-VOICE SALE PRICE
15W-15" WOOFER
E-V 847 MID-RANGE
4401 HORN TWEETER
BUILT-IN CROSSOVER—
30-15,000 CPS

$179.95

A new 3-way High Fidelity console speaker system which features a beautiful blond oak cabinet, an Electro-Voice $78.00 net 15" woofer and mid-range horn, University 4401 tweeter and 3-way crossover network. Electro-Voice 15W, 15" woofer has a frequency response from 30 to 1200 cps, essentially flat. Woofer has a net weight of 37 lbs. Mammouth 5 1/4 lb. Alnico V magnet measures 8" in diameter and is 4 1/4" deep. Has 2 1/2" voice coil, will take up to 30 watts. Electro-Voice 847, 2-way driver horn is used as the mid-range speaker with response of 300 to 10,000 cps. University 4401 tweeter is of the horn type and responds to frequencies up to 15,000 cps. 3-way crossover network is of the inductance-capacitance type which presents a constant resistance type load to your audio system. Equipped with an L-pad to vary loudness of the middle-high ranges. This crossover blends all three speakers into a practical system with only two wires to connect to any 8 ohm output of your high fidelity amplifier. Quality blond oak cabinet measures 43" tall, 31" wide and 23 1/2" deep. Intended for a TV set, this cabinet cost the manufacturer over $100.00. We have converted it to a speaker cabinet, adding a full acoustical lining and back. This saving makes our low price possible.
Model EV84-15W, complete speaker system. Ship. wt. 150 lbs. Sale price, $179.95.

CONSOLE HI-FI SPEAKER SYSTEM $49.95

12" G.E. PM WOOFER—10" PM MID-RANGE—8" G.E. MODEL 850 MID-HIGH RANGE SPEAKER AND 600 CYCLE L-C CROSSOVER NETWORK.



Have Juke Box tone quality in your own home. Strictly High fidelity. Three speakers all connected to a 600 cycle frequency dividing network, so that only 2 wires feed the system from any 4 or 8 ohm radio or amplifier. A variable tone compensating control incorporated in the circuit makes brilliant highs or boomy lows to your own taste. Any amplifier that you now have will give you a much wider selection of acoustical arrangements with this speaker system. The 3-way system is shipped ready to connect to your amplifier or hi-fi radio. Equipped with a General Electric 12" woofer, an 8" famous G.E. 850 plus a 10" middle range speaker, Frequency response 30 to 15,000 cps. Take your choice of cabinets; blonde or mahogany. (Specify finish desired when ordering) 37" high, 24" wide and 20" deep. Ship. wt. 75 lbs. Stock No. HF-33GE. Sale price, $49.95.
Model HF-44GE, console speaker system, same as above except has a heavy duty 12" G.E. PM model 1201, plus 8" G.E. PM Model 850, 10" mid-range speaker and 5" hard cone tweeter. Sale price, $54.95. (Specify cabinet finish.)
Model HF-55GE, super deluxe quality console speaker system, same as HF-33GE described above, except has 15", 21 oz Alnico V magnet woofer, 10" mid-range PM speaker and Model 4401 University horn type tweeter. All 3 systems incorporate 600 cycle L-C type crossover network with variable tone compensating control. Model HF-55GE, Sale price $69.95 (specify cabinet finish).

McGEE'S NEW 1957 MODEL

25 WATT 12" COAXIAL SPEAKER

★ 14 1/2 oz. G.E. 12" WOOFER—
★ 3 1/2" COAXIALLY SUSPENDED TWEETER—
★ BUILT-IN CROSSOVER—
★ ALUMINUM VOICE COIL WOOFER—

$18.95

McGee's new 1957 model, GE-120XT, 12" 25 watt high fidelity coaxial PM speaker. No frills or dummy pot cover, it's all speaker value. Features a General Electric 12", 14 1/2 oz. Alnico V woofer with aluminum voice coil and exponential, molded seamless cone. The tweeter is a specially made 1.47 oz. Alnico V, 3 1/2" speaker which extends the high frequency response to 17,500 cps. It is electrically connected to accept only the upper register of audio. Only two wires connect this complete high fidelity speaker to any 8 ohm amplifier. Ship. wt. 8 lbs. Stock No. GE-120XT. McGee Sale price, $18.95.

DELUXE CONSOLE SPEAKER SYSTEM $89.50

15" UTAH WOOFER—10" MID-RANGE—2—5" TWEETERS—CROSSOVER

New, deluxe quality High-Fidelity speaker system, housed in a beautiful blond oak console cabinet with full doors and attractive matching grill cloth. Has 15" Utah woofer with 21 oz. Alnico V magnet, 10" mid-range speaker and two 5" cone type tweeters. This is the finest console speaker system that we have ever offered. All 4 speakers are connected to a 600 cycle frequency dividing network so that there are only two wires to connect to any 4 or 8 ohm output of your radio or amplifier. Has variable tone compensating control built-in. Cabinet size: 43" tall, 31" wide and 23 1/2" deep. Model DHF-15X4, deluxe quality Hi-Fi console speaker system. Ship. wt. 145 lbs. McGee's sale price, $89.50. This system is in the same cabinet as our $179.95 system pictured to the left.

McGee's Famous
12 AND 15 INCH COAXIAL P.M.
HIGH FIDELITY SPEAKERS

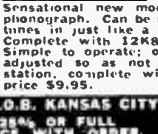
$12.95 12-Inch Model CU-14Y
$23.95 15-Inch Model P15-CR

Model CU-14Y, 12" high fidelity coaxial PM speaker. Response from 30 to 17,500 cps. Full 6.8 oz. Alnico V magnet in the 12" woofer. Special coaxially suspended high frequency tweeter. Built-in crossover network. Only two wires to connect to your radio or amplifier. Matches 3.2 to 8 ohm output. Don't confuse this speaker with many cheap speakers that are offered. This is a fine quality speaker. Stock No. CU-14Y. Sale price $12.95 each. two for $25.00.
Model P15-CR, 15" high fidelity coaxial PM speaker. Response down to 20 cps, and up to 17,500 cps. Full 21 1/2 oz. Alnico V magnet in the 15" woofer. Specially made, coaxially suspended 5" high frequency tweeter. Built-in crossover network. Only two wires to connect. Matches 3.2 to 8 ohm output transformer. A regular $62.50 list speaker. Model P15-CR. McGee's Sale Price. $23.95.
McGee's new 15" Junior coaxial PM speaker. 15" woofer has 6.8 oz. Alnico V magnet. 5" coaxially suspended tweeter with crossover. Only two wires to connect to any 8 ohm radio or amplifier. Frequency response from 40 to 15,000 cps. Model No. M15-CR, 15" Junior coax PM speaker, Sale price, $16.95.

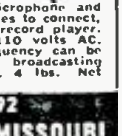
THEATER QUALITY HIGH FIDELITY SPEAKER SYSTEM $39.95

15" WOOFER PLUS—ELECTROVOICE MODEL 847 MID-HIGH RANGE SPEAKER—600 CYCLE LC CROSSOVER.

A theatre quality, powerful speaker system for homes and sound demonstration rooms. This speaker arrangement will connect to any high fidelity audio amplifier (8 ohms impedance) Features a 15" electro-dynamic heavy duty woofer which is equal to a PM speaker with up to 10 lbs. of Alnico V magnet. This woofer reproduces the low audio register from 600 cycles down to 20 cps. An Electro-Voice Model 847 horn type speaker is used for the middle range and high range of audio. These two speakers are connected to the 600 cycle inductive-capacity crossover network. Built in the network is the field exciter for the 15" woofer. You could spend over $100 for a speaker system and not beat this one. Stock No. EV-15847X. McGee's sale price, $39.95.



MINIATURE BROADCASTING STATION FOR MICROPHONE AND PHONO WITH CRYSTAL MICROPHONE
SALE PRICE $9.95



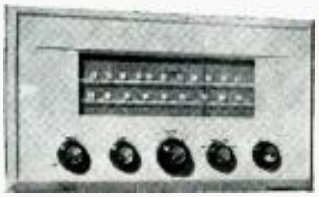
Sensational new model MCL-E3 miniature broadcasting station for microphone and phonograph. Can be received on any broadcast radio in the home. No wires to connect, tunes in just like a radio station. Has input jacks for crystal mike or record player. Complete with 12K8 and 70L7 tubes and instructions. Operates on 110 volts AC. Simple to operate; one control fades from microphone to record. Frequency can be adjusted so as not to interfere with local radio stations. Miniature broadcasting station, complete with crystal hand mike and instructions. Ship. wt. 4 lbs. Net price $9.95.

McGEE RADIO COMPANY

PRICES F.O.B. KANSAS CITY
SEND 25% OR FULL REMITTANCE WITH ORDER. BAL. SENT C.O.D.

TELEPHONE VICTOR 2-5092
1903 McGEE ST., KANSAS CITY, MISSOURI

McGEE's $100,000 SALE! FM/AM CHASSIS-CHANGERS — MONEY-SAVING VALUES



ESPEY 14 TUBE REGULAR $119.50 VALUE FM/AM TUNER ON SALE $79.95

24 WATT HIGH FI AMPLIFIER $39.95 EXTRA

34 WATT HIGH FI AMPLIFIER $54.95 EXTRA

McGEE'S FINEST VALUE EVER OFFERED

YOU COULD SPEND MORE But Get NO BETTER

ESPEY 14-TUBE MODEL 700G FM/AM TUNER

ESPEY 24 WATT MODEL 501G AMPLIFIER

McGee offers you for only $79.95 Espey's regular $119.50 14 tube Deluxe AM-FM tuner. (Separate audio amplifier required such as model 501G or 501E.) Prices above with 14 tubes including rectifiers. Tuner has its own built-in AC power supply. Your savings are almost $40.00. Espey Model 700G performance features: Sensitivity 3mv on AM, 5mv on FM for 30db quieting. AM selectivity 10kc at 6db. FM 240kc at 6 db. Audio response flat from 20 cps. to 20,000 cps. with less than 1/4 percent distortion with one volt audio output. Chassis is 14" long, 8 1/2 high and 10 deep. Features a one-piece molded, gold-colored, plastic front which makes custom installation easy. Features full tuner RF stages—AFC on FM with defeating switch for easy FM tuning. Built-in pre-amplifier for GE variable reluctance phono cartridge, Pickering, etc. Three-position equalizer switch for—LP, AES or European phonograph records. Separate bass and treble tone controls with 23db. boost. Chassis is equipped with AC outlet jacks, auxiliary input jacks for tape recorder, etc. Built-in ferrite loop antenna for AM broadcast and 300-ohm input for FM band.

The Espey 700G FM AM tuner is second to none. It has all the features you might expect even if you laid up to $200.00 for a tuner.

This 700G FM AM tuner chassis has all controls on the front which is desirable when you are using it with any good audio amplifier many of which are designed with no tone control or preamplifier circuits. We offer the 700G FM/AM tuner at only $79.95. Shipping wt. 20 lbs.

Espey 700G with Model 501G 8-tube Hi-Fi audio amp. both for $119.90. Stock No. 700G-501G. Shipping wt. 42 lbs.

Espey 700G with Model 501E 8-tube 34-watt Hi-Fi power amplifier, $134.90.

Espey model 501G 8-tube ultra linear high fidelity 24 watt audio amplifier matching unit for use with model 700G tuner. Regular $79.95 value—$53.95 when purchased alone and $39.95 when ordered with the Espey 700G tuner. This amplifier features less than 1/2 percent distortion with high fidelity audio frequency response from 10 cps. to 20,000 cps. Hum level so low it can be detected by electrical instruments only. Chassis size—12"x5"x8". Output tubes—4 6V6GT in push-pull Williamson high fidelity. Plus 6SN7 phase inverter and 2 5V4G rectifiers. Features an eight-pound potted case $20.00 value output transformer with grain oriented iron core. Output impedance taps for 4, 8 and 16 ohms. Each **$39.95**

Espey model 501E 8-tube 34-watt ultra linear high fidelity audio amplifier companion unit to be used with the Espey 700G tuner. Same appearance as model 501G. Equipped with 4 EL 37 English Mullard output tubes. Regular $79.95 value—$69.95 if purchased separately; $54.95 if purchased with our 700G tuner. Each **$54.95**

ESPEY DEAL—1

Espey 700G-501G tuner with 24 watt amplifier plus Monarch UA6U and Goldring phono cartridge. Net **$144.95**

If 34 watt amp is desired in place of 24 add $15.00.

ESPEY DEAL—2

Espey 700G-501G tuner with 24 watt amplifier plus new 456 Collaro changer equipped with a GE RPX-052A cartridge. Net **$164.95**

If 34 watt amp is desired in place of 24 add $15.00.

ESPEY DEAL—3

Espey 700G-501G tuner with 24 watt amplifier plus Garrard RC-98 equipped with a GE RPX-052A cartridge. Net **$194.95**

If 34 watt amp is desired in place of 24 add $15.00.

SPEAKERS RECOMMENDED

Order any of the following speakers with your Espey tuner and amplifier

12" coaxial PM Model CU-14Y—$10.00 extra.

15" coaxial PM Model P15-CR—$20.00 extra.

Imperial IV system—$15.00.

Imperial VI system—$25.00.

Norelco 9762—12" regularly $59.50 at $30.00 extra.

EV84—15W system—$150.00 extra.

BUY YOUR AUTOMATIC CHANGER AT McGEE

COLLARO 456 - $34.50

MONARCH UA6U - $29.95

WEBCOR ON 8ASE

GARRARD RC-98

4-SPEED COLLARO

Latest 1957 Model RC-456. Collaro 4 speed record changer. Plays all 4 speeds, 16, 33, 45 and 78 RPM both automatically and manually. Intermixes records of the same speed and shuts off after last record. Fast 6 second change cycle. Automatic disengagement of idler wheels eliminates flat spots that cause wow and flutter. All of the desirable features of the Model RC-532, plus 4 speed operation. Model RC-456 Collaro 4 speed automatic record changer, less cartridge, Sale price, $34.50. RC-456 with G.E. variable reluctance cartridge with 3 mil sapphire and 1 mil diamond stylus, Sale price, $46.95. Large spindle $3.30.

Monarch Model UA6U—new, imported high fidelity 3 speed automatic record changer. Plays 7", 10" and 12" records automatically. Intermixes records of the same speed in any order. Features a 4 pole high fidelity motor eliminating rumble and wow. Pickup automatically returns to rest and motor turns off after last record has played. Full size 10" turntable has molded rubber pallet for better record cushioning. Base size, 10 7/8"x12 3/4". Tone arm is counter balanced to assure minimum record wear. The changer features, at no added cost the regular $9.50 net value Goldring 500 variable reluctance cartridge for the finest high fidelity record reproduction. Output 10 millivolts. Response, 20 to 16,500 cps. It requires the same input gain as popular American made variable reluctance cartridges. Model UA6U. Monarch automatic changer with Goldring cartridge, ship. wt. 15 lbs. Sale price, $29.95; Large spindle for 45 RPM records, $1.88 extra.

Popular Webcor changers at McGee for less money. Webcor 1642-1—popular 3-speed changer on metal base equipped with crystal cartridge. Sale price $27.95.

Webcor 1642-21. Same as above with base as pictured except with GE RPX-050 VR cartridge. Sale price, $31.95.

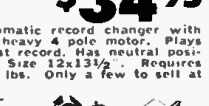
New 1957 Garrard Model RC98, "crown II," 3-speed super automatic changer, one of the world's finest. Provides the greatest combination of Hi-Fi features ever found in an automatic changer. Model RC98 changer, less cartridge—$66.15. With VR cartridge, 1 mil diamond and 3 mil sapphire needles, RPX-052A—$78.15. Large 45 rpm. center spindle $3.43, extra.

Popular RC88 "Triumph" model with most of the features of the 98. RC88, less cartridge—$53.41. With RPX-052A cartridge as above—$65.41.

NEW CHROME WEBCOR CHANGER WITH RPX-050 G.E. VAR. REL. CART. $34.95

New Webcor model 1121-270, chrome plated, 3 speed automatic record changer with RPX-050 General Electric variable reluctance cartridge. Has heavy 4 pole motor. Plays all 3 speeds and all 3 sizes. Shuts off automatically after last record. Has neutral position to prevent damaging of drive wheels. Chrome plated. Size 12x13 1/2". Requires 2 1/2" below and 6" above mounting board. Shipping wt. 15 lbs. Only a few to sell at this low price of $34.95. Not illustrated.

G.E. VR CARTRIDGE WITH DIAMOND 1 MIL STYLUS SIMILAR TO RPX-052A $15.95



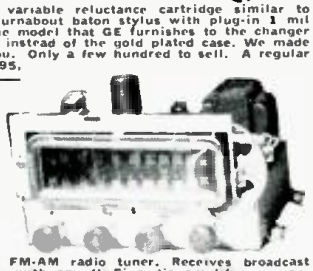
Stock No. VR-52A, genuine General Electric variable reluctance cartridge similar to RPX-052A Golden Treasure model. Has new turnabout baton stylus with plug-in 1 mil diamond and 3 mil sapphire stylus. This is the model that GE furnishes to the changer manufacturers and it has a stainless steel case instead of the gold plated case. We made a terrific purchase and pass the saving on to you. Only a few hundred to sell. A regular $23.00 value on sale at McGee for only $15.95.

AIR KING FM-AM TUNER

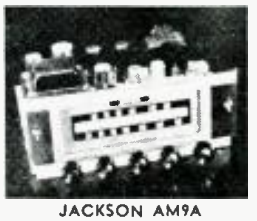
SELF POWERED

Use with any Audio Amplifier

SALE PRICE $24.99



Air King factory built, 6 tubes self-powered FM-AM radio tuner. Receives broadcast 540 to 1620 kc and FM 88 to 108 mc. Use with any Hi-Fi audio amplifier or connect it to your TV set for FM-AM reception. Selector switch has 4 positions for TV-Phono-FM and AM. 3 other controls are volume-off-on, tone and tuning. With tubes: 12AT7, 2—6AU6, 6AL5, 6SQ7, and 5Y3 rectifier. Chassis size, 11 1/2" x 7 1/2" x 6 1/4" high. Illuminated slide rule dial 7 1/2" x 2 1/2", with escutcheon plate and knobs. Self-powered with its own power transformer. FM-AM tuner chassis No. 703 as used in Air King model 17K1C combination TV-Radio-Phono with power supply added. Note: A separate audio amplifier is required to operate a speaker. Stock No. AIR-K6, self-powered FM-AM tuner, complete. Ship. wt. 10 lbs. Sale price, $24.99



JACKSON AM9A

9-TUBE HI-FIDELITY

20 Watts Audio

Dual Tone Controls

Push-Pull Mullard EL 37

$39.95 LESS SPEAKER

RECEIVES BROADCAST 550 TO 1650 K.C.

Jackson Model AM9A, 12 watt high fidelity audio amplifier and broadcast tuner combined, at less than you would normally pay for the amplifier alone. Push-pull EL37 output. Frequency response from 30 to 15,000 cps. Inputs for crystal or G.E.-7. variable reluctance pickup and crystal or dynamic microphone. Separate bass boost and treble tone controls. Radio-phono switch on front of chassis. Shielded output transformer matches 3.2 or 8 ohm speaker. Heavy duty 150 mil power transformer. 9 1/2" illuminated slide-rule dial with etched glass scale. 3 gang condenser with tuned R.F. stage and loop antenna. Receives broadcast 550 to 1650 kc. Size 13" long, 6" high and 9 1/2" deep. Complete with tubes: 2-6BA6, 6AU6, 6BE6, 6SN7, 6AT6, 2-EL37 and 5Y3. Knobs, escutcheon, diagram and instructions included.

Model AM9A, Hi-Fi amplifier and tuner. Ship. wt. 9 lbs. Sale price, $39.95.

Model AM9A with our CU-14Y 12" coaxial PM speaker, both for $49.95.

Model AM9A with our P15-CR 15" coaxial PM speaker, both for $59.95.

11-TUBE FM-AM HALLICRAFTERS

HALLICRAFTERS S-78A

Regular $89.50

McGEE'S SALE PRICE $59.95 LESS SPEAKER

★ HIGH FIDELITY

★ AUTOMATIC FREQUENCY CONTROL

Hallicrafters Model S-78A, 11 tube FM-AM superhet custom chassis. Size 73/8" x 12 1/2" x 11" deep. Complete with tubes, knobs, escutcheon, diagram and instructions. Receives broadcast 540 to 1700 kc, plus FM 88 to 108 mc. AFC holds FM stations in perfect tune. Output transformer matches 3.2 ohm or 500 ohm. High fidelity response, 50 to 14,000 cps. Bass boost tone control. A full 11 tube transformer powered chassis with push-pull 6K6 audio. This chassis found in $400 to $600 radio combinations. Has input for crystal phono pickup.

S-78A Hallicrafter 11 tube FM-AM chassis. Ship. wt. 22 lbs. $59.95

S-78A Hallicrafter with our CU-14Y 12" coaxial PM speaker $69.95

S-78A Hallicrafter with our P15-CR 15" coaxial PM speaker $79.95

6-TUBE, 6-VOLT AUTO RADIO

WITH 6x9 SPKR. $19.99

6-TUBE 12-VOLT $29.99

Six-tube, 6 volt universal mounting auto radio. Thin neat construction lends itself to a nice looking underdash installation. Some auto dash panels have room to cut out for custom installing. Speaker is not built in. Set is furnished with the popular 6x9 size. Set dimensions—9" wide, 4 1/4" tall, 7 1/4" front to back. Dial is 5 1/2"x2 1/2". Priced with tubes. Shipping weight, 12 lbs. Stock AH-759. Made to sell for much more than our $19.99 price.

NEW 12-VOLT MODEL WITH SPEAKER $29.99

Model AH-1259, 12 volt universal mounting auto radio. This is the same set as pictured above (AH-759), except made for 12 volt model 1955 and 1956 cars. Stock No. AH-1259 with 6x9" or 5x7" speaker, $29.99.

NEW 8 TUBE 6 VOLT PUSH-BUTTON MODEL $37.95

New model SH-78555-X, 8-tube, 6-volt universal mounting auto radio with push buttons and 6x9 speaker. Made for Hudson cars, but their compact construction lends them to underdash installation. Has push-pull 6AQ5 high-powered audio. Stock No. SH78-555-X with 6x9 speaker—$37.95. With 2 — 5x7 speakers — $39.95; with 1—5x7 speaker $37.95. Specify speaker size wanted. Three-section top cowl mounting antenna —$2.29 extra.

McGEE RADIO COMPANY

PRICES F.O.B. KANSAS CITY. SEND 25% OR FULL REMITTANCE WITH ORDER. BAL. SENT C.O.D.

TELEPHONE VICTOR 2-5092

1903 McGEE ST., KANSAS CITY, MISSOURI

SEPTEMBER 11-12
Second RETMA Conference on Reliable Electrical Connections, Irvine Auditorium, University of Pennsylvania, Philadelphia, Pa. Reserve through Engineering Dept., RETMA, 11 W. 42nd St., N. Y. 36, N. Y.

SEPTEMBER 27-30
New York High Fidelity Show and 1956 Convention of the Audio Engineering Society, New York Trade Show Bldg., Eighth Ave. & 35th Street, New York, N. Y. Open to public, admission 50 cents.

OCTOBER 1-3
Twelfth Annual National Electronics Conference and Exhibition, Hotel Sherman, Chicago, Ill. Sponsored by the AIEE, IRE, Illinois Institute of Technology, University of Illinois, and Northwestern University. Information on Conference from V. J. Danilov, Illinois Institute of Technology, Chicago 16, Illinois.

OCTOBER 1-3
Canadian IRE Convention, Automotive Building, Toronto, Ontario. Convention office at 745 Mount Pleasant Road, Toronto, Ontario for further details.

OCTOBER 3-5
Fifth Annual Meeting of the Standards Engineers Society, Hotel Willard, Washington, D. C. Society's mailing address P.O. Box 281, Camden 1, N. J. for further information.

OCTOBER 8-9
Second National Symposium on Aeronautical Communications, Hotel Utica, Utica, N. Y. Sponsored by the Professional Group on Communications Systems, IRE.

HAMFESTS

EGYPTIAN-ST. LOUIS
Annual Hamboree and Picnic sponsored by Egyptian Radio Club, Sept. 16 at Club grounds, one block south of U.S. 66 on east side of Chain of Rocks Canal. Mobiles work W9AIU on 3940, 3990, and 29,640 kc. No admission charge. Write WØQDF, chairman, in care of club, Box 320A, R.R. #1, Granite City, Ill. for details.

WASHINGTON
National Capital Area Hamfest, sponsored this year by Washington Mobile Radio Club, Oct. 7 at Gaithersburg Fair Grounds, Gaithersburg, Md. Noon to 9 p.m. Mobiles will work 75, 10, 6, and 2 m. bands. Gay E. Milius, Jr., W4NJF, is chairman.

Loran APN/4 Oscilloscope

Easily converted for use on radio-TV Service Bench!

BRAND NEW
Completely Assembled

Supplied only with 5" Scope type 5CP1 and RCA Crystal Unit...

$14.95

TS-100/AP OSCILLOSCOPE

BRAND NEW (worth $750) **OUR LOW PRICE** **$34.50**

Can be used with linear sweep or general purpose test scope. Cables included. Also used with circular sweep as precision range calibrator. Self contained in metal case 8" x 12½" x 16" deep. For 110V 50 to 1200 cycles AC. Demilitarized, New, with all tubes including crystals and C. R. Tube.

TS-16/APN TEST SET

Very Special at this low price. **BRAND NEW.** Complete with all cables..... **$12.95**

Type 2J1F1 SELSYNS

Operates from 57½ volts, 400 cycles. New tested. Conversion diagram for 110 volts AC included. **BRAND NEW,** each..... **$2.95**

CAPS FOR ABOVE..... **.50c**

SELSYN ZEROING ANALYZER

Model B—Made by ROLLER-SMITH

High precision testing instrument for checking alignment and operation of selsyns. Also excellent general purpose AC-DC Volt-Ohmmeter. In polished wood cabinet with hinged cover. Complete with all connecting cables and test leads.
BRAND NEW, value $150.
A BUY at only..... **$34.95**

BC-906-C FREQ. METER—SPECIAL!

Cavity type, 144 to 235 Mc. BRAND NEW in original factory packing, complete with antenna & operating manual.
OUR LOW PRICE..... **$9.95**

NAVY RECEIVER TYPE ARB

Four Band, 105 to 9050 kc. Low Freq., Ship, Broadcast—10 to 80 meters. Includes tubes and dynamotor, for 24 volt operation. Easily converted for 110 V., 12 V. or 6 V. Schematic Included. Excellent Condition. Overall: 8¼" x 7¼" x 15¼". Wt. 30 lbs.
COMPLETE WITH ALL TUBES.
Special..... **$21.50**

MOBILE TRANSCEIVER DYNAMOTOR

Special Buy! Output 625 Volts DC @ 225 Ma. Input 12½ V @ 18.7 Amps. DC. Size 8x 4¼x4".
BRAND NEW **$10.95**
Excellent Used **$8.95**

OTHER DYNAMOTOR VALUES:			Excellent	BRAND
Type	Input	Output	Used	NEW
DA-19-A	28V 11A	400V .400A	$4.99	$6.95
DM-28	28V	224V .07A	1.95	4.95
DM-32A	28V 1.1A	250V .05A	2.95	5.95
DM-33A	28V 5A	575V .16A	1.95	3.95
	28V 7A	540V .25A	1.95	3.95
DM-34D	12V 2A	220V .080A	4.25	5.50
DM-37	25.5V 9.2A	625V .225A	5.95	8.95
DM-40	14V 3.4A	172V .138A	1.75	3.45
DM-53A	28V 1.4A	220V .080A	3.95	5.95
DM-64A	12V 5.1A	275V .150A		7.95
PE-73C	28V 20A	1000V .350A	8.50	11.50
PE-86	28V 1.25A	250V .050A	2.95	5.24
PE-103	6V	500V .160A		
	12V	500V .160A	19.50	34.50
PE-186	28V 11A	400V .400A		6.95

MG-149-F INVERTER

Special

Input 24 VDC @ 36A
Output 26VAC @ 250 VA;
115V. @ 500 VA.
single phase, 400 cycles.
$19.49

SPECIAL G.E. DYNAMOTOR

INPUT: 28 V. D.C. @ 19 A.
OUTPUT: 1000 V. D.C. @ .350 A.
Model 5D18S9A. **BRAND NEW.**... **$4.95**

2-VOLT BATTERY "PACKAGE"!

1—2V. 20 Amp. Hr. Willard Storage Battery. **$2.45**
1—2V. 7 prong Synchronous Plug-in Vibrator **1.49**
1—Quart Bottle Electrolyte (for 2 cells)... **1.45**
ALL BRAND NEW!
Combination Price... **$4.99**

Willard 6-Volt Midget Storage Battery
3 Amp. Hour. **BRAND NEW.** 3⅝" x 1-13/16" x 2⅜". Uses Standard Electrolyte..... Only **$2.22**

BC-946B BROADCAST RECEIVER

520 to 1500 Kc. 6 tubes: 3—12SK7, 12SR7, 12A6, 12K8. For dynamotor operation. Easily converted to 110 or 32 Volt. 2—IF stages, 3-gang tuning cond. Complete with all tubes, in original sealed carton.
BRAND NEW **$19.95**

BC-457 TRANSMITTER—4-5.3 Mc. complete with all tubes and crystal. BRAND NEW..... **$7.88**
BC-458 TRANSMITTER—5.3 to 7 Mc. Complete with all tubes and crystal. BRAND NEW..... **$7.88**
BC-459 TRANSMITTER—7-9.1 Mc. complete with all tubes and crystal. BRAND NEW..... **$11.95**
BC-696 TRANSMITTER—3 to 4 Mc. BRAND NEW, complete with all tubes & crystal..... **$8.88**

SCR-274 COMMAND EQUIPMENT

ALL COMPLETE WITH TUBES

Type	Description	Used	Excellent Used	Brand NEW
BC 453	Receiver 190-550 Kc..	$9.95	$11.95	$14.95
BC 454	Receiver 3-6 Mc.....	7.19	8.29	11.95
BC-455	Receiver 6-9 Mc.....	5.25	7.95	9.95
BC 456	Modulator	2.24	2.75	4.24
BC-450	3-Receiver Control Box ...		1.49	1.95
BC-451	Transmitter Control Box ...		1.25	1.49
BC 696	Xmtr 3-4-Mc (like new ...		6.95	8.88

110 VOLT AC POWER SUPPLY KIT

FOR ALL 274-N and ARC-5 RECEIVERS

Can be assembled quickly and easily, on predrilled chassis. Plugs into the rear of any model 274-N receiver and delivers 24 volts as well as "B" voltages. Complete kit of parts with metal case, instructions..... **$7.95**

SPLINED TUNING KNOB for 274-N RECEIVERS. Fits BC-453, BC-454 and others. Only..... **49c**

ARC-5/R-28 RECEIVER

2 Meter superhet, 100 to 156 Mc in 4 xtal channels. Louvred alum. cabinet 7⅜ x 4⅞ x 14". Complete with 10 tubes and 4 xtals
Excel. Cond. **$12.95**

ARC-5/T-23 TRANSMITTER

Companion for above, incl. 2-832A, 2-1625 tubes and 4 xtals. **BRAND NEW**..... **$14.95**
Less Tubes..... **$6.95**

ARC-5 MARINE RECEIVER-TRANSMITTER

Navy Type Comm. Receiver 1.5 to 3 Mc BRAND NEW with 6 tubes..... **$16.95**
Navy Type Comm. Transmitter 2.1-3 Mc BRAND NEW with 4 tubes and Xtal..... **$12.45**

Ham Special! Famous BC-645 XMITTER-RECEIVER

With DIAGRAM for Easy Conversion to CITIZEN5' BAND!

BRAND NEW

Makes wonderful mobile rig for 420-500 Mc. Easy to convert for phone or CW 2-way communication. CONVERSION DIAGRAM INCLUDED. This swell rig originally cost over $1000—yours for practically a song. You get it all, in original factory carton, BRAND NEW, complete with 17 tubes, less power supply. **Conversion Instructions Included.** Shpg. wt. 25 lbs..... **$29.50**

PE-101C DYNAMOTOR for BC-645, has 12-24V input (easy to convert for 6V Battery operation)..... only **$7.95**
UHF ANTENNA ASSEMBLY, for BC-645..... **$2.45**
Complete set of 10 Plugs for BC-645..... **$5.50**
CONTROL BOX for above..... **$2.25**
SHOCK MOUNT for above..... **1.25**
CONVERSION BOOKLET. Instructions for most useful surplus rigs..... **$2.50**

TG-34A CODE KEYER

Self-contained automatic unit, reproduces code practice signals recorded on paper tape. By use of built-in speaker, provides code-practice signals to one or more persons at speeds from 5 to 25 WPM.
BRAND NEW, in original carton. **$19.95**
TAPES FOR ABOVE AVAILABLE

TG-5-B TELEGRAPH SET

Made for USA Army Signal Corps. A dandy little field set for 2-way communication. Sturdy metal container, 6¼ x 8½ x 7½", with hinged covers, complete with telegraph key and headset. BRAND NEW, in carrying case with shoulder strap..... **$9.95**
Used, exc. Cond..... **$7.95**

NEW! Cathode Ray Tubes NEW!

3CP1	$ .88	5BP4	$2.22
3FP7	.88	5CP1	2.45
5BP1	2.22	9LP7	1.88

BUBBLE SEXTANT

Made for U. S. Armed Forces, by AGFA ANSCO. Actually worth $150 or more! Has illuminated averaging disc for nighttime use. Complete with carrying case. Only..... **$9.95**

WRITE FOR FREE CATALOG!

Please include 25% Deposit with order—Balance C.O.D. MINIMUM ORDER $3.00. All Shipments F.O.B. Our Warehouse N.Y.C.

G & G Radio Supply Co.
Dept. N-9
51 Vesey St., New York 7, N. Y., CO 7-4605
Branch: 5009 N. Neva Ave., Chicago 31, Ill.

BC1206-C BEACON RECEIVER

195 to 420 Kc. made by Setchel-Carlson. Works on 24-28 volts DC. 135 Kc. IF. Complete with 5 tubes. Size 4" x 4" x 6". Wt. 4 lbs. **BRAND NEW..** **$8.88**
Brand New, less tubes..**$5.95**
USED, with tubes..... **$5.95**
USED, less tubes..... **2.95**

SCR-522 FINEST 2-METER RIG!

Terrific buy! VHF Transmitter-Receiver, complete with all components. 100-156 Mc. 4 channels. Xtal-controlled. Amplitude modulated voice. They're going fast! Excellent condition.
SCR-522 Transmitter-Receiver, complete with all 18 tubes.
COMBINATION..... **Special** **$33.33**
Receiver Only, with all tubes..... **$19.50**
Transmitter Only, with all tubes..... **$22.25**

LORAN APN-4

FINE QUALITY NAVIGATIONAL EQUIPMENT

Determine exact geographic position of your boat or plane! Complete, BRAND NEW installation consists of: ID-6B/APN-4 Indicator; R-9B/APN-4 Receiver; PE-206 Inverter; Set of Plugs; Visor for Indicator; Operation manual; Brand New, Export packed. **COMPLETE** **$129.50**

R65/APN-9 LORAN Receiver-Indicator, complete with tubes and operating manual, BRAND NEW, export packed..... **$295.00**

SPECIAL APN-9A LORAN Receiver Indicator, less tubes, NEW (demilitarized)..... **$29.50**

AIRCRAFT RADIO TRANSMITTER-RECEIVER

RADIO SET SCR-AR-283. Consists of: RECEIVER, 201 to 398 Kc and 2500 to 7850 Kc. TRANSMITTER, 2500 to 7700 Kc. for unmodulated, tone-modulated, or voice. Here's what you get, at this fantastically low price: Receiver complete with 6 tubes; transmitter complete with 4 tubes, Dynamotor for 24 V DC operation, 5 coil sets, 2 control boxes, antenna switching relay, operating manual. ALL BRAND NEW—and All Yours, for only.... **$15.95**

BC-221 FREQ. METER..... **$129.50**

BC-221 FREQ. METER CASE

Aluminum case for BC-221 or TS-161 Freq. Meters. With cdt. reg. supply using VR105, 2 ballast tubes, relay, cable, etc. Inside front: 9¾ x 7½ x 7¾". Inside rear: 2" deep. Shock-mounted.
BRAND NEW, (Add 50c for packing) **$3.99**

Original Crystal for BC-221..... **$8.45**
1000 Kc BRAND NEW..... **$1.95**
COMPLETE OPERATING MANUAL for BC-221 Freq. Meter..... **$1.95**

BENDIX DIRECTION FINDER

MF-9H-C, 12-tube remote control Navigation Direction Finder and communications receiver. 150 to 1500 Kc in 3 bands. 28 V. DC input. Ideal for commercial navigation on boats and planes. Complete installation comprises:..... **$16.50**
MN-26-C Receiver, used, with 12 tubes..... **$22.50**
MS-26-C With 12 Tubes, BRAND NEW..... **4.25**
MN-26-E Rotatable Loop..... **2.95**
MN-52 Azimuth Control Box.....

MN26Y BENDIX DIRECTION FINDER

150 Kc. to 7 Mc. Complete with tubes, motor. **BRAND NEW**..... **$26.95**
Used, like new, incl. tubes and dynamotor..**$18.95**

MICROPHONES

Model	Description	Excellent Used	BRAND NEW
T-17	Carbon Hand Mike.....	$5.45	$7.95
T-30	Carbon Throat Mike,..	.33	.69
T-45	Navy Lip Mike.....		.99
RS-38	Navy Type	2.45	4.95
T-24	Carbon Mike		3.95
TS-9	Handset		4.95

HEADPHONES

Model	Description	Excellent Used	BRAND NEW
HS-23	High Impedance.....	$2.25	$4.35
HS-33	Low Impedance ...	1.99	4.65
HS-30	Low Imp. (featherwt.) .	1.49	2.25
H-16 U	High Imp. (2 units) ...	2.75	7.95
CD-307A	Cords, with PL55 plug and JK26 jack.....		.99

SOUND POWER Headphone with Dynamic Mike, BRAND NEW..... **$3.95**

HI-FI DYNAMIC HEADSET with Cushions
Freq. Range: 40-14000 CPS. No Distortion. **BRAND NEW**..... **$5.95**

EE-8 FIELD PHONES

OUR PRICE, EACH..... **$16.66**

BC-442 ANTENNA RELAY UNIT

Wonderful Value! Consists of ¾ amp 2" RF Ammeter (antenna current indicator, 0-10 scale, Transmitter-Receiver Switching relay, in aluminum case with associated components. **BRAND NEW**..... **$2.24**

CONCORD'S SUMMER CLEARANCE SPECIALS

Concordia RECORDING TAPE

12 Reels **$1.69** Net Each **1200 Ft.**

Buy A "BAKERS DOZEN"
Pay for 12 Reels — Receive 13

Manufactured for Concord Radio by one of America's most highly respected Recording Tape Manufacturers. Frequency response at 7½ IPS is 40 to 15,000 cycles with extremely low distortion and maximum signal-to-noise ratio. Wound facing in. Output will not vary more than ½ db within any given reel, and not more than ½ db within any 2 reels. No risk is involved. If you are not completely satisfied, all of your money will be returned, no questions asked! Shpg. wt. 14 oz. ea. 1200 ft.

Stock No. TE-1-B6.....single 600 feet reel. $1.24
Stock No. TE-2-B6.....single 1200 feet reel. $1.69
Stock No. TE-3-B6.....single 1800 feet reel. $2.21

1800-ft.	1200-ft.	600-ft.
13 for $26.52	13 for $20.25	13 for $14.50
3 for $6.45	3 for $4.95	3 for $3.50

UNCONDITIONAL MONEY BACK GUARANTEE

Concord's HI-FI COAX SPEAKERS

15"—$19.95 **8"—$7.95**

These superb instruments are built especially for Concord by one of the leading audio manufacturers in the country. Acoustically designed for finest reproduction, quality built into every component for years of enjoyable performance. Sold at prices that are really exceptionally low! All of these fine speakers have remarkable power handling capacity with lowest distortion. One piece molded cones in both woofer and tweeter. Has crossover network. Response uniform 50-13,000 cps. Speakers use extremely heavy Alnico magnets (15" model has 2 lb. magnet).

12"
$9.95

Concord's Famous-Brand PM's

P-M SPEAKER VALUES. Class "A" replacement speakers at Bargain Basement prices. All have heavy Alnico V magnets, are constructed to give a lifetime of trouble-free performance.

SIZE	Singly	Lots of 3 Each	SIZE	Singly	Lots of 3 Each
4"	$1.39	$1.25	5 x 7"	$2.19	$1.82
5"	$1.49	$1.35	6 x 9"	$2.79	$2.80
6"	$1.90	$1.80	8"	$2.79	$2.59
4 x 6"	$1.95	$1.80	10"	$2.99	$2.70
All Prices are Net.			12"	$4.29	$3.95

$6.67 ea.
2 for $12.95

UTAH 5" Tweeter

Response beyond audibility. Built in crossover network. 6 db. per octave attenuation. 3.16 oz. Alnico V magnet. Binding posts. 8 ohm voice coil impedance.
Tweeter B6. Shpg. Wgt. 2 lbs.
Faithful Reproduction of All High Frequencies.

COMPLETE STANDARD COIL UHF-VHF TUNER

reg. 34.95 **Covers Channels 2 thru 83**

Concord's Price **$17.77 ea.**

Genuine Standard coil UHF-VHF front end all in one factory built one-piece tuner. Popular 41 mc type as employed in all recent models of TV sets. Our low price includes 3 tubes, 1 each 6BZ7, 6U8 and 6AF4. Fully shielded to assure low oscillator radiation. No more when these are gone.

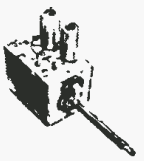
REG. PRICE $19.50.

KIRBY R-C SUBSTITUTION UNIT

RANGES—12 each resistance and capacity. 150 ohms to 10 Megohms. Capacity—.0001 to 40 mfd. Complete with handy test prods & instructions.
Size—4" x 3" x 1¼".

CONCORD'S CLOSEOUT $9.75 Each

21 mc or 41 mc. Please specify type wanted



Sarkes Tarzian CASCODE VHF TUNERS

All have 5" (or longer) shaft.

Singly $7.50

Lots of 3 **$6.95 ea.**

Top replacement tuner value is this latest model Sarkes-Tarzian 2-tube Cascode Tuner for less than manufacturer's cost. For all 13 VHF channels. Unusually high sensitivity, low co-channel interference. Tough construction to last a lifetime. Good for especially difficult fringe area reception. These units come with tubes, in excellent operating condition for immediate use.

Stock No. A6-ST-41. For 41 mc. Wt. 5 lbs. Net $7.50

LONG SHAFT

$11.99 ea. Lots of 3 **$13.00 ea.**

Latest Design 41 mc Standard Coil 2 Tube Cascode Tuner

Features long shaft. One of the most popular tuners, it is of particular interest to servicemen for replacement on earlier less efficient units. Best unit for use in fringe areas. Complete with 6J6 (or 6U8) and 6BZ7 (or 6BQ7) tubes. Cut shaft to desired length. Used in millions of sets today. Dealers stock up now.

Stock No. SC-104-B6. Shipping Wgt. 3 lbs.

UTAH DIAMOND GEM 8" HI-FI SPEAKER

"Where Hi Fi Is Desired and Space Is at a Minimum"

FEATURES: BUILT-IN TREBLE UNIT WITH LATEST CONE DISPERSER.
HANDLES 8-10 WATTS WITH EASE.
FREQUENCY RESPONSE IS BETTER THAN 40-13,000 cps.
8 ohm V.C. HEAVY ALNICO MAGNET.

STOCK #UT-8-H-C6
SHIPPING WGT. 6 Lbs.

CONCORD PRICE.....Each **$4.89**
LOTS OF 3.....$13.50

Our Price **$19.95**

DUAL DIAMOND STYLI

For Popular Cartridges

DUAL DIAMOND REPLACEMENT FOR RPX-050.
Identical to GE RPJ-012. Dual diamond. .001 mil for LP and .003 mil for Standard. List $39.50.

Stock No. 99-H-G-11D

$135 DELCO SELECT-O-MATIC RADIO

• 9 TUBES • 6 VOLT

General Motors Finest Radio

• Ideal for Cars, Boats, Trucks, Tractors, Farms, Summer Camps • Push-Pull 6V6 Output! • 9 Tube Circuit • Extended Range 6" x 9" PM Speaker • Covers Full B'cast Range • Volume, Tone and Sensitivity Controls • Signal Seeker Tuning and • Manual Tuning TOO!

CONCORD SPECIAL
$34.95
Complete

KIRBY Oscilloscope Preamplifier

Your choice of X100 or X1000 amplification. Complete with four tubes (2—12AX7's, 6X4, 0D3). Freq. response 30 cycles to 20 KC. Balancing and low freq. phase correction adjustment for good square wave patterns.

Concord's Closeout PRICE **$17.99**

- With Manual & Schematics
- Increase Voltage Gain in Oscilloscopes by 100 (or 1000)
- Calibrated Amplification Scales
- Unit Can be Used as High Gain Phono Preamplifier
- Can be Used as Signal Tracer (With Suitable Probe)

Stock No. AM-1-100 — Price either unit Wired
Stock No. AM-1-1000 — **$17.99**
Shipping Wgt. 9 lbs.

Also available in kit form — Price either unit Units are Partially wired
Stock No. AM-1-100K
Stock No. AM-1-1000K — **$12.99**

REPLACEABLE Dual Styli with SLIDING DIAMOND and SAPPHIRE TIPS!

$11.65 ea. List $30

For GE RPX-050 • EXACT Replacement for GE CARTRIDGES
Replacement for GE RPJ-013

The ideal stylus to protect those precious LP records, popularly priced to please your pocket! Dual stylus Diamond (LP) and Sapphire (78). Will fit all G.E. RPX-050 series cartridges. This fine stylus will give you many hundreds of playing hours with the best reproduction and the least record wear.

Stock No. 99-K-G-115D.....List $30.00.....Our Low Price **$11.65**

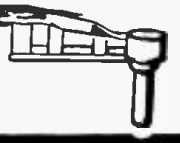
FAMOUS BRAND REPLACEABLE DIAMOND

Exact Replacement for GE RPJ-004

No finer Diamond stylus made. First quality. American manufactured and guaranteed by Concord to be the finest diamond stylus available at any price. Will add years of additional life to your favorite records.

Stock No. 99-K-G-10LPD...Reg. Net $16.17...While They Last $10.95

$10.95 ea.



CONCORD RADIO • 45 Warren Street, N.Y. 7, N.Y.

CONCORD's HiFi BARGAIN DEPARTMENT

Webcor 3 Speed Fully Automatic Changer

With GE RPX-050 Cartridge

33⅓, 45, and 78 rpm on 7", 10" and 12" records. Automatically shuts off after last record. Balanced lightweight magnesium tone arm and heavy duty motor combine to give low wow performance and maximum record protection. Mounting space required—14½" x 13½"—6 5/16" above and 2 1/16" below mounting board. 105-120 volts 60 cycles AC.
Stock No. A6-1400-P—Shpg. Wt. 14 lbs.

Concord's New Price **$27.99** ea.

NEW 4-SPEED

16⅔ | 45
33⅓ | 78

Automatic Record Changer with Famous Hi-Fi Cartridge

NEW 4-SPEED AUTOMATIC RECORD CHANGER

NEW EXCLUSIVE VM 4-SPEED RECORD CHANGER. Plays 33, 45 and 78 plus the new 16 RPM "talking book" speeds. Has new patented constant speed turntable drive. Rumble-free performance, gives twice the life, half the wear. VM Tri-o-matic spindle gently lowers precious records on air cushion to turntable. Will play for hours without interruption.
Stock # 1593-B6 Wgt. 14 lbs.

$24.99 each

45 rpm spindle wt. 2 lbs.
Stock # A45-3-B6.....$1.98

MODERN COMPACT 3 SPEED CHANGER AND AMPLIFIER

FLIP HI-FI CARTRIDGE — HEAVY DUTY SPEAKER

FEATURES
3 Speeds—78, 45, 33⅓ R.P.M.
Flip Over Dual Stylii
Intermixes 10" & 12" Records
4 Pole Motor
Extended Range Tone Control
Weighted Turntable

Concords presents a compact, 3 speed changer and amplifier, with features found only in the finest record players, full range tone control, plus a powerful amplifier and fine 5" P.M. speaker, enable the listener to get the utmost in musical entertainment.
Shipping Wght.: 18 lbs.
45 R.P.M. Spindle.....$2.99
Shipping Wgt.: 8 ozs.

$35.88 Reg. 69.00

Stock # B6-ASR — IMPORTED BRITISH UNIT

MARKEL

MODEL 72 Record Changer

Plays BOTH sides of 78 RPM Records automatically, in sequence. Separate Hi-Fidelity arm for 33 RPM records. Finest dual-styli obtainable. Weighted turntable. Motor is finest of its type. Push button selection.

Reg. Cost 125.50
Almost 70% Off
CONCORD'S WHOLESALE PRICE

$32.95 each

SPECIAL CONCORD IMPORT

FINEST IMPORTED HIGH FIDELITY AUTOMATIC CHANGER

CLOSEOUT PRICES

3-speed automatic-intermix record-changer

Reg. $49.95
Concord's Low-Low Price
$29.95 ea.
Lots of 3
Less Cartridge

45 spindle $1.88

- With Goldring No. 500 Var. Rel. Cartridge
- 4 Pole Motor for Low Rumble and Wow
- Shuts Off After Last Record
- Intermixes Records of Same Speed
- Response Is Better Than 20 to 16,500 cps.
- Tone Arm Is Counterbalanced

Automatically plays and changes 7", 10", 12" records at 33⅓, 45, or 78 RPM. Intermixes them in almost any order. 4-pole motor practically eliminates "rumble" and "wows." Fitted suspension springs keeps down feed-back. Ten-record capacity. Simple design for long, trouble-free life. Arm comes down into lead groove unfailingly. Pick-up arm comes to rest and motor switches off after last record plays. Combined 3-speed control and on-off-reject switch. Operates on 100-125 V. 60 cyc. AC. This one is a beauty.
A6-UA6 (stock No.) SHIPPING WGT. 15 LBS.

COLLARO RC 54 CHANGER

FEATURES:
3 Speeds 78, 45, 33⅓ RPM.
4 Pole Motor.
Plug in head with flip over crystal cartridge.
Dual fine styli.
Weighted turntable.
Intermixes 10" and 12" big records.

Dealers—Servicemen. Here is your opportunity at the right price!

Complete with Flip-Over Hi-Fi Cartridge

CONCORD'S CLOSEOUT PRICE

$27.95 each

Intermixes All 10" and 12"

45 SPINDLE $3.65 FOR ABOVE

Collaro is England's finest record changer. It took Concord Radio Corp. to bring this unit to you at a price designed to allow all music lovers to own one. Such outstanding features as the finest 4 POLE motor which minimizes "wow" or "rumble," a plug-in head with a HI-FIDELITY dual styli, weighted turntable, and intermixing of 10" and 12" records are only a few reasons to consider when you order your Hi-Fidelity Record Changer.

Famous Make
Concord's Low-Low Price
$17.95

3 WAY PORTABLE RADIO

CONCORD SUPER SPECIAL

4 Tubes plus Rectifier. 1U4, 1U5, 1R5, 3V4. Built-in Antenna. Sturdy Modern Plastic Case. Slide-Rule Dial. Powerful Circuits Enable Long Distance Reception. Fine Alnico Magnet PM Speaker. Lightweight. Weighs 4 Lbs. (Less Batteries). Latest Superhet. Circuit.
Reg. Price $32.50

Complete Set of Batteries for above $3.25

DeLuxe PICK-UP ARM

With Famous Hi-Fidelity Dual Sapphire Turnover Cartridge

- Famous Hi-Fidelity Turnover Cartridge
- Hi-Fidelity Dual Sapphire Styli
- Balanced Tone Arm
- The ideal unit for replacement purposes

Stock No. DEL-PIK
Shipping Wgt. 1 lb.

REGULAR PRICE $11.95
CONCORD'S PRICE
$4.55
With Cartridge

98¢ WORTH $8.95

78 RPM CUTTING ARMS

It's absolutely unbelievable!! We wouldn't believe ourselves if it didn't appear in our own catalog . . . but here it is, and we hope you make the most of it. Brand New 78 RPM magnetic cutting arms, complete with output transformer to match from 6V6 output to magnetic cutting cartridge. Arms are counter-balanced and have adjustable cutting pressure. Ideal for building your own low cost record cutter. Quantity limited, so buy now . . . avoid disappointment.

Stock No. 99K-DP78C.....Worth $8.95.....Only 98c ea.
CUTTING NEEDLES FOR ABOVE—Package of 5 high carbon cutting needles for use with above arm.
Stock No. 99K-5CSR.....Reg. $1.50.....Now only 98c

Unbeatable value from Concord Radio. Complete with 6V6 output transformer. Counterbalanced arm with adjustable cutting pressure. Concord's Closeout Price 98¢
Stock No. 99K-DP78C
Shipping Wgt. 2 Lbs.

DIgby 9-1132

CONCORD RADIO CORP.

45 WARREN ST., N. Y. 7
DEPT. RN-9-6

RUSH THE FOLLOWING ITEMS:

1—.....
2—.....
3—.....
4—FREE CATALOG

☐ I AM ENCLOSING $.....
☐ SEND C.O.D. I ENCLOSE 20% DEPOSIT

NAME .....
ADDRESS .....

G-E PROMOTIONAL CATALOGUE

The Tube Department of *General Electric Company,* Schenectady, New York has illustrated over 100 different service aids for television and radio service dealers in its 16-page 1956-57 promotional catalogue.

New dealer aids featured in the catalogue include "Sign-A-Rama," win-

dow valance, "See-Lect-A-Tube," and a deluxe tube caddy. Other new dealer aids illustrated include an illuminated wall-shelf clock, a brochure of assorted radio commercials, children's color books, picture tube "nek-rest," one-color ad mats, assorted postcards, bench mirror, and a technician's raincoat.

The catalogue also includes business identification signs, window streamers, self mailers, postcards, ad mats, TV commercials, doorknob hangers, public relations material, business stationery, business aids, service aids, TV service clothing, and technical publications.

A copy of this Promotional Catalogue (ETD-589-D) is available to service dealers through authorized *G-E* electronic tube distributors.

* * *

RCA FALL CAMPAIGN

Radio Corporation of America is launching a heavy, all-media campaign to introduce its 1957 line of hi-fi and home radio and TV receivers to the public.

The program, outlined recently to dealers and the trade press, includes one of the largest Sunday supplement campaigns ever launched by a single manufacturer; a heavy schedule of cooperative lineage; a saturation schedule of radio spots aimed at the weekend motorist; sponsorship of TV spectaculars in color and a minimum of one-hour color programming each night; in addition to in-store aids of all types.

The new merchandising campaign

will cover the company's black-and-white and color television line; the newly announced, low-priced stereophonic tape players; and several hi-fi home phonograph instruments.

* * *

GARAGE DOOR OPENER DISPLAY

An eye-catching, three-dimensional display featuring the company's garage door opener has been released to the trade by *Perma-Power Company* of

4727 N. Damen Avenue, Chicago, Illinois.

Designed in four brilliant colors, with the most modern art techniques, this point-of-sale piece is an excellent traffic producer. Added to its three-dimensional effect is a flashing light which lights the push-button on the dashboard and the bottom panel of the door at the same time—making the door look as if it were actually opening.

Further information about the display and the garage door opener is available from the manufacturer direct.

* * *

E-V SALES TOOLS

Electro-Voice, Inc. of Buchanan, Michigan is backing up its new "Power-Point" phonograph cartridge-needle combination units with heavy advertising support and ten tested sales tools.

The theme of the campaign is "Pete

Power-Points the way to profits"—"Pete Power-Point" being a cartoon character created especially for this merchandising program.

The sales tools for distributors include a slidefilm, an introductory package which contains full information on the cartridges, a phonograph record with "Pete Power-Point" as the spokesman, and sealed-in-plastic samples of the product.

Dealers will receive point-of-purchase cards, window and wall stream-

ers, phonograph records, and envelope stuffers aimed at consumers. Dealers will be shown the slidefilm.

All of this promotion is being reinforced with full-page, two-color ads in trade publications.

* * *

PLASTIC FUSE CADDY

Littelfuse, Inc. of Des Plaines, Illinois has developed a new transparent plastic fuse caddy which has been designed to fit easily into the technician's tube caddy and contains an assortment of 15 different types of fuses.

The unit provides a compact storage unit for the technician's fuse needs

and permits rapid inventory checking before answering a service call. The fuses included in the caddy will handle all of the fuse replacements normally encountered by the technician. Three compartments are left empty so that the technician can fill them with the particular fuses for which he has special needs.

The Model No. 094037 fuse caddy is being marketed as a unit by the electronic parts jobbers handling the company's line.

* * *

"JUMBO ZOO"

Admiral Corporation is offering a "jumbo zoo" consisting of four large stuffed animals in realistic colors which will be given free with every purchase of a 21" black-and-white TV set or any of the company's major appliances.

Dealers are being supplied with a complete promotion display kit. This contains both store and window displays, including a window banner, pennants, special co-op ads, radio spots, individual product displays, etc.

* * *

"TEN TOP TUBES"

"Ten Top Tubes" is the title of a new concept in tube packaging recently announced by *Westinghouse Electric Corporation* of Elmira, New York.

Under the new plan, dealers and distributors are able to buy in a single package the ten highest volume types of receiving tubes as listed by the RETMA in 1955.

The new package contains fifty tubes, five of each type. In addition, each package contains, as a premium, a thermal picnic bag valued at $2.95 retail. Prices of the tubes are not affected by the new packaging plan. Each pack contains the following tube types: 6BZ7, 6CB6, 6AU6, 6BQ7A, 6AL5, 12AU7, 6J6, 6SN7GTB, 1B3GT, and 5U4GB. The pack has a double handle built into the box to permit the technician to carry these tubes on home service calls when his tube caddy is filled. —30—

LIFETIME GUARANTEED TUBES

SAVE

BRAND NEW

PICTURE TUBES

- RCA Licensed
- One Year Unconditional Guarantee

Type	Price	Type	Price
10BP4	$11.90	17BP4	$20.63
12LP4	$14.38	19AP4	$24.81
14BP4	$16.86	21AP4	$28.79
16RP4	$19.38	21EP4	$28.79
16LP4	$19.38	24AP4	$42.50

Picture Tubes shipped F.O.B. Harrison, N. J. Above types are most popular. However, you may order any equivalent size at the same price.

SAVE

USED

TV SETS

Picture Tube Guaranteed To Work!

- Emerson
- RCA
- Philco
- GE
- Motorola
- Zenith
- Capehart
- Others

10" SET Table Model ... $16.95 Console ... $19.95
12" SET Table Model ... $22.95 Console ... $24.95
14" SET Table Model ... $27.95 Console ... $31.00
16" SET Table Model ... $32.00 Console ... $34.95
17" SET Table Model ... $37.00 Console ... $39.00

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- Each Tube Individually Boxed and Guaranteed
- Over A Half Million Tubes Always in Stock
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0Z4	.43	3BN6	.70	6AV6	.39	6K8	.65	7C6	.43	14B6	.38
1A7GT	.43	3CB6	.52	6AX4GT	.60	6L6	.68	7C7	.45	14Q7	.50
1A7G7	.43	3Q4	.46	6AX5GT	.57	6L7	.42	7E5	.45	19BG6G	1.15
1B3GT	.65	3Q5GT	.57	6B4G	.52	6N7	.60	7E6	.55	19T8	.65
1C5GT	.41	3S4	.47	6B8	.69	6Q7	.40	7E7	.70	21A	.39
1D5GP	.43	3V4	.47	6BA6	.47	6S4	.40	7F7	.59	25AV5GT	.78
1E7GT	.41	4BQ7	.89	6BA7	.58	6SA7	.45	7F8	.70	25BQ6GT	.78
1G6GT	.41	4BZ7	.95	6BC5	.47	6SC7	.48	7G7	.75	25L6GT	.47
1H4G	.43	5AW4	.75	6BC7	.80	6SG7	.41	7H7	.50	25W4GT	.43
1H5GT	.47	5BG6G	1.15	6BE6	.45	6SH7	.43	7J7	.75	25Z5	.37
1J6GT	.47	5J6	.63	6BF5	.40	6SJ7	.43	7K7	.75	25Z6	.37
1L4	.45	5T4	.69	6BF6	.50	6SK7	.45	7L7	.75	27	.25
1L6	.55	5U4G	.43	6BH6	.50	6SL7GT	.55	7N7	.50	35A5	.46
1LA4	.57	5U8	.74	6BJ6	.47	6SN7GT	.55	12AT6	.37	35B5	.50
1LA6	.47	5V4G	.59	6BK5	.68	6SQ7	.39	12AT7	.66	35C5	.50
1LB4	.57	5Y3	.31	6BK7	.76	6SR7	.42	12AU6	.41	35L6GT	.47
1LC5	.49	5Y4G	.36	6BL7GT	.75	6SS7	.41	12AU7	.53	35W4	.34
1LC6	.47	5Z3	.41	6BN6	.58	6T4	.95	12AV6	.35	35Y4	.34
1LD5	.57	6A7	.57	6BQ6GT	.78	6T8	.68	12AV7	.67	35Z3	.39
1LE3	.57	6A8	.45	6BQ7	.78	6U8	.75	12AX4GT	.65	35Z5GT	.34
1LG5	.57	6AB4	.43	6BY5G	.58	6V3	.80	12AX7	.58	37	.29
1LH4	.64	6AC7	.67	6BZ7	.88	6V6GT	.46	12AZ7	.63	50A5	.46
1LN5	.47	6AF4	.79	6C4	.37	6W4GT	.39	12B4	.68	50B5	.50
1N5GT	.50	6AG5	.50	6C5	.35	6W6GT	.53	12BA6	.46	50C5	.50
1R5	.50	6AG7	.69	6CB6	.49	6X4	.34	12BD6	.48	50L6GT	.43
1S5	.42	6AH6	.69	6CD6G	1.15	6X5	.34	12BE6	.46	75	.42
1T4	.50	6AJ5	.70	6D6	.48	6X8	.73	12BH7	.60	76	.42
1U4	.47	6AK5	.54	6E5	.44	6Y6G	.55	12BY7	.65	77	.38
1U5	.42	6AL5	.39	6F5	.37	7A4	.45	12BZ7	.61	78	.38
1V2	.65	6AQ5	.46	6F6	.38	7A5	.53	12CU6	.95	80	.34
1X2	.61	6AR5	.46	6G6	.40	7A6	.45	12SA7	.45	84/6Z4	.44
2A3	.55	6AS5	.48	6H6	.38	7A7	.43	12SJ7	.45	117L7GT	1.09
2A5	.57	6AS6	1.70	6J4	1.79	7A8	.45	12SK7	.45	117N7GT	1.09
2A7	.55	6AS7G	2.19	6J5	.39	7B5	.39	12SN7GT	.56	117P7GT	1.09
3A4	.51	6AT6	.39	6J6	.47	7B6	.42	12SQ7	.37	117Z3	.35
3A5	.50	6AU4GT	.65	6J7	.43	7B7	.41	12SR7	.45	117Z6GT	.63
3AL5	.45	6AU5GT	.59	6J8G	.85	7B8	.45	12V6GT	.45		
3AU6	.46	6AU6	.42	6K6GT	.37	7C4	.39	12X4	.37		
3BC5	.54	6AV5GT	.65	6K7	.39	7C5	.42	14A7	.42		

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- FREQUENCY 120 KC TO 260 MC
- 120 KC TO 130 MC ON FUNDAMENTALS
- LABORATORY ACCURACY AND QUALITY

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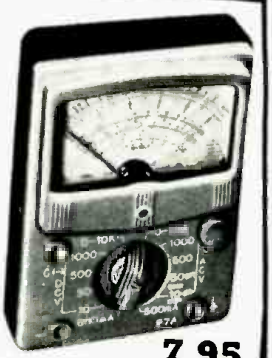
A completely wired and tested instrument not to be confused with units sold in kit form at almost the same price, but with a quality and accuracy of instruments 3 to 4 times its price. Six overlapping ranges generate signals of 120KC — 320KC, 320KC—1000KC, 1MC—3.2MC—11MC, 11MC—38MC and 37MC—130MC all on fundamentals with calibrated harmonics from 120MC to 260MC. Selector switch gives instant choice of ranges. Switch gives choice of internal modulation of 400 CPS or use of any external source at other frequencies. For audio testing the 400 cycle signal can be used separately. Outputs are unmodulated RF, modulated RF and 400 CPS audio. RF output is in excess of 100,000 microvolts and jacks are provided for choice of either high or low RF output. Stability is insured by special circuit design. Has a fine adjustment RF control. AF output is 2-3 volts. AF input is 4 volts across 1 megohm. Large clear 5 inch etched dial plate and pointer are protected by transparent plastic bezel. Common AF terminals for EXT-MOD input and INT-AF for audio tests eliminate need for special AF output connectors. Machine engraved panel lettering. Handsome gray metal case with carrying handle. Measures 6½" x 10" x 4½". Comes complete with pair of leads. AC line cord and plug. Operates on 105-125V 50-60 cycle AC. Shpg. wt., 8 lbs.

LAFAYETTE LSG-10 SIGNAL GENERATOR 22.50

NEW POCKET AC-DC VOM MULTITESTER

2,000 ohm per volt Sensitivity on both DC and AC

160 ua 3" METER
1% PRECISION RESISTORS
SILVER CONTACT SELECTOR SWITCH



FULL SCALE RANGES

DC Volts: 0-10; 0-50; 0-500; 0-1000 Volts — *AC Volts:* 0-10; 0-50; 0-500; 0-1000 Volts—*DC Current:* 500 ua and 500 ma — *Resistance:* 0-10K; 0-1 Meg — *Decibels:* — 20 to +22; +20 to 36 db (0 db — 0.775 V)—*Capacity:* 250 mmfd to .2 mfd—.005 mfd to 1 mfd—*Output Ranges:* 0-10; 0-50; 0-500; 0-1000 volts

7.95

Best Buy in America! A very accurate and sensitive VOM. This Multitester is a complete instrument (not a kit) with high quality and sensitive 160 microamp meter; 2000 ohm per volt on both AC and DC. Single selector switch, 1% precision resistors, 3" meter. Features extreme versatility, accuracy and ruggedness. In attractive plastic front panel, with metal bottom for ruggedness and shielding. First capacity range requires 50 volt AC source. Second capacity range requires 10 volt AC source. Size 4¼"x3½"x1⅝". Complete with test leads and batteries. Shipping weight 4 lbs.

RW-27A ..... Complete 7.95

NEW! LAFAYETTE CAPACITANCE-RESISTANCE TESTER WITH "IN-SET QUICK CHECK"

COMPLETELY WIRED AND TESTED

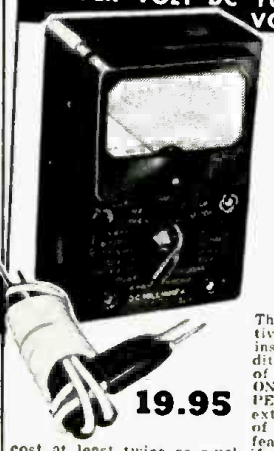
- TWO INSTRUMENTS IN ONE
- CHECKS ELECTROLYTIC, PAPER, MICA AND CERAMIC CONDENSERS
- 4 DIRECT READING CAPACITY SCALES FROM .00001 MFD TO 1000 MFD
- CHECK FOR OPEN SHORTS, LEAKAGE AND INTERMITTENTS
- 2 RESISTANCE RANGES FROM 100 TO 5 MEGOHM

34.50

Here is a "must" for servicemen and lab technicians. A completely self-contained AC operated capacitance and resistance bridge, plus a quick check for in the set testing. Large 5 direct reading scale has 4 ranges of .00001-.005 MFD, .001-.5 MFD, .1-50 MFD and 20-1000 MFD. Resistance ranges are 100-50,000 OHMS and 10,000 to 5 megohm. Quick check feature enables you to check capacitors for shorts, open or intermittent while in circuit—no need to remove them from the set till you're sure they need replacement. Leakage test switch gives you choice of 25, 150, 250, 350 or 450 volts for checking leakage under correct potential. Separate power factor control with continuous settings from 0 to 50%. Operation is simple and accurate, using a magic-eye tube as the null detector. Attractively finished steel case with etched panel and rounded corners, measures 14½"L x 8¼"H x 5"D. Shpg wt. 19 lbs.

MODEL LC-4 ..... NET 34.50

HIGH SENSITIVITY 20,000 OHM PER VOLT DC 10,000 OHM PER VOLT AC MULTITESTER



LOOK AT THESE FULL SCALE RANGES!

D.C. Volts: 0-6; 0-30; 0-120; 0-600; 0-1200; 0-6000 Volts — *A.C. VOLTS:* 0-6; 0-30; 0-120; 0-600; 0-1200 Volts — *RESISTANCE:* 0-10K; 0-100K; 0-1 Meg; 0-10 Megohms— *D.C. CURRENT:* 0-60 Microamp; 0-6; 0-60; 0-600 Milliamps — *DECIBEL:* — 20 to +17 db (0 db—0.774V) — *CAPACITY:* .0001-.01; .005-.15 mfd — *INDUCTANCE:* 20-2000 millihenry —*OUTPUT RANGES:* 0-6; 0-30; 0-120; 0-600; 0-1200 Volts

19.95

The new Lafayette high sensitivity Multitester is a complete instrument (not a kit). In addition to its unusual sensitivity of 20,000 OHMS PER VOLT ON D.C. AND 10,000 OHMS PER VOLT ON A.C., and the extraordinary number and scope of its ranges, it is packed with features that would make it cost at least twice as much if made in this country. Uses 1% precision resistors, silver contacts on selector switch, 35 ua 3" meter. Dependable, rugged and accurate. Even the test leads are heavy duty with high voltage insulation. Voltage source required for low capacity range is 120V A.C., for high range capacity and inductance scale is 6V A.C. Attractive plastic front with metal bottom. Size 6¼"x4¼"x2½". Complete with batteries and leads. Shipping weight 4½ lbs.

RW-30A ..... Singly, Each 19.95
In lots of 3, Each 19.25

NEW! LAFAYETTE CAPACITOR-RESISTANCE TESTER

COMPLETELY WIRED AND TESTED

21.50

- CHECKS ALL TYPES OF CONDENSERS FOR CAPACITY, LEAKAGE, OPEN SHORTS OR INTERMITTENT CONDITION
- DIRECT READING SCALES FROM .00001 TO 1000 MFD AND 100 TO 5 MEGOHMS

A stable and accurate bridge type circuit measures capacitance in 4 ranges of .00001-.005 MFD, .001 to .5 MFD, .1 to 50 MFD and 20 to 1000 MFD. Two resistance ranges of 100-50,000 and 10,000 to 5 megohms. Check leakage under actual load with choice of 25, 150, 250, 350 or 450 volts available by selector switch. Power factor control from 0 to 50%. Checks for leakage, open, short, or intermittent operation. All readings taken directly off scales after setting magic eye to maximum. Completely self-contained power supply. Attractively finished steel case with rounded corners and etched panel. Operates from 110V AC. Size 9⅝"L x 7⅛"H x 5¼"D. Shpg. wt. 10 lbs.

MODEL LC-15 ..... NET 21.50

32.50

FM-AM TUNER KIT

- SIMPLIFIED DETAILED INSTRUCTION MANUAL
- MEETS FCC REQUIREMENTS FOR RADIATION
- GROUNDED GRID TRIODE AMPLIFIER

- ARMSTRONG FM CIRCUIT WITH FOSTER-SEELEY DISCRIMINATOR
- AFC DEFEAT CIRCUIT WITH FRONT PANEL CONTROL

The excellence of its design and the quality of its components combine to provide this compact high-fidelity FM-AM tuner with superb characteristics normally found in units costing several times as much, and with performance unbelievable at this low price. Features Armstrong FM circuit with limiter and Foster-Seeley discriminator. Simplified tuning with slide-rule dial and flywheel counterweighted mechanism. AFC defeat circuit combined with tuning control. Attractive etched copper-plated and lacquered finish.

SPECIFICATIONS

FREQUENCY RANGE: FM, 88-108 MC; AM, 530-1650 KC. **ANTENNA INPUT:** FM, 300 ohms; AM, Ferrite loopstick and high impedance external antenna. **CONTROLS:** 2 — a function control for AM, FM, PHONO, TV and a tuning/AFC defeat control. **DISTORTION:** Less than 1% rated output. **FREQUENCY RESPONSE:** FM, ± .5 db 20 to 20,000 cps; AM, ± 3 db 20 to 5000 cps. **SENSITIVITY:** FM, 5μv for 30 db quieting; AM, Loop sensitivity 80μv/meter. **SELECTIVITY:** FM, 200 KC bandwidth, 6 db down — 375 KC FM discriminator peak to peak separation; AM, 8 KC bandwidth, 6 db down. **IMAGE REJECTION:** 30 db minimum. **HUM LEVEL:** 60 db below 100% modulation. **TUBE COMPLEMENT:** 2-12AT7, 1-6BA6, 1-6BE6, 2-6AU6, 1-6AL5 plus 1-6X4 rectifier. **SIZE:** 5¼" high x 9⅝" wide x 9½" deep (excluding knobs). **CONSUMPTION:** 30 watts. For 110-120V 60 cycles AC. Less metal case. Shpg. wt., 9 lbs.

KT-100 ..... Net 32.50
ML-100 ..... Metal cage for above, shpg. wt., 3 lbs. ..... Net 5.00

SLIM HIGH OUTPUT DYNAMIC MICROPHONE

NEW!

Reg. Price 41.50 Net 9.95

A pencil-slim design, high output PA Dynamic Microphone of exceptional quality, at a price that is ⅓ of the price of any comparable microphone on the market today. Very smooth response, 50-11,000 cycles. Omnidirectional, tiltable head. Switch on side gives choice of either high impedance (50,000 ohms) or low impedance (250 ohms). Instantly removable bracket permits use either on stand or as hand mike. Features exceptional mechanical strength. Cast case with satin chrome finish, ⅜"-27 thread. Acoustically-treated grille head, 8" long; 1¼" barrel diameter. Shipping weight 2 lbs.

PA-29 ..... In lots of 3, Each 9.25
Singly, Each 9.95

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THE FINEST TRANSCRIPTION TURNTABLE AND TONE ARM FOR THE PROFESSIONAL USER AND THE AUDIOPHILE

PK-100A TRANSCRIPTION TURNTABLE

New 3-speed instrument with built-in stroboscope and viewer for exact speed determination, and magnetic brake for instantaneous speed variation. Precision engineered to meet professional standards for wow, rumble and flutter content. Heavy 12" cast aluminum rim-driven turntable. Variable speed control permits adjustment of each speed within ± 7% using efficient frictionless magnetic brake. Heavy-duty constant speed 4-pole induction motor freely suspended and isolated by shock-mountings to eliminate vibration transferral. R-C filter network suppresses "pop" in speaker. Truly a delight for the connoisseur. Size: 13½" x 14" and requires 2¾" clearance above and 3¾" below motorboard. For 110-130V and 60/50 cycle AC. Power consumption 12 watts. Handsome hammertone gray finish. Shpg. wt., 20 lbs.

PK-100-A ..... Net 49.50

PK-90 VISCOUS-DAMPED TONE ARM

This transcription arm assures dependable and stable operation, utilizing the "floating action" principle of "viscous-damping." The arm is supported at a single point by a pivot and jewel bearing having negligible friction. Damping is accomplished by a silicone fluid occupying the gap between a ball and socket. This damping control permits high compliance and negligible tracking error, and prevents damage to either record or stylus should the tone arm be accidently dropped. Low frequency resonance, skidding and groove-jumping are likewise minimized. The tone arm accepts all records up to 16" and accommodates virtually all hi-fi cartridges by means of precisely engineered adapters which simplify installation and provide proper stylus pressure.

This tone arm is a quality companion to the PK-100 with matching finish. Shpg. wt., 2½ lbs.

PK-90 ..... Net 19.50

HIGH FREQUENCY TWEETER WITH ACOUSTIC LENS
DIRECT IMPORTATION MAKES THIS PRICE POSSIBLE!

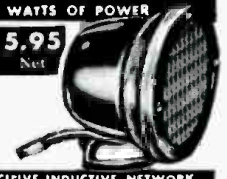
- FREQUENCY RESPONSE FROM 2000 CPS TO BEYOND AUDIBILITY
- LOUVERED ACOUSTIC LENS FOR UNIFORM SOUND DISPERSION
- HANDLES 25 WATTS OF POWER
- PRICED EXCEPTIONALLY LOW

New high frequency tweeter featuring a louvered acoustic lens for uniform sound dispersion and capable of handling up to 25 watts of distortion-free power. The directional tendency of high frequency notes is overcome by the natural wide dispersion angle of the short horn and the acoustic lens which disperses and radiates the high notes smoothly throughout the entire listening area. The lens is detachable for panel mounting, with a separate base for the tweeter furnished for external mounting where desired. Aluminum voice coil has 16 ohms impedance. Size: 4¼" long x 3" diameter, lens extends 2½". Requires a crossover network, preferably one with a level control, such as the LN-2. With full instructions. Shpg. wt., 5 lbs.

HW-7 ..... Net 14.95

METAL-CASED CONE TYPE HI-FI TWEETER
FREQUENCY RESPONSE 2000-16,000 CPS - HANDLES 20 WATTS OF POWER

Highest quality cone type high frequency tweeter having a range from 2000 to 16,000 cycles. Especially efficient at higher end of audio spectrum where other cone type tweeters tend to lose clarity and volume. Entirely closed in a metal case with a base so that it can stand by itself or be mounted on a flat surface with mounting bracket supplied. Rated to handle 20 watts of power. A crossover network is required: the Lafayette LN-2 is ideal. Voice coil impedance 8-16 ohms. Size: 3⅛" x 2⅛" x 3" Diam. Shpg. wt., 3 lbs.



HK-3 ..... Net 5.95

CROSSOVER NETWORK
- CAPACITIVE-INDUCTIVE NETWORK WITH CROSSOVER AT 2000 CPS
- BUILT-IN LEVEL BRILLIANCE CONTROL

The frequencies above 2000 cycles are channeled to the high frequency tweeter by means of the high-Q inductance and capacitance comprising this efficient crossover network. The highs and lows are brought into acoustic balance by means of a continuously variable level-brilliance control. Control has a 2½ ft. long cable for remote mounting. Network matches 8-16 ohm speakers with insertion loss reduced to a minimum. Enclosed in metal case 6" L x 2⅝" H x 2⅝" D. With full instructions. Shpg. wt., 5 lbs.

LN-2 ..... Net 8.75

IMPORTED 12" HI-FI COAX. SPEAKER

- FREQUENCY RANGE 30-15000 CPS
- HANDLES 20 WATTS OF POWER
- COMPLETE WITH LEVEL CONTROL
- POWERFUL TSK-5 MAGNETS
- SPECIAL SHEEPSKIN-EDGED CONE

A Lafayette exclusive import and exceptional value. Consists of a 12" woofer, coaxially mounted 2½" tweeter and a built-in crossover network. The specially processed fibre cone has a sheepskin edge to suppress unwanted nodal vibrations and insure beautiful tone quality. Highly efficient TSK-5 magnets. Level control provides variation to 6 db cut. Maximum input 20 watts. Impedance 8 ohms. Rugged all-metal frame. If made in this country, would cost at least $49.50. Shpg. wt., 11 lbs.

SK-58 ..... Net 29.50

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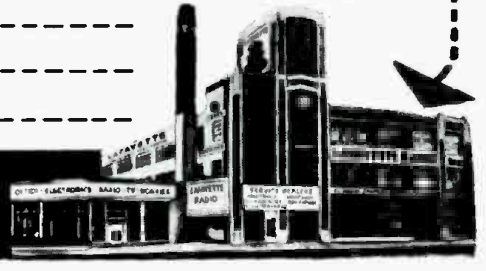


CUT OUT AND MAIL TODAY!

TRANSISTOR BRIDGE OSCILLATOR

By L. FLEMING

THE simple transistor oscillator shown in the diagram is a handy replacement for the somewhat unreliable microphone hummer used in the older Heath impedance bridges and in the General Radio 650-A bridge. In addition, it can be used as a 1000-cycle tone source for audio and p.a. service work, where it will deliver a good waveform into any load impedance, down to practically a short circuit. Power drain is about 4 ma. from a 6-volt source, which may be the regular battery in the impedance bridge cabinet.

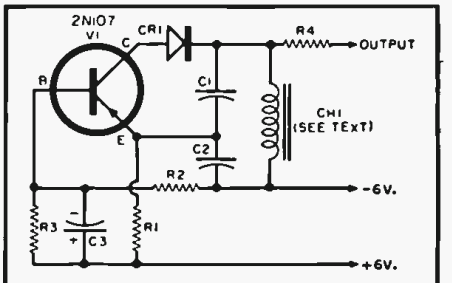
The oscillator circuit is a Colpitts with some bias stabilization. The special feature is a tank circuit with an unusually low L/C ratio (judged by vacuum-tube standards). This does a better job of matching the low impedance requirements of transistors. In addition, it permits operation into low impedance external loads without much degradation in waveform. The 4700-ohm resistor, R_4, is added for isolation, so that the external load can be practically anything, such as a 2-μfd. capacitor or an r.f. choke, without affecting the 1-kc. frequency of oscillation by more than 1 per-cent or so. This is particularly necessary in impedance bridges.

While the circuit is designed to use a simple coil without taps, the coil must have good "Q" at 1-kc. This rules out the use of a 100-mhy. r.f. choke. To save the cost of a toroid, however, it is feasible to cut off the winding of an old midget-type filter choke and rewind it full of No. 28 enameled wire. Adjust the air gap with thin cardboard until the inductance is about right. A rather large gap is best. Inductance can be anywhere between 80 and 150 mhy. Pad capacitor C_1 to get the frequency right.

The circuit does not appear to be at all critical as to transistor characteristics. Any other good junction type available, such as the CK722 or the 2N35, should work as well as the unit specified.

The crystal diode CR_1 is poled so that it conducts when the transistor is drawing normal collector current from the battery. On the reverse half-cycles of oscillation, the tuned circuit tries to swing the collector into the opposite polarity. With a tube, this is OK, but with a transistor the collector will look like a short circuit to reverse voltage. The clipping that would result is eliminated by means of the diode. —30—

The transistorized bridge oscillator.



R_1—330 ohm, ½ w. res.
R_2—10,000 ohm, ½ w. res.
R_3—2200 ohm, ½ w. res.
R_4—4700 ohm, ½ w. res.
C_1—.3 μfd. paper capacitor
C_2—2 μfd. paper capacitor
C_3—50 μfd., 6 v. elec. capacitor
CH_1—.1 hy. toroidal inductor (UTC MQE-7) or rewound filter choke, see text
CR_1—1N34 or similar crystal diode
V_1—2N107 transistor (G-E)

OLSON RADIO FOR GREATEST BUYS IN RADIO AND TV SUPPLIES

TIMEX MAGNETIC DISC RECORDER

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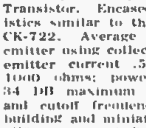

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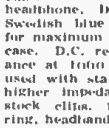

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FAMOUS COLLARO INTERMIX

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$28.88 Each

DELUXE 3-SPEED

Made in England. Highest Quality. Complete with Shure Ceramic Turnover Cartridge and Dual Sapphire Needle.

Powerful 4-pole motor and balanced rubber covered turntable. Changes discs in 7 seconds. Jamproof! Output .6 volts, response to 7000 cycles. AUTOMATIC SHUT-OFF after last record. INTERMIXES 7", 10" and 12" discs. 33⅓, 45 and 78 RPM. AUTOMATIC MUTING SWITCH eliminates sound during change cycle. Has STYLUS ADJUSTMENT and speed selection and "on-off-reject" CONTROLS. Size: 12" x 13½". Clearance required 2⅜" below, 5⅛" above.

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New 4 Speed Changer Model 1210

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Stock No. RP-15

$25.96

3 Speed Changer Model 950

Plays 33⅓, 45 and 78 RPM records. Size 11¾" x 13" x 4½" above plate, 2⅛" below plate. $52.50 list.

Stock No. RP-1

$20.96

"GOLDEN GATE" 8" SPEAKER

With "Whizzer" Sound Disperser

STOCK NO. S-229

List Price $12.50 Olson's Price, Ea. $4.95

2 for $9.50

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With Double-Cartridge Crystal

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3 pair for $11.00

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Two station telephone set. Talk back and forth for up to one mile. Powerfone is guaranteed to give as good tonal quality as your telephone. Built in buzzer and push button on each instrument. Also has push-to-talk button. Sensitive enough to hear a whisper. Uses flashlite batteries. Complete with 2 batteries, 2 wall hangers and 50 ft. of wire.

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Stock No. W103 100 ft. $1.19
Stock No. W104 250 ft. $2.50

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COMPLETE ANTENNA KIT. NOTHING MORE TO BUY. Olson's outstanding value—All Aluminum—All VHF Channel. Contains everything you need to put up a professional installation: (2)—8-element conical bays with stacking bars, (2)—5' mast sections, (1) mounting base, (50') 300 ohm lead-in, all necessary stand-off insulators and hardware. Easy to install. New Preassembled "Snap-Up" Type Antenna—No loose rods and parts. Shpg. wt. 15 lbs.

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PLASTIC BASE

1200' on 7" Dia. Reel

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NEW L-O-N-G-E-R PLAY 1800' TAPE ON 7" REEL

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50% more recording time on a 7" reel. Shpg. wt. (one doz.) 12 lbs.

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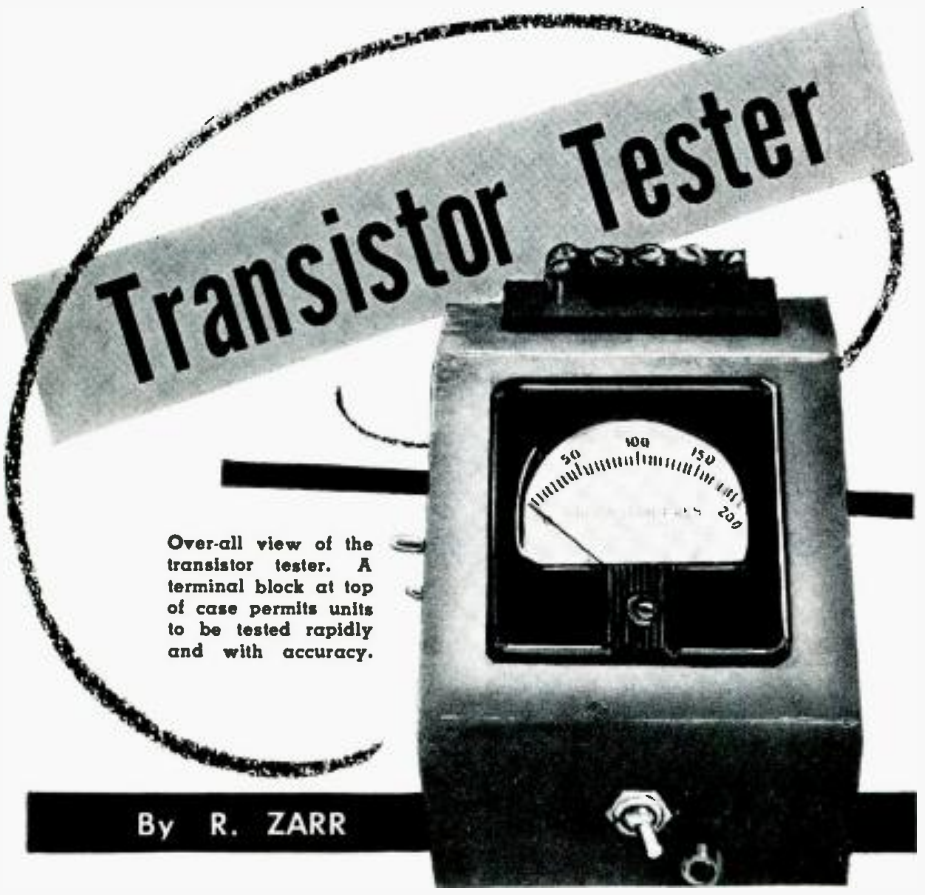
Transistor Tester



Over-all view of the transistor tester. A terminal block at top of case permits units to be tested rapidly and with accuracy.

By R. ZARR

Construction details on a simple, compact unit which will test both "p-n-p" and "n-p-n" type transistors.

THE transistor tester to be described is a simple, handy, and compact device. It can *compare* transistors for quality, and can *select* matched pairs for balanced amplifiers or measuring instruments. It can indicate when a transistor is poor, perhaps to be used only as a last resort, or discarded altogether. The device is useful for checking "surplus" transistors now on the market, so you can separate the bad from the good. A transistor tester like this can save considerable time and bother, and prevents placing the blame on equipment that behaves poorly when the transistors may be at fault.

This instrument can test transistors with long wires or with clipped leads. It can handle units with equally spaced pins (like the CK722) or those with polarized basing (like the 2N112). It is easily converted from *p-n-p* to *n-p-n* tests. Its battery supply voltage is low, thus avoiding danger to any transistor including the latest r.f. and surface-barrier types which are limited to a few volts on the collector.

A transistor, like a tube, has many characteristics that may be measured. These characteristics include leakage, gain, temperature effects, frequency response, impedance, etc. Many authorities agree, however, that the first two are of primary importance. *Cut-off* (or collector leakage with zero input) is often a definite indication of approching "old age" in a transistor. Excessive leakage means low efficiency, limited output, and probably distortion, so it is important information for the user to have. *Gain* can predict the performance of a transistor as an amplifier or oscillator, and it is probably the best single indication of quality. This instrument checks for both *cut-off* and *gain*.

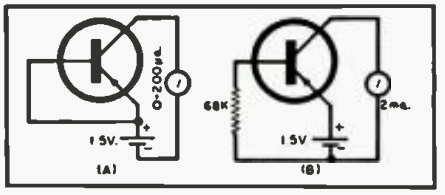


Fig. 1. (A) Circuit for measuring cut-off current (B) Circuit for measuring large signal gain. Refer to text for details.

Cut-Off

Collector cut-off is measured in the circuit shown in Fig. 1A. Base and emitter are shorted to insure zero input. The meter is a 0-200 μa. instrument. It measures the reverse current flowing between base and collector. Good transistors should show very low leakage, usually 10 μa. or less. One unit tested showed a leakage of over 100 μa. Obviously, it is already loaded down with idling current so it cannot deliver as much useful power as a low leakage unit. Furthermore, this high current represents wasted battery current.

Gain

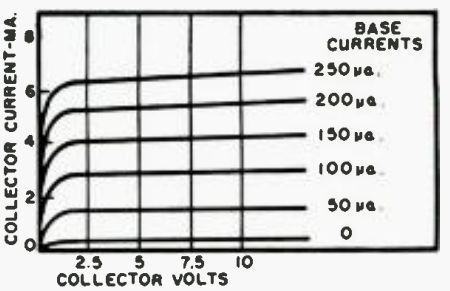
The current *gain* of a transistor is found by dividing the output by the input. In a grounded-emitter circuit, the gain is called *beta*. When the collector load is negligible, maximum output flows, so this is the condition for maximum *beta*.

The gain of a grounded-emitter circuit may be measured in one of two ways. There is the *small signal gain* which requires a steady bias and a relatively small signal. This may be shown by referring to Fig. 2, which shows typical characteristic curves for a CK722. Assume 2.5 volts on the collector and negligible load (for example, only a current meter). Under these conditions, voltage drop in the collector circuit remains zero irrespective of current, so the operating "curve" must be on a vertical line through 2.5 volts. Let the base bias current be 200 μa. and the signal 10 μa.

Referring to Fig. 2, the 200 μa. bias results in an output current of about 5.2 ma. The 10 μa. signal corresponds to an increase of about .25 ma., for a total of about 5.5 ma. Then the *small signal gain is* 250/10 or 25. It is not easy to measure this because two currents are required. Furthermore, the *increment only* is important and this small current tends to get lost in the large idling current when both are measured on the same meter. For example, .25 ma. is very small when compared with 5.2 ma. If the signal is a.c., so is the desired increment in the output. The latter, being a.c., is then easily separated from the d.c. idling current and can be measured. Unfortunately, a.c. instruments are generally more expensive and less accurate than those for d.c.

The problem is eased considerably by measuring the *large signal gain*. Here the bias is also the signal. First the output is measured with zero base current, then with some convenient current flowing into the base. For example, Fig. 2 shows that a 50 μa. signal causes a change of about 1.1 ma., so the gain is simply 1100/50 or 22. Note how this compares with the gain found previously. In practice, the leakage (output with zero base current) is small enough to be ignored, so the first part of this measurement may be omitted.

Fig. 2. Characteristics curves for a CK722.



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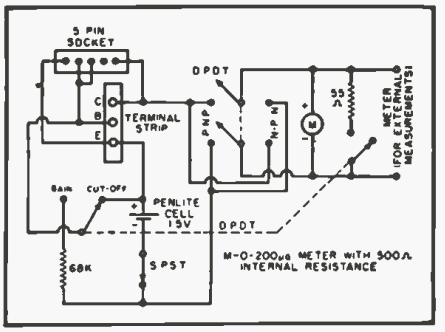


Fig. 3. Complete schematic diagram of the transistor tester. Extra binding posts on front panel enable meter to be used for applications other than transistor tests.

The *small signal gain* and the *large signal gain* bear a definite relationship to each other and are generally in the same range, especially for small currents. Since the latter is so much easier to measure, it is the basis of the tester described here. The circuit is shown in Fig. 1B.

The base resistor controls current from the battery. A 68,000 ohm resistor was found to permit a flow of exactly 20 μa., a convenient value. The meter measures a maximum of 2 ma. output current. At full scale, therefore, it indicates a gain of 2000/20 or 100. Since the meter scale is calibrated from 0-200, the actual measured gain is always one-half the value indicated on the scale.

The schematic diagram of the tester is given in Fig. 3. The switch is shown in "cut-off" position, which shorts out the base and emitter of the tested unit. In this position the meter is a 0-200 μa. instrument and it measures leakage or cut-off directly.

In the "gain" position, the penlite cell forces a current of 20 μa. through the base. This current is amplified and indicated on the output meter. Note that in the "gain" position, a 55-ohm shunt is placed across the 500-ohm meter. This is a "multiply by 10" shunt so the meter now registers a maximum of 2 ma. or 2000 μa. As already described, the transistor gain is equal to one-half the scale value shown on the meter.

Now, how about *n-p-n* transistors? Normally the battery in this tester is polarized for the *p-n-p* type of transistors which are more frequently used than the *n-p-n* variety. To test *n-p-n* units, the penlite cell is removed from its holder and replaced with opposite polarity. The cell is quickly and easily slipped in or out, because its holder is conveniently located near the open bottom of the meter box. Also, the reversing polarity switch must he thrown to *"n-p-n"* because output current flows in the opposite direction in this type of transistor.

Construction

The tester is built into a 4-inch sloping-panel meter box. A Bakelite strip with screw terminals for holding transistors with long leads is installed on top of the box. A subminiature 5-pin socket is set into this strip at one end. The strip is mounted with long screws and spacers. Corresponding terminals of the strip and the socket are tied together (Fig. 3). For convenience, paint a red dot or other identification mark to show the collector terminal. Note that terminals 2 and 3 are tied together at the socket, to permit testing of transistors having the old or new basing system.

To test a *p-n-p* transistor, plug it into the socket if its leads are clipped. If it has long wires, connect them to the terminal strip by means of the screws. Observe collector red dot or other marking. All switches should be in normal position, that is, battery switch "off" and polarity switch at *"p-n-p."* Both switches are on the side of the meter box. The front switch may be left in "cut-off" position.

When the battery switch is turned on, a slight deflection may be noted on the meter. This is the direct reading of leakage. In a good unit, the meter should read less than 10 μa., probably less than 5 μa. Now the front switch may be thrown to "gain." The correct answer is equal to one-half the meter indication, as previously explained. The procedure for *n-p-n* transistors has been discussed.

This instrument is useful because it can test, compare, and pair transistors. Besides leakage and gain, it can also detect drift or creep, random fluctuation, and other defects which may be present.

The results obtained with this device on both standard and "surplus" transistors are given below. All standard units had low leakage currents, *i.e.*, 5 μa. or less. Gain values were as follows:

CK722	22		2N112	45	
2N113	70	2N114	100 (plus)		
2N34	100		2N35	65	
		2N76	35		

Tests were also conducted on an assorted group of transistors now selling as surplus stock. These come in a variety of sizes and shapes, some with mysterious markings such as "TS," "A2," etc. Each is identified as to collector, some with a red dot, others by a small indentation on top of the metal envelope, or a line running up and down near the collector. Of ten tested, one gave negative results, two had a gain of about 15, while three others showed the surprisingly high gain of nearly 100. Generally speaking, these units have a somewhat higher leakage than standard types and, of course, unpredictable gain, but seem to work in most amplifier and oscillator circuits tried.

The big item in this tester is the microammeter which is used here to cover two ranges. It would be wasteful to restrict its utility merely to test transistors, so terminals have been added on the front panel for external leads. Tests and measurements requiring a 0-200 μa. or 0-2 ma. range are made by plugging leads into the pin jacks. Of course, no transistor should be connected at the time and the battery switch should be shut off. —30—

Series Multivibrator

(*Continued from page 67*)

easy to surmise that since the sawtooth current is limited by the maximum ratings of the tubes used, that a moderate to high impedance deflection yoke may be needed to obtain reasonable deflection. It may be necessary to design a special yoke for this use.

The circuit shown in Fig. 4B is an extremely simple "two-terminal" *LC* oscillator, and may be used at r.f. as well as at audio frequencies. With a low impedance as well as a high impedance output (high impedance at 2, low impedance at 6), it should find wide application in signal generator and similar applications. Since it can be "locked-in" to some extent with an external signal, it may find application in r.f. transmitters as a buffer amplifier with a low impedance resistive output, when preceded by a crystal-controlled oscillator stage. It is quite possible that a modification of the circuit shown in Fig. 4B will permit direct operation as a crystal-controlled oscillator, but with a low impedance resistive output.

To the author, the circuit shown in Fig. 4C offers almost fantastic possibilities in circuit applications. First, it is one of the simplest *RC* sine-wave oscillators the author has ever used, much simpler than a Wien bridge oscillator, and much more reliable than a phase-shift circuit. Further, it is capable of being "locked-in" with an external signal if desired, but is quite stable even when "free-running." Finally, the circuit offers both a high impedance (at 3) and a low-impedance resistive output (7). This last feature, alone, points up many possible applications as an audio signal generator.

The circuit shown in Fig. 4D is almost a "natural" as a horizontal sweep oscillator for a cathode-ray oscilloscope, for it delivers a high-impedance linear saw-tooth output signal (4 in Fig. 6) and may be easily synchronized with an external signal by applying the signal to the grid of V_2. See Fig. 3.

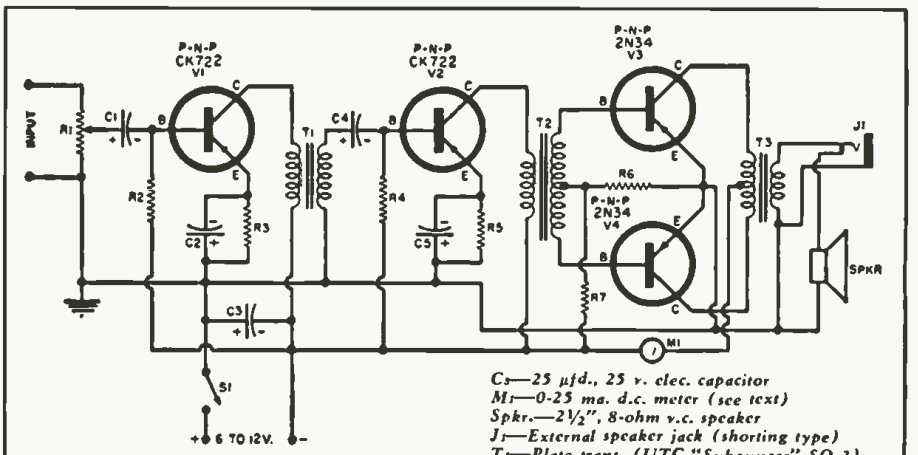
In addition to the applications outlined, the basic circuit may be used as a pulse generator, as a special waveform generator, or in virtually any of the applications in which conventional multivibrators are employed. When used as an oscillator, it may be keyed or modulated by applying the control signal to one of the grids (Fig. 3). The circuit may be converted to monostable operation, for use as a gate or one-shot "oscillator" by applying a fixed bias to either of the grids, holding the corresponding tube in either a conducting or non-conducting state until an external signal is applied. When used as a gate, it offers the added attraction of a low impedance output. The serious experimenter will find other applications for the series multivibrator and its modifications. —30—

Transistorized Class B Amplifier

Construction details on a small unit that may be used as a low-power amplifier, sound-level, or applause meter.

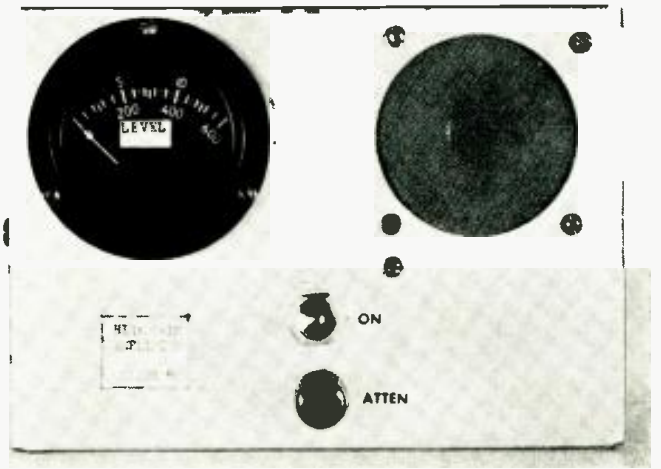
MINIATURIZATION is expected of most transistorized equipment. This power amplifier cannot claim this feature, however, since it measures 7" x 5" x 2". It has so many other unusual features that size may well be overlooked. It carries its own speaker, meter, and batteries. It is suitable for making audio tests, measurements, and comparisons. It has high gain and puts out approximately 100 milliwatts (with 12-volt input), more than enough for many applications. It is class B, so efficiency is very high.

The amplifier can satisfy many audio requirements. It can be used to modulate low-power ham rigs, or as a spare or emergency unit. It is suitable as a "nursery guardian" to watch over baby as he sleeps or plays or it may be used as a burglar alarm. These applications call for a low power drain so it may be left on all night or for extended periods. That is where class B comes in. In a class B amplifier, the output current is nearly zero when no signal is applied. In this case the floating (or "no-signal") current is



R1—10,000 ohm pot ("Attenuation")
R2—270,000 ohm, ½ w. res.
R3, R5—47 ohm, ½ w. res.
R4—120,000 ohm, ½ w. res.
R6—56 ohm, ½ w. res. (see text)
R7—3900 ohm, ½ w. res.
C1, C2, C4, C5—4 μfd., 4 v. elec. capacitor
C3—25 μfd., 25 v. elec. capacitor
M1—0-25 ma. d.c. meter (see text)
Spkr.—2½", 8-ohm v.c. speaker
J1—External speaker jack (shorting type)
T1—Plate trans. (UTC "Subouncer" SO-3)
T2—Transistor to p-p sec. trans. (UTC "Subouncer" SO-8)
T3—Push-pull transistor to v.c. trans. (UTC "Subouncer" SO-9)
V1, V2—"p-n-p" transistor (Raytheon CK722)
V3, V4—"p-n-p" transistor (RCA or Sylvania 2N34)

Complete schematic diagram of the transistorized amplifier with 2½" loudspeaker.



Front-panel view of amplifier. Because of meter and loudspeaker, miniaturization is not possible. The meter is calibrated in arbitrary units but is shunted down for 25 ma. full-scale reading. See text.

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only about .5 ma. with a 6-volt supply. Because of this the power supply (four type "C" cells) will last for thousands of hours. Only when a signal is fed in (like baby crying or the noise of an intruder) does the output current rise. At full volume the current reaches a peak of about 25 ma.

Another important application of this amplifier is in sound survey work or noise analysis. Here is where the meter comes in handy. In a class B circuit, the output may be indicated or measured by a meter because it varies with the strength of signal. As the signal rises, so does the meter deflection. This makes the class B circuit useful for comparing mikes, plotting directional response of a microphone, measuring noise level, etc. It also makes an excellent applause meter at amateur shows, lodge meetings, and similar affairs. Simply set the volume control so that average applause results in a meter reading near mid-scale. This may be determined beforehand or by asking the audience for one or two trials. Then the applause for each contestant is noted on the meter and recorded.

Some readers may be timid about building a class B circuit like this one. The truth is that class B is no more difficult to construct than class A. It is just a matter of using the correct transformers and bias. Even the type of transistor is not critical as long as it is correctly biased. R_6 (see schematic) is the resistor that must be chosen for optimum output and minimum distortion. If the value is correct, the quality will compare favorably with most intercoms and radios but, of course, it will not be high-fidelity.

A pair of 2N34 transistors (in a push-pull hook-up) is used in the output stage. Ordinary CK722 types have been tried for V_3 and V_4 with fairly good results. V_1 and V_2 are CK722's. The transformers are "Subouncers" by *UTC*. The driver transformer is an SO-8 and the output transformer is an SO-9. The first transformer is an SO-3. All these are subminiature types and are mounted on a plastic sheet with the transistors. Because of the small size of these components it is suggested that the amplifier proper be constructed as an integral unit with its own terminal strip. This strip may provide connections for: input, two transformer centertaps, ground, and "A minus." The amplifier unit is mounted inside the aluminum chassis next to the 2½-inch speaker.

R_6 controls the "no-signal" current. If its resistance is too high, operation will approach that of class A with higher fidelity. However, this defeats the purpose of class B which is to keep the "no-signal" current low and total efficiency high. Furthermore, it is undesirable in a measuring circuit where we want the meter to register zero with no signal input. The resistor used here is 56 ohms. It keeps the "no-signal" reading under .5 ma.

When a.f. is fed into this amplifier, it becomes a highly sensitive a.f. millivoltmeter. If you have a standard meter available for calibration, the class B meter readings may be recorded and converted in terms of millivolts. Generally, however, only relative readings are needed to test microphones, measure level, and align tuners or i.f. amplifiers. If sound output is not wanted during a sound measurement test, a phone plug inserted into the "external" jack disconnects the internal speaker. An 8-ohm resistor should terminate the plug leads so that the amplifier will not be left open during this time. Plugging in an external speaker will also disconnect the internal 2½" speaker and permit use of an external unit.

On several occasions this amplifier has been used to test junction transistors. A standard a.f. signal was fed into the circuit and the volume control adjusted for mid-scale meter reading. Then the unknown transistor was substituted for one of the class A transistors (first two stages). Now the meter may read higher or lower than before, indicating a transistor with higher or lower gain than the unit first used. This constitutes *dynamic* testing, since the measurement is made under actual a.f. conditions.

This device is not complicated, as can be seen by studying the schematic. However, if you have not done much work with miniature parts the following aids will help. Be careful of the tiny parts such as transformers for they are not as rugged as tube-sized components. For example, the leads of a transformer may pull out if you tug too hard. Don't apply too much heat from a soldering iron near a transistor. Use 5-pin "in-line" subminiature tube sockets for the transistors. Then strap pins 2 and 3. This will permit you to use either CK722 transistors (which have leads equally spaced) or other types (where the emitter and base leads are closer together). The transformers and sockets are mounted on a plastic sheet. Holes drilled into the plastic hold the sockets firmly in place, but the transformers are held by their own leads passing through small holes in the sheet. The meter should have a maximum range of 25 ma. A more sensitive movement may be used if it is properly shunted down.

The base capacitors are tantalum types now available at most radio parts stores and mail order houses. They are quite expensive but are so thin they can fit almost anywhere.

If an oscilloscope is available, you may adjust the base resistors for optimum output with lowest distortion. R_6 may also be adjusted or varied in the same way.

The power supply is a group of four small (size "C") flashlight cells, with leads soldered to them. These cells fit neatly into one corner of the 5" x 7" x 2" aluminum chassis which houses the amplifier. The speaker, 2½ inches square, should be protected by a metal grille. —30—

"The Showman"

(*Continued from page* 54)

loaded "hats" lengthens the antenna electrically, the current is equal and opposite in each half of the "hat" and, therefore, there is no radiation from the "hats" themselves. With the short dipole end loaded, the radiation resistance is increased to about 30 ohms, but the dipole is still highly capacitive.

The next problem then is to compensate for the capacitive reactance. This is accomplished by the addition of series inductances (Fig. 3D). At each low-band channel, the inductances can be tuned so that they represent an inductive reactance which is equal and opposite to the capacitive reactance of the end-loaded dipole. See Fig. 3E. Thus, the dipole can be resonated on each low-band channel so that its impedance is a pure resistance of about 30 ohms.

The next step in the design is to develop a way to raise the 30-ohm impedance to 300 ohms so that a perfect match to the transmission line can be obtained. This is accomplished by the use of an autotransformer (Fig. 3F).

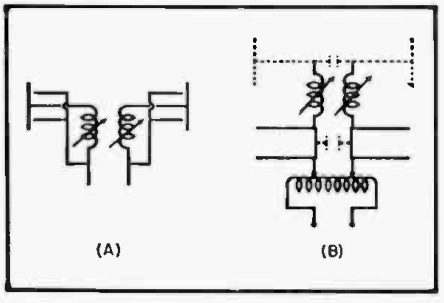
High-Band Dipole

The high-band dipole which is fitted into the structure is also less than a half wavelength and, therefore, its reactance is capacitive. However the "compression" is not nearly as great as for the low-band element and its effects are partially compensated by forming the dipole so that it appears as two "U's" with the short legs facing each other, see Fig. 4A.

The use of a separate high-band dipole tied into the circuit, as shown in Fig. 4B, permits the use of the low-band dipole and its associated variable inductances to be used for shunt compensation across the terminals of the high-band dipole. By tuning the variable inductances, the capacitive reactances can be tuned out and the high-band dipole impedance appears as a resistance. This impedance is stepped up to a proper match of 300 ohms through the autotransformer.

Credit for the development of the "Showman" antenna belongs to Chief Engineer Harry Greenberg and Project Engineer Julius Green of the *Channel Master Corporation.* —30—

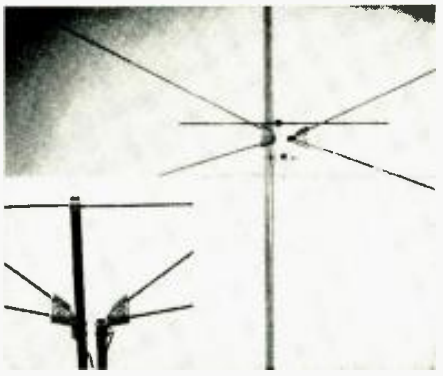
Fig. 4. Simplified diagram of the "Showman" antenna showing the high band and low band elements (A). (B) indicates how the tuning inductors are used to compensate the high-band capacitive reactance.



Antenna News

ALL-WEATHER ANTENNA

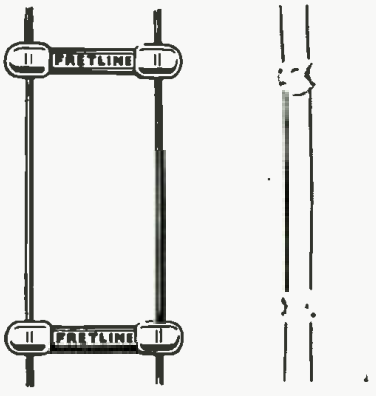
Myers Allweather Antenna Manufacturing Corp., 350 S. Egg Harbor Road, Hammonton, N. J., has just placed on the market a conical anten-



na which has its solid aluminum elements mounted on a giant tuning fork, eliminating the front insulator. This antenna is directed particularly at seashore cities and industrial towns where there is a high content of salt or soot in the air. Since the antenna, in effect, uses an air insulator between the elements, the accumulation of foreign matter such as salt, soot, dirt, etc., will not result in deterioration of antenna performance.

LEAD-IN LINE PATENT

Fretco, Inc., 406 N. Craig St., Pittsburgh 13, Pa., has just been issued a patent covering its open-wire transmission line, trademarked "Fretline" and "Saucerline." The company plans to license other manufacturers to make the transmission line under the

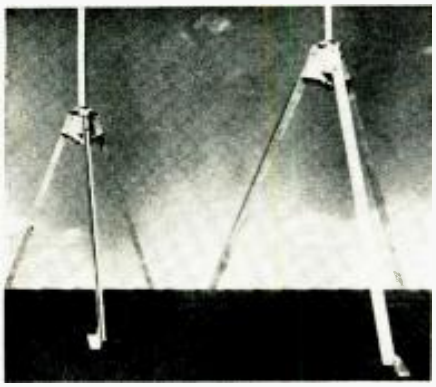


patent. A spokesman for the company related that it took five years to obtain the patent and that they intend to police the field of open transmission line to the fullest extent.

FIVE-FOOT TOWER

Baker Mfg. Co., Evansville, Wis., is now making a new five-foot antenna tower as the answer to TV installers' desire to eliminate guy wires on antenna installations up to 20 feet

above the roof. The tower is called a "yug," which is a letter reversal of guy. The extremely wide base (48



inches) of this tower permits increased height without increase in roof load in high winds.

The "yug" is hot-dipped galvanized, fits any pitch roof, and is almost completely assembled (one leg is detached for easy shipping and compact storage). Up to a 2-inch diameter mast may be used in this tower.

Illustrated literature is available on request.

CONICAL ANTENNAS

Technical Appliance Corp., Sherburne, N. Y., announces the release of a complete line of conical antennas comprising 8 single and 8 stacked models. The new line has been designated as the "Turret" series. These antennas feature rapid assembly and mounting. The "Turret" head is designed to accurately maintain the element spacing and forward angle.

This line has been specifically designed to provide the service dealer with a means of selling new antenna installations as a replacement for old, and in many cases, inadequate ones.

Catalogue sheets on the "Turret" line of conicals are available from the manufacturer.

AMATEUR ANTENNA KIT

Illumitronic Engineering Co., 680 E. Taylor Ave., Sunnyvale, Calif., now has available inexpensive antenna kits designed for the novice or beginning amateur. Three different "Ham-tenna" kits cover the amateur bands from 10 through 80 meters.

The antenna in each kit is a folded-dipole type with the radiator constructed of steel-core Ladder Line. Lead-in wire and all necessary accessories are furnished in each kit.

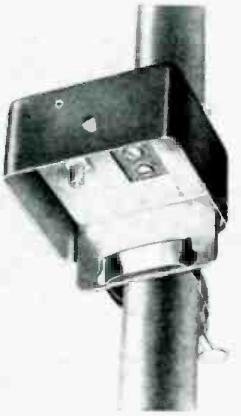
MATCHING TRANSFORMER

Jerrold Electronics Corp., 23rd & Chestnut Sts., Philadelphia 3, Pa., now has available an outdoor impedance matching transformer which passes a.c. and is for use in the remote operation of r.f. amplifiers over twin-lead and open-wire transmission lines. This transformer connects the r.f. output of a 72-ohm booster or preamplifier to 300-ohm twin-lead or open-

(*Continued on page* 150)

wire, while supplying 24-volt power over the same line. The unit can also be used to connect a 300-ohm antenna to a 72-ohm line and may be mounted directly on the mast under the antenna.

The transformer is contained in a rust resisting "Iridite" weatherproof



housing and uses a solderless coaxial fitting and screw terminals.

For additional information write to the manufacturer for literature on the model TO-374.

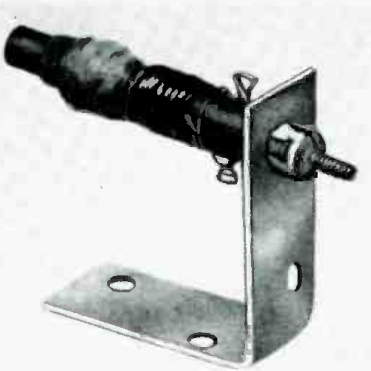
FIBERGLAS AUTO AERIAL

Ward Products Corp., 1148 Euclid Ave., Cleveland, Ohio, is producing a new Fiberglas auto radio antenna with a metallic chrome-like finish. It is called the "Silveramic."

This antenna is completely rust resistant. It is available in front or rear mounts and measures 38 inches in height.

FERRITE CORE COIL

Vidaire Electronic Mfg. Corp., Lynbrook, N. Y., is manufacturing a new variable ferrite-core coil for use as a replacement antenna in radio receiv-



ers, tuners, etc. This adjustable antenna, the model VL-15, has a "*Q*" on the order of 300. Adjustment can be made for peaking with most variable capacitors in use for small radios. A universal bracket is supplied for simplified installation.

TELESCOPING MAST

Andrew Corp., 363 E. 75th St., Chicago, Ill., recently introduced a new telescoping mast available in 30-, 50-, and 100-foot hydraulic or pneumatic models. This mast may be used for mobile radio, broadcast or microwave

survey work; TV broadcast remote pickup; and for emergency communications.

The 100-foot mast may be raised to full extended height in 15 minutes. The 30-foot car-top model is operated from the vehicle's electrical system.

Additional information is available from the manufacturer on request.

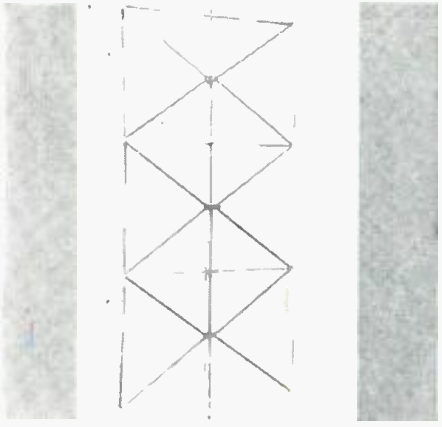
FOUR SET TAP-OFF

Blonder-Tongue Laboratories, Inc., 526-536 North Ave., Westfield, N. J., has a new unit furnishing four isolated TV outlets in a small weather-protected box. The model MIT-4 is designed for use in community and master TV systems.

Each outlet is isolated by 17 db from the line and the line insertion loss is .3 db per outlet. The response is constant over the full v.h.f. range.

TRELLIS ANTENNA

Trio Manufacturing Co., Griggsville, Ill., is now offering an antenna that is designed to be used as a lawn trellis



for TV reception in metropolitan areas. The "Ground-Master" is offered with a complete kit which includes a mounting stake, lead-in wire, and all necessary hardware.

ROOF TOWERS

Rohn Manufacturing Co., 116 Limestone, Bellevue, Peoria, Ill., announces the first two in a full line of roof towers for TV antenna installations. The models available now are the TRT60, five-foot size, and the TRT36, the three-foot size. They have a hot-dipped galvanized finish.

New dealer and distributor catalogues are also now available on the

firm's complete line of TV and communications towers and accessories, as well as allied products.

PATENT AGREEMENTS

M. D. Ercolino, President of *Telrex, Inc.*, Asbury Park, N. J., recently made known that his company had signed patent license agreements with *JFD Manufacturing Co.*, of Brooklyn, N. Y., and *RMS* of the Bronx, N. Y. These firms are now licensed under *Telrex's* patent covering the conical antenna.

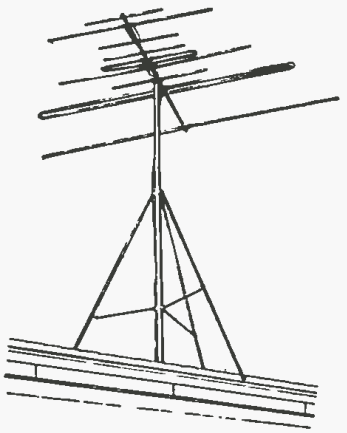
NEW ANTENNA COMPANY

Just out is a new line of communication and auto antennas manufactured by *Tenatronics, Ltd.*, 811 Union Commerce Bldg., Cleveland 14, Ohio. Bob Cull, a former partner of *Tenna Manufacturing Co.*, is director of the new company, and Julius Fine, formerly sales manager for the *Ward Products Division* of the *Gabriel Company* and *Tenna Manufacturing Co.*, is sales manager.

In addition to a complete line of quality antennas, the company will manufacture and distribute a full line of accessories. The line includes both regular and heavy-duty communications equipment and front, rear, and side mount auto antennas.

TRIPOD TOWER

The Winegard Co., 3000 Scotten Blvd., Burlington, Ia., is marketing a



combination tripod tower and antenna known as the "Minute-Mount." This combination is designed for fringe

area service under conditions of extremely high winds.

The high-gain antenna is furnished with a ten-foot non-corrosive all-aluminum mast, lead-in wire, seven insulators, lightning arrester, ground wire, and ground rod.

REPLACEMENT AUTO AERIAL

Snyder Manufacturing Co., Philadelphia, Pa., is now producing a chrome-plated, 3-section, replacement auto antenna staff, the Model RE-8. If the old antenna is broken, it is no longer necessary to replace it completely, merely slip this staff over the

protruding section of the old antenna, as shown here, and tighten the set screw.

This replacement will fit virtually every make of antenna. It is 22 inches long when collapsed and with the three sections extended, it is 56 inches high. —30—

Certified Record Revue

(*Continued from page* 64)

greater sharpness and delineation of the inner orchestral details. This was quite unbelievable and I heard things on the tape that were but tenuous hints on the discs. String tone? You've never heard anything like this! Even in the highest registers of the first violins there was no screech, no eardrum piercing edginess, rather there was a smoothness only previously encountered in the confines of the concert hall. The richness of the second strings, the mellow throb of the celli, the dark sonority of the contrabassi, all were vibrantly alive with realism. The contrabassi were especially spectacular. Ordinarily even on good records and through good hi-fi equipment, the bass viols have a sort of "voom-voom" sound . . . low enough in frequency to be sure, but without much character. Here on the 3-channel stereo, you can begin to appreciate the throbbing power they generate, and you can perceive the individual tones and timbres of each string, you can feel the deep resonance, hear the higher harmonics, detect subtleties and nuances of bowing and fingering impossible to hear on a disc.

With 3-channel stereo, brass sonorities are breathtaking. Trumpets have a clean brightness equalled only by the real thing. And with this brightness there is a roundness and fullness of tone, a sense of swelling power not found on discs or on regular tape either. In staccato and other rapid passages, there is no blurring or fuzziness whatever . . . all is sharp and incisive. Trombones have their

characteristic blare, but again with a rounder, fuller tone, and when they are guttural and growl 'way down in the low frequencies, you can still perceive the timbre of the instrument . . . it isn't lost in muddy distortion as on so many discs. The woodwinds are quite extraordinary. The stereo probes extremes of the various instruments in a fashion almost totally alien to discs and monaural tapes. The characteristic breathiness of the flute and piccolo is almost palpable in its liveness and realism. Vibrato is noted to a much greater extent than on the other media. The clarinet, bassoon, oboe, English horn, are heard with exceptional purity of tone.

Returning for a moment to the brass, that most difficult of instruments to record—the French horn—is heard on stereo as a very clean, full-bodied and richly resonant sound. Its heroic sound, embellished by the spaciousness of stereo is a thing of unearthly beauty. Percussion on 3-channel stereo is best described as awesome. On bass drum not just the whump and the thud is heard, but the tone as well. More than this, you can feel the tremendous power as the sound envelope hits you. Tympani are super clean, crisp, and precise, and you can feel the tautness of the stretched drumskin. It is also a great deal easier to discern whether the tympanist is using hard or soft mallets or bare sticks. Snares, whether gut or wire, are easily distinguished, cymbals, gongs, bells, triangles, xylophones . . . the whole percussion battery can be heard with a cleanness and articulation not possible in anything but 3-channel stereo.

The directionality of the 3-channel stuff I heard was fantastic and actually I was surprised at the degree of superiority over 2-channel stereo. With tri-stereo, it was not necessary to stay in a more or less circumscribed spot, to obtain the maximum directional effect. Positioning oneself right or left of the center line naturally threw into focus the instruments which prevail on one or the other side of the orchestra, yet there was little difficulty in perceiving the interplay between the various choirs. Best of all . . . the "whole" which is more or less apparent in many bi-stereo tapes, was no longer evident. In fact this elimination of the center "hole" with the third or middle speaker seems to have much more significance than I would have believed. With the three channels no matter where you stand or how uneducated your ear, it is completely and instantly obvious that you are listening to stereophonic sound. Probably the most important aspect of the third channel, however, is not the increased "right-to-left" directionality that it affords, but that it adds the new dimensions of "front-to-back." This is truly the crux of the case for 3-channel stereo . . . the attainment of depth for a true three dimensional sound. The third channel is cumulative in its effects, and the totality adds up to the fact that when it is combined with two other channels, it is markedly superior to the two channels alone. The addition of the depth makes the illusion of presence complete and unless you hear tri-stereo, you won't believe the fantastic difference that third channel makes in terms of musical realism.

"Tabuh-Tabuhan" came to its triumphant conclusion and I was sitting with mouth agape when I suddenly woke up and started firing questions. *IS* there any more . . . Is this just experimental . . . etc., etc., *ad infinitum!* Well good people, *here is the thing that is going to stagger you! Mercury* has been recording 3-channel stereo since the beginning of the year and already has built up an impressive backlog! This is a continuing program and everything *Mercury* now records for disc is also recorded in tri-stereo! *WHY* is *Mercury* doing this? They are recording 3-channel stereo *with the intent and purpose*

of releasing recorded tapes for public consumption! No, I'm not kidding you . . . it's a fact!!!

What repertoire is now available you ask? Sad to relate my friends but, at the moment, nothing is available. Oh yes, like I said, they have tapes all right . . . that same evening I was treated to parts of many works. Dorati and the Minneapolis doing the Brahms "Third," reviewed in these pages last month, the same conductor and orchestra doing Tchaikovsky's "Cappricio Italien" which I reviewed two months ago, Paul Paray and the Detroit Orchestra doing Debussy's "Iberia," the same conductor and orchestra in new items like Chausson's "Symphony in B Flat," and some Wagnerian works. Dorati again with Richard Strauss' "Till Eulenspiegel" and there are many others. As you can see, I was literally drowned in gorgeous tri-stereo and I can tell you that this was the hi-fi experience of a lifetime. It was simply an overwhelming thing and I hope that before too long others will be able to experience the same thrills. I said nothing was available at the moment and here are the whys and wherefores. Remember, I told you this material was all on special half-inch tape instead of the standard quarter-inch. Reason for this, of course, is that the wider tape and the extra width of the gap in the three special heads will afford a better signal-to-noise ratio which is important if quiet tape dubs are to result. So that's the first reason . . . non-standard tape width. I suppose that if some millionaire were to indulge himself with a tri-stereo *Ampex* 300 modified for half-inch he might be able to get a stereo tape dub from *Mercury*.

Quite obviously, if *Mercury* is to release this 3-channel stereo, the economics of the matter dictate that 3-channel *quarter-inch* tape will be the medium. Now here is the rub . . . the number of 3-channel quarter-inch *Ampex* units that have been produced is quite minute. To my knowledge there is but one unit on the whole East Coast! Again it is obvious that although *Mercury* could dub its half-inch stuff down to one-quarter, this machine-to-machine at regular tape speed hardly constitutes a method of quantity production. So the problem is really one of duplication.

I have been given to understand that *Mercury* is trying to work out a feasible method of quantity production and if they are successful, they hope to be able to release some tri-stereo this fall or winter. I might add here, that like any new development, initial costs will probably be fairly high although every effort will be made to keep the tapes as reasonable as possible.

By now the thought has probably occurred to you that even if the *Mercury* tapes were ten cents each and plentiful as potatoes, they wouldn't be much use to you without a tape playback machine which could handle 3-channel stereo. And so we have come full circle and we are back at the other end of the problem. I think everyone will agree that the prime problem with 3-channel stereo is tape availability. Now that we know at least one company is doing something about it, it is safe to assume that other companies will soon follow suit. So having gotten a good start on the tape problem, there is now the question of the tape playback and who makes it and for how much? I wish I could give you more information about this . . . for the affluent there is of course, *Ampex*. For Joe Doakes, music lover, I cannot give much encouragement beyond this . . . one company, well known for its inexpensive "component-type" tape machines has gone so far as to build prototype 3-channel, ¼-inch heads. If successful, and there is every reason to believe they will be, these heads would be available with their regular production tape mechanisms and as a replacement or

addition to heads in existing units. What will these units cost? I have no way of knowing but the fantastic figure of "under $200" has been bandied about and if this were to be true, it means that with three of the most modest amplifiers and three small but reasonable quality speakers a 3-channel stereo system could be had for about 400 to 500 dollars. This still isn't chicken feed I'll admit, but I will guarantee to you that it will sound better from a musical standpoint than the most expensive and elaborate single-channel system. So there you have it friends.

We are on the threshold of fabulous 3-channel stereosound, years earlier than we had any right to expect. That there are still problems to be solved with both tapes and machines is evident, but at least a start has been made and if the hi-fi public will get behind the idea and show the various manufacturers that they are really interested . . . you'll see the problems cleaned up in short order. I will watch the progress on this matter and try to keep you well informed.

As you can see, this important report was quite lengthy, but I certainly think it was worthwhile. In consequence of its length, we won't have much space for reviews so I'll make up for it next month with literally no introductory yak and as many reviews as we can squeeze in the column.

Equipment used this month. *Components Corp.* turntable; New *Weathers* viscous damped arm, cartridge, and oscillator; *Marantz* audio consolette; 2-60 watt *McIntosh* amplifiers; *Jensen* "Imperial" speaker; *Electro-Voice* "Georgian" speaker; and *Ampex* tape equipment.

MOZART
CONCERTO #13 FOR PIANO AND ORCHESTRA
CONCERTO #20 FOR PIANO AND ORCHESTRA
Julius Katchen, pianist with New Symphony Orchestra of London conducted by Peter Maag. London LL1357. RIAA curve. Price $3.98.

Another *London* contribution to this Mozart year, this recording is especially welcome for the fine version of the "13th Concerto," which is not heard very often. Katchen is in fine form here with vigorous and well-paced readings. His phrasing and dynamic shading seem much improved over some of his recent work. His tone is quite big, but fortunately he avoids excesses like percussive harshness. His reading of the "13th Concerto" certainly is the best that is presently available. In the "20th" he fares less well, being faced with such formidable competitors as Serkin, Gieseking, and Novaes, all of whom reflect considerably more warmth in their traversals of the score. However, Katchen has a big advantage over all other versions in terms of the sound his engineers have afforded him. This is typical *London* "big hall" recording . . . close-up, sharply accented detail coupled with big spacious liveness. The piano is very clean toned, liquid-smooth and I could not detect any wow or flutter. Frequency and dynamics are ultra-wide here and the over-all sound is one of compelling realism.

SCHUBERT
SYMPHONY #6
GRIEG
OVERTURE "IN AUTUMN"
OLD NORWEGIAN ROMANCE WITH VARIATIONS
Royal Philharmonic Orchestra conducted by Sir Thomas Beecham. Angel 35-339. RIAA curve. Price $4.98.

This is Sir Thomas' first recording to result from his new affiliation with *Angel*. Actually, Sir Thomas had been recording for *Angel's* parent company *EMI (British Columbia)* for many years, but in that complicated re-alignment of recording companies which occurred about 3 years ago, he found himself allied with the big *Phillips* combine of Holland who released in America through *Columbia Records*. This was not the most prolific nor artistically satisfactory period in the recording history of Sir Thomas. In fact, it is more than a little puzzling why the great talents

of Sir Thomas and his fine orchestra were so poorly utilized by the *Phillips* group. Well, whatever the reasons, their loss is *Angel's* gain and from what I can understand there is a large and ambitious program of recording all lined up for Sir Thomas and his talented aggregation.

The Schubert "6th" and the little Grieg works on this record are generally considered "minor league" repertoire and I suppose many people will think it odd that *Angel* starts its Beecham recordings with such material. Actually, this is just the sort of thing that Sir Thomas is best noted for . . . the championing of little known works, and the application of his considerable talent to make the material far more interesting than ever before. This is the 7th recording of the Schubert to appear in the LP catalogue and except for the good Keilberth reading on a *Telefunken* disc it has no competition. Sir Thomas gives us a reading that is wholly satisfying. His tempi are just, his meticulous phrasing keeps everything clean-lined and avoids the ponderosity given it by lesser conductors. And while Sir Thomas adheres largely to its classic contours he spices the work with his vigorous and good-humored handling of the dynamic contrasts of the score. The Grieg works are quite ingratiating, altogether charming little musical cameos that deserve more frequent hearings and certainly justify the loving attention Sir Thomas affords them. The sound is quite clean throughout.

BRAHMS
SYMPHONY #2

N.W.D.R. Symphony Orchestra conducted by Hans Schmidt-Isserstedt. Capitol P18000. RIAA curve Price $3.98.

This disc is one of *Capitol's* continuing efforts in European recording and I must say they are doing a pretty good job. Nothing generally spectacular you understand, but good solid, substantial musicianship and excellent sound. This Brahms "2nd" is a case in point. While Schmidt-Isserstedt may not have the perception on the score that is the province of a Toscannini, nor the warmth of conception of a Van Beinum, he nonetheless puts forth a convincing performance, nicely paced, never forcing and allowing the music to speak out for itself rather than make it subsidiary to conductorial mannerisms. The orchestra is a fine group and with Schmidt-Isserstedt as the permanent conductor, he has had the time to mold the orchestra into one of the better musical organizations of Northern Europe. Soundwise this has an excellent string tone, generally good brass and woodwind, percussion is accurate but somewhat

(*Continued on page* 158)

subdued. Over-all frequency and dynamic range is fairly wide, but cannot be favorably compared with *Capitol's* domestic recordings. For fanciers of Brahms with a stronger Germanic flavor and less Viennese gemutlichkeit, this is for them.

MOZART
A MUSICAL JOKE
DIVERTIMENTO #11

NBC Symphony Orchestra conducted by Fritz Reiner. Victor LM1952. RIAA curve. Price $3.98.

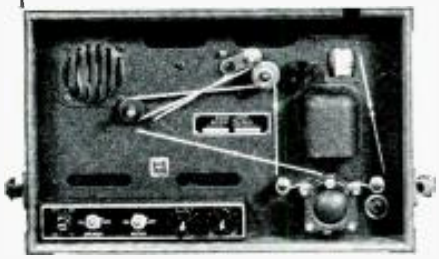
Mozart and more Mozart! Happily, this disc is not a senseless duplication as so many of the Mozart year releases have been. Reiner has always had a convincing way with Mozart and this disc is no exception. The hilarious "Musical Joke" here receives the best performance now on records, complete with "wrong notes, off-keys and flats"! The delightful "Divertimento #11" is splendidly performed by the crackerjack musicians of Toscanini's old orchestra and is especially welcome since the old *Mercury* recording is being deleted from the LP catalogue, leaving only the Casals Festival Orchestra performance which is only adequate compared to Reiner's and which soundwise is a pale shadow beside this resplendent recording. Highly recommended.

COLIN McPHEE
TABUH-TABUHAN
CARTER
THE MINOTAUR

Eastman Rochester Symphony Orchestra conducted by Howard Hanson. Mercury MG50103. RIAA curve. Price $3.98.

I heard the disc recording of "Tabuh-Tabuhan" before I heard the work in its 3-channel stereophonic form. I was much impressed with the score and remember musing to myself how sensational this would sound in the stereo medium . . . little knowing that about 10 days later I was to get my wish! Tabuh is a Balinese word literally meaning "to strike, or beat . . . as on a drum." With the native Balinese Gamelan orchestra which is almost wholly percussion McPhee derived this fascinating score and quite rightly subtitled it a "Toccata for Orchestra." In three movements, the beginning Ostinatos and the Finale are widely scored for an amazing array of exotic percussion instruments including two specially pitched Balinese gongs, and Balinese cymbals. With all this formidable array of percussion the work is still quite melodic and the opening phrases are very beautiful. But for the hi-fi fan questing for something new, different, and spectacular, the Finale will give forth hi-fi pyrotechnics to delight the ear of all such seekers of the slam bam and bing-bang! The scoring in the Finale calls for frenzied work by the orchestra as a whole and by the percussionists in particular. With two pianos, marimba, xylophone, celeste, the various gongs and cymbals, the bass drum, triangles and even sandpaper, going full blast, the effect has to be heard to be believed! A very contrasty work, the dynamic range involved is tremendous and is one of those recordings that requires a little experimenting before you casually turn up your amplifier gain! The "Minotaur" on the flip side of the disc is an interesting ballet score, if somewhat atonal at times. A provocative and stimulating score, it has moments of great intensity but nowhere does it equal the orchestral *tour-de-force* of "Tabuh-Tabuhan." Both works are performed with great vigor by Dr. Hanson and his splendid orchestra and in terms of overall sound must rank with among the finest recordings by *Mercury*. Believe me, when I listened to this disc *after* I heard the music on the 3-channel stereo, and it was still impressive . . . *it's got to be good!* —30—

PRACTICE CODE TAPE SETS



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BC-347 Amplifier—1 6F8G tube...N: $3.95: U:		1.95
BC-357 Beacon Rec.—75 MC.....N: $4.95: U:		2.95
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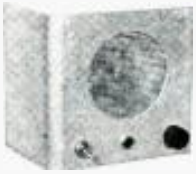

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1956 NEW YORK HI-FI SHOW

(September 27-30)

THE Institute of High Fidelity Manufacturers, Inc. will sponsor a gigantic high-fidelity equipment show in New York, September 27th through 30th (Thursday-Sunday). The affair will be held at the New York Trade Show Building, 8th Avenue and West 35th Street in New York City.

The 1956 convention of the Audio Engineering Society will be held concurrently and in conjunction with the Show. An extensive program of technical papers has been planned for the AES convention. Topics to be covered will include magnetic recording and reproduction, disc recording and reproduction, transistor application problems, audio systems and components, home music system design, loudspeakers, audio standards, and measurement methods. The Society's annual banquet and presentation of awards will be held the evening of September 27th.

At the time this issue of the magazine went to press, the audio firms listed below had indicated that they would participate in the event. Each of the exhibitors will have its latest audio gear on display. A comprehensive tour of the Show will enable the audiophile to hear and compare all of the latest models of amplifiers, preamps, record and tape playing equipment, etc.

The Show will be open to the public at an admission charge of 50 cents. —30—

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Apparatus Development Co.
Wethersfield, Conn.

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Great Barrington, Mass.

Altec Lansing Corp.
New York, N.Y.

AMI, Inc.
Grand Rapids, Mich.

Audak Co.
New York, N.Y.

Audio Devices, Inc.
New York, N.Y.

Audiogersh Corp.
New York, N.Y.

Audio Magazine
Mineola, N.Y.

A-V Tape Libraries, Inc.
New York, N.Y.

Barker Sales Co.
(Beam Instruments)
Ridgefield, N.J.

Bell Sound Systems, Inc.
Columbus, Ohio

Berlant Concertone
Los Angeles, Calif.

Bogen, David, Co., Inc.
New York, N.Y.

Bozak, The R. T. Sales Co.
Darien, Conn.

British Industries Corp.
Port washington, N.Y.

Brociner Electronics Corp.
New York, N.Y.

Cabinart
Brooklyn, N.Y.

Colbert Labs
Jamaica, New York

Dauntless International
New York, N.Y.

DeJur-Amsco
Long Island City, N.Y.

Dyna Co.
Philadelphia, Pa.

Electro-Sonic Labs, Inc.
Long Island City, N.Y.

Electro-Voice, Inc.
Buchanan, Mich.

EMI (Capitol Records)
New York, N. Y.

Ercona Corp.
New York, N.Y.

Fairchild Recording Equip.
Whitestone, N.Y.

Fenton Co.
New York, N.Y.

Fisher Radio Corp.
Long Island City, N.Y.

General Electric Co.
Syracuse, N.Y.

Gernsback Publications
New York, N.Y.

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Manchester, Conn.

Harmon-Kardon, Inc.
Westbury, N.Y.

International Electronics Corp.
New York, New York

Jensen Mfg. Co.
Chicago, Ill.

Klipsch & Assoc.
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Laboratory of Electronic Engineering, Inc.
Washington, D.C.

Lansing, James B. Sound
Los Angeles, Calif.

Marantz Co.
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Malden, Mass.

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Neshaminy, Pa.

Orradio Industries, Inc.
Opelika, Ala.

Ortho-Sonic Instruments
New Rochelle, N.Y.

Pentron Corp.
Chicago, Ill.

Pickering & Co., Inc.
Oceanside, N.Y.

Pilot Radio Corp.
Long Island City, N.Y.

POPULAR ELECTRONICS
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Precision Electronics, Inc.
Franklin Park, Ill.

Presto Recording Corp.
Paramus, N.J.

Racon Electric Co., Inc.
New York, N.Y.

RADIO & TELEVISION NEWS
New York, N.Y.

Rauland-Borg Corp.
Chicago, Ill.

Reeves Soundcraft Corp.
New York, N.Y.

Rek-O-Kut Co.
Long Island City, N.Y.

Rider, John F. Pub., Inc.
New York, N.Y.

Rockbar Corp.
Mamaroneck, N.Y.

Ronette Sales Corp.
New York, N.Y.

Schober Organ Corp.
New York, N.Y.

Scott, Hermon Hosmer, Inc.
Cambridge, Mass.

Sherwood Electr. Labs, Inc.
Chicago, Ill.

Simpson, Mark Mfg. Co., Inc.
Long Island City, N.Y.

Sonotape Corp.
New York, N.Y.

Sonotone Corp.
Elmsford, N.Y.

Stephens Mfg. Co.
Culver City, Calif.

Tandberg
New York, New York

Tannoy (America) Ltd.
New York, N.Y.

Tetrad Co., Inc.
Yonkers, N.Y.

Thorens Co.
New Hyde Park, N.Y.

United Audio Products
New York, N.Y.

University Loudspeakers
White Plains, N.Y.

Westminster Recording Co.
New York, N.Y.

WQXR
New York, New York

Keep Your Customers

(*Continued from page 59*)

and should invest in a new one. He will respect your opinion more than that of a salesman. Do not abuse your position as an expert to high pressure someone into either an unwise repair or an unnecessary purchase of a new set.

"Another problem encountered is that of children collecting around you and getting in the way. Such a moment calls for extreme tact, especially if the mother is present. Begin by pointing out that her little ones may be seriously hurt—*not* that they are bothering *you;* the psychology here is obvious. If you are left alone with the children, put them to work. Ask them in a very serious voice if they will sit across the room and let you know the moment the picture comes back.

"You'll be surprised how anxious they'll be in some cases to do your bidding if they really feel they are helping you. Another method for keeping small children out of your way is to bring out small candies and offer them to all present in return for their good behavior. A small, sanitary bag of gum drops in your tool kit can be a good investment in peace of mind.

"In the case of pets that insist on licking your nose at crucial moments, you can again point out to the owner the danger to their pet. The overfriendly animal will always be taken to another room. Under no circumstances even suggest that *you* are being bothered by their animal."

The job completed, the technician will carefully place everything back into its original position in the room. The *professional* technician will use printed service forms on which he will list all of the tubes and any other parts that were necessary to complete the job.

The use of printed service order forms gives a business-like, professional touch to the transaction. Some companies have the customer sign a service order form before the technician starts to work on the set. This procedure is legally correct and psychologically sound for it immediately establishes the service call as a C.O.D. business transaction. If the term C.O.D. is prominently shown on the face of the order, the customer is less likely to ask to have it charged when the work is completed. Most service technicians have the customer sign the work order again after the job is completed as evidence of satisfaction with the work done.

Many technicians have found it to be a good follow-through on customer relations to ask permission to phone their headquarters after the work is completed and money collected. People like to feel that they patronize busy, successful businesses and an apparent demand for service indicated by the calls jotted down by the technician will have a good psychological effect.

One shop owner, who preferred to

handle the field service calls himself, hired a bench technician to handle the shop work. As his volume of service grew to the point that he could not handle all of the field service work, he kept his new field technician with him for two weeks to teach him all of the fine points of good customer relations.

This man claims that the ability to get along with people, to make customers like you, is far more important than technical competence in servicing sets in the home. He makes each service call a production of the studied application of good customer relations practices from the time he parks his service truck until he drives it away on the next call. —30—

Realistic High-Fidelity

(*Continued from page 74*)

Crossover Networks

These circuits should really be called dividing networks; that is the term used in engineering circles, since their function is to divide the output of the amplifier into low-frequency and high-frequency bands; but as they are used to achieve a crossover frequency between tweeter and woofer, the less satisfactory term has crept into popular usage.

The whole frequency spectrum should not be divided abruptly, for a sudden switch from the woofer to the tweeter would be audibly distressing. On the other hand, too great a degree of merging would result in overload of the tweeter at maximum power owing to inadequate bass cut-off from that unit. Fig. 19 illustrates various types of dividing networks with their corresponding frequency responses. These, you will understand, are simply combinations of low- and high-pass filters, and are normally arranged to give a cut of 6 or 12 db per octave at crossover frequency. The regular type of dividing network consists of half or whole section filters in series or parallel; they are not so popular for less expensive installations as the constant resistance type, for the latter can be made up from the same sizes of capacitors and inductors, thus reducing production costs. But it is important to realize that constant resistance networks only have constant resistance when the loads across the output (speaker) terminals are pure resistances, and loudspeakers are not pure resistances; they have inductance as well.

I have mentioned that too gentle an overlap at crossover frequency may result in low frequencies getting into the tweeter, but there is a further disadvantage of such an arrangement. The impedance presented by the speaker system depends on the speaker resonances as well as other factors. You are aware that there is a substantial rise in impedance through the natural bass resonant frequency of the woofer, and the other rise in impedance is at the top end of the spectrum. The more effective the filter, that is, the greater its attenuation,

the less will be the effect on the whole network impedance by change of terminal impedance. The simplest constant resistance network gives an attenuation of 6 db per octave; the whole half-section type 12 db per octave, a figure usually accepted as adequate for good installations. With this degree of attenuation I consider the impedance variation excessive, and would recommend adoption of full section filters giving an attenuation of 18 db per octave. This adds to the cost, of course, but if better performance is desired, the cost must be faced. Attenuations steeper than this are likely to lead to the disadvantage of too rapid transition from the woofer to the tweeter.

The foregoing networks are for use between the output transformer and the speakers themselves; this is the usual way the division is carried out, since a speaker system is expected to work on any amplifier; but it is not the only way of doing the job. Fig. 18 shows a low distortion system devised by P. Klipsch, which has the great advantage of dividing before the output transformer. One of the limiting factors in any audio installation is the output transformer, for it is quite an expensive matter to build an audio transformer which has low distortion and a wide frequency range; in the Klipsch circuit there are two transformers each handling a restricted frequency range, and the cost of the two can be appreciably less than that of one wide-range transformer of equivalent performance.

The frequency division can be carried out between stages in the amplifier itself. The driver of the output stage is used to feed a high-pass and a low-pass filter, each of which leads to its own output stage, output transformer, and speaker. There is a great deal in favor of such an arrangement, for the cost of the filters is substantially reduced, since their terminals are high impedance instead of the very low impedance existing between the output transformer and speaker; the input to the two output stages can be controlled to a very substantial degree, both as to frequency and amplification, so very careful control can be applied to the respective speakers to balance them for acoustic output. Unfortunately these technical advantages are not likely to be received on the open market with any degree of enthusiasm, since the average high-fidelity enthusiast prefers to select his amplifier for one reason and his speaker or speakers for some other reason. For myself I would always consider the power output stage of the amplifier as an inseparable part of the loudspeaker design. But who am I to tell my readers what is good for them? At any rate I am telling you, dear reader, now; but I wonder how long it will be before there is a big enough market for us to revert to the sensible methods of Rice and Kellogg in 1926, who marketed their speaker complete with its own suitably designed power stage.

(To be continued)

Matching Components

(*Continued from page 69*)

speakers to each other in terms of their output level. Typically, although not always, tweeters are more efficient than woofers. Thus in a two-way system, there should be provision for attenuating tweeter level by means of an L-pad or similar device. In a three-way system, at least two of the speakers should be equipped with attenuators, and so on for still more complex speaker systems.

Assume we are dealing with a two-way system. Each speaker should produce about the same output in the region of the crossover frequency. When balancing output, the crossover network is bypassed and each speaker is alternately fed directly by the amplifier, as illustrated in Fig. 5. Assume that the two-way system uses an 800 cps crossover. Then the speaker levels should be matched by using an audio oscillator to feed the amplifier several frequencies in the region of 800 cps. It is desirable to use several frequencies ranging, say, from 600 to 1000 cps, rather than just the 800 cps tone in order to permit averaging out irregularities in speaker response characteristics. The ear is quite a reliable instrument for equating the output level of the two speakers inasmuch as on single tones it can perceive differences on the order of about 1 db. In the balancing process, as one goes through a range of frequencies from 600 to 1000 cps, sometimes the tweeter may appear to give more output, and sometimes the woofer. If this division appears to be fairly equal, balancing is probably about as good as can be practically obtained.

The procedure used for matching the speakers in a two-way system is also used for matching speakers in adjoining frequency ranges in three- and four-way systems.

Matching Without Instruments

The preceding discussion has freely assumed that all the necessary instruments for generating frequencies and measuring voltage and wattage are readily available. But what if they are not? What is the audiophile to do who has purchased components but cannot borrow the necessary instruments nor has available the services of an audio technician?

Although the possibilities of improper matching may not be completely reduced to zero without the use of instruments, on the other hand, to the extent that the owner makes use of the principles involved in proper matching and to the extent that he has high-quality components, in particular a good preamplifier, the chances of mismatch can be greatly minimized. Some of the top-notch preamplifiers can produce as high as 15 volts output with IM distortion within 1%. Obviously such a component is less apt to overload than one rated for 2 or 3 volts output.

Another factor in the audiophile's favor is that in the case of preamplifiers, unlike power amplifiers, distortion rises relatively slowly rather than abruptly once the rated output has been reached. Still another favorable factor is that although overload may occur on peaks, the preponderance of program material may be at sufficiently low level to come through satisfactorily. Although proper matching cannot be blithely ignored in assembling an audio system, it is not necessarily a critical process.

The following matching procedure may be suitable if no instruments are available:

1. Connect FM tuner, preamp, power amplifier, and speaker. Tune in a station of about average strength.

2. Turn preamp gain control down. Turn tuner gain control, power amplifier input control, and preamp input level set, if any, full on. Gradually turn up the preamp gain control until reasonable maximum desired volume is reached. If the preamplifier gain control is not yet in full clockwise position, turn down the preamp input level set and correspondingly turn up gain to maintain maximum volume. Repeat this procedure until the preamp gain control is all the way up. This gives fairly good assurance that input to the preamp is not so high as to cause overload.

3. Turn the preamplifier gain control all the way down. Noise and hum from the speaker should be virtually inaudible in a quiet room at distances more than three or four feet from the speaker. If noise and hum are excessive and come from the preamplifier, reduce the power amplifier input control enough to reduce noise and hum to a satisfactory level. Correspondingly turn up the preamplifier level set (with the gain control all the way up) so as to provide the same amount of volume from the tuner as before. This should give a satisfactory combination of low noise and low distortion.

If the preamplifier has no input

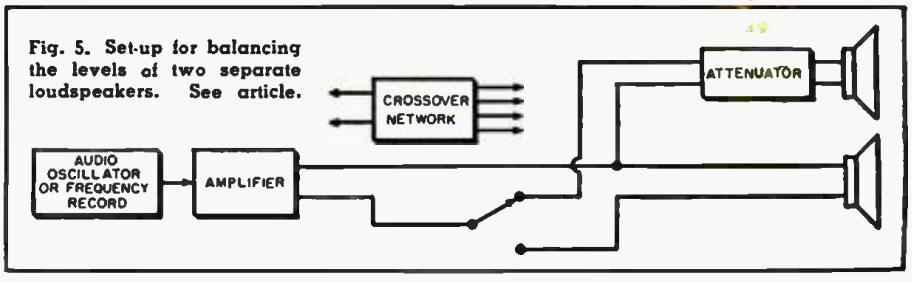


Fig. 5. Set-up for balancing the levels of two separate loudspeakers. See article.

level-set, then the tuner's volume control can take the place of the level-set in making the adjustments described in steps 2 and 3.

If the sound system does not include a tuner but only a phonograph, then the latter, playing a typical recording, may be substituted as a sound source. If audio input level must be reduced, then a suitable attenuating device, as previously discussed, should be used.

After settings have been determined for the preamp's tuner level-set and for the power amplifier input control, the preamp level-sets for other sources may be adjusted so that the volume produced by these sources is comparable to that from the tuner.

As for matching speakers, it has already been stated that the ear is a satisfactory instrument for equating levels. A phonograph test record containing a variety of frequencies can be used as a fairly adequate, though less convenient, substitute for an audio oscillator. —30—

SIMPLE SAW-TOOTH GENERATOR

By R. E. PITTET, JR.

MOST "hard tube" saw-tooth generators require two tubes or a dual tube such as the 12AT7, 6SN7, 6J6, etc. The components associated with two tubes (resistors and capacitors) make a rather bulky and complicated circuit, especially when space is a primary consideration.

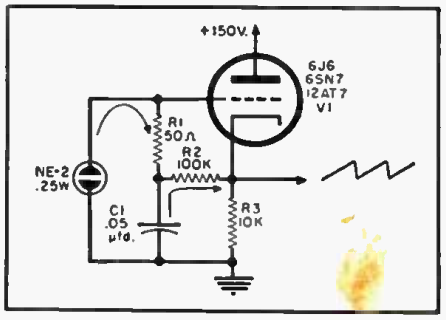
The "bootstrap" saw-tooth generator is a real space saver and despite its simplicity gives a surprising degree of linearity to the desired waveshape.

The action of the circuit is as follows: Capacitor C_1 charges through R_2 toward the positive potential of the cathode of V_1. However, the grid of V_1 is always at the same potential as the capacitor so it follows the capacitor toward the positive potential of the cathode.

Since the grid is going positive the tube will conduct more and the potential of the cathode goes even higher. It is this "bootstrap" action that gives the rising saw-tooth voltage its good linearity. When the capacitor and, of course, the grid reach the firing voltage of the neon tube, it will ionize. The flow of current discharges the capacitor, the voltage drop caused by the current through R_1 sends the grid negative, and the neon tube extinguishes due to the drop in voltage at the cathode of V_1. The cycle will then repeat itself with a repetition rate dependant upon the time constant of C_1 and R_2.

For a 200 cycle-per-second saw-tooth wave, use the component values indicated on the diagram below. —30—

Schematic of simple saw-tooth generator.

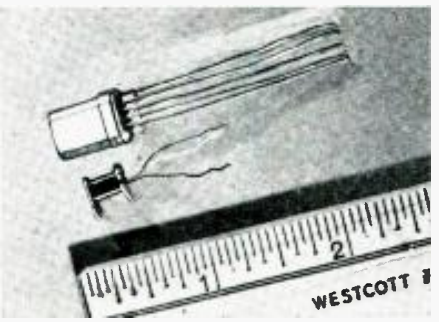


What's New in Radio

"TINIEST RELAY"

The Electronics Division of *Elgin National Watch Company*, Elgin, Illinois is now in mass production on its "Neomite" relay, said to be the world's smallest electronic switching device.

Small quantities of the relay are available with 1000, 500, 200, and 50



ohm coils with 100 mw. sensitivity. In quantity, the company can supply the component with a 2000 ohm coil. The relay weighs 1/16 ounce and measures 1/3" x 1/2".

Application of this relay in airborne control systems is suggested because of its minimal size and weight. The relay has been tested upwards of 4 million operations without failure.

DESK CABINET RACKS

California Chassis Co., 5445 E. Century Blvd., Lynwood, California has gone into production on a line of desk cabinet racks, in black and gray wrinkle or gray hammertone finish, for electronic manufacturers, ham operators, and industrial electronic users.

The "CalChassis" line includes nine sizes, ranging in height from slightly over 10½ inches to nearly 37 inches with panel space from 8¾ inches to 35 inches. The deluxe cabinet rack line is produced with universal notching, accommodating *W.E.*, RETMA, or amateur notched panels.

Write the manufacturer direct for full details and complete specifications.

TRANSISTOR TRANSFORMERS

Microtran Company, 45 East Mineola Avenue, Valley Stream, Long Island, N. Y. now has a stock line of ultraminiature push-pull transistor transformers which are available for immediate delivery.

Measuring only 3/8" x 3/8" x 11/32" and weighing .005 lb., the transformers are supplied with 4" color-coded leads suitable for use in dip-soldered printed circuits.

Molded nylon bobbins, high-nickel laminations, and Mylar insulation are used to permit maximum size reduction. Primarily designed for transistor circuitry, in guided missiles, wrist radios, airborne equipment, these stock units are also available for single-ended and vacuum-tube applications as well.

A catalogue covering the line is available on request.

COMPACT V.T.V.M.

Leitch Engineering Corporation, Manchester, New Hampshire is now introducing a new model of its "Meter-Matic" vacuum-tube voltmeter for service applications.

The new Model 21-56 "Compact" retains all the performance features of its prototype, including fully automatic range switching, automatic scale indicator lights, direct reading on an 8½ inch meter (without zero multipliers), and complete burn-out protection up to 2000 volts. In addition, the new model is compact in size (10" x 8½" x 6"), and

convenient to service with easy access to batteries, fuses, and the various controls.

An illustrated bulletin on this new unit will be supplied to interested persons upon written request.

RENEWAL COLOR TUBE

Sylvania Electric Products Inc. is now offering what is believed to be the industry's first color picture tube for renewal use, for replacement of the picture tubes in existing color sets.

The new tube, designated the 21AX-P22, is a direct-view, metal picture tube and can produce either a full-color or black-and-white picture. The tube uses three electrostatic focus guns spaced 120 degrees apart with the axes tilted toward the tube axis to facilitate convergence of the three beams at the shadow mask. The approximate deflecting angle is 70 degrees horizontal and 55 degrees vertical. Featuring magnetic convergence and magnetic deflection, the tube has individual convergence control of each beam radially

by internal magnetic poles and supplemental control of the blue beam tangentially by internal magnetic poles.

VECTOR EXTENDERS AND ADAPTERS

Vector Electronic Company, 3352 San Fernando Road, Los Angeles 65, California, has released a new line of socket extenders and subminiature adapters for all types of electronic applications.

The socket extenders, catalogue Nos.

1262, 1263, and 1265, are provided in 8-pin octal, 9-pin noval, and 7-pin miniature styles, respectively. The subminiature adapters, Nos. 1439 and 1440, are 7-pin subminiature and 8-pin subminiature round (in the socket type) and 9-pin novals in the plug-in versions.

A data sheet on these socket extenders and adapters is available upon request.

MERIT TRANSFORMERS

Merit Coil Products Co., Inc., 4427 N. Clark Street, Chicago, Illinois has introduced a new series of transistor transformers which feature very small size, high efficiency nickel alloy cores, bobbin wound windings, and flexible coded leads. They have open type mountings.

Currently available in the line are output, input, and interstage units. Write the company for full specifications on any or all of these items.

TRANSISTOR TESTER

Sonex, Inc., Upper Darby, Pa. is now offering a general-purpose transistor tester for laboratory, field, and industrial use. It measures and reads on a four-inch meter and provides informa-

tion on small signal *beta*, collector leakage current, and collector resistance.

These parameters may be measured on all *n-p-n*, *p-n-p*, surface barrier, grown, or diffused junction transistors.

The tester is self-calibrating and the transistor under test is operated in a temperature-stabilized circuit, insuring that each unit is tested under identical biasing conditions.

The unit is powered by one battery with very low current drain. The circuit itself uses three transistors.

MULTI-PURPOSE ANALYZER

Pyramid Electric Company, 1445 Hudson Boulevard, North Bergen, N. J. has recently introduced a moderately priced, multi-purpose analyzer for service technicians.

The Model CRA-2, a capacitor-resistor analyzer, is suitable for use in industrial and military electronics, black-and-white and color television, and all related fields. When making leakage current measurements, the values are read directly from the meter while the rated operating voltage is applied to the capacitor.

The vacuum-tube ohmmeter circuit in the unit displays accurate insulation-resistance values on the meter for many types of capacitors. The extended range calibrated power factor control permits power factor measure-

ments of electrolytics rated as low as 6 and as high as 600 d.c. working volts. This special circuit performs rapid "in circuit" tests for shorts, opens, intermittent high r.f. impedance, and high power factor without removing or disconnecting the component from its operating circuit.

NEW PHOTOTRANSISTOR

General Transistor Corp., 130-11 90th Ave., Richmond Hill 18, New York is now in production on a new germanium *p-n-p* alloyed junction three-lead phototransistor which is intended for use in circuits employing a.c. amplification for modulated light.

Known as the type GT-66, the new unit may also be used as a two-lead device with d.c. (unmodulated) light. Its performance level is such that it will operate a relay.

A data sheet giving complete specifications and several sample circuits is available without charge from the company. Ask for the Tentative Specification Bulletin on the Type GT-66.

JUNCTION TRANSISTOR CHECKER

Alfred W. Barber Laboratories, 32-44 Francis Lewis Blvd., Flushing, N. Y. has announced the availability of a simple and accurate junction transistor checker which will measure the significant characteristics of *p-n-p* or *n-p-n* transistors, namely collector leakage with base grounded, collector current at zero base current, and base to collector current gain at 4.5 volts on the collector.

The self-contained unit, whose battery will last over a year in normal

use, is quick and easy to use. The meter reads gain directly, showing up defective units and indicating relative gain. A novel and useful feature is the providing of pin jacks connected to base emitter and collector circuits for plugging in clip leads.

Write the *Instant Circuits Division* of the company for additional information on this checker.

COLOR-CODED CONTACT SOCKETS

Scalectro Corporation, 186 Union Avenue, New Rochelle, New York is now offering a new line of color-coded, space-saving "Press-Fit" miniature contact sockets to take the popular .080" test probes.

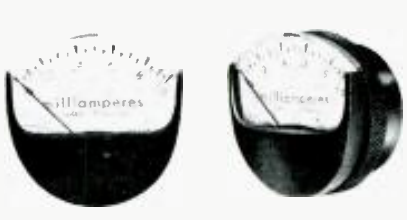
The units are now available in three different probe sizes, .040" and .050" in addition to the new .080" version. The bushing or insulator body measures only .185" in diameter with .218" diameter front face which permits spacings as close as ¼" between centers if desired.

For color-coding purposes, these contact receptacles come in eight RETMA colors: white, brown, yellow, blue, red, orange, green, and gray—with coloring throughout the Teflon body. Companion color-coded plugs are also available.

1½-INCH PANEL METER

Marion Electrical Instrument Co., Grenier Field, Manchester, New Hampshire has released a compact new 1½-inch version of its "Medalist" panel meter.

Characterized by large numerals, long pointer, and a scale length equal



to 2½" round instruments, the acrylic plastic case affords shadow-free scale illumination from all angles. It is available in numerous standard and

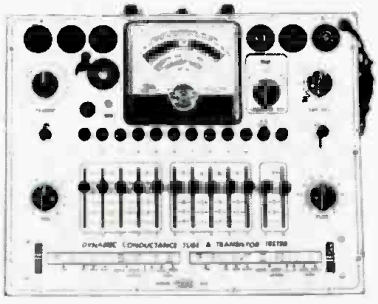
special colors to enhance equipment styling.

Designated as the MM-1, the new meter is interchangeable with standard 1½" JAN types. It is available in all standard ranges and with self-contained accessories. Further information is available from the manufacturer.

TUBE-TRANSISTOR TESTER

A dynamic conductance tube and transistor tester, the Model 666, has been released by *Electronic Instrument Co., Inc.*, 84 Withers St., Brooklyn 11, New York for color and monochrome television servicing applications.

Featuring simple, speedy operation, close simulation of actual tube operating conditions, the new unit will test all receiving tubes including subminiatures, special purpose, and series-



string types. Both *n-p-n* and *p-n-p* transistors can be checked by means of a two-step test using the internal d.c. power supply. Leakage measurement of collector current and direct reading of current amplification factor or *beta* are provided.

This *Eico* tester is available in both kit and factory-wired form. Write the company direct for complete details.

MINIATURE SOLDERING IRON

Oryx Co., 9015 Wilshire Blvd., Beverly Hills, California is marketing a pencil-sized soldering instrument which weighs only ¾ ounce and is 7¼" long. The Model 18, rated at 18 watts, has removable tips. Two styles are offered. Tip F is a fast alloy tip 3/16" diameter and Tip G with a special pure nickel end which offers considerably longer life over the standard cycle.

The company will supply full information on this and other soldering tools in its line upon request.

HEATHKIT TRANSMITTER

The Heath Company, Benton Harbor, Michigan has designed a new transmitter in kit form which provides phone and c.w. operation on 80, 40, 20, 15, 11, and 10 meters. Plate power input is 65 watts on c.w. and controlled-carrier modulation peaks to 50 watts on phone. The unit provides complete bandswitching.

The power transformer and choke are potted and the entire circuit is well shielded. There is a two-stage 12AX7 speech amplifier, a 12AU7 mod-

ulator, 12BY7 oscillator, 12BY7 buffer, and a 6146 final. The buffer stage assures plenty of drive to the final on all bands. Pi network output coupling is employed for easy antenna loading.

There is provision for the switch selection of three different crystals which can be changed without removing the transmitter cabinet.

Additional information on the DX-35 is available on request from the company.

TV TEST EQUIPMENT

Telonic Industries of Beech Grove, Indiana has added several new test instruments to its line of gear for the television technician.

Two units for color work, the Model CB-2 color bar generator and the DG-1 white dot generator and two television sweep generators for the v.h.f. and u.h.f. bands are now available from the company.

The color bar generator has the correct luminance, chrominance, and phase angle as specified by the NTSC and displays six colors plus black and white simultaneously.

The white dot generator produces small, square dots as well as crosshatch, horizontal bars, and vertical bars.

The sweep generator is available for v.h.f. (covering channels 2-13 and i.f.) and u.h.f. (covering a frequency range of 460-910 mc. with a sweep width of 0-50 mc.).

TV REMOTE CONTROL

Allen B. Du Mont Laboratories, Inc. of Clifton, New Jersey has added a "Dial-O-Matic" unit to its television receiver line to permit the remote selection of channels while automatically muting the set during the change in channels.

The new compact unit also permits the remote control of picture brightness and sound volume. Operation is identical to that of a telephone dial and permits the dialing of all twelve channels, 2-13.

TRANSISTOR KIT

Tran-Kit Electronics Co., 3472 Fish Avenue, New York 69, N. Y. is now offering a two-transistor pocket radio kit, the No. TK101.

The kit includes a clear plastic case measuring 1 x 2⅝ x 3⅝ inches, a crystal diode, a variable loop-type antenna, a subminiature volume control and switch, miniature driver transformer, 15-volt battery, two transistors, resistors, subminiature capacitors, and all necessary hardware. The kit comes complete with pictorial diagram, schematic, and parts list.

A dynamic earphone for use with the radio is also available. Write the company for a data sheet on the TK101 kit.

4-TRANSISTOR SUPERHET

Lafayette Radio, 100 Sixth Ave., New York, N. Y. has added a four-transistor superhet kit to its line of small, transistorized radio receivers.

Completely subminiaturized, this new circuit requires no external antenna or ground connections. The circuit uses one 2N136, one 2N135 and two 2N107 transistors. The Model C1-101 receiver is available as a complete kit or the individual parts may be purchased separately. A dynamic earphone for use with this circuit is available separately at extra cost. The circuit can be mounted on a Bakelite board 2½" x 3¾" which can be installed in the housing of the user's choice.

MONITORING RECEIVERS

Gonset Co., 801 South Main Street, Burbank, California has announced a new series of four economically priced FM and AM receivers for communications monitoring and emergency applications in the v.h.f. region.

All of the receivers are complete, ready-to-operate, and have built-in

speakers, self-contained a.c.-d.c. power supplies, and adjustable length strip antennas. They are housed in gray plastic cases, have calibrated full-vision dial scales, and vernier tuning dials.

The receivers are available in the following ranges: 30-50 mc. and 152-174 mc. FM and 112-132 mc. and 32-52 mc. AM. The power supplies are universal for either 115 volts a.c. or d.c.

SOLDER-COATED FOIL

The Delta Company, 333 W. 24th Place, Chicago 16, Illinois is now in production on a solder-coated copper foil for use in the manufacture of printed circuits.

Copper foils in weights of ½, 1, 2, or 3 ounces, coated with solder on one side only or on both sides is available in widths varying from ⅛" to 12".

Samples are available to manufacturers who write on their letterheads direct to the firm. —30—

"RADIO ELECTRONICS" by Samuel Seely. Published by *McGraw-Hill Book Company, Inc.*, New York. 473 pages. Price $7.00.

Designed as a companion volume to the author's "Electronic Engineering" (reviewed April 1956 issue of this magazine), this newest volume covers a different phase of the electronic field with remarkably little overlap between the two texts.

Since both volumes have been treated as separate entities, certain of the basic material has had to be repeated but the reader will not find this reiteration annoying. This volume concentrates on the processes and circuits which are important in the field of radio communications. The fifteen chapters in the book cover an introduction to communication systems, characteristics of electron tubes, rectifiers and filters, vacuum triodes as circuit elements, basic amplifier principles, untuned potential amplifiers, special amplifier considerations, untuned power amplifiers, tuned potential amplifiers, tuned power amplifiers, oscillators, AM, demodulators, FM and detection, and information theory.

Four appendices round up the material with notes on general network analysis, plate characteristics charts for vacuum tubes, characteristics of transmitting tubes, and a table of Bessel Functions of the first kind.

The student is counseled to have his mathematical techniques well sharpened before tackling this text.

* * *

"THE THEORY OF SOUND" by Lord Rayleigh. Published by *Dover Publications*, New York. Two volumes. Price $1.95 (each volume). Paper bound.

This is an unabridged and revised edition of a standard work which first appeared in 1877. Although almost three-quarters of a century have elapsed since this work was first published, most of the material, based on Lord Rayleigh's original investigations, is valid.

Since the author was primarily a mathematician, winning highest honors in this field at Cambridge, his treatment of his subject is largely mathematical. Those with the requisite background to understand and appreciate the monumental quality of this work will welcome the appearance of this new edition of a text which is a "must" for all engineers and researchers in the audio and acoustical fields.

Those who acquire this two-volume set for their libraries will be happy to note that the bindings are sturdy enough to stand the repeated thumb-

ings to which they will undoubtedly be subjected. The publishers are to be congratulated for making this classic available to a whole new generation of engineers.

* * *

"RADIO RECEIVER LABORATORY MANUAL" by Alex W. Levey. Published by *John F. Rider Publisher, Inc.*, New York. 105 pages. Price $2.00. Paper bound.

This is a practical workbook for students of radio, high school physics classes, Boy Scout troops, and other similar groups. This manual's outstanding virtue is that the work is progressive and the student, by the end of his course, has completed the construction of a six-tube, two-band superheterodyne receiver.

In the course of assembling this receiver the student has acquired considerable electronic "know-how" through a rather painless osmosis process. There are 33 progressive experiments in the manual ranging from the resistor color code and using the ohmmeter to troubleshooting a superhet.

A series of experiments is included at the end of each laboratory section and the student is required to perform the experiments and enter his test results on a tear-out report form which is turned in for checking and grading.

Radio instructors will find this manual an invaluable aid in planning and conducting courses in radio receiver fundamentals.

* * *

"COMMERCIAL BROADCASTING IN THE BRITISH WEST INDIES" compiled by Central Rediffusion Services Limited. Published by *Butterworths Scientific Publications*, 88 Kingsway, London W.C. 2, England. 91 pages. Price 5/10 including postage (approx. 90 cents U. S.).

Although this little book is rather circumscribed and specialized, many readers will find it of interest since it discusses both the technical and ideological problems encountered and overcome by the *Rediffusion Services* in setting up broadcasting services in the West Indies.

In this area of the Caribbean with its unfortunately high rate of illiteracy, radio is much more than a means of entertainment. Since high percentages of these islands' populations are either illiterate or only semiliterate, much of the task of education and information must be handled by means of the spoken word.

This book, then, is an accounting of one group's stewardship and the means that they have used to provide adequate (though still far from lavish) radio broadcasting facilities.

* * *

"AN INTRODUCTION TO AMATEUR TELEVISION TRANSMISSION" by Michael Barlow, G3CVO. Published by *"CQ-TV,"* 10 Baddow Place Avenue, Great Baddow, Essex, England. 27 pages. Price 3/6 (approx. 50 cents U. S. plus postage). Paper bound.

Many hams in the U. S. have an active interest in amateur TV and this report of the current status of such transmissions in England should prove stimulating.

This book has been prepared under the auspices of the British Amateur Television Club and serves as an introduction to the subject. Because of its limited size, the book can do little more than stimulate the reader's appetite for further information. The booklet itself is divided into six sections covering fundamentals; the scanning system and video amplifier; the video amplifier, time bases, and power supplies; a simple camera and pulse generator; mixers and modulators; and r.f. equipment. A bibliography and pertinent portions of the regulations governing British amateur TV transmitting licenses are also included.

Although the circuits discussed and described utilize British components, there is no reason why U. S. amateurs cannot use this information as a springboard to further experiments.

* * *

"AUDELS TV AND RADIO SERVICE LIBRARY" by E. P. Anderson. Published by *Theo. Audel & Co.*, New York. Two volumes. 1500 pages. Price $6.00.

These two new volumes in the *Audel* series of practical servicing manuals are packed with information on modern television receiver circuitry, radio receivers, electronic devices of various types, transistors and transistor circuits, as well as pertinent data on record changers, rectifiers, p.a. systems, tape recorders, phono pickups, FM auto radios, radio compasses, shortwave gear, radar equipment, etc.

The text material is written in easy-to-understand form and is amplified by the lavish use of diagrams, charts, photographs, and other supplementary material.

Small enough to be carried on a service job, these volumes represent a veritable "reference shelf" for the technician who services both home and industrial electronic gear.

* * *

"WORLD RADIO TELEVISION VALVE HANDBOOK" edited by O. Lund Johansen. Published by *O. Lund Johansen*, Copenhagen, Denmark. Available from *Gilfer Associates*, P. O. Box 239, Grand Central Station, New York 17, N.Y. 195 pages. Price $2.50.

There has long been a need for a "pocket-size" manual covering foreign tubes since many U.S. service technicians are encountering European-built radio equipment in the course of their routine work.

This volume covers receiving tubes, scope and television tubes, crystal diodes, transistors, etc. and lists characteristics, applications, and interchangeability information.

The tubes are listed in numerical order in a compact index with reference to the appropriate tube basing diagram and characteristics chart.

This volume covers tube data up to and including those tubes released in

November 1955. A real boon to technicians with "international clientele."

* * *

"INDUSTRIAL ELECTRONICS" by Edward J. Bukstein. Published by *Frederick Ungar Publishing Co.*, New York. 190 pages. Price $3.95.

This is an expanded and up-to-date version of the author's earlier book, "The Magic of Electronics" (reviewed in July 1954 issue).

The author has adopted the "question and answer" technique in presenting his subject. The text material is divided into nine categories covering: resistance welding, photoelectricity, x-rays, thyratrons, counters and scalers, time delay circuits, special circuits, miscellaneous applications, and test instruments.

Both technicians and laymen will find this book helpful and interesting.

* * *

"CIRCUIT DATA FOR OLD SETS" compiled by M. N. Beitman. Published by *Supreme Publications*, Highland Park, Ill.

In answer to many requests, *Supreme Publications*, producer of service data manuals, is now making available schematics of radio receivers made during the years 1939 through 1942 and sets from 1926 to 1938.

Schematics for the most recent years are contained in annual volumes while the 1926-1938 schematics have been compiled into a single large manual.

Write the publisher direct for information on prices for schematics to meet your specific requirements. List model number and year, if at all possible.

* * *

"COLOR TELEVISION" by The Electronic Education Unit, *Philco Corporation*, Donald G. Fink, consulting technical editor. Published by *Philco Corporation*, Philadelphia. 152 pages. Price $5.00. Paper bound.

This book has been prepared especially for practicing service technicians who are ready to take the plunge into color work, and is part of the company's "Factory Supervised Service" program.

The text material covers all phases of color, including theory, design, transmission, reception, installation, and servicing. A brief but comprehensive review of black-and-white theory and practice has been included to enable the user to start off on the right foot. The balance of the nine chapters covers colorimetry, transmission and reception, circuit description, color tube assembly and associated circuits, color tube and receiver adjustments, color receiver alignment, servicing procedures, and the installation of a color TV receiving system.

The presentation of the material is elaborate and colorful. Graphs, circuit diagrams, and scope patterns in full color contribute a great deal to the over-all picture of the subject. —30—

Mac's Service Shop

(Continued from page 76)

mumps, or the one about the TV set that went dead just on the afternoon before the big party—and we are going to do something to help if at all possible. Sure, I know we'll be taken for a sucker on these now and then, but we'll not worry about that. We're going to take a personal interest in our customers' problems even if they are imaginary ones!"

"That certainly ought to help you hang on to your old customers."

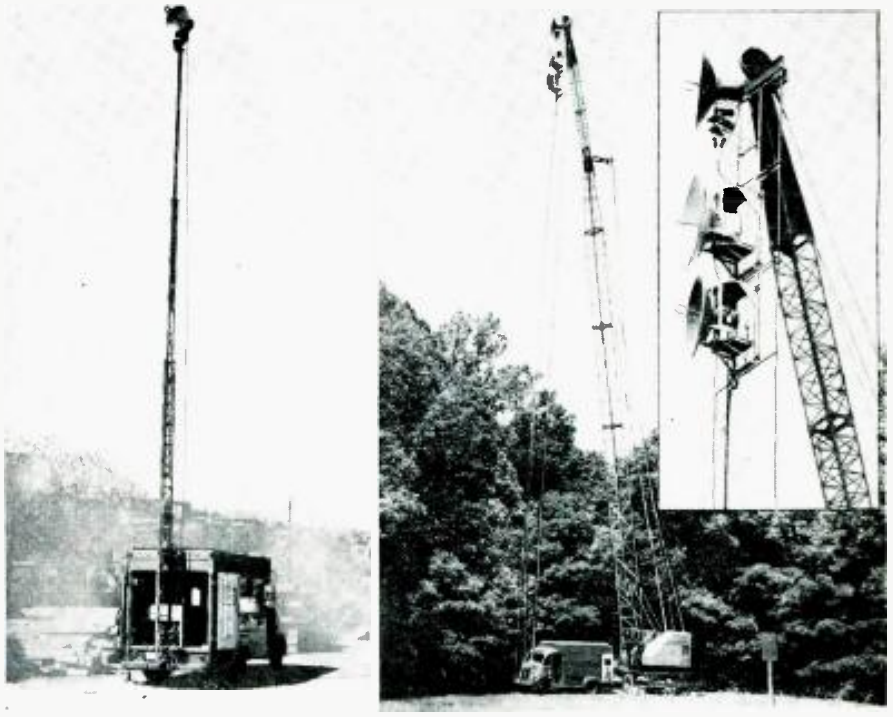
"Unless I'm greatly mistaken, it will help us get new customers, too." Mac remarked. "I'm still convinced the very finest advertising in the world is the kind you cannot buy: word of mouth advertising from satisfied customers. This has been brought home to me very sharply since that new Air Force Base went in southeast of town, and a lot of people working at the base are living here in the city. You've seen a lot of these people coming into the shop, no doubt; but have you noticed how many of them say something like, 'I live next door to Joe Blow, and he sent me here. He says you do all his work and that you treat a fellow right.' Probably no amount of handbills, newspaper advertising, or radio commercials would have carried the weight with that new customer that the simple recommendation from our old customer, Joe Blow, did."

"If a mere woman may chime into this learned discussion," Matilda remarked, looking up from her typewriter, "I might add that the ability to hold your old customers is the best barometer in the world of the quality of service that a concern is putting out. Even though the level of a business is temporarily bolstered by high-powered advertising that brings in a constant influx of new customers, the concern that does not hold on to a high percentage of its old customers has something seriously wrong with it and is headed for the rocks. I worry when even one of our old customers drifts away."

"Well that is going a little far," Mac said with a grin, "for no shop can hope to please one-hundred per-cent; but I most certainly agree with what you say about the deep significance of repeat business. Right now, though, Barney and I had better get on the sets and let you continue with addressing the cards, or we'll not have any customers for our services, old or new!"

"I might have known this pleasant 'vacation' was too good to last!" said Barney with a deep-down sigh. —30—

Leon B. Davis, General Engineer of the Chesapeake and Potomac Telephone Company, has sent us the photographs below showing the company's use of a telescoping tower on a mobile transmission unit. The antenna is rotated by means of a motor with the elevation controlled by a central shaft which, in turn, operates the elevation adjusting screw. The telephone company used this technique as early as April 20, 1954. They also have used truck mounted cranes as temporary towers. A cross-arm is bolted to the end of the crane boom and cable suspension strand is stretched under approximately 1000 pound tension to anchors in the ground or the bumper of a truck. These strands are used as guides for the remotely controlled antenna mounts. At the top, where it is used, the strands are quite rigid. No noticeable attenuation, due to vibration, has been experienced during moderate winds on paths up to thirty-two miles using the strand technique. Both elevation and azimuth are controlled by remote motors. This technique was originally reported in our June issue.



Spot Radio News

(*Continued from page 14*)

triggered by a single control box. This has been found to be particularly useful when effects on two different type scopes are desired. The control box may also be fixed to trip the shutter at periodic intervals without using the photoelectric cell.

It has been estimated that the electronic setup cuts the viewing time of the final film threefold, plus allowing for more viewing continuity.

SINCE 1926, it has been known that when electrons of relatively low energy strike a solid surface, some of the scattered electrons lose energy in small amounts that are characteristic of the solid. The same result, a kind of line spectrum of energy-loss distribution, is obtained when the electrons are scattered by passage through thin layers of solid. Although a number of investigations of the effect have been reported in the last quarter century, considerable uncertainty remains in regard to both the experimental findings and their theoretical interpretation. Much greater attention has been directed to the scattering of high-energy electrons, with interest centered on interactions with nuclei.

Seeking a better understanding of low-energy scattering, the Bureau of Standards in Washington has been conducting a systematic exploration of this phenomenon. The study is expected to throw light on many problems in solid state physics. The well-known applications of solid-state physics to semiconductors and transistors were achieved with only a minimum experimental basis. Thus, the results of electron scattering studies should not only strengthen solid state theory, but may add considerably to its practical potential.

Equally important is the application of scattering data to the study of radiation effects. This is of as much interest in medicine and biophysics as it is in fundamental physics. Most radiation, such as x-rays, does not act directly, but rather by way of the electrons released in matter. Hence, when the action of the individual electron in a single collision is more adequately known, a better picture can be formed of the total effect of the radiation under investigation.

The Bureau's experts also noted that the study bears directly on problems in electron optics. In the electron microscope, as an example, the primary process of image formation is the scattering of electrons in the specimen. If this process introduces differences in the velocities of the electrons, chromatic aberration results. Still another problem that may be clarified by electron-scattering studies is secondary electron emission, which is essential to the operation of many types of vacuum tubes.

Two principal instruments have been used in the Bureau's experiments. The

first resembles an electron microscope. In its original form, the microscope's electron gun sent the primary beam down towards a thin film of specimen. Passing through, the scattered electrons were focussed by an electrostatic objective lens into an image on an opaque screen. A slit in the screen served to allow part of the image to be magnified by a cylindrical lens, the analyzer. If the electrons all had one velocity, or the analyzer were free from chromatic aberration, a single image of the slit would be formed. However, if the slit is moved away from the optical axis, the chromatic aberration will be greatly increased. The result is a spectrum, with separate images of the slit corresponding to the different velocities of the electrons. The spectrum is recorded on a photographic plate and a microdensitometer is used to determine the energy distribution.

The Bureau's modification featured two major improvements. It was found, first, that the precision of intensity measurements could be increased by replacing the photographic plate with another kind of detector. This is a fluorescent layer connected by a light pipe to a photomultiplier. Since only a narrow segment of the spectrum may reach the detector at one time, energy scan is provided by varying the analyzer lens potential and recording, simultaneously, the output of the photomultiplier. The other change eliminates errors due to chromatic aberration in the objective lens by inverting the positions of the objective lens and specimen. With this arrangement, the objective is not used during actual scattering experiments. It is often convenient, however, to be able to examine an enlarged image of the specimen. To do this, the objective is switched on and a highly reduced image of the electron source is formed just above the specimen. This image projects an enlarged shadow image on the specimen of the slit plane.

In this and in the other electron-optical instruments designed by the Bureau, an effort has been made to use a fixed, well-determined value for a solid angle subtended by the analyzer entrance. A survey of previous work in the field showed that this angle was often defined either poorly or not at all. Since the Bureau studies indicated that the angular distributions for elastically (with zero loss) and inelastically scattered electrons were quite different, it became obvious that investigators using different acceptance angles would obtain different relative intensities and spectral line shapes for the two kinds of electrons.

To investigate scattering at angles up to 150° from the forward direction of the primary beam, a second instrument was designed at the Bureau. Though having a resolution of only one part in 2000, it has been found adequate for many applications. In particular, the device has made possible the first extensive study of the

angular distribution of scattered electrons and has supplied information about the relation between angle and relative intensities of spectrum lines.

Current plans in Washington call for an extension of the electron scattering studies. An important project for which preparations have been made is the study of scattering by metallic vapors. If the energy loss spectra of a metallic vapor is the same as that of the solid metal, this would indicate that the collision process involves individual atoms of the scatterer. If the spectra are different, support would be obtained for those theories that assume interaction between the electron and the scattering atoms as a collective whole.

OFFICIAL AUTHORIZATION to use the scatter technique for long-distance, over-the-horizon communications was extended recently by the Commission to the *A. T. & T.*

The telephone company received permission to furnish radiotelephone service, on a regular basis, between Florida and Cuba, using the ultra-high frequencies of 840 to 880 megacycles, which are part of the TV bands. The 180-mile span, over water, will be covered without the use of any relays.

STALLED BY SUMMER, few TV-station grants have appeared on the record books during the past weeks.

The authorizations, as they stood at press time, appear on page 12 of this issue.

THE FIFTEENTH anniversary of the birth of regular TV broadcasting and the fourth birthday of the lifting of the freeze was celebrated in Washington during the first week of July.

Before the freeze was lifted in the mid year of '52, there were slightly more than 100 stations, all very-high, on the air, operating in about 60 areas. And there were about 15 million sets in use.

Today, there are 477 TV stations on the air, and 647 have been authorized to operate. More than 90 per-cent of the nation's population are said to be within range of at least one TV station, and about three in every four homes have a television receiver. According to industry estimates there are about 38 million sets in use today.

Quite a progress report for a youngster!

COMMENTING ON THE TERRIFIC growth of our industry during the past 30 years, *Motorola*'s president said recently that there is amazing strength in every phase of the business. Said he: "We're fast growing, volatile, ambitious, and energetic. . . . And believe it or not, the biggest part of the growth and the greatest expansion into complex new fields are still ahead of us. . . . The future size of our industry today has something in common with an iceberg. . . . The biggest part of it is under the surface where you can't see it." . . . . . L. W.

(Continued from page 28)

into the hands of an entirely new group headed by Edward A. Glaeser . . . **UNITRONICS CORPORATION** is the new corporate name of **OLYMPIC RADIO & TELEVISION, INC.**, and its affiliated companies. It will become the parent firm with several divisions. The company also announced the purchase of **PRESTO RECORDING CORPORATION** of Paramus, New Jersey, as part of its continuing expansion in the electronics field . . . The formation of the **FARNSWORTH ELECTRONICS COMPANY,** Pacific Division, has been announced following the acquisition by **FARNSWORTH** of the **BENNETT PRODUCTS MANUFACTURING COMPANY** of Palo Alto. The division will be operated as a wholly owned subsidiary of the parent firm, a division of **I. T. & T.** . . . **ALTEC SERVICE CORPORATION** has changed its corporate name to **ALTEC COMPANIES, INC.** No changes in personnel or operation are anticipated . . . **ED CORNFIELD** has resigned as national sales manager of the tape recorder division of **DeJUR-AMSCO CORPORATION** to set up his own manufacturer's representative firm with headquarters at 39-25 51st Street, Woodside 77, New York . . . **W. L. CUNNINGHAM & ASSOCIATES** has been established at 435 Addison Avenue, Elmhurst, Illinois, to function as sales engineers of electronic equipment in the Chicago metropolitan area . . . **KUBRICK-YURMAN CO.** has been established as the result of a merger between the **DAVE KUBRICK CO.** and **SAM YURMAN,** an independent representative. Offices will be maintained at 200 West 34th Street, Suite 1606, in New York City . . . **CAL-TRONICS CORPORATION** of Los Angeles has announced the formation of a new division to be known as **FOTO-ETCH CIRCUITS.** The plant is located at 2631 Southwest Drive in Los Angeles . . . The name of **MORAND ELECTRONICS CO.** has been changed to **NATIONAL ELECTRONICS CORPORATION** with headquarters at 2538 So. Highland in Los Angeles. The company also announced the acquisition of **EL RAY MOTORS, INC.,** of North Hollywood, California, manufacturer of all types of fractional horsepower motors.

* * *

A. N. HAAS, JR. of *Bud Radio, Inc.* of Cleveland, has been elected chairman of the Association of Electronic Parts & Equipment Manufacturers. It was the first time in the 21-year history of the 120-company Midwest trade group that a nonresident member has been chosen to head the group.

Helen Staniland Quam of *Quam-Nichols Co.,* Chicago, was named vice-chairman, and Kenneth A. Hathaway of *Ward-Leonard Co.* was named

treasurer. Kenneth C. Prince of Chicago was re-elected executive secretary of the group.

Mr. Haas was also named to the board of directors of the Radio Parts & Electronic Equipment Shows, Inc.

* * *

JAMES O. BURKE has been elected president of *Standard Coil Products Co., Inc.*, succeeding Glen E. Swanson, who has been named chairman of the board.

Mr. Burke, who became executive vice-president in June 1954, assumed the responsibilities of president in April when Mr. Swanson was granted a leave of absence for reasons of health. He was one of the original founders of the firm in 1935.

The company operates plants in Melrose Park, Illinois, Los Angeles, Bangor, Mich., and North Dighton, Mass.

* * *

WESTINGHOUSE is building a four-story addition to its new research laboratories at Churchill Borough, about 10 miles east of downtown Pittsburgh, Pa. Completion is scheduled for late 1957 . . . The Communication Equipment Section of **GENERAL ELECTRIC COMPANY** is building a new plant on a 158-acre tract on Route 441, ten miles northwest of Gainesville, Fla. The new plant is the second to be announced by the company in Florida within a two week period. Completion will take about two years . . . **TEMCO AIRCRAFT CORPORATION** is building a million-dollar engineering center adjacent to its Garland, Texas, plant. The new center is expected to be ready for occupancy early next spring . . . A contract for the first $400,000 unit in the **ELECTRONIC ENGINEERING COMPANY OF CALIFORNIA'S** new laboratory in Santa Ana has been awarded and construction will start immediately . . . A new regional sales-engineering office to service the New York area has been opened by the **PERKIN ENGINEERING CORPORATION** of El Segundo, California. The address is 1060 Broad Street, Newark 2, N. J. . . . The acquisition of an additional building that will eventually add over 50,000 square feet of research, engineering, and testing space to present facilities, has been announced by **GULTON INDUSTRIES** of Metuchen, New Jersey . . . **RAYTHEON** has purchased a 15-acre site in Goleta, California, 5 miles west of Santa Barbara, for a new engineering laboratory to be used in the design and development of airborne electronics and infrared equipment . . . **WESTINGHOUSE** will expand its receiving tube manufacturing facilities in Bath, New York, to include design, development, and pilot work on new types of tubes . . . **COOK RESEARCH LABORATORIES** of Skokie, Illinois, is building a new plant in Morton Grove, Illinois, which will provide 31,000 square feet of additional space and will be used principally for radar research. —30—

Tube Tester

(*Continued from page 42*)

the tube under test is applied to a d.c. amplifier and then to the meter. All test voltages applied to the tube are reduced approximately ten per-cent for the "life expectancy" test, and the resulting change in G_m is noted.

The partial schematic diagram of the card-operated switch system is shown in Fig. 2. The arrows indicate the movable contacts which normally touch their respective contact strips under the pressure of individual phosphor-bronze coil springs. When a "Perfo System" card is inserted into the slot provided on the tester panel, as shown in Fig. 1, all contacts are opened except those that are in mechanical alignment with the perforations in the card. The holes in the card permit these contacts to close under pressure. The specific contacts that remain closed are those that correspond to the proper socket pins and test voltages for the tube under test. Of course, the locations of the holes in the card are different for different tubes.

Not shown in the schematic diagram is a Microswitch which is used for power "on-off," and is actuated by the complete insertion of a card into the slot. Inserting a card automatically turns the tester on; withdrawing the card shuts off the tester.

Although contacts 6, 7, and 8 are not shown connected to their respective counterparts on each switch section, they are so connected. This has not been shown on the diagram for the sake of clarity. Two pin positions (10 and 11) are provided on each switch section to allow for new socket development; one complete switch section is provided as a spare for future use.

The most important of the many problems encountered in the design of this instrument was the choice of contact surface platings and the accommodation of a huge number of individual contacts in a small space.

Each moving contact is a large-diameter steel ball, heavily plated with a special non-corrosive alloy. The balls are maintained in contact with the strips (similarly plated) under pressure applied by phosphor-bronze coil springs. The thickness of the card determines the amount of spring deflection and hence the operating life of the spring. For this reason, the card thickness is 1/32nd of an inch, resulting in so small a spring deflection as to be almost negligible.

The operation of the "DynaMatic" tube tester requires the following steps:

1. Set the "Heater" control to that number corresponding to the heater voltage required by the tube to be tested and insert the tube into the appropriate socket. For a 19BG6 tube, for example, the heater switch setting is 19. The first numerical part of the tube designation is the correct setting.

2. Refer to the chart furnished with the instrument. Opposite the tube type will be a hyphenated number; the first half of the number refers to the card to use, the second half is the setting for the "Calibration" control. Insert the card into the slot on the tester panel and set the "Calibration" control.

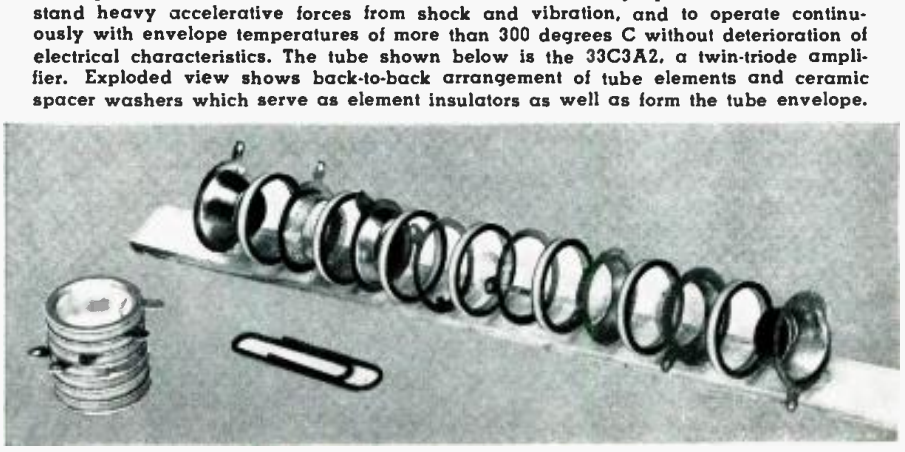
3. Allow the tube under test to warm up and then turn the third knob to "Short." If the neon bulb does not remain lit, proceed with the G_m test.

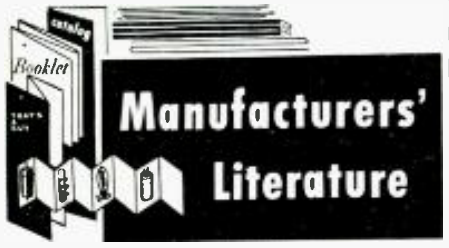
Turn the knob to the "Life Test." If the meter pointer drops appreciably, the life expectancy of the tube is short.

In the "Gas" test, the pointer will rise suddenly and fall quickly to zero in testing a non-gassy tube. If the pointer does not fall to zero, the tube is gassy or has grid emission.

When the card is removed from the slot, the instrument is turned off and is ready for the next tube. —30—

A new concept in electronic receiving tube manufacture was revealed recently when Eitel-McCullough, Inc., San Bruno, Calif., released information on a new Eimac stacked ceramic receiving tube. The company, which specializes in power transmitting tubes, developed the new tube under Air Force contract to provide a small unit which would withstand environments found in airborne and missile applications. Life of the new tubes is so long that they will be wired directly into the equipment, thereby eliminating need for tube sockets. Also, their design permits them to withstand heavy accelerative forces from shock and vibration, and to operate continuously with envelope temperatures of more than 300 degrees C without deterioration of electrical characteristics. The tube shown below is the 33C3A2, a twin-triode amplifier. Exploded view shows back-to-back arrangement of tube elements and ceramic spacer washers which serve as element insulators as well as form the tube envelope.





SILICON RECTIFIER HANDBOOK

The Rectifier Division of *Sarkes Tarzian, Inc.*, 415 N. College Ave., Bloomington, Indiana has announced publication of its "Silicon Rectifier Handbook," which sells for $1.00 a copy.

This compact, 24-page booklet covers the theory of operation, manufacturing process, rectifier characteristics, construction, key to coding, electrical ratings and mechanical dimensions, engineering data, and mounting hardware for stud and plug-in type rectifiers.

The text material is lavishly illustrated with graphs and photographs of the units discussed.

STANCOR TRANSFORMERS

The Chicago Standard Transformer Corporation, 3501 West Addison Street, Chicago 18, Illinois has published a completely new catalogue covering its *Stancor* line of transformers for industrial, communications, television, and radio applications.

This 24-page publication lists 570 transformers for all types of application. All stock units are listed with detailed specifications, including dimensions and illustrated mounting styles. A separate section is devoted to TV replacement transformers. It includes a quick preference listing of exact replacement flybacks, arranged by original manufacturer and original part number.

Catalogue No. S-102 will be supplied without charge by any of the company's distributors or by the company direct.

TUBE SELECTION CHART

A selection chart listing the company's "5-Star" high-reliability tubes for critical applications is now being offered by the Tube Department of *General Electric Company*.

The chart classifies the 34 tubes, applicable military specifications, heater voltages and currents, and gives average characteristics.

The chart (ETD-1276) may be obtained from the Tube Department at 1 River Road, Schenectady, New York.

RELAY CATALOGUE

A broad range of relay types from most of the major manufacturers is included in Catalogue C-7 just released by *Relay Sales, Inc.*, Box 186, West Chicago, Illinois.

This 28-page publication lists items which are carried in stock and are available for immediate delivery. Types include telephone relays, AN-approved series, keying relays, midget units,

hermetically sealed relays, steppers, motor starters and contactors, timers, and sensitive relays in practically all popular contact arrangements and coil ratings.

1956 BATTERY INDEX

The National Electronic Distributors Association has announced publication of its "1956 Battery Index," which lists 28 different brand names or a total of 1063 numbers—all comparative and interchangeable with NEDA's 133 standardized numbers.

Compiled in cooperation with all battery manufacturers, the current Index is the answer to the industry's need for a unified numbering system for batteries. The style of the 1956 edition, in contrast to last year's Index, is changed so that NEDA numbers are designated in the middle of the chart and appear in red ink.

The current Index includes a folded type chart and the heavy tagboard chart, both 22" x 27". Prices are $9.00 per hundred for the folded Index and $23.50 per hundred for the heavy tagboard Index. Either type may be ordered from NEDA's national headquarters at 4704 Irving Park Road, Chicago 41, Ill.

SUPREME MASTER INDEX

Supreme Publications, 1760 Balsam Road, Highland Park, Ill. has announced the availability of its "Master Index to Most-Often-Needed Television and Radio Servicing Information" for 1956.

The index, which is available for 25 cents a copy, gives a complete cross-reference to the publisher's 16 radio volumes and 11 television manuals.

"THIS IS MALLORY"

P. R. Mallory & Co., Inc., Indianapolis 6, Indiana has issued a 32-page brochure outlining its facilities and products in this its Fortieth Anniversary Year.

Entitled "This is *Mallory*," the brochure is a word-picture story of the firm's facilities and departments, divisions, subsidiaries, and affiliates and provides the reader with an over-all picture of the scope of the company's products and activities.

SOLDERLESS PHONO PLUGS

Workman TV, Inc., 309 Queen Anne Road, Teaneck, New Jersey is currently offering a one-page data sheet which describes in detail its unique solderless phono plug.

The Model #PP (on which a patent is pending) is pictured and full information on its installation given. Write for a copy of Form #CS23 for full details on this plug.

SIMPSON PUBLICATIONS

Simpson Electric Company, 5200 W. Kinzie, Chicago 14, Illinois has recently published two new booklets of interest to the industry.

The first, a six-page brochure, gives concise descriptions and specifications on products in the company's extensive line of test instruments designed

for the radio and television service industry and refrigeration technicians. Among the instruments pictured and described in Bulletin No. 2056 are the "Varidot" generator, a 7-inch "Colorscope," a "Capacohmeter," v.o.m.'s v.t.v.m.'s, ohmmeters, etc.

The second release, an 87-page technical manual, describes the complete line of electrical indicating instruments and test equipment made by the company. Profusely illustrated with photographs, wiring diagrams, and dimensional drawings, the new manual is indexed for ready reference to any product.

A 37-page panel meter section combines in a single publication complete descriptions and illustrations of more than 800 different kinds and sizes of panel meters which the company carries in stock or can supply on demand.

MICROPHONE CATALOGUE

The Astatic Corporation of Conneaut, Ohio has released a new, fully illustrated 14-page general microphone catalogue.

The new publication, #S-442, includes the company's complete line of professional, general purpose, and amateur microphones, and microphone accessories. An entire section is devoted to the company's "Futura" series of dynamic microphones, their specifications, features, performance, accessories, plus architect's and engineer's specifications.

The new catalogue is available from the company's representatives and distributors or by writing the Director of Sales of the firm.

BERKSHIRE "LABSTROBE"

A one-page, two-color catalogue sheet, No. 18A-1, has been issued by *Berkshire Laboratories* giving details on its "Labstrobe," a small, light, inexpensive stroboscope unit for checking rotation speeds of motors and the operation of phonograph turntables.

When used with the company's "Phonostrobe Disk," the "Labstrobe" can be employed to check all three of the usual record speeds. The catalogue sheet includes instructions for using the unit and a table for converting to rpm the different number of marks on the disc.

Write the company at 566 Bank Village, Greenville, New Hampshire for a copy of this catalogue sheet, which includes a complete description of the unit and price data.

RETRACTILE CORDS

Koiled Kords, Inc., Box K, New Haven 14, Conn. has issued a new, two-color catalogue which shows its complete line of retractile cords for industry, communications, and home application.

More than 25 illustrations picture as many different uses for these springlike cords that extend to approximately six times their retracted length and, when released, return to their neatly coiled normal size.

The catalogue is available without charge to design engineers, maintenance

nance managers, purchasing agents, and others interested in retractile cords. Address all requests for this publication to E. L. Love, Sales Manager of the company.

ALLIED FLYER

Allied Radio Corporation, 100 N. Western Ave., Chicago 80, Ill. has issued a 32-page supplement which lists hundreds of special values on audio equipment, kits, antennas, tools, radio receivers, garage door openers, Geiger counters, ham gear, test instruments, and items for the experimenter.

This new publication is available without charge on request. All of the items listed are available by mail, if desired.

G-E CERAMIC TUBES

The Tube Department, *General Electric Company*, 1 River Road, Schenectady, New York has just issued a new 20-page booklet containing additional data on its microminiature metal-ceramic receiving tubes.

Design and construction innovations of the tube are described in the booklet, which also contains additional applications data, operating characteristics, and construction features. Illustrations show the extensive facilities, advanced equipment, and engineering and technical skills employed in the manufacture of the tubes.

The booklet, ETD-1212-A, is available without charge on request.

CAREERS IN ELECTRONICS

Capitol Radio Engineering Institute, 3224 16th St., N.W., Washington 10, D. C. has issued an interesting 48-page booklet, entitled "Your Future in the New World of Electronics," which outlines the opportunities open to technically trained men.

A 9-page, detailed, and factual report outlines the growing importance of electronics in the world, the status of various branches of electronics, career opportunities, and the outlook for the future.

The publication also describes the school's home study course and explains the curriculum which includes practical radio-electronic engineering, broadcast radio engineering, radar and servo engineering, practical television engineering, and practical aeronautical electronic engineering.

Copies of the booklet are available from the Registrar without charge.

CONTROL-RESISTOR CATALOGUE

Clarostat Mfg. Co., Inc., Dover, N. H. has issued a comprehensive 28-page catalogue which lists just about every type and size control or resistor needed for the usual run of applications.

Among the listings are composition-element and wirewound controls in several sizes including miniaturized versions, convenient field-attached shafts and switches, power rheostats, sound-system controls, precision and laboratory-grade controls, wirewound fixed and adjustable resistors, precision deposited-carbon resistors, bal-

lasts, line-voltage regulators, fuse-type resistors, a power resistor decade box, etc.

A copy of Catalogue No. 56 is available either from the company direct or from any of the firm's distributors.

PACKAGED MICROWAVES

The Government & Industrial Division, *Philco Corporation*, 4700 Wissachickon Ave., Philadelphia 44, Pa. has issued a 16-page descriptive brochure relating the firm's microwave communications equipment to different types of industry.

The booklet, which contains a large number of photographs and diagrams of actual microwave installations, describes typical expandable systems for 500 miles, 120 miles, and 90 miles. One system is capable of handling 48 voice channels.

NEW TRIAD TRANSFORMERS

Triad Transformer Corporation, 4055 Redwood Avenue, Venice, California has issued a four-page folder which illustrates and describes all of the new items which are mentioned for the first time in the company's 1956 general catalogue.

Included among the new items are various audio, isolation, filament, output, modulation, auto radio replacement transformers, swinging filter reactors, blocking oscillator transformers, deflecting yokes, etc. All of the items are pictured and described.

LAFAYETTE CATALOGUE

Lafayette Radio, 100 Sixth Ave., New York, N. Y. has issued a value-packed, 96-page general catalogue which it is offering free to experimenters, hobbyists, service technicians, school executives, and audiophiles.

The publication pictures and describes hundreds of items of interest to the electronic industry. Copies of Catalogue 5-56 will be forwarded upon written request to the company. —30—

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96	United Air Lines
98	General Electric Company
174	Chesapeake and Potomac Telephone Co.
180	Eitel-McCullough, Inc.

ERRATUM

The schematic diagram on page 59 of the April 1956 issue ("A Portable Geiger Counter") contained an error. The bottom end of the volume control, R_{10}, should be connected to terminal "B" on P_1 instead of to ground as shown.

INDEX OF Advertisers

SEPTEMBER 1956

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

Classified

RATE: 50c per word. Minimum 10 words. November issue closes September 10th. Send order and remittance to: RADIO & TELEVISION NEWS, 366 Madison Ave., N. Y. C. 17.

RADIO ENGINEERING

COMPLETE radio, electronics theory & practice; television; broadcasting; servicing; aviation, marine, police radio. 18 or 21 months. Catalog. Valparaiso Technical Institute, Dept. N, Valparaiso, Ind.

FOR SALE

DIAGRAMS for repairing radios $1.00. Television $2.00. Give make, model. Diagram Service, Box 672-RN, Hartford 1, Conn.

TUBES—TV, Radio, Transmitting And Industrial Types At Sensibly Low Prices. New, Guaranteed, 1st Quality, Top Name Brands Only. Write For Free Catalog or Call Walker 5-7000, Barry Electronics Corp., 512 Broadway, New York 12N, N. Y.

NAVY Surplus-used, complete with tubes—Receiver, R 28, 100 to 156 MC $8.00, Transmitters, T-19, BC 696-3 to 4 MC, $5.00, T-20, BC 457—4. to 5.3 MC $3.95, T-21, BC 458—5.3 to 7 MC, $3.95, Jack Box New BC 1366 M, $1.00. Prices F.O.B. B'ham, Ala. Rogers Trading Co. 2101 Second Ave. North, Birmingham 3, Ala.

DIAGRAMS! Repair Information! Radios—amplifiers—recorders $1.00. Televisions $1.50. Give make, model, chassis.—Norelco-Philips and Amperex tubes in stock! TV Miltie, Box 101 RA, Hicksville, New York.

DIAGRAMS—Radios, Amplifiers, Changers, $1.00 Each. Television Service Data $2.00. Unknown Models, Give Tube Layout And Part Numbers. Kramer's Radio Service, Dept. 656, 36 Columbus Ave., New York 23, N. Y.

SERVICE time cut in half with Trouble Shooting Test Instrument made from old television. $2.00. Sterling, 129 West Long Ave., New Castle, Pa.

COMPLETE Television Sets $11.95. Jones TV, 1115 Rambler, Pottstown, Pa.

WIRING houses with relays and low voltage control. Diagrams, information. Box 154, Paramount, Calif.

TRANSISTOR Kits. Free information. Transit Electronics, Box 15-N2, Alden Manor, Elmont, N. Y.

V-O-MA pocket multimeter kit. All parts to build a unit we manufacture by the thousands for the Army. Complete with cable harnesses, 1% resistors precut and bent. Test leads and sturdy vinyl carrying case included. Simple, easy assembly. Dual color meter scale. 0-10-30-300-1000-5000 AC-DC volts. 0-5000-500,000 ohms. 0-10-100 milliamps. A top quality meter at an unusually low price of only $17.50 net. Atomic Engineering Corporation, Box 1701, Grand Junction, Colorado.

WANTED

WANTED: ART-13 transmitters and parts—also ARC-1, ARC-3 and ARN-7. Have requirement for ARN-6 material, Iron Core Loops, need all types Collins and Bendix Aircraft Radio equipment. Florida Aircraft Radio & Marine, Inc. P. O. Box 205, International Airport Branch, Miami 48, Florida.

CYLINDER and old disc phonographs. Edison Conqueror, Idelia, and Oratorio models. Berliner Gramophones and Zono-o-phones, Columbia cylinder Graphophones, and coin-operated cylinder phonos. Want old catalogues and literature on early phonos prior to 1919. Will pay cash or trade late hi-fi components. Box 50 % RADIO & TELEVISION NEWS.

AIRCRAFT Electronics Needed: BC-788, I-152, ARN-7, ARC-3, ARC-1—or any type airborne electronics. Electronic Tubes Needed: Broadcast (water and air cooled), transmitting, receiving (in quantity only), Magnetrons, Klystrons, etc. Top Prices Paid: Write or phone description for immediate action. Bob Samuel, W6REN, 1521 S. Edris Dr., Los Angeles 35, Cal. Phone: CRestview 1-3856.

TUBES and equipment bought, sold, and exchanged. For action and a fair deal write B. F. Gensler, W2LN1, 56 Crosby St., N. Y. 12N, N. Y.

AN/APR-1, AN/APR-9, other "APR-," "ARR-," "TS-," ARC-1, ARC-3, ART-13, everything surplus: Tubes, Manuals, Laboratory equipment. Describe, price in first letter. Engineering Associates, 131 Patterson Rd., Dayton 9, Ohio.

ART—13/T17A Transmitters, $175.00; ART—13/T47 Transmitters, $125.00; BC-788 C Altimeters, $175.00; ARC-3 Transceiver Complete, $325.00; R5/ARN-7 Radio Compass, $175.00; BC-348 Rec'r Modified, $25.00; BC-348 Rec'r Unmodified, $50.00; ARC-1 Transceiver, $300.00; BC-312 Rec'r, $50.00; BC-312 Rec'r, $40.00; I-152-C Indicator, $50.00. Ship Via Express, C.O.D. Subject To Inspection To H. Finnegan, 49 Washington Ave., Little Ferry, N. J.

WANTED: Receiver R5/ARN-7, MN-62A Transceivers, RT18/ARC-1, AN/ARC-3, BC-788C, I-152C, Collins, Bendix equipment. Test Sets, Dynamotors, Inverters. We pay highest prices. Advise quantity, condition, price first letter. Aircraft Radio Industries, Inc., 15 East 10th St., New York City, telephone LExington 2-6254.

RC221's WANTED—Highest cash price for RC-221's paid even more if the unit has modulation and hasn't been tampered with. Original Book needed. Write giving Model No. to Weston Laboratories, Inc., Bolton, Mass.

REPAIRS AND SERVICING

HIGH Fidelity Speakers Repaired. Amprite Speaker Service, 70 Vesey St., N. Y. 7, N. Y. Ba. 7-2580.

TELEVISION Tuner Repairs. Dan's Television Laboratory, 606 Sunrise Highway, Babylon, N. Y.

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3J30	30.00	717A	.35	5703WA	4.50
*4-65A	16.50	723A B	7.85	5718	2.50
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4-400A	58.50	800	.90	5726	2.50
4B24		802	2.25	5744	1.25
4E3C	4.50	803	2.00	5749	1.25
4C35	13.50	805	5.00	5763	1.20
4E27	8.50	807	1.20	5812	1.00
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5C22	19.10	5933	2.85	5840	6.00
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1H5GT	.58	6AM8	1.10	6SF5	.72
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1L6	.79	6AN8	1.15	6SG7	.65
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2X2	.49	6BD5	1.35	7A5	.69
2X2A	1.35	6BD6	.73	7A6	.78
3A3	1.05	6BE6	.65	7A7	.75
3A4	.50	6BF5	.82	7A8	.75
3A5	.64	6BF6	.68	7AD7	1.65
3AL5	.65	6BG6G	1.75	7AF7	.89
3AU6	.70	6BH6	.79	7AG7	.95
3AV6	.60	6BJ6	.69	7AH7	.95
3B4		6BK5	.95	7B4	.75
3B7	.39	6BK7	1.05	7B5	.65
3BC5	.80	6BL7	1.05	7B6	.75
3BN6	1.05	6BN6	1.10	7B7	.75
3BY6	.75	6BQ6GT	1.15	7B8	.85
3CB6	.80	6BQ7A	1.15	7C5	.75
3CF6	.85	6BX7	1.20	7C6	.75
3D6	.39	6BY5G	1.25	7C7	.79
3LF4	.85	6BZ7	1.20	7E7	1.15
3Q4	.65	6C4	.38	7F7	.85
3Q5	.75	6C5	.48	7F8	1.10
3S4	.65	6C5GT	.46	7G7	1.10
3V4	.69	6C6	.49	7H7	.79
4BQ7A	1.30	6C8G	.85	7J7	1.25
4BZ7	1.35	6CB5	4.40	7K7	1.15
5AM8	1.05	6CB6	.68	7L7	1.10
5AN8	1.10	6CD6G	1.75	7N7	.85
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5J6	.90	6D6	.59	7Z4	.65
5R4GY	1.45	6DC6	.95	12A4	.85
5T4	.90	6E5	.75	12A6	.57
5U4G	.58	6F5	.59	12A8GT	.79
5U8	1.10	6F6	.85	12AH7GT	1.05
5V4G	.88	6F6GT	.69	12AL5	.65
5V6GT	.70	6F7	.85	12AQ5	.70
5W4GT	.65	6F8G	.72	12AT6	.48
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5Y3GT	.49	6H6G7	.49	12AU7	.75
5Y4G	.65	6J4	2.55	12AV6	.52
5Z3	.69	6J5	.48	12AV7	.95
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6A3	.95	6J6	.68	12AX4	.85
6A6	.82	6J7	.82	12AX7	.78
6A7	.89	6J7GT	.65	12AY7	1.15
6A8	1.05	6K6GT	.65	12AZ7	.85
6A8GT	.95	6K7	.74	12B4	.85
6AB5/6N5	.59	6K7GT	.59	12BA6	.60
6AB7	.95	6K8	1.10	12BA7	.89
6AC5	1.05	6K8GT	.95	12BD6	.70
6AC7	.85	6L6	1.69	12BE6	.65
12BF6	.60	14B6	.69	35W4	.44
12BH7	.89	14C7	.95	35Y4	.65
12BK5	.95	14E6	1.05	35Z3	.65
12BQ6GT	1.35	14E7	1.15	35Z5	.44
12BY7	.90	14F7	.85	41	.75
12BZ7	.95	14F8	1.10	42	.69
12C8	.69	14H7	.85	43	.79
12CU6	1.35	14N7	.85	50A5	.68
12H6	.59	14Q7	.85	50B5	.68
12J5GT	.65	14R7	1.20	50C5	.68
12K7GT	.85	1457	1.10	50L6	.62
12K8	.69	14W7	1.25	50X6	.85
12Q7GT	.75	19BG6G	1.89	50Y6	.78
12SA7	.69	19T8	.95	5DY7	.78
12SA7GT	.69	25AV5	1.25	53	.92
12SC7	.75	25AX4	1.05	70L7	1.15
12SG7	.79	25BK5	.95	75	.65
12SH7	.65	25BQ6GT	1.25	77	.47
12SJ7	.65	25CD6G	1.75	78	.57
12SK7	.69	25CU6	1.30	80	.59
12SL7	.85	25L6GT	.65	81	1.85
12SN7	.75	25W4GT	.72	83	.95
12SQ7	.59	25Z5	.25	83V	.95
12SR7	.59	25Z6	.62	84/6Z4	.49
12V6GT	.73	30	.65	117L/M7	1.95
12W6GT	.87	32L7	.85	117N/P7	1.85
14A4	.95	35A5	.68	117Z3	.68
14A5	1.30	35B5	.68	117ZY4	1.05
14A7	.75	35C5	.68	117Z6	.95
14AF7	.95	35L6	.65		

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TRANSMITTING TUBES

0A3/VR75	.86	2D21W	1.95	4X150A	22.45
0B3/VR90	.73	2E22	3.15	4X150G	31.95
0C3/VR105	.68	2E24	1.95	5BP1	2.35
0D3/VR150	.68	2E26	3.25	5BP4	1.95
1B22	1.25	2E30	1.55	5C22	27.50
1B23	2.68	2G21	2.45	5CP1	1.95
1B24	4.85	2J31	14.00	5CP1A	8.45
1B27	12.95	2J32	12.50	5CP7	7.95
1B35	3.45	2J33	14.00	5D21	7.45
1B38	33.50	2J34	14.00	5FP7	1.20
1B40	3.45	2J36	14.95	5J29	29.50
1B41	3.75	2J51	97.50	5J30	17.25
1C21	1.89	2J55	39.50	5J33	6.95
1N21	.39	2J61	12.95	5JP1	12.45
1N21B	1.45	2J62	12.95	5JP2	6.35
1N23	.68	2K23	15.25	5JP5	9.95
1N23B	1.40	2K25	11.95	5LP1	7.40
1N34	.42	2K28	27.50	5NP1	4.95
1N34A	.48	2K33A	56.90	6AC7W	1.45
1P21	29.50	3AP1	2.90	6AK5W	1.45
1P22	13.25	3B24	.95	6AL5W	.95
1P23	1.85	3B24W	4.95	6AQ5W	1.70
1P24	1.45	3B25	4.95	6A56W	2.69
1P25	64.50	3B26	7.45	6BF7W	3.45
1P28	8.95	3B27	3.45	6C4W	6.75
1P30	1.95	3B29	5.95	6C21	14.95
1P32	.95	3BP1	2.45	6F4	2.65
1P39	1.45	3C22	59.50	6J4WA	4.45
1P40	1.25	3C23	3.45	6J5WGT	3.90
1P41	2.45	3C24	1.26	6J6W	2.20
1P42	2.35	3C45	8.95	6J6WA	3.90
2AP1	4.95	3D21A	2.95	6K4	2.20
2B22	1.95	3DP1	3.25	6SN7WGT	1.85
2C21	.39	3E29	8.43	6X4W	1.20
2C34	.25	4-65A	13.25	6X5W	1.35
2C36	21.50	4-125A	18.95	7BP7	4.45
2C39A	10.95	4-250A	29.50	12DP7	14.50
2C40	9.45	4C27	3.25	15E	1.45
2C43	9.75	4C28	17.45	15R	.49
2C52	2.95	4C35	13.45	28D7	.95
2C53	10.75	4E27	7.95	100TH	6.25
2D21	.65				

100TL	8.25	885	.95	5829	1.35
211	.45	902	2.45	5840	4.40
249B	2.95	918	1.65	5841	7.40
249C	1.95	923	1.25	5844	.95
250TH	18.95	925	1.50	5851	3.45
250TL	14.75	927	.95	5876	12.50
262B	4.95	930	1.19	5879	1.25
274A	1.95	931A	2.45	5881	2.95
274B	.85	954	.25	5886	3.25
304TH	7.95	955	.35	5894	15.95
304TL	9.95	956	.35	5896	4.45
307A	1.10	957	.35	5899	3.95
350A	2.65	958A	.35	5902	5.95
350B	2.35	959	1.32	5905	8.75
371B	.85	991	.29	5906	14.95
393A	4.50	1603	2.95	5908	7.85
WL417A	2.95	1616	.50	5932	3.95
417A/5842		1619	.30	5933	2.25
	12.45	1622	1.45	5963	5.45
434A	2.95	1624	.95	6021	4.45
450TH	47.50	1625	.29	6080WA	2.95
450TL	35.00	1626	.19	6096	1.45
575A	9.95	1633	.85	6097	1.45
705A	.68	1635	1.48	6098	1.85
707A	4.95	1641	1.35	6099	1.35
707B	3.95	1654	1.75	6101	1.45
715B	2.95	2050	1.10	6113	1.25
715C	10.95	2051	.65	6146	4.75
717A	.35	5516	6.45	6161	69.50
721A	.65	5517	1.65	6187	3.95
723A/B	8.45	5634	6.95	6189	2.25
725A	2.95	5636	2.90	6263	11.45
726A	4.95	5637	4.95	6264	11.45
726B	32.50	5638	7.45	6539	2.95
726C	32.50	5639	8.95	8005	4.75
750TL	65.00	5641	5.95	8008	3.95
801A	.38	5642	.95	8012	.98
802	2.45	5643	5.95	8013	2.65
803	1.40	5647	3.95	8013A	3.75
804	8.85	5651	1.35	8014	67.50
805	3.95	5654	1.25	8020	1.25
806	4.85	5656	7.90	8025	1.45
807	1.18	5670	1.10	9001	.82
808	1.25	5675	10.95	9002	.60
809	2.20	5676	1.25	9003	1.20
810	9.50	5678	.89	9004	.35
811	2.75	5686	1.95	9005	1.39
811A	3.25	5687	2.65	9006	.25
812	2.75	5692	5.10	C1JA	10.95
812A	3.25	5693	4.65	C6J	7.95
813	10.50	5696	.90	CK1005	.32
814	1.95	5702	1.95	CK1006	3.45
815	1.95	5703	.95	CK1007	.65
816	1.15	5704	1.85	CK1038	4.70
826	.65	5718	2.75	CK1039	4.70
828	7.42	5718A	4.75	F123A	2.75
829B	7.95	5719	2.15	F127A	22.50
830B	.65	5725	1.45	F128A	14.95
832	5.75	5726	.60	FG17	3.50
832A	7.95	5727	1.25	FG27A	10.90
833A	41.50	5732	2.95	FG32	3.95
836	1.45	5744	1.75	FG95	17.50
837	1.25	5751	1.45	FG105	12.95
838	.69	5762	99.50	FG172	17.95
845	4.85	5763	1.25	HF100	6.95
851	8.95	5783	4.45	HF200	9.95
860	2.75	5787CK	4.95	HF300	17.50
861	12.95	5794	5.95	WL616	47.50
866A	1.10	5812	2.70	RK65	7.50
872A	1.25	5814	.95	RK72	.50
878	.72	5819	32.50	RX21	5.50
884	.95	5823	1.35	TZ40	3.50

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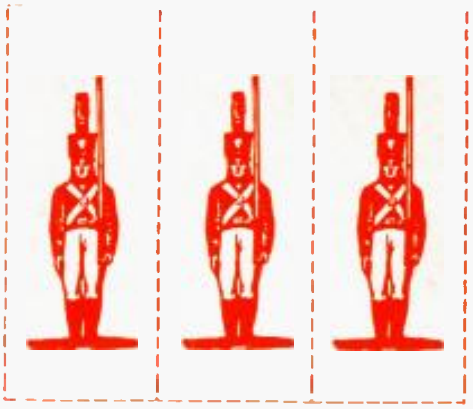

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