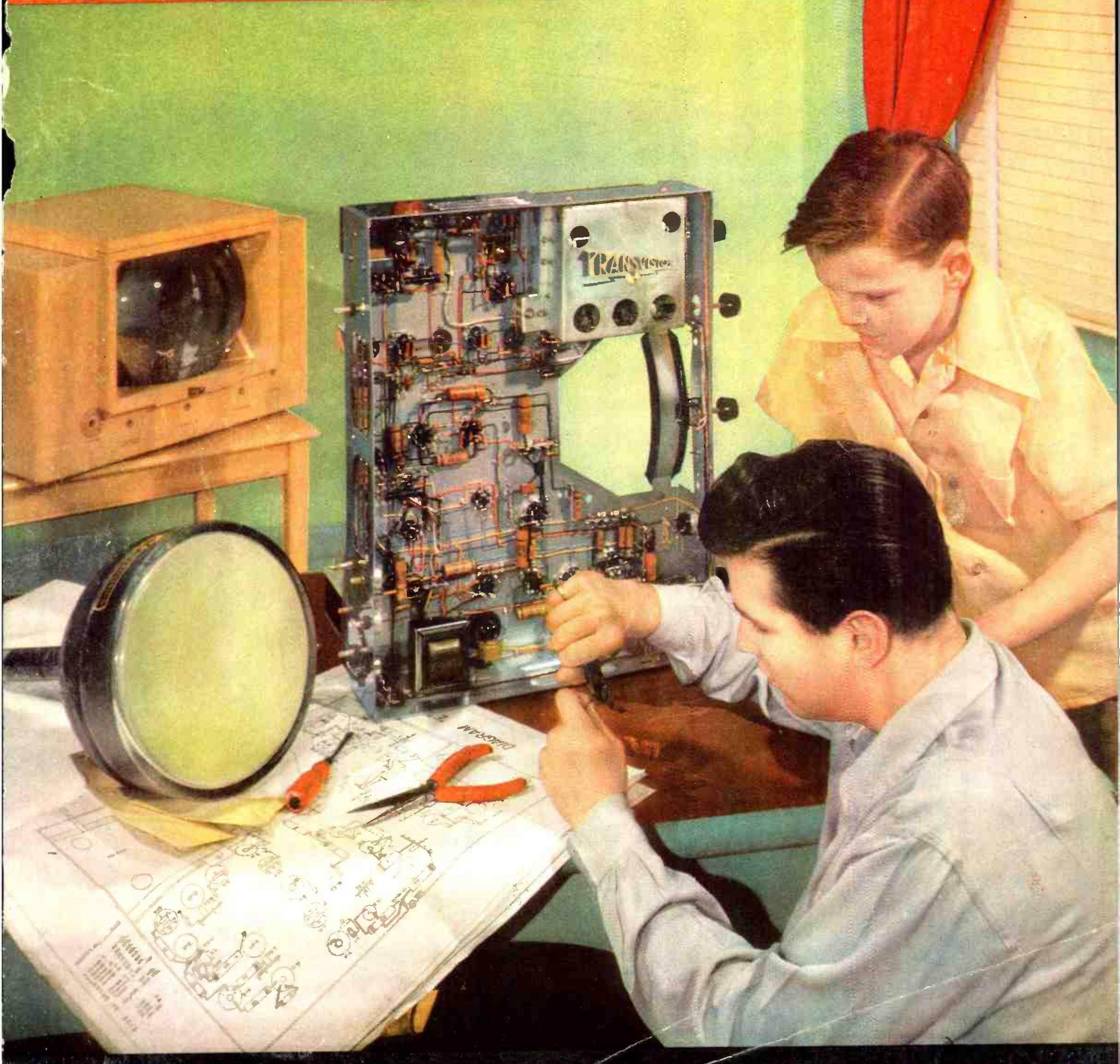
OCTOBER 1948

RADIO-ELECTRONIC ENGINEERING EDITION

RADIO & TELEVISION NEWS



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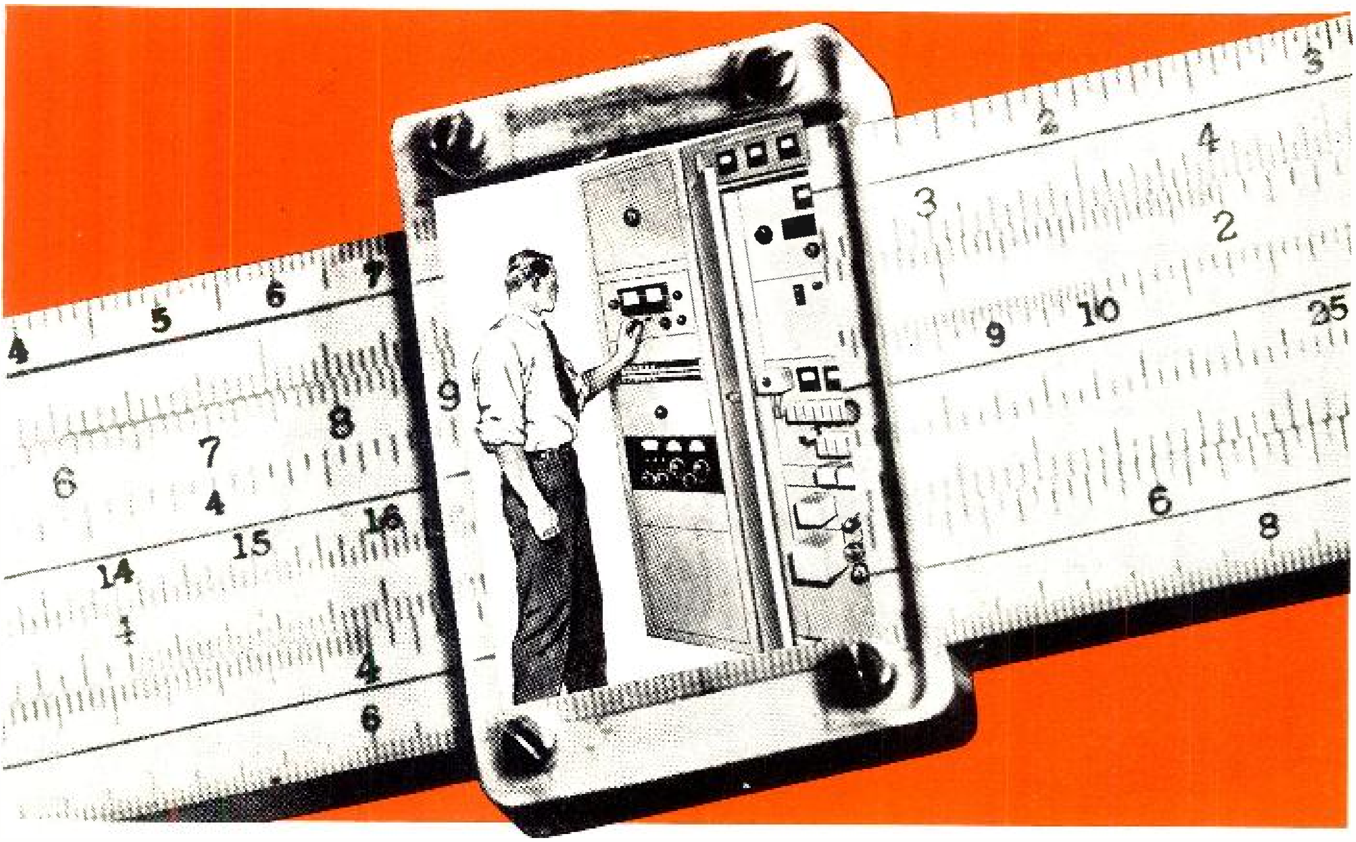
Capitol Radio Engineering Institute—Pioneer in Radio Engineering Instruction Since 1927



Here's how you can figure on a *BETTER JOB* in

RADIO-ELECTRONICS, Broadcasting, Television, Servicing, Manufacturing

Add CREI Technical Training to Your Present Radio Experience, Then Get That Better Radio Job—Make More Money—Enjoy Increased Security.

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☐ PRACTICAL RADIO-ELECTRONICS ☐ PRACTICAL TELEVISION
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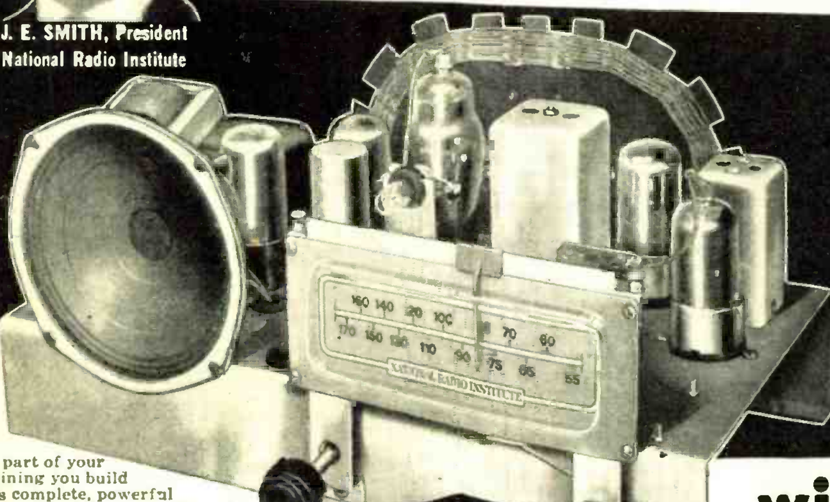
BY PRACTICING IN SPARE TIME

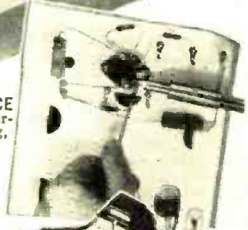


As part of your training you build this complete, powerful Radio Receiver that brings in local and distant stations. N. R. I. gives you ALL the Radio parts . . . speaker, tubes, chassis, transformer, sockets, loop antenna, etc.

You Build This MODERN RADIO and Many Other Circuits

YOU BUILD this Tester that soon helps you EARN EXTRA MONEY fixing neighbors' Radios, in spare time.

YOU PRACTICE with this A. M. Signal Generator. Provides amplitude-modulated signals for many tests.



YOU PRACTICE Radio soldering, mounting, connecting with equipment and Radio parts I send.

YOU BUILD this Superheterodyne receiver circuit.

I Trained These Men

GOOD JOB IN RADIO STATION

"Am Broadcast Engineer for Station KROP. Fundamentals of Radio learned in N. R. I. training invaluable."—JERRY G. COLLETT, Brawley, California.

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with BIG KITS of parts I SEND YOU

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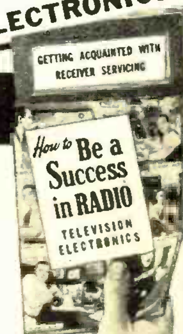

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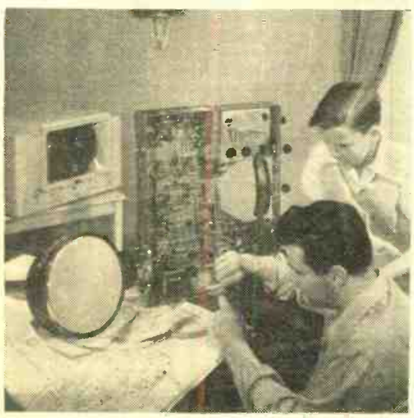

COVER PHOTO: A Transvision 10BL television kit nears completion as Herbert Cohan explains its simplified construction to his enthusiastic audience of one—young Gene Ferguson—who approves! (Photo by Walter Steinhard)

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For discriminating listeners on all wave bands (FM/AM) . . . who appreciate the thrill of superior performance . . . who want dependability of reception with high-fidelity audio . . . who want a few extra controls but not too many.

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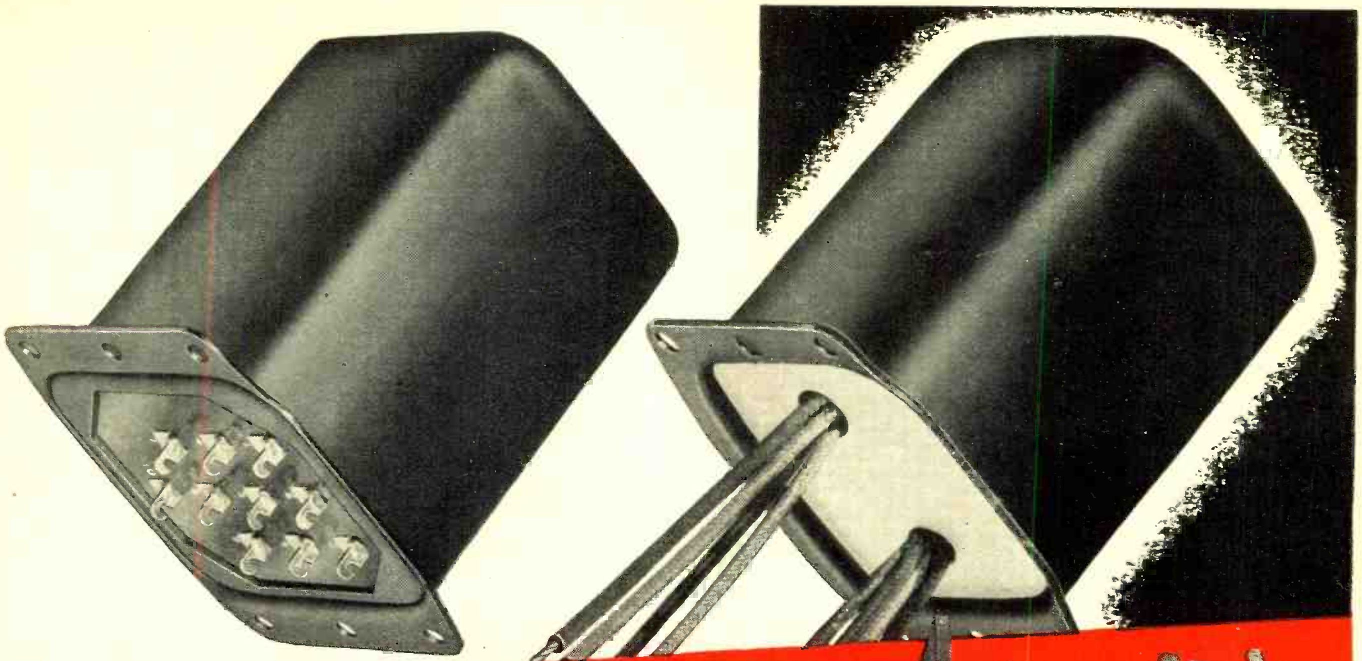
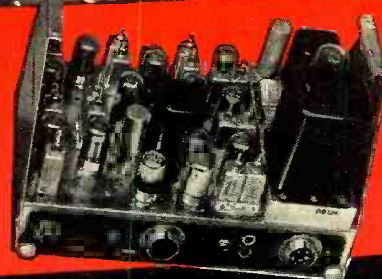


note the New Look

in Power Transformers



Typical Motorola FM two-way radiotelephone receiver utilizing *Sealed in Steel* Chicago Transformers.

With *CT's* Famous

Sealed in Steel Construction

The clean, streamlined appearance and compactness of CT's new *Sealed in Steel* construction contribute immeasurably to the trim, precision-like effect of any electronic equipment.

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The design of these new power transformers assures maximum performance with minimum physical size and minimum temperature rise in accordance with RMA standards.

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Write direct for catalog illustrating, describing and listing the complete line, or contact your nearest radio parts jobber at once.

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Primary 117 Volts, 50-60 Cycles

Catalog Number	HIGH VOLTAGE SECONDARY A.C. Volts	D.C. Ma.	D.C. Volts Output	FILAMENTS Rectifier Volts	Rectifier Amps.	No. 1 Volts	No. 1 Amps.	No. 2 Volts	No. 2 Amps.
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PC-55	270-0-270	55	260	5	2	6.3CT	2	......	
PC-70	335-0-335	70	320	5	2	6.3CT	3	......	
PC-85	330-0-330	85	320	5	2	6.3CT	3	......	
PC-105	345-0-345	105	320	5	2	6.3CT	3.5	......	
PC-120	375-0-375	120	380	5	3	6.3CT	4	......	
PC-150	370-0-370	150	390	5	3	6.3CT	4	6.3CT	1
PC-200	385-0-385	200	390	5	3	6.3CT	4.5	6.3CT	1
For REACTOR INPUT SYSTEMS									
PR-55	350-0-350	55	260	5	2	6.3CT	2	......	
PR-70	425-0-425	70	320	5	2	6.3CT	3	......	
PR-85	440-0-440	85	325	5	2	6.3CT	3	......	
PR-105	445-0-445	105	325	5	2	6.3CT	3.5	......	
PR-120	500-0-500	120	400	5	3	6.3CT	4	......	
PR-150	505-0-505	150	400	5	3	6.3CT	4	6.3CT	1
PR-200	520-0-520	200	410	5	3	6.3CT	4.5	6.3CT	1
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For the RECORD

BY THE EDITOR

THE VIDEO SERVICE DILEMMA

ONE of the largest manufacturers of television and radio sets recently completed an extensive survey throughout New York and Pennsylvania in order to determine owner and non-owner preferences in video sets, and to analyze other factors influencing the sale, distribution, and maintenance of various types of television equipment.

The great majority of those surveyed, in fact 84%, indicated that their installation was completely satisfactory. They indicated that their dealer or special installation service organization was well trained and did a thorough job. The sets requiring service were not numerous and little time was required in making proper adjustments. As a matter of fact many complaints were the result of insufficient signal from the television transmitter rather than lack of proper installation of the set. We may conclude from the above that radio-television dealers and independent service organizations are rapidly equipping themselves to meet the new requirements that video presents and most of them are now giving satisfactory service in the opinion of the set owners.

We recently picked up a copy of "Television Service and Installation—a Manual of Experience" published and distributed by NEWA. It contains proposals for the operation of television service and installation departments by television receiver *distributors*. They recommend that the wholesaler maintain a "non-profit" service department. It provokes us to find these proven uneconomical procedures encouraged by people who should know better. Perhaps the greatest burden on the radio service industry has been the manufacturers' blithe indifference to the realities of the justifiable charges warranted for good, efficient radio service.

The public has long been led to believe, from receiver sales promotion and advertising, that their radios seldom need service and when they do the cost for this service should be negligible. This, of course, is misleading and tends to engender a feeling of suspicion and distrust on the part of the customer toward the serviceman.

We fail to see where any business can afford to operate a planned non-profit service department. It is not only economically unsound for the individual business, but it also leads the majority into a plethora of "something for nothing service" that leeches away the life blood of the business. If television wholesalers generally adopt the practice of a non-profit television installation and service function (with concessions to sales as recommended) it would not be very long before the television service picture would be in a pitiful mess.

Another recommendation that strongly indicated a lack of sound thinking on what will be best for the television industry as a whole, was the suggestion that the wholesaler use the independent service companies only as a temporary expedient until the dealer's personal staff has been trained and the shops equipped to handle their own television service. It is obvious that back of this thinking is the feeling that where the independent television service company must get fees for their work that will permit them to operate soundly and profitably, the dealer who handles his own service might be persuaded to give "service concessions" to persons making or contemplating a purchase.

We feel that if industry were to adopt such a proposal, it would lead even further into a complete state of confusion.

Successful merchandising depends upon prompt and efficient service. This applies particularly to anything as intricate as television. Local dealers are smart enough to realize that when a complaint comes in, it is to their advantage to be "Johnny on the Spot." They know, too, that future sales depend upon the goodwill created by the type of service they are able to render when the need arises.

Suppose Mrs. Brown had to wait many hours for a distributor's serviceman to make a trip from a downtown area to handle a service complaint in a remote suburb, after having relied upon her local dealer for prompt radio service over many years' time. Do you think for a minute that such an arrangement would win her favor? Most distributors are located in downtown areas and it would be impossible for them to give the type of service expected. Many dealers are open evenings and will even make service calls on Sundays and holidays. What distributor would be willing to do the same?

It is hoped that manufacturers and distributors will formulate suitable service training programs for their dealers that will result in prompt and intelligent service. It would be to their mutual advantage..............O. R.

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180 VALUE-PACKED PAGES

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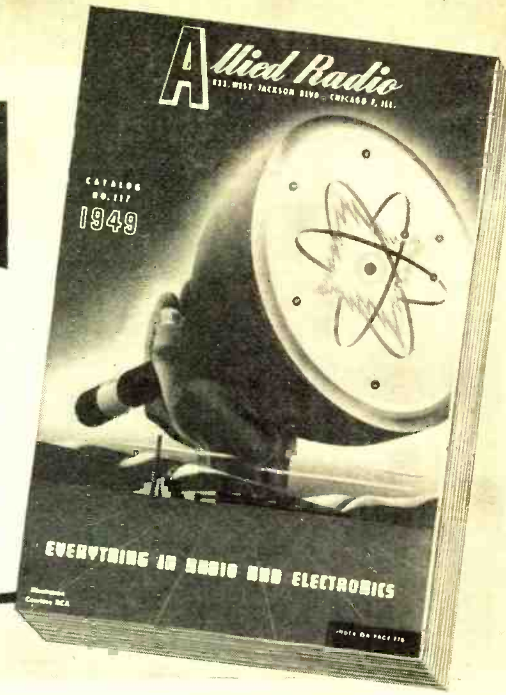

The Preferred Radio Buying Guide

It's ready for you—the new 1949 ALLIED Radio Catalog! Get the Radio Buying Guide that's the first choice of thousands of expert service technicians, engineers, soundmen, Amateurs, builders and experimenters. The new ALLIED Catalog—Radio's largest and most complete—brings you 180 pages packed with the widest selections of the newest and finest equipment, at today's lowest, money-saving prices! Here's everything in radio for everyone in radio: new Television and home receivers; radio-phonos with new Dual-Speed Changers; packaged Sound Systems, high-fidelity sound components and P. A. equipment; latest Amateur receivers and station gear; test instruments; builders' kits; thousands of parts, tubes, tools, books—the world's largest and finest stocks of nationally known equipment. Take advantage of ALLIED's speedy, expert shipment and the personal attention of seasoned old-time radio men. Get the details, too, of radio's most liberal Time Payment Plan. Write today for your FREE copy of ALLIED's newest and greatest Catalog—the preferred Radio Buying Guide!

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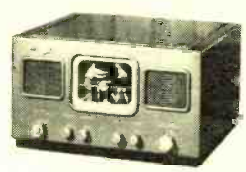
Send for your FREE copy of Radio's Most Complete Catalog. Use the coupon below—NOW!



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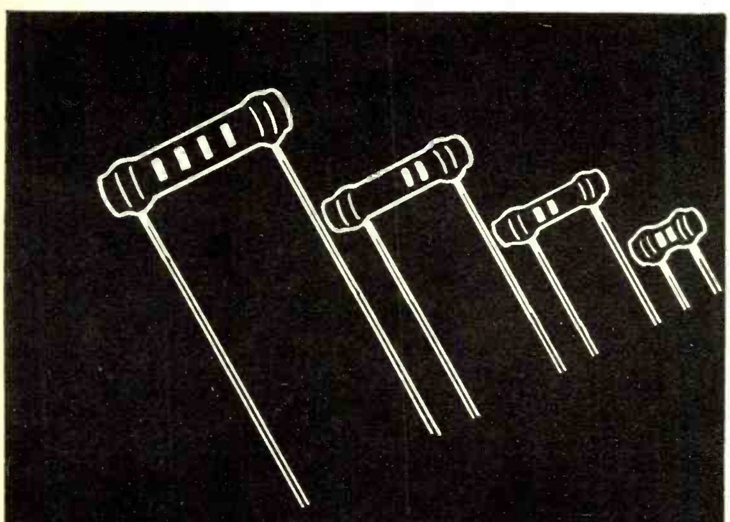
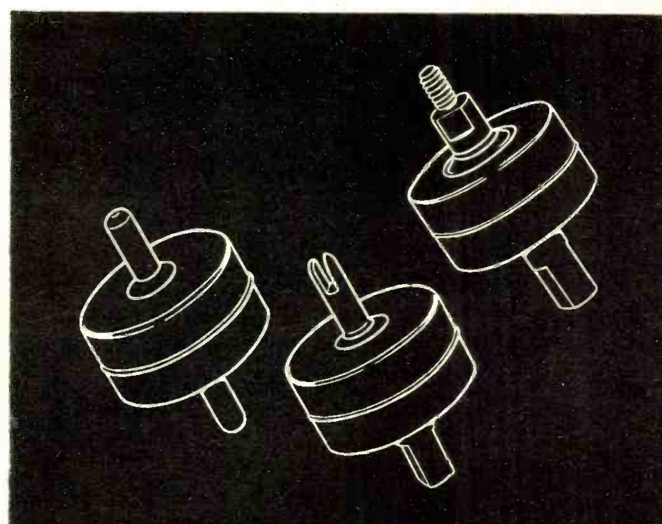


"Hi-Kaps": CRL line of ceramic By-pass and Coupling Capacitors gives you ceramic dependability and permanence at a new low price! Packaged in a convenient envelope of five, *Hi-Kaps* are clean, easy to stock and handle. Wide range from .000050 to .010000 mfd. Rating — 600 WVDC, 1000 V. flash tested. Ask your Centralab Distributor for all the facts.



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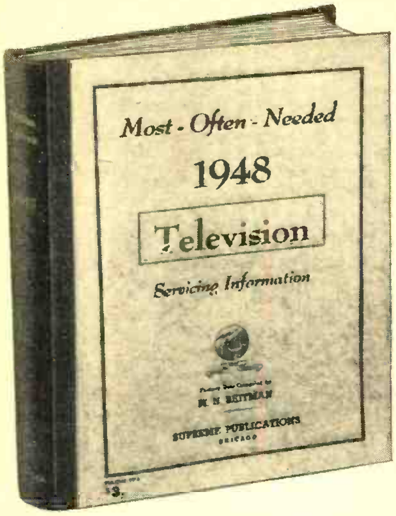
New 1948 TELEVISION *Manual*



Contains material on popular television receivers of Admiral, Belmont Radio, DuMont, Farnsworth, General-Electric, Hallicrafters, Motorola, Philco, R.C.A., Sonora, Stromberg-Carlson, and others. Gives description of circuits, many pages of test patterns, response curves, alignment tables, oscilloscope waveforms, service hints, many diagrams in the form of giant double-spread blueprints, test points, voltage charts, etc. Large size: 8½x11 in., manual style binding, flexible covers, price only.... $3.00

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Compiled by M. N. Beitman, radio engineer, teacher, author & serviceman.

FIND-FIX ALL TELEVISION FAULTS

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For 15 years, radio servicemen expected and received remarkable values in **Supreme Publications** service manuals. The new 1948 **Television** Manual is a virtual treatise on practical television repairs. By normal standards, such a large manual packed as it is with practical data, illustrations, diagrams, charts, photographs, and expensive extra-large blueprints, should sell for $10. — but as another **Supreme** special value, it is priced to servicemen at only $3, postpaid. Only a publisher who sold over one million of various radio manuals can offer such bargain prices based on tremendous volume-sales. Read about this new T-V manual at left. Find out about other radio manuals listed below. Use and save with Supreme Publications.

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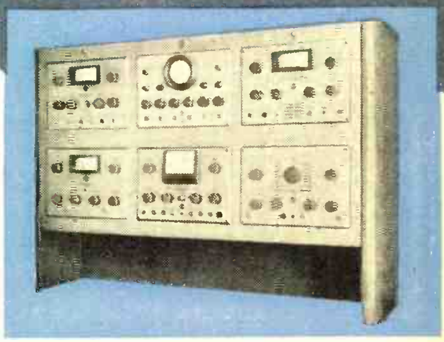

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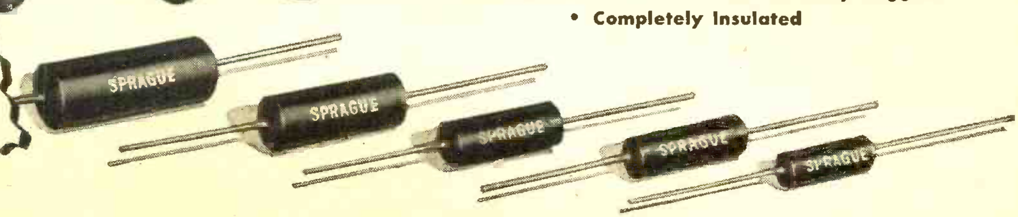

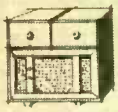

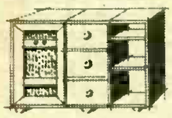

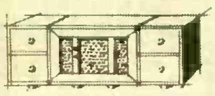

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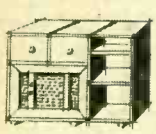

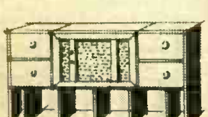

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WASHINGTON EDITOR

THE LIFE OF 12-CHANNEL TV, which has been the subject of quite a controversy within the FCC, was a focal point of comment during the testimony of former FCC Commissioner E. K. Jett at the recent allocation hearings in Washington. He forecast a life of at least ten years for low-band TV, substantially longer than the two-year term predicted by FCC Acting Chief Engineer John A. Willoughby at a recent luncheon-meeting of broadcasters.

Mr. Jett, who is now vice president in charge of radio for the *Baltimore Sunpapers,* stated that undoubtedly many more channels will be added to the TV setup, but the basic structure of present-day TV would not be altered. Two prominent Washington consulting engineers, C. M. Jansky, Jr., and Glenn D. Gillett, offered similar long-life opinions at an NAB meeting in West Virginia. In the opinion of Mr. Gillett, high-frequency TV or color TV is still eight to ten years away.

THE USE OF DIRECTIONAL ANTENNAS in telecasting, negated by the FCC in their 1945 report on TV, was sponsored by many during the allocation hearings. In a report on the effectiveness of directional antennas, Jack Poppele, president of the Television Broadcasters Association and chief engineer of WOR, declared that the problem of protection of video stations is not unlike the same problem which regional stations have faced in standard broadcast for years.

Analyzing the investment in the antenna, he stated that the cost of a directional antenna is in a far smaller ratio in comparison with the total cost of a TV plant and in comparison with TV operating expenses, than is a directional antenna for the standard broadcast station. And the problem of obtaining a suitable location for directionalized TV operation should be less complicated than that encountered in regional station construction, Mr. Poppele declared. Enlarging on this point, he said:

"A television station requires only sufficient land for the erection of a tower and a transmitter building, while the regional standard broadcast station requires acres of land to erect a multiplicity of towers and install an adequate ground system. In areas of irregular terrain, the regional station must also find rather extensive cleared plots of ground which have no great terrain irregularities and which are purchasable. It, therefore, seems reasonable that full consideration should be given to the practicability of directional antennas in television allocation matters, and that because of the possible use of these antennas, it is entirely feasible to provide adequate protection to areas in which the program service of other stations would not be replaceable."

Mr. Poppele stated that the FCC opinions on directional antennas, drafted during the war, were not in keeping with present developments. In their report, the Commission said: ". . . The Commission desires to avoid as much as possible resort to directional antennas for television. With the great increase in civil aviation as a result of the war, it is going to be increasingly difficult to find suitable antenna sites that do not contribute a hazard to air navigation . . . there is much less flexibility in choosing antenna sites. . . . Moreover, directional antennas will have to be located away from cities with the result that shadows and multipath distortions in rendering service to cities will be much greater than where the antenna is located in the city itself."

Mr. Poppele pointed out that directional antenna operation requires only one tower. The then-expressed fears of multipath distortions where the antenna is not located in the city itself has not been completely founded in fact, he continued.

"Because of the height problems involved, zoning restrictions and cost," he explained, "many present television grantees and applicants propose sites outside of the cities to be served and anticipate excellent coverage."

Other experts agreed with Mr. Poppele and it appears as if the directional-antenna plan, which will permit many more TV stations to go on the air, will be woven into the new allocation plan.

TV RECEIVER PRODUCTION continues to hit new highs. In June, over 64,000 receivers were made, bringing the total TV set production since the war to over 460,000. According to the Radio Manufacturers Association, RMA member-companies turned out 100,000 more television receivers dur-

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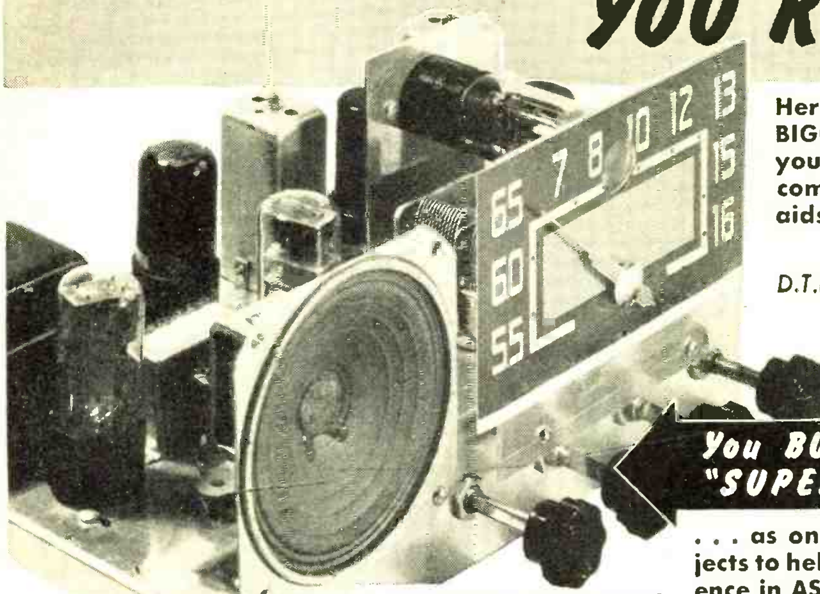

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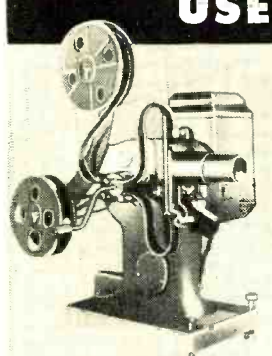

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ing the first half of '48 than they did during the entire year of '47. In the first half of '48 278,896 receivers were produced as compared with 178,571 in '47. The '48 second quarter output was 160,869, with an average weekly production of 12,375, which represented an increase of 36 per-cent over the first quarter's output. In the second quarter of '47 only 23,060 TV sets were made.

Commenting on the growth of TV, Frank M. Folsom, executive vice-president of *RCA*, declared at the Western Radio and Appliance trade dinner in San Francisco, that by the end of this year industry should produce more than 850,000 receivers and more than 60 stations will be on the air. Interest in TV will be increased further, he said, with the introduction of complete coast-to-coast television networks which are expected to be in operation by the end of 1952. And before that time, regional links will connect cities such as San Francisco with its municipal neighbors, he said.

In another TV-progress address, R. C. Cosgrove, executive vice-president of the *Avco Manufacturing Corp.*, and former president of RMA, predicted that coast-to-coast television, via coaxial cables, will be in operation in two years. Speaking at a luncheon of *J. N. Ceazan Company*, Southern California distributors for *Avco's Crosley* division, Mr. Cosgrove said that full scale production of 10,000 12-inch table model TV sets every month will be scheduled as soon as picture tube shortages are eliminated. This he hoped would prevail before the year is out.

TELEVISION RECEIVER advertising of many manufacturers is now being prepared under a tough code, issued recently by the National Better Business Bureau. According to the code:

"Advertising shall clearly and conspicuously indicate whether the price advertised for a television receiver includes the cost of installation, antenna, or other equipment, or service necessary for reception. If the price does not include cost of installation, that fact shall be clearly and conspicuously stated in conjunction with the price.

"If an installation charge is quoted in advertising, the charge quoted shall be the total charge required of the purchaser, for assuring *satisfactory reception on all channels within the range,* unless it is stated that the charge quoted is a minimum charge, or unless it is otherwise disclosed that additional charges will be made for any installation adjustments which may be required to assure satisfactory reception on certain stations currently operating or on stations which start operating after the original installation.

"The statement 'Free Home Demonstration' shall mean a demonstration in the home without obligation to buy.

(*Continued on page* 122)

You receive all parts, including tubes, for building this fine, modern Superheterodyne Receiver. This and other valuable standard equipment becomes your property.

Learn RADIO

TELEVISION, ELECTRONICS *by* SHOP METHOD HOME TRAINING

Let NATIONAL SCHOOLS, of Los Angeles, a practical Technical Resident Trade School for almost 50 years, train you for today's unlimited opportunities in Radio

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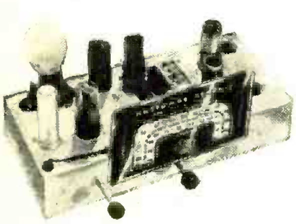

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4. How Signal Currents Are Converted into Sound.
5. How the Tuning Condenser Operates.
6. How the R-F Transformer Handles the Signal and other data, with diagrams and illustrations.

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Electronically engineered to give top performance. Frequency response (30 to 15,000 cycles). Two high impedance microphone input channels 116 db. gain (RMA), each with individual volume control. Two hi-impedance phono channels, one for hi-level and one for low-level pickups. Can be used with popular low output magnetic pickups. Phase inversion and inverse feedback used to obtain low distortion and uniform frequency response for various load conditions. Unique balanced tandem tone control circuit. Choke filtered power supply for minimum hum and uniform regulation. Large functionally designed control knobs. Accessible output terminal board and replaceable cartridge type fuse conveniently located in rear. Set of locking-type 3 pin Cannon plugs and receptacles for each microphone input. Also available with 2 low impedance inputs (250 ohms).

15 watt push-pull Output— Noise-free electronic mixing— Switch for high-low power output requirements — Underwriters-approved.

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Complete with RCA Tubes......Now only $197^{50}

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In Canada: RCA VICTOR Company Limited, Montreal

Within the INDUSTRY

THE ELECTRICAL EQUIPMENT COMMITTEE of the National Safety Council was recently accorded full sectional status as one of the 24 industrial sections of the Council.

Chairman of the new Electrical Equipment section is E. K. Taylor, safety director of *Zenith Radio Corporation.* Serving with Mr. Taylor as divisional vice-chairmen are: O. C. Boileau, safety director of the *RCA Victor Division* of *Radio Corporation of America*—Radio and Electronics; H. B. Duffus, supervisor, accident prevention service, *Westinghouse Electric Corp.*—Heavy Apparatus; M. F. Biancardi, manager, health and safety department, *Allis-Chalmers Manufacturing Co.*—Light Apparatus; C. R. DeReamer, general safety supervisor, *General Electric Company*—Appliance and Lamps; C. N. Fogg, safety engineer, *Simplex Wire and Cable Co.*—Electric Wire and Cable.

Other officers of the Committee include: G. W. Greenwood, safety director of *Western Electric Company;* E. C. Woodward, director of safety of *A. O. Smith Corp.;* J. M. Transue, security director of *Philco Corporation;* Frederick A. Gass, safety engineer of *General Electric Company;* J. J. Lawler, area safety engineer of *Sylvania Electric Products Inc.;* and A. M. Baltzer, staff representative of the National Safety Council.

Two sessions at this year's National Safety Congress and Exposition, to be held October 18-22 in Chicago, will be devoted to the problems of the electrical industries including the safe handling of electrical hand tools, and safety in the manufacture of radio and television equipment.

* * *

GEORGE W. HENYAN heads the new Industrial and Transmitting Tube Division recently formed within the Tube Divisions of *General Electric Company's* Electronics Department.

This new division will consolidate all sales, design engineering, and manufacturing activities related to the former Power Electronics Division which makes rectifiers for industrial and power users, and the transmitting and industrial tube lines marketed to broadcasters and industry.

Mr. Henyan joined *General Electric Company* in 1916 upon his graduation from college and except for a period from 1917 to 1919 when he was on military duty he has been continuously associated with the company. In 1921 he entered the radio department and has since been associated with this phase of the company's work. From 1939 until 1943 Mr. Henyan was manager of both the Transmitter and Tube Sales Divisions and since 1943 has been assistant to the vice-president.

* * *

CHARLES J. NESBITT has been appointed advertising manager of the *Hallicrafters Company* of Chicago.

Joining the *Hallicrafters* organization from a post at *Montgomery Ward* in Chicago, Mr. Nesbitt is a licensed radio amateur and was a communications officer with the Air Forces in Greenland during the war.

He was formerly associated with *Goodyear Tire and Rubber Company.* He is a graduate of Loyola University and a native Chicagoan.

* * *

BEN OPPENHEIM has been named manager of the Radio Electronic Parts Department of *Krich-Radisco, Inc.* of Newark, New Jersey.

Prior to joining the *Krich* organization, Mr. Oppenheim was vice-president in charge of sales of an incandescent lamp company. During the war years he served as Chief Administrator of the Civilian Engineering Branch of both the Signal Corps and Army Air Forces staff at Fort Monmouth. Before the war he was president of *B & O Radio, Inc.,* a former New Jersey wholesale distributor.

Mr. Oppenheim is a member of the Society of American Military Engineers and of the Army Signal Association.

* * *

WESTINGHOUSE ELECTRIC CORPORATION has announced two important appointments of interest to the industry.

Harold W. Schaefer, veteran radio and electronics engineer, has been named as assistant manager of the company's Home Radio Division of Sunbury, Pennsylvania. Mr. Schaefer, who has been in charge of engineering development and research, previously had held administrative, manufacturing, and engineering positions with the Division. In his new post he will con-

"KEN-RAD TUBES STAND UP!"

W. B. STYLES *of Styles & Appleton, Oakland, California*, one of thousands of reliable servicemen who depend on Ken-Rad tubes to build repeat business.

"Nobody can tell me about Ken-Rad tubes—I've been using them for 14 years!

"When you've used them as long as I have, you know you can depend on them.

"I don't know any tube that stands up better than Ken-Rad tubes. They're quality through and through.

"Customers like them. This means repeat business—better business.

"Ken-Rad tubes do the trick, all right!"

JAMES E. CAMPBELL, *Foreman, Quality Control Section,* who oversees the quality sampling inspection (below) before tubes are accepted into warehouse. Ken-Rad tubes are constantly being tested to assure dependable performance, long life.

"KEN-RAD TUBES *MUST* STAND UP!"

"They *have* to stand up—through test after test.

"This comprehensive testing results in dependable tubes that satisfy your customers, increase your business.

"Ken-Rad tubes are factory-tested for noise, microphonics, static, life, shorts, appearance, gas, air and hum.

"No wonder they're tops in quality, stamina and endurance. No wonder they're customer-pleasers, profit-makers."

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PRODUCT OF GENERAL ELECTRIC COMPANY

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The Serviceman's Tube

tinue in charge of product development and research activities with headquarters at Sunbury.

The second appointment named Hobart C. McDaniel to the post of manager of Technical Press Service in the Public Relations Department of the company. Mr. McDaniel will be responsible for the company's publicity in the technical and trade magazines. He succeeds Carl E. Nagel who has resigned to join *McGraw-Hill Book Company* in New York as editor of mail sales books for the industrial and engineering fields.

* * *

A. A. EMLEN, well-known figure in the transformer industry, has joined the engineering staff of the *Peerless Electrical Products Division of Altec Lansing Corporation.*

Mr. Emlen was vice-president in charge of engineering for *American Transformer Co.* from 1927 to 1946 and subsequently occupied the same position at *Newark Transformer Company.*

* * *

DAVID H. ROSS of San Francisco has been named manufacturer's representative for *Air King Products Co., Inc.* of Brooklyn, manufacturers of a line of radios, combinations, wire recorders, and television receivers.

Mr. Ross, who opened his sales organization at the beginning of the year, will represent *Air King* in the territory of northern California from a line below the trading area of Fresno plus the entire state of Nevada.

Headquarters of Mr. Ross' firm are at 104 Ninth Street, San Francisco.

* * *

MORRIS ZIGMAN, president of *Morhan Exporting Corporation,* has just completed an agreement with Hugo Sundberg, jobber sales manager, whereby his company will act as the exclusive export sales representatives for *Utah Radio Products Division* of *International Detrola Corporation.*

Morhan Exporting Corporation will serve *Utah* interests in every country throughout the world, except Canada and Mexico. The company maintains offices in New York City.

* * *

ROBERT BLODGET, formerly manager of product design of the Accessory Division, has been appointed Television Product manager for *Philco Corporation.*

Mr. Blodget joined *Philco* in 1936 and worked in the inspection, quality control, and test equipment engineering departments of the factory until 1938 when he became a field service engineer.

Early in the war Mr. Blodget devel-

(*Continued on page* 108)

For those who Demand the Finest...

Meissner

PRESENTS PRECISION ENGINEERED PERFORMANCE

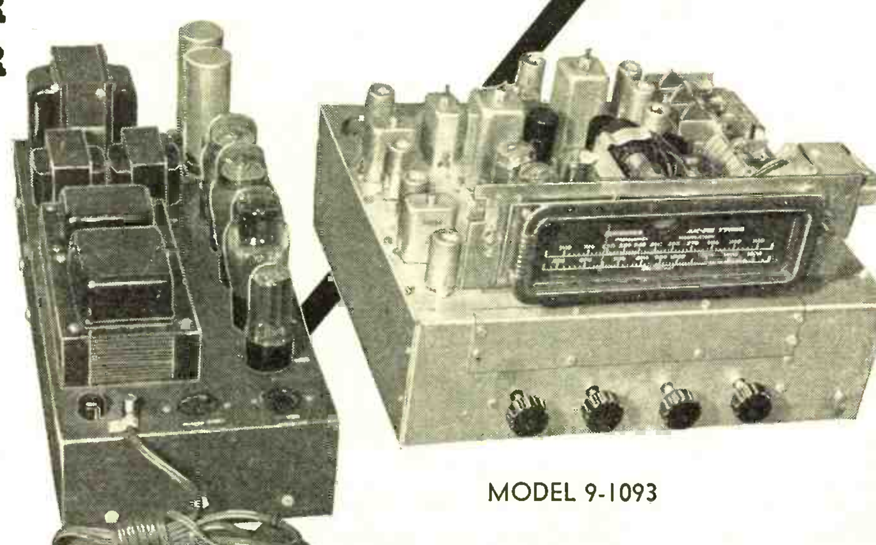
FM RECEPTOR

Now, the incomparable beauty of FM reception is available to all with the Meissner model 8C FM Receptor. Here is the full scale fidelity of FM reception, unbelievably free from static, interference or fading. The new FM band is 88 to 108 MC; power supply is 105 to 125 volts, 50 or 60 cycles AC; consumption is 35 watts. Audio Fidelity, flat within plus or minus 2 db, from 50 to 15,000 CPS. For the best FM reception, remember MEISSNER, it's the finest.

AM-FM TUNER AND AMPLIFIER

AM-FM TUNER AND AMPLIFIER

If you appreciate quality—you'll want MEISSNER. The Meissner Model 9-1093 AM-FM Tuner and Amplifier has a frequency range of 535 to 1620 KC (AM Band) and 88 to 108 MC (FM Band). It has a power output of 18 watts at less than 2% harmonic distortion, and a hum level, 65 db below full output. It's delivered complete with tubes, two antennas and all hardware required to mount the chassis units in the cabinet. The antennas consist of a low impedance 12" x 16", noise reducing loop for AM broadcast and an indoor type folded dipole, 300 ohm, for FM broadcast. Insist on the finest, insist on MEISSNER, it's your finest for more listening pleasure.



MODEL 9-1093

MEISSNER MANUFACTURING

DIVISION OF MAGUIRE INDUSTRIES, INC. MT. CARMEL, ILL., U. S. A.

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COMPOSITION RESISTORS

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Gives complete data and list of RMA values. Includes dimensional drawings and handy color code. Write for it, today.

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THE IOWA FLYING SERVICEMAN

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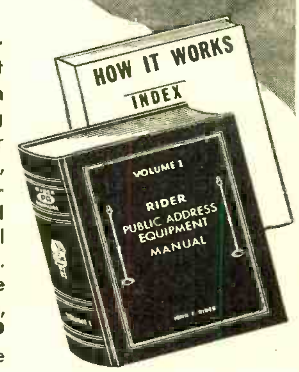

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NOTE: The Mallory Radio Service Encyclopedia, 6th edition, makes reference to only one source of radio receiver schematics—Rider Manuals.
ANOTHER NOTE: The C-D Capacitor Manual for Radio Servicing, 1948 edition No. 4, makes reference to only one source of receiver schematics—Rider Manuals.

4 microphones in one

TURNER "U9S" DYNAMIC
. . . WITH NEW, IMPROVED, HEAVY DUTY IMPEDANCE SWITCH

Adjustable saddle permits semi- or non-directional operation. Fits any standard microphone stand. {Desk stand as shown at extra cost.}

MODEL "U9S"

LIST PRICE: $40.00

Complete with 20-ft. balanced line quick-change shielded cable set.

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The outstanding dynamic in its field, made even better with a new, long-life, trouble-free metal switch, designed exclusively for Turner. Professional in appearance and performance. High in convenience. Built-in tapped multi-impedance transformer with improved 4-position switch gives positive selection of 50, 200, 500 ohms, or high impedance output. *One microphone serves any standard equipment.* Voice coil and transformer leads are insulated from ground and microphone case. Line is balanced to the ground. Engineered with smooth wide-range response from 40 to 9000 c.p.s. Level: 52 db below 1 volt/dyne/sq.cm. at high impedance. Richly finished in baked gun-metal.

The Turner "U9S" is widely recommended for broadcast, public address, communications, sound systems, recording, and general purpose applications.

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INDIVIDUALIZED TELEVISION INSTALLATIONS

By B. TABER

While certain installation procedures are more or less standardized, each setup will require some adaptations in order to bring the video receiver to peak performance.

DURING the past few years a great deal has been written about television receiver installation. Most of this information has apparently concerned itself with procedures best adapted for reception of only one local station, and that with very little difficulty.

While it is perfectly true that the average television receiver is within range of only one station at this moment, multiple-reception areas are increasing rapidly. With better receivers, and higher transmitting power, moreover, reception is being demanded from relatively distant cities. In addition, an imposing array of other installation troubles are becoming more important daily.

Reflecting this trend, newer technical articles have appeared explaining how to compromise in various ways, to adapt one television dipole to correct several problems.

To effect such compromise, it has been pointed out, dipoles may be cut and parasitic elements spaced to about the center frequency of an entire band of channels, or one dipole may be oriented to point somewhere between two or three stations lying in different directions, or a severe ghost may be played down at the expense of the signal-to-noise ratio, etc.

Such methods have been used in making the majority of installations which exist today. However, the possibility of selling a compromise installation depends mainly upon the customer's willingness to accept something less than perfection. At the present stage of the art, persuasive explanations are often successful. Too much explanation and not enough capable work, however, will inevitably backfire at the expense of the installer.

Thus on many occasions, especially when dealing with an expensive receiver, the technician faces the task of finding quick and inexpensive ways of eliminating ghosts, interference, distortion, tearing pictures, weak signals, noise, etc., on two or more stations lying at widely separated points, some having transmitting towers over the hills and far away, as well as some practically looking down the chimney.

Occasionally, in fact, the installer is expected to provide good reception with indoor antennas alone, due to "landlord trouble."

This distasteful situation has generally been delicately avoided by the technical writer, while the know-how possessed by many seasoned television installation veterans has been hidden in an inside pocket for competitive reasons. This article aims to explain the simple and logical methods which are used by manufacturers' service and installation organizations as well as large independent television specialist organizations for such difficult installations.

In troubleshooting a television installation it is good to review one of the earliest lessons which we have all learned in the course of troubleshooting AM receivers, record changers, and other "standard" equipment. This lesson is quite familiar—troubleshoot for one trouble at a time. Surprisingly enough, such an obvious procedure is one of the chief stumbling blocks for novices at television.

Since the types of troubles which appear on one television channel may be entirely different from those on another channel, the first step must be to clear up all troubles on one particular station, and then proceed to

Variations in home construction alone will present individualized installation problems for the TV serviceman.

Fig. 1. A typical case of "tearing" which may result from several different receiver faults. The strip near the bottom is not tearing but is a news ticker strip which is part of test pattern being transmitted.

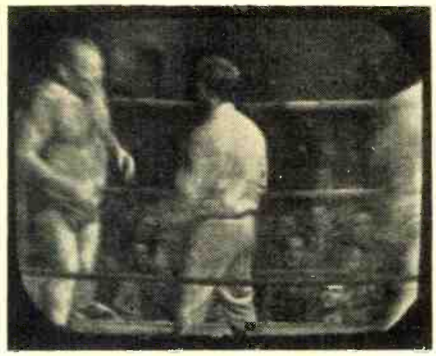


Fig. 2. The referee and his two reverse ghosts, at his immediate right, bawl out the gunt-and-groaner and his two ghosts. The problem of ghost images is often a difficult one for the serviceman to solve.

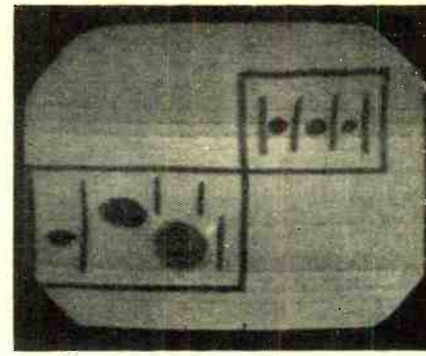


Fig. 3. The horizontal dotted lines and shaded strips across this non-objective sketch tend to embellish the art, but objectively are symptoms of noise interference riding in on a weak television signal.

Fig. 4. Diathermy interference with its characteristically interesting pattern—not quite strong enough to tear out the center part of the transmitted TV picture.

Fig. 5. Distortion caused by strong interfering FM signal. Little modulation can be seen. The same sort of pattern may be due to an AM signal of the same frequency.

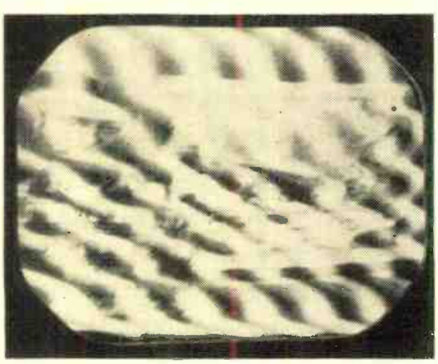


Fig. 6. John "Are You An Artist" Gnagy who is seen regularly over New York stations appears to be swimming around in a picture nearly torn up by FM interference.

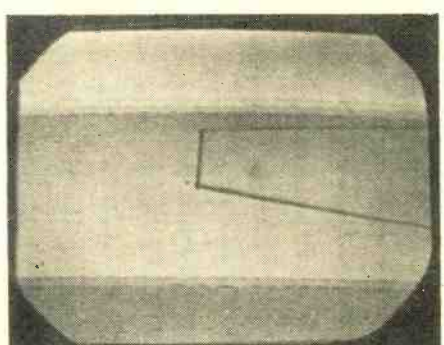


Fig. 7. More of the vibrator-type noise—with a trace of FM interference. It is difficult to tell which part of the picture is due to art and which is due to tearing.

deal with the others, one at a time.

In the so-called "compromise" technique, a *primary* channel is selected, either arbitrarily by the installer, or specified by the set-owner. Then a *secondary* station is chosen, with the understanding that the picture quality on this secondary channel might be sacrificed to some extent in order to favor the primary channel, similarly for third and fourth choice channels.

In the method to be outlined here, however, *all* stations are to be treated as primary, with no compromise, therefore it matters little which station is chosen first. This, in itself, permits faster work, since time spent waiting for the *primary* station to come on the air or transmit a proper signal, as well as time spent comparing performance between channels, is entirely avoided.

As is customary, a "probing" dipole is connected to the receiver through a long transmission line and "walked" around the roof to find a location for good reception. By means of battery or sound powered telephones between the rooftop technician and the man at the receiver, the proper orientation, element length, spacing, etc., is determined experimentally as has been described in previous issues of RADIO NEWS ("Television Installation," by W. W. Waye, September, 1947, through February, 1948) *with one significant difference,* the procedure is followed through on only one station, with no thought given, at this time, to any other channel.

Depending upon the set's location, however, several of these faults may be observed during the course of this work, (A) Distorted or tearing pictures (as in Fig. 1.), (B) Ghosts (as in Fig. 2.), (C) Poor signal-to-noise ratio (as in Fig. 3.), and (D) Signal interference (as in Fig. 4).

A word of caution is in order at this point, never jump to conclusions about the source of the trouble! This can best be explained by discussing the above faults one at a time.

(A) Distorted and tearing pictures can be caused by one or more of the following, listed in the order of the frequency of their occurrence:

1. Excessive signal overloading r.f. or i.f. stage.
2. Incorrect hold control setting, or faulty horizontal oscillator or sync circuits.
3. Interfering signals.
4. Interfering noise.

The fact that varying the position or orientation of the rooftop "probing" dipole affects the distortion or tearing must *not* in itself lead the installer to assume that the trouble is due to one or another of these causes, for interfering noise and signals are also affected by the dipole's position, while even a very faulty horizontal oscillator may be synchronized properly with exactly the right signal.

Therefore, rather than spend the next few hours chasing around the roof, the exact cause for the tearing or distortion should be determined. This is done by means of a *variable pad box,* inserted in the antenna transmission line close to the receiver, as in Fig. 8A.

Variable pad boxes are something with which most servicemen have had little experience. They consist of decade-connected attenuation pads, in ladder or lattice arrangement, with calibrated variable taps. Their design for audio frequency work is generally attempted only by an experienced engineer using standard hyperbolic function formulas. At television frequencies, however, other problems are involved such as phase angle correction, insulation losses, constancy of wiring impedance, skin effect of contacts and conductors, and inductive qualities of resistors and leads, which cause the design for a variable pad box calibrated for television work to be more cut-and-try than theoretical. Fortunately, however, at least one such unit designed for television servicing, the *Tele-Pad,* is on the market at present.

This box is arranged for use on either 300 ohm line or 72 ohm line, depending upon the installation. Leaving the dipole in position for greatest freedom from ghosts and strongest signal strength, the variable pad box knob is rotated through its entire range of attenuation.

If the tearing or distortion is caused by an overloading signal (number 1 on the list of common causes), a step will be found at which the picture clears up, and further attenuation has no effect aside from weakening the cleared picture.

However, if further attenuation causes the tearing to reappear at the same place or at another, the trouble is likely either in the sync-oscillator or the hold circuits (cause number 2). To determine which, rotate the attenuator knob to the greatest attenuation step which will give a faint but definite picture, and reset the horizontal hold control on this weakened signal. Now if varying the *Tele-Pad* shows the set to be still too critical of signal strength, the trouble will likely be found in some component of the sync or horizontal oscillator circuit.

Cause number 3 is generally made fairly evident by the appearance on the screen of one of the patterns characteristic of signal interference, aside from the tearing portions of the picture. Typical screen patterns of this type, caused by FM stations, diathermy machines and other signal-producing sources are usually illustrated in most manufacturers' service manuals. Several are shown in Figs. 5, 6, and 7. These faults can usually be corrected by means of a wave trap such as those described in the article "Interference Traps for Television" by Stanley N. Finley in the March, 1948 issue of RADIO NEWS.

Cause number 4 for tearing and distorted pictures, which also varies with dipole position, is recurrent or staccato noise as illustrated in Fig. 7. Here too, as a rule, the cause is more or less evident from patterns, streaks, bursts or spots on the picture, as well as from audio channel noise. The FM sound is designed, of course, to diminish a good part of this noise. However, the noise which is strong enough to tear the picture can generally be heard with the volume turned up, especially if the fine tuning control is purposely set to "ride the side" of the incoming signal.

Having now determined the exact cause for the tearing, the proper steps must be taken to eliminate it. The rather obvious solutions are indicated in Table 1 (Page 136). In curing overloading signals, the first cause of tearing and associated distortion, care must be taken to use the proper circuit. Either "T" or "Pi" basic type pads may be used, depending upon the necessary attenuation and the physical layout of the receiver or pad container. 300 ohm receivers generally take balanced circuits, such as "U," "H" or "O" types as shown in Fig. 11, while low-impedance coaxial sets usually require ordinary unbalanced types such as those shown in Fig. 12.

The resistance values used are quite critical, for aside from adding the proper value of attenuation, they must match both transmission line and receiver input lest mismatch effects result. This is discussed further, under the subject of "ghost," later in this article.

The firm which manufactures the

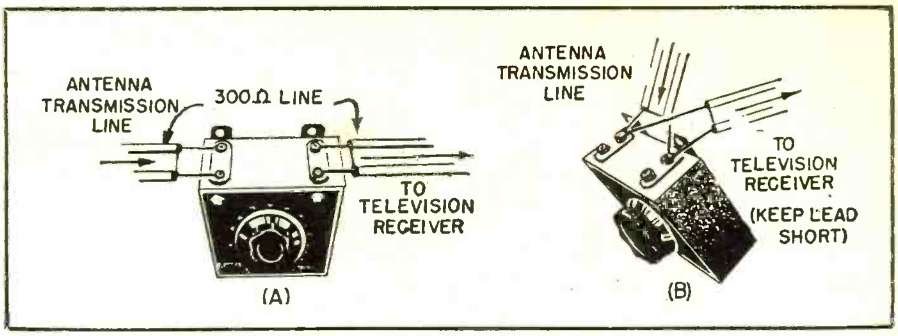


Fig. 8. (A) A variable pad box consisting of decade-connected attenuation pads. This unit is used to reduce signal strength without introducing mismatch. (B) The box used to bridge a single loading resistor across a transmission line.

Fig. 9. (Left) Signal selector and equalizer box with cover and knob in place. Station call letters are inscribed in ink or pencil for home or tavern installations. For dealer store demonstration setups, receiver model numbers may be written in instead of calls. (Right) A commercially-built variable pad box for TV installations.

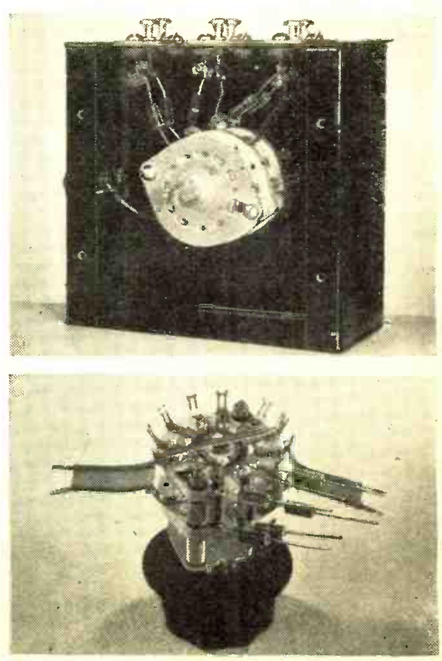


Fig. 10. Internal wiring of typical low loss selector and equalizer switching box. (Top) Receiver terminals are on left wall of box while top side carries three terminal strips for the one, two, or three dipoles. In photo, the first and third positions have fixed attenuation "O" pads connected for 300 ohm lines, while the second or middle position has 72 ohm "pi" type attenuator. The fourth switch position, at far right, makes through connection without attenuation for weak signal on new channel 13 station. (Bottom) Under side view of the switch seen in top photo.

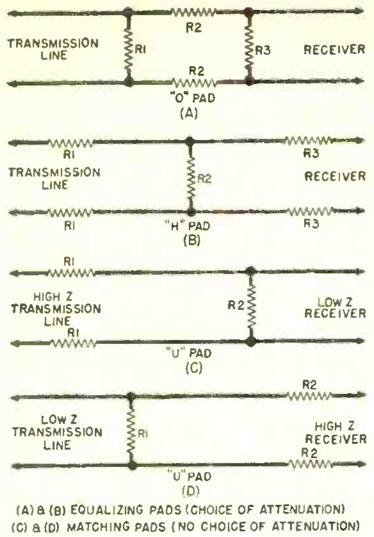


Fig. 11. Typical balanced pads for use on balanced transmission lines. Resistors with same subscripts are equal. Whether or not R_1 and R_3 in A and B are equal depends on whether or not the dipole's transmission line is of same impedance as set's input.

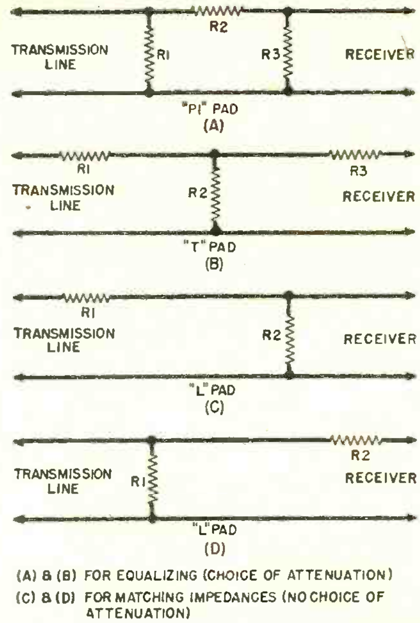


Fig. 12. Typical unbalanced pads for unbalanced circuits. Conditions applying in Fig. 11 are applicable in this instance.

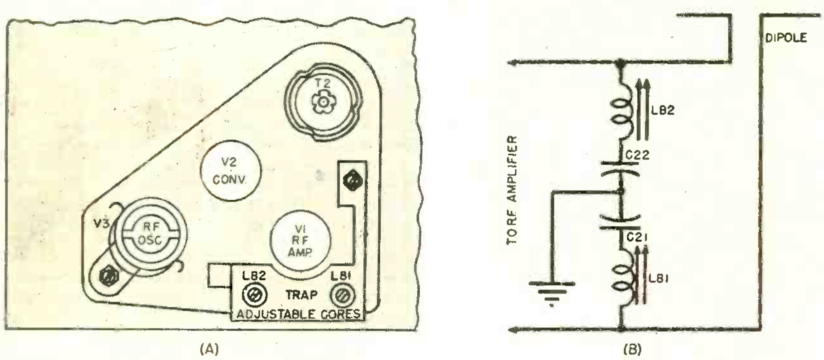


Fig. 13. Signal interference wave trap mounted across antenna input terminals of some models of the RCA 721 TCS television receiver.

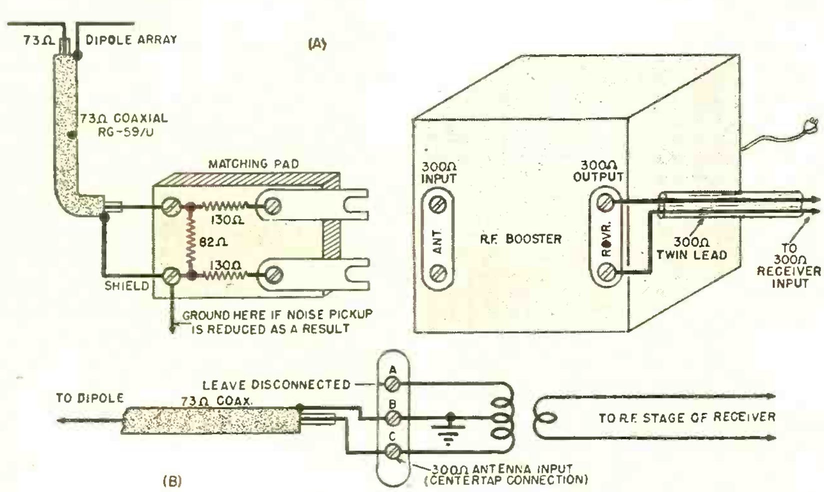


Fig. 14. (A) To match noise-free shielded coaxial line to 300 ohm receiver which has no input centertap, use 73 ohm to 300 ohm matching pad (loss 11.2 db., voltage ratio 3.5 to 1) and 300 ohm booster amplifier (gain 16 db., voltage ratio 1 to 6.3 for typical single-stage booster). (B) On receivers provided with centertap on 300 ohm antenna input strip, coaxial transmission line may often be connected as shown, without matching pad. If this connection causes unbalance, use matching pad of (A), connecting 300 ohm side to terminals A and C. Leave B disconnected or grounded, depending on which results in the least noise.

Tele-Pad variable attenuator supplies with it a complete set of instructions, circuit charts, and tables of resistor values, which require no mathematics or engineering knowledge. This completely eliminates the need for otherwise complicated computations.

Backtracking momentarily to our discussion of "compromise" installations, it may now be remarked that another common practice of installers is to cut down excessive signal strength by purposely mis-orienting the dipole. The undesired effect of this, however, is to decrease the signal-to-noise ratio, and increase ghost pickup and susceptibility to interfering signals, and generally to provide a poor substitute for an *individualized* installation. Such methods are responsible for a great many needless call-backs, the greatest single deterrent to installation profits.

To correct the second cause for tearing pictures as listed in Table 1, certain preliminary checks, such as hold control adjustment, may be made on all sets, while some receivers have horizontal discriminator transformer frequency and phase adjustments. Each manufacturer's service manual describes their own procedure for setting these adjustments. If the trouble persists, check the tubes. Beyond this lies a complete bench-type trouble-shooting procedure, which is outside the scope of this article.

Around the third cause for tearing, interfering sigals, some controversy and a great deal of confusion exists. Claims are made by as many people condemning the use of wave traps as by those favoring them. The writer has seen many types of wave traps employed quite successfully, and they will be found mounted across the antenna input terminals in some new receivers on the market, as shown in Fig. 13. Construction details of one particular type appears in the already-mentioned article appearing in the March, 1948 issue. The cure given for the fourth cause of tearing pictures, interfering noise, is self-explanatory.

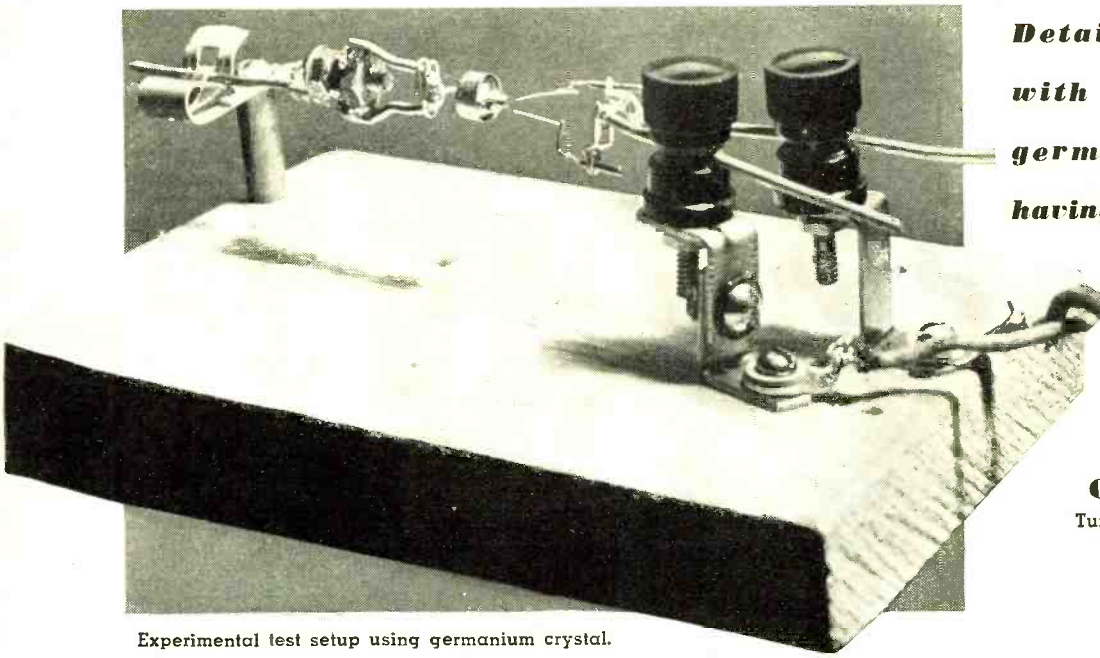
What we have discussed thus far are the four causes and cures for tearing and distorted pictures discovered during preliminary dipole "probing" operations on one channel. Of course, other channels may have similar or identical faults resulting in tearing pictures, calling for attenuation or matching pads, or wave traps. It is obvious that some form of low-loss switching arrangement will have to be used at the receiver, to insert the correct items into the antenna circuit as the television set is switched between channels.

A good arrangement of this sort is shown in Fig. 10, while Fig. 9 shows the cover and knob in place, and a convenient form of panel marking for the station call letters or channel numbers.

Going back to the preliminary dipole probing operation, it will be recalled that three other faults, aside from

(*Continued on page* 135)

A Crystal that AMPLIFIES



Experimental test setup using germanium crystal.

Details of experiments with a double-contact germanium type crystal having transconductance.

By

C. E. ATKINS

Tung-Sol Lamp Works, Inc.

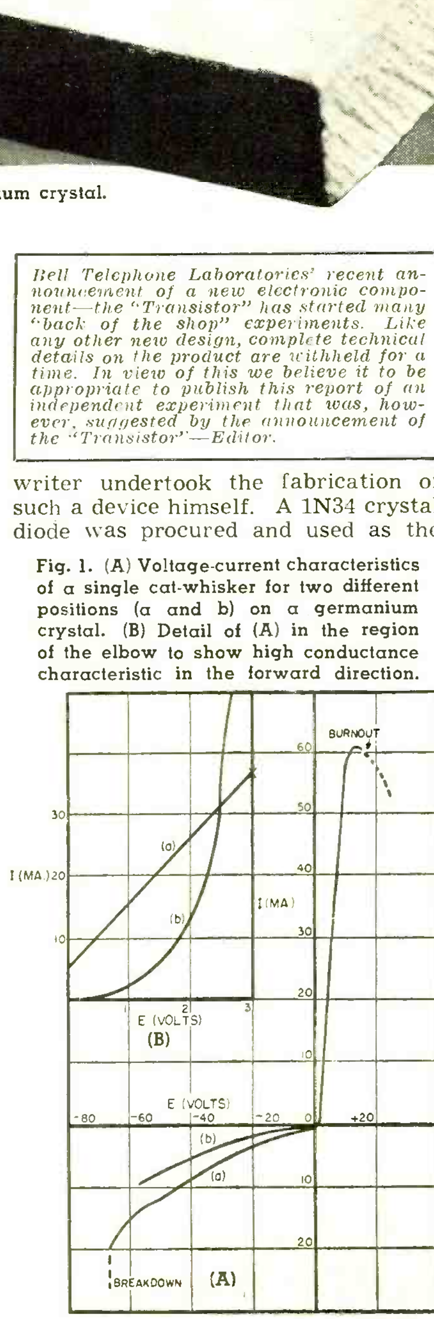
RUMORS of a recent sensational development in crystal transducers led the writer to explore a field he had not touched since the early 1920's. Like thousands of other boys, he built the usual crystal receivers and tinkered endlessly with "cat-whiskers" and coils. The very words "silicon" and "galena" evoke nostalgia for the halcyon days now, alas, so rapidly receding into a dim and remote era. Even in that day the electron tube had largely supplanted the crystal detector, once the mainstay of wireless reception. In addition to its role as a detector, amplification and oscillation were also attempted without much success. RADIO NEWS in 1923 carried articles on the Zincite crystal, wherein feeble oscillations were developed because of a small negative resistance exhibited under certain rather critical conditions. This was elaborated on in further articles in September and October, 1924. This was referred to as the "Crystodyne Principle," a term copyrighted by RADIO NEWS.

Nothing much came of these developments and with the increasing availability and lower cost of vacuum tubes, crystal devices of this kind were largely relegated to the historical museum. However, during the second World War, vast strides were made in the development of fixed crystal detectors for use in radar where at ultra-high frequencies they were, in many instances, superior to electron tubes.

Spurred on by the fragmentary press releases and general trade gossip regarding a three terminal crystal transducer using a germanium crystal, the writer undertook the fabrication of such a device himself. A 1N34 crystal diode was procured and used as the source of a ready mounted germanium crystal. By holding the 1N34 with a pair of long-nosed pliers gripping the cathode or negative lead (which is clearly marked) the crystal may be exposed by chopping the ceramic adjacent the metal cap at the negative end with side-cutters. The ceramic will shatter, and there is a brass stud inside against which the cutting force expends itself. The germanium crystal is mounted on the stud and, with ordinary care and good fortune, it is possible to strip the ceramic away without impairing the crystal.

Bell Telephone Laboratories' recent announcement of a new electronic component—the "Transistor" has started many "back of the shop" experiments. Like any other new design, complete technical details on the product are withheld for a time. In view of this we believe it to be appropriate to publish this report of an independent experiment that was, however, suggested by the announcement of the "Transistor"—Editor.

Fig. 1. (A) Voltage-current characteristics of a single cat-whisker for two different positions (a and b) on a germanium crystal. (B) Detail of (A) in the region of the elbow to show high conductance characteristic in the forward direction.



The writer's attempts to utilize the cat-whisker used with the 1N34 were unsuccessful, so this part of the assembly was discarded. Workable cat-whiskers can be made from the heater wire of almost any 150 ma. radio tube. The tubes can be defective for almost any cause—even heater failure, if in the right place. The average radio shop generally has many of these at hand. The writer used type 35W4 because several defective ones were currently available. By breaking the glass bulb and clipping the support leads to all elements except the heater, it is possible in most cases to slide the heater out of the cathode sleeve. The structure can be further disassembled by gripping one of the base pins with a pair of long-nosed pliers while all the glass around the pin is chipped away with side-cutters. One then has a base pin and lead welded to a segment of coated heater wire. It is necessary to leave the ceramic coating on the heater wire in order to give it sufficient rigidity. It may be trimmed to suitable length with a small pair of

(*Continued on page* 181)

REPRODUCTION OF MICROGROOVE RECORDINGS

Technical details covering the new Columbia LP records and the styli and turntable equipment required.

By

NORMAN C. PICKERING
Pickering & Co., Inc.

and

JOHN D. GOODELL
The Minnesota Electronics Corp.

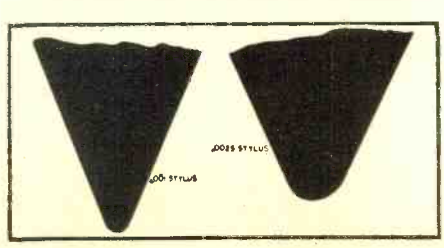
Jeanne Cagney, star of United Artist's "The Time of Your Life," auditions one of the new Columbia Microgroove records on the Philco 1405. This table model combination has two tone arms plus automatic record changer to play standard records automatically as well as the new Long-Playing Microgroove discs.

IT IS A GOOD many years since *Columbia* released a demonstration record with an announcer's voice saying, "Columbia Double Disc Records—Music on both sides! A different selection on each side! Double value for your money, plain as daylight!" Once more, with the Microgroove long playing records, *Columbia* is able to say, "Double value for your money!" This time their achievement represents the resolution of technical difficulties considerably greater in magnitude than those involved in providing an impression on both sides of the record.

It is of some historical interest to note that Edison manufactured vertical records recorded at approximately 200 lines per inch which in their day were technically superior to competitive products. It is also interesting that a diamond stylus was provided for playback. Edison's vertical records covered the approximate frequency range of 150 to 4000 cycles per second, which for his era was indeed remarkable. In producing the Microgroove discs, *Columbia* faced the problem of recording and pressing at groove pitches of 180 to 220 lines per inch on lateral records with a frequency response range from 30 to 10,000 cycles per second. Initially released pressings indicate that they have been extremely successful. Specifically, records ML4023 (Dvorak's Symphony No. 5 in E Minor, The Philadelphia Orchestra conducted by Eugene Ormandy) and ML4056 (a collection of operatic arias sung by Bidu Sayao), when reproduced on suitable equipment, are distinctly superior to usual standard speed recordings with regard to surface noise, frequency response, and "clean" reproduction. They are a great deal better than most audio and recording engineers expected them to be.

It should be borne in mind that an engineering staff concerned with Microgroove discs faces all of the not inconsiderable problems involved in recording and pressing under standard conditions multiplied by a dimensional factor of approximately 2, in addition to certain special considerations. To establish a reference for this, it may be pointed out that at 33⅓ r.p.m. using a .0025 spherical radius for the playback stylus tip, the 7-inch diameter groove will be down about 20 decibels in frequency response at 10,000 cycles per second. The smaller the diameter (the lower the relative velocity of the groove with respect to the stylus), the shorter is the wavelength at a given frequency and the more abrupt are the corners the stylus is required to track. When a half wavelength is comparable to the dimensions of the stylus, it can only bounce slightly in greatly distorted saw-tooth type waveforms. If the stylus radius is reduced to .001", it should be able to track a shorter wavelength successfully. This is true only if proper coupling to the groove is obtained, which requires proportional scaling down of groove dimensions. This leaves an excessive amount of land between the grooves and makes it possible to close up the pitch. (Loading effects on the cutter are neglected here since they may be properly compensated with little difficulty.) The amplitude of the cutter drive must also be lower in proportion. Note, too, that the diameter at which the 20 decibel loss appears for 10,000 cycles per second becomes proportionally smaller. Microgroove recordings are cut in no closer than a 4¾ inch diameter so that the difficulties are appreciably reduced.

Fig. 1. A comparison of stylus sizes used with regular and Microgroove recordings.



In all disc recording the excursion

amplitude is limited by groove spacing at low frequencies, which is the principal reason for constant amplitude recording below a turnover frequency around 300 to 500 cycles per second. This limitation does not appear at high frequencies recorded at constant velocity because the excursion amplitude at constant velocity is inversely proportional to frequency. In Microgroove recording the maximum amplitude of low frequencies is about half the amplitude possible with standard grooves. This introduces the advantage that high frequencies may be recorded at higher *relative* amplitudes (with respect to low frequencies) with Microgroove techniques. In standard groove recordings it is common practice to attempt to compensate for losses at high frequencies in the relatively small diameter portion of the records with equalization that boosts the high frequency energy. It has also been deemed desirable to use recording curves such as the NAB and Orthacoustic curves with considerable high frequency pre-emphasis to allow for noise reduction with de-emphasis networks in the playback system. In accordance with the figures discussed above, this would mean that the combination of pre-emphasis and diameter equalization in standard groove recording would require a rising characteristic amounting to between 35 and 40 decibels at 10,000 cycles per second at seven-inch diameters on 33⅓ r.p.m. recordings. In Microgroove recordings the obvious associated problems are minimized by the fact that a given high frequency excursion is relatively larger with respect to the maximum allowable low frequency excursion, plus the fact that the recorded section is not carried to as small relative inner diameters.

The design of playback cartridges for Microgroove records may include essentially the same mechanical properties as for standard records. However, the limitation on low frequency maximum excursions imposed by reduced land area between the grooves may again be used to advantage. With standard groove techniques there is an approximately equal amplitude tracking problem at low and high frequencies. With Microgroove dimensions the low frequency tracking problem is greatly reduced while the high frequency tracking problem is unaffected. This means that it becomes possible to favor high frequency tracking characteristics in the design of the pickup cartridge.

There is one important exception in scaling the dimensional relationships. In considering the reduction in surface area beneath the stylus tip when its spherical radius is reduced from .0025 to .001, the factor is squared. This is the derivation of the assumption that a tracking pressure of approximately five grams is suitable. If 20 grams is satisfactory for a .0025 stylus in a standard groove, then five grams may be accepted as suitable for a .001 stylus in a microgroove. In this connection it may be pointed out that high quality equipment for standard discs is usually designed with tracking pressures approximating 20 grams or less. If suitable precautions in connection with stylus materials, pickup arm design and turntable characteristics are followed, the five-gram tracking pressures are very satisfactory with properly designed cartridges.

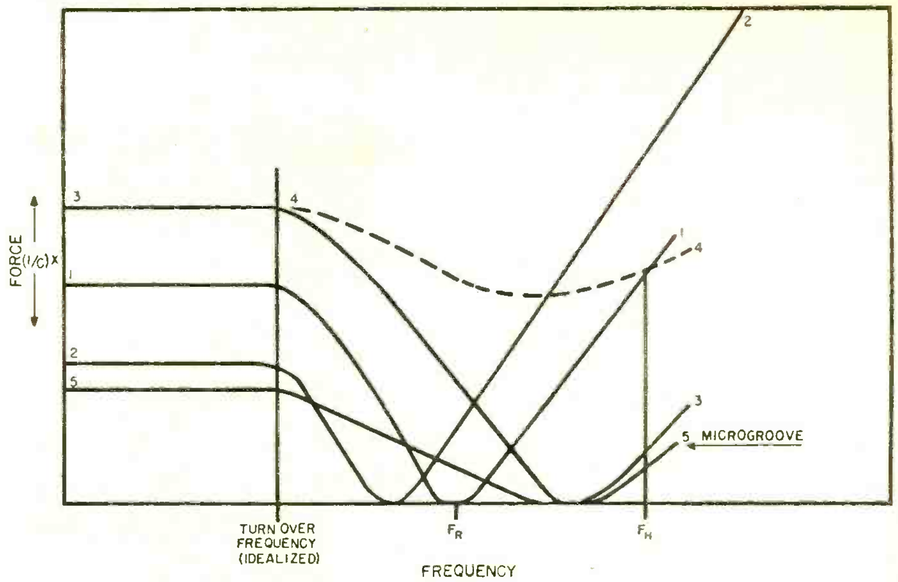


Fig. 2. Family of curves indicating design considerations for optimum pickup structures with respect to reactive and resistive forces.

The light tracking pressure brings up another problem in pickup design which is worthy of discussion. The lateral forces on the stylus must never be allowed to exceed the tracking pressure or the needle will be forced out of the groove. The forces acting on the stylus may be expressed in a simple differential equation:

$$\Sigma F = M\frac{d^2x}{dt^2} + R\frac{dx}{dt} - \frac{X}{C}$$

ΣF is the sum of all the forces acting on the stylus.

M is the moment of inertia referred to the stylus tip.

R is the damping factor in mechanical ohms.

C is the compliance of the stylus suspension.

x is the displacement of the stylus tip.

This states that the sum of the forces producing lateral motion at the stylus tip consists of the forces required to overcome the damping in the suspension, to accelerate the mass of the stylus and its suspension, and the force required to displace the stylus against its own stiffness. The stiffness term is important only where the displacement is large, hence principally at frequencies below the turnover point (approximately 500 c.p.s.) Good engineering practice in the design of

(*Continued on page* 155)

Webster-Chicago's new Model 133 automatic Microgroove record changer. Equipped with a new balanced tone arm, the changer will handle ten 12" or twelve 10" records at 33⅓ r.p.m. turntable speed so that up to four hours of continuous record play can be obtained with a single loading. The unit is mounted on a metal base.

A home-constructed unit can achieve a "professional" look when housed in a specially built cabinet. Unit at right has built-in magnifier lens.

A better understanding of video components and behavior of the circuits results from the actual construction of a TV set.

By MARK FLOMENHOFT

The TELEVISION KIT

IT SHOULD be especially timely to pause at this still early stage in the growth of the television industry in order to take inventory of the design practices that are at last crystallizing in the kit field. There are, of course, other reasons to justify a study of trends in over-all kit design. Consideration of kits offers a picture of the industry as a whole since, in basic principle at least, differences between factory and home-constructed sets are quite superficial. More to the point, however, is the fact that many people still believe that a layman cannot build a good instrument, and so an authoritative discussion of problems actually uncovered by what is now more than a year of experience may serve to end prejudices that are caused by the absence of concrete information. By the same token, the dealer himself should be capable of more forceful and intelligent sales arguments if he is familiar with the inside story behind the procedures of the television kit he distributes.

Because specific examples and illustrations often hasten an understanding of general principles, material supplied by *Transvision, Incorporated,* New Rochelle, New York, has been used to illustrate the subject matter.

A representative milestone of progress in television design is to be found in the deflection circuits currently in vogue. It may be recalled that the first kits to appear on the market featured seven inch kinescopes that employed electrostatic deflection. Consequently, simple capacity charging circuits with timing controlled by equally simple multivibrators were employed for the generation of deflection voltages. (See horizontal and vertical oscillators of Fig. 2.) But consistent with the inescapable American attitude in such matters, the passage of time has occasioned an insistence for larger pictures that even now is progressively restricting the applications for which smaller tubes are deemed acceptable. A by-product of this eagerness for large pictures, is the growing popularity of the "blow-up" lens.

But taking this demand for large pictures as a starting point, let us recapitulate the straightforward—in fact, obvious—steps that have led to the more elaborate deflection circuits of Fig. 1.

First of all, what kind of deflection should be used in a larger picture tube? The answer—electromagnetic, of course. There are many reasons. The electromagnetic tube is better and cheaper to manufacture, for one thing. It is better because it permits a greater concentration of the beam, and this fact, in turn, provides superior definition and brilliance. It is cheaper to manufacture because the absence of deflecting plates removes many causes for "shrinkage" (rejects) in addition to eliminating numerous operations in the assembly of the tube. By no means trivial is the smaller size of the electromagnetic tube, a property that facilitates cabinet design appreciably. From a design standpoint, furthermore, the larger electrostatic cathode-ray tubes require deflection voltages in excess of 600, while sweep circuits for similar electromagnetic tubes can function satisfactorily with the conventional 350 volts. Perhaps of lesser importance is the somewhat greater illusion of realism imparted by the flat faces of electromagnetic tubes.

The next decision to be made concerns the selection of an impulse generator. Fig. 1 discloses that blocking oscillators have replaced the multivibrators of Fig. 2, and to avoid what

EDITOR'S NOTE: *The increasing popularity of television kits is due, largely, to intelligent engineering and practical construction approach of these kits.*

The Editors of this magazine have preached the gospel of "learn by doing" for a long time. Realizing that one of the best ways to get acquainted to TV circuits is to build up a set from scratch, we considered total cost of components plus labor (not to mention the messy job of chassis fabrication) and pre-tuning problems and compared this figure to equivalent manufactured sets.

It didn't take long to make the decision in favor of the "kit" idea. Many months of engineering go into a TV kit. Drawings of elaborate proportions are simplified to the extent that almost anybody can produce a set that compares favorably with many production receivers. As a result, a kit has the advantage of being an instrument of instruction as it develops into a finished article capable of providing endless hours of entertainment.

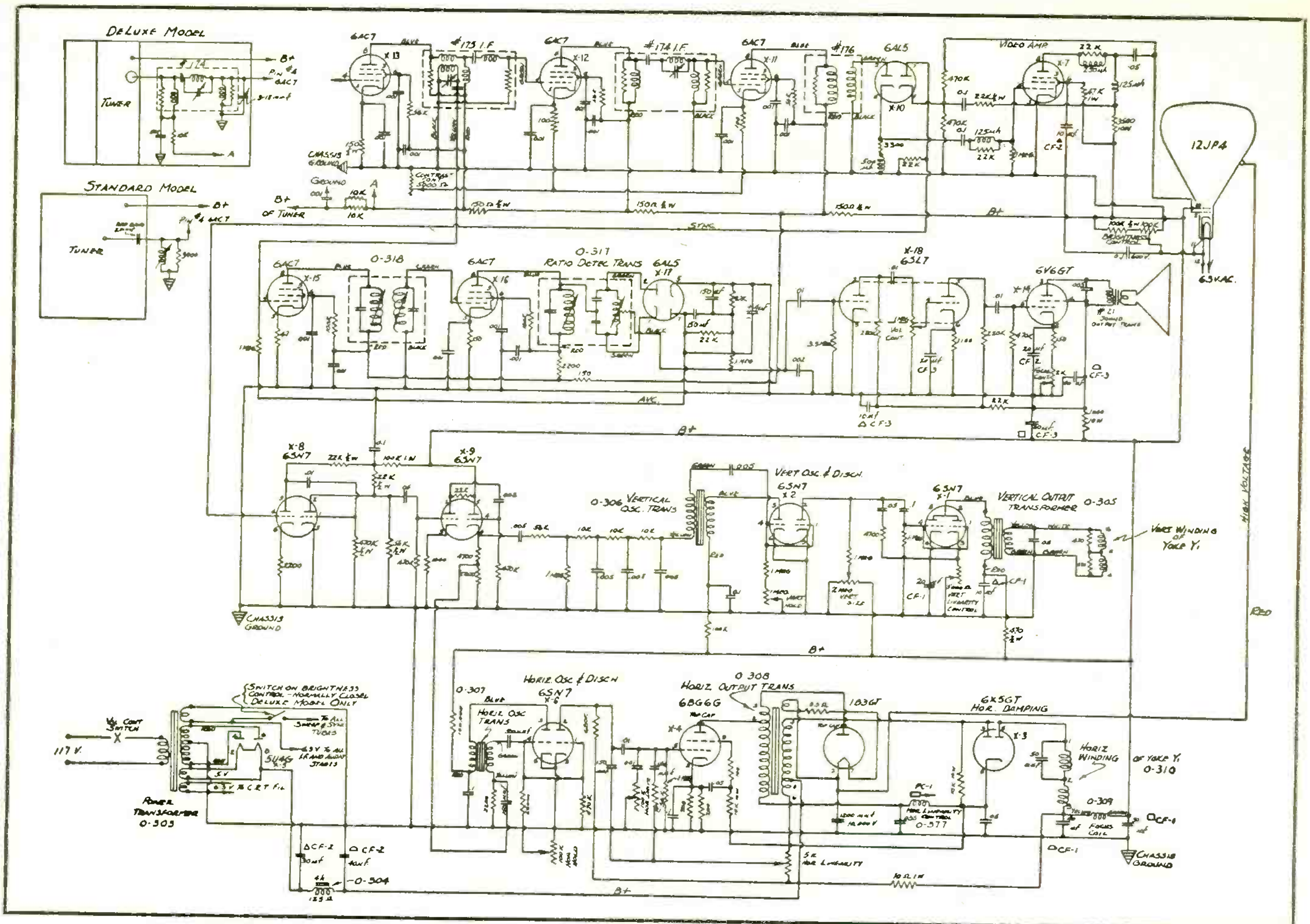


Fig. 1. Circuit diagram of Transvision's deluxe model receiver. An electromagnetic picture tube is used in this kit.

would now be an outmoded debate of virtues offered by these methods, let us make two brief observations.

1. Experience has definitely verified the superiority of the blocking oscillator for both stability (e.g., resistance against misfiring, an occurrence that the spectator interprets as "tearing") and what is really a smaller dose of the same problem, constancy of the triggering point (e.g., the point on the deflection waveform at which triggering occurs, a circuit property that enables the picture to appear sharper to the spectator).

2. The feasible price and performance of blocking oscillator transformers make their use a virtual "must."

At this point it is necessary to settle the issue of high voltage. By elimination we choose the "fly-back" circuit. Here we find that by utilizing the enormous inductive "kick" generated during the brief retrace time of the horizontal scanning cycle, the desired voltages can be obtained both economically and conveniently. Some shielding precautions, or at least a favorable arrangement of parts, must still be observed to prevent harmonics of the 15,750 cycle fundamental in the horizontal oscillator from interfering with nearby AM radios.

Referring to the horizontal oscillator, let us assume that initially the left-hand section of the 6SN7 (X-6) is cut off. Now suppose a positive pulse is conveyed from the right-hand cathode section of X-9 to the point marked "yellow" on the diagram. For successful triggering the magnitude of this pip must raise the grid voltage by an amount that permits conduction. This current flow and the ensuing drop in the transformer winding sharply drops the voltage at the point marked

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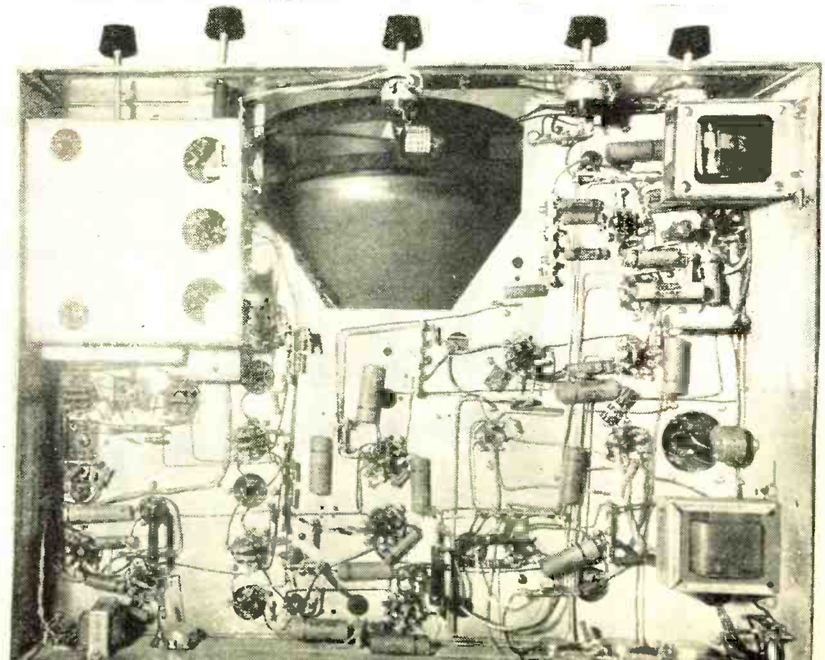
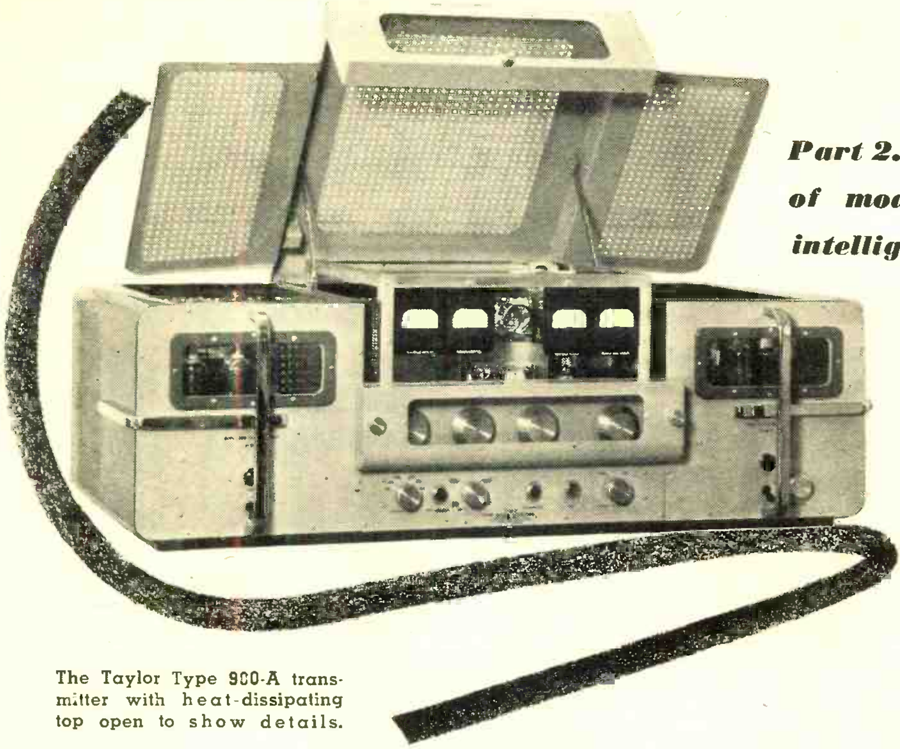
Under chassis view of video receiver constructed from Transvision kit.



The Taylor "SUPER-MODULATION*" Principle



The Taylor Type 900-A transmitter with heat-dissipating top open to show details.

Part 2. A discussion of a new system of modulation providing increased intelligence transmission efficiency.

By

R. E. TAYLOR

Taylor Transmitters

IN PURSUIT of a means toward greater *"Intelligence Transmission Efficiency"* or *ITE,* with either orthodox or advanced methods, further inspection of the systems discussed so far, along with the action of the linear detector in receivers, shows some interesting features.

As previously mentioned, conventional practice of necessarily having the sideband or talk power 6 db. or more below the carrier level, has been a great handicap to amateur and other forms of radio communications. Therefore, if there can be devised some method of bringing up the sideband or talk power level and of reducing or compressing the original carrier power interference level at the same time, we will have quite a reduction in interference and noise, with an increase in the power level and range of the intelligence to be transmitted and received. Past methods of transmitter modulation for sideband power have made this impossible. One of the reasons is the detector action in the receiver. Any attempt at greater than so-called 100 per-cent modulation for increased sideband power, or the reduction of the carrier level with respect to a given amount of audio supplied in the form of modulation, results in detector distortion. Thus, we have been limited to the sideband power 6 db. or more below the carrier interference level.

Suppressed carrier transmission has been used commercially for quite some time along with single sideband. However, in re-introducing the carrier at the receiver, it has to be properly phased and within a few cycles of that of the transmitter, while the amplitude of the re-introduced carrier is also important where a low degree of distortion from the receiver detector is important. There is a reduction in noise level in single sideband however, characteristic of any really narrow-band reception. However, heterodyne interference by the carrier from another AM transmitter with receiver-carrier re-introduction is another matter to be considered.

The one past exception for increased true sideband power is wideband FM in high frequency broadcast service where the permissible modulation index is high and the frequency swing is about 75 kc. each side of the instantaneous carrier frequency. Here, the carrier in some instances is almost all converted to true sideband power of a high *ITE,* as the power distribution of the modulation also affects the amplitude of the carrier frequency.

However, when the modulation index and frequency swing is held down as in NBFM, the resulting sideband power is limited to about one half or less that of a standard AM signal. On long distance communications or where the signal is weak, it often sounds as though the percentage of modulation is low with a strong carrier. In cases of amateur BCI trouble, NBFM has been substituted for AM with a great loss of sideband power. For the fellow with a telegraph transmitter, it has been an easy way to get on phone.

In approaching greater sideband power and reduced carrier interference levels, further tests of the 900-A transmitter previously described disclose some very unusual accomplishments.

Sideband power has been increased 3 or 4 db. to about plus 48 db. in each sideband, while the carrier or interference level has been lowered by about 3 db. to an effective level of about plus 49 db. or about 1 or 2 db. difference in level of the separate functions. Now we find that by raising one level and lowering the other, we have almost overcome the 6 to 10 db. difference normally experienced, and effectively increased our *"Intelligence Transmission Efficiency"* by 6 or 10 db. from the transmitter-receiver standpoint.

With past reasoning and methods as a basis for understanding, we bring to light a number of new principles heretofore unused, in permitting the above. Of the new principles involved, some have been previously mentioned. However the coordinated functioning of additional effects with controls, permits new thinking and advanced reasoning, opening many new fields as follows.

The application of the positive modulation energy directly to the carrier output power, in the form of r.f. power triggered at an audio rate and controlled by the positive audio to be transmitted, adds to sideband power.

By effectively dividing the positive and negative half cycles of audio for modulation, we can extend or limit their amplitudes and time linearly as desired.

The effective separation of the r.f. carrier portions with respect to positive and negative modulation and time, so that each as divided may be classified as positive modulation carrier and

* The modulation system disclosed in this article carries a U. S. patent and foreign patent with other patents pending.

negative modulation carrier, allows control of each as desired.

The semi-suppression or compression of the carrier power, during positive modulation for sideband power, to a predetermined level quite some degree below that of the non-modulated carrier level, becomes possible.

The transmission of the r.f. carrier negative cushion of predetermined amplitude and time for the negative modulation half cycle prevents distortion by negative peak clipping in the receiver detector.

The audio a.c. component reference level or zero is elevated to a new increased operating position during positive modulation and high sideband power production.

The carrier component is reduced during positive modulation to a low interference level, far below that of the non-modulated carrier power level.

The successful use of separate tubes for carrier and sideband production, both independently controlled and contributing their power directly to the transmitter output as required is possible.

Provision may be made for a cross-over of sideband power and carrier power levels, with the sideband power far above, and the carrier power below the originating point levels. This permits correspondingly greater signal voltage out of the detector at reduced carrier level interference, due to the effective raising of the audio a.c. component and the reduction of the r.f. reference or zero levels in the receiver detector action.

A modulation effect in the receiver detector is apparent as a result of the changing reference levels and a.v.c. action, contributing somewhat to increased detector action efficiency. This brings about a corresponding reduction in the receiver bandwidth, noise level, and other effects common with any narrow-band reception.

It has been known for some time that modulation greater than 100 per-cent can be used on positive peaks to great advantage if it is linear, provided the negative peaks do not clip or shut off the carrier. This effect does not appear as objectionable distortion in the output of the receiver detector, but appears as added signal intelligence output on the upward swing in the linear detector of the modern receiver.

In Fig. 1, careful study of transmitter modulated output waveforms with both conventional and linearly extended positive peaks discloses some interesting conditions. Detector reproduction in both cases at *B* and *D* can be identical in waveform to that of the transmitter at *A* and *C*. However, in *C* considerably more sideband power is produced by the transmitter with greater signal strength out of the detector at *D* as compared to *B*. If we check for the center line or reference zero along the vertical lines between the tips of the positive and negative peaks at *C*, we find it effectively elevated by one half over the normal

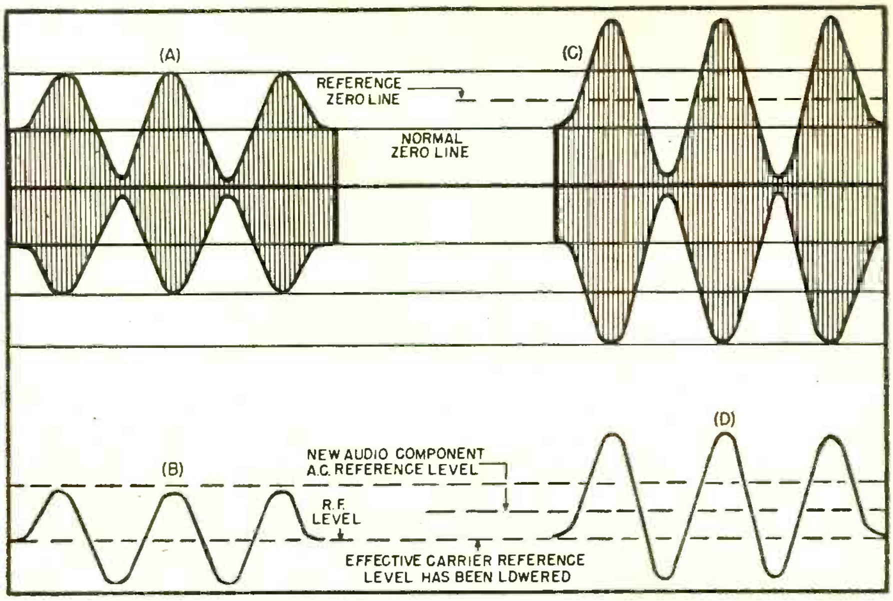


Fig. 1. The effect of extending positive modulation peaks with carrier constant by increased or expanded audio a.c. reference level.

zero of *A*. Consequently, at the same time, by raising of the reference level, we have effectively reduced or caused the r.f. component reference level to be placed at a position lower in amplitude. This is duplicated in the detector action of the receiver.

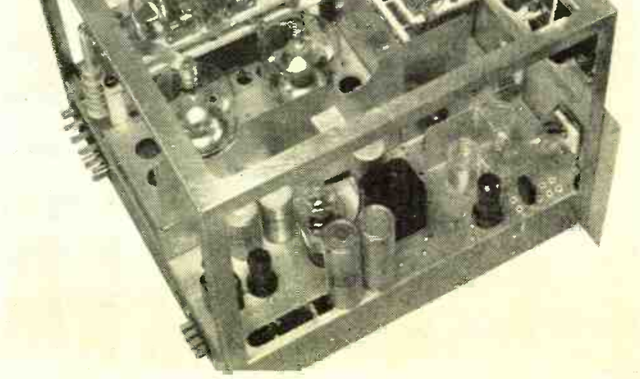
With this simple function as a working basis we determine that increase of the sideband power along with the decrease of the carrier or interference level is possible, if properly arranged.

As mentioned, output of the two tubes *PA* and *PM* of the 900-A transmitter as to power delivery and timing control was the result of the divided audio out of the modulation transformer acting to trigger the positive and negative modulation for sideband power. We noted before, that during positive modulation by tube *PM* a certain amount of the unmodulated carrier power being delivered by tube *PA* was replaced by that from tube *PM* with a reduction in power required by tube *PA*, effectively amounting to the increase of *PA's* operating efficiency with respect to the power level as at no-modulation.

This reduction of the tube *PA* power output is of course caused by a proper and efficient reduction of the plate power input, which was the result of lowering the r.f. drive as mentioned and shown at DP_2 of Fig. 3. Control of this function was the result of the r.f. voltage swing across the voltage dividing net of C_m and C_p, energized from the r.f. reservoir *R*. Having determined that tube *PM* can be put to work for the short time required, it was found that it could be made to do the majority of the work as far as providing power output during positive modulation, as well as to deliver power far greater than conventionally allowed.

With this high power delivery function of tube *PM*, its power output is increased with the decrease of tube *PA's* power output from normal carrier level downward. *PA's* decrease is then simultaneously replaced by that from tube *PM* on the upward sweep, but *with r.f. triggered at the audio rate of the r.f. excitation drive pulse to tube PM*. We have then replaced, during positive modulation, some of

Modulation and r.f. section of the Type 900-A transmitter.

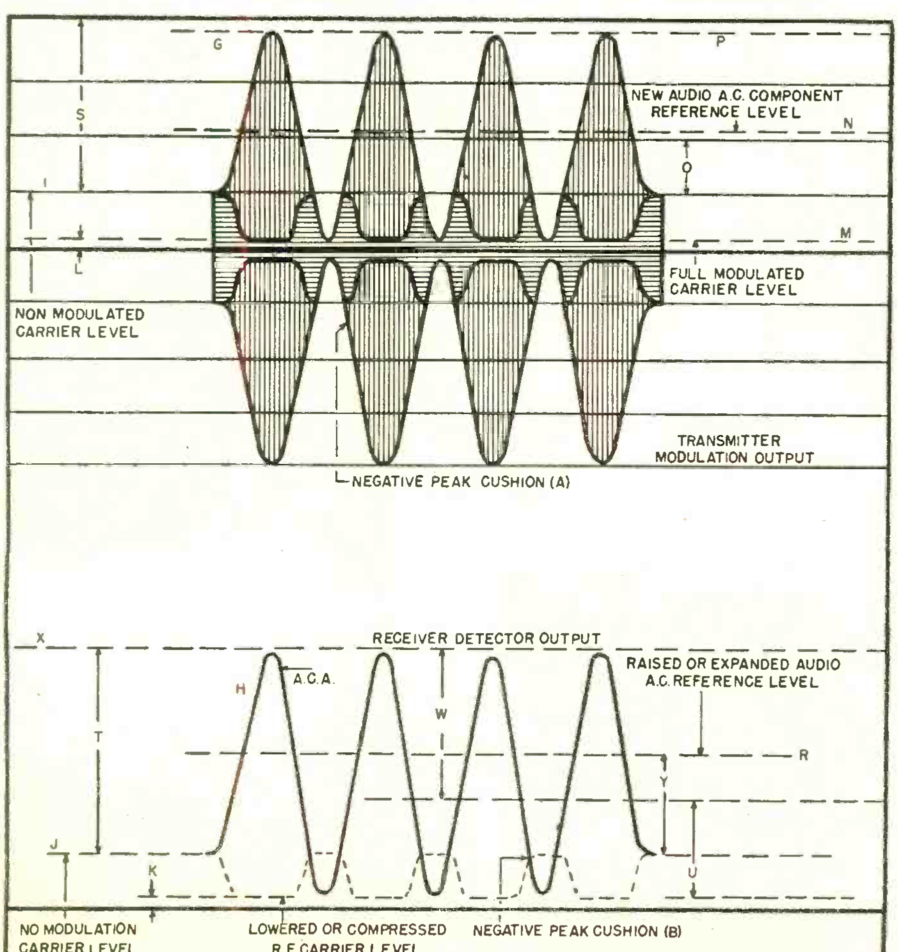


the normal carrier power, with modulation energy in the form of triggered r.f. This turns up as sideband power produced by tube *PM* in addition to the non-modulated carrier. Then, during positive modulation, we have tube *PM* producing sideband power both above and below the non-modulated carrier level. The carrier, containing no intelligence, has been compressed or moved down to make room for the greater upsweep of the tube *PM*. Although it is an r.f. tube, *PM* contributes the r.f. at the audio rate of its r.f. drive. Of course during this compressed carrier period, the interference level at the receiver has been reduced by the almost total absence of carrier, with no receiver carrier reinsertion required.

Now comes one of the unorthodox events; the return of the carrier to about full non-modulation level, or less if desired, for the function of the negative modulation half cycle, providing a cushion for the negative modulation peak, and preventing flattening or clipping by a so-called overmodulation effect. This restored carrier cushion is for, and only during, negative modulation, with the amplitude and time of the restored carrier cushion subject to regulation. Functioning as the carrier cushion for negative modulation, for maintenance of the linearity during the over-all upward and downward sweep, the timing and amplitudes of both the negative peak and the carrier cushion depth can be adjusted to prevent overmodulation on the negative half cycle of modulation. Carrier semi-suppression, which we shall hereafter refer to as carrier compression, then takes place during that time that the positive modulator is allowed to fill the compressed carrier valley with sideband power energy. Effectively then, during transmission, the transmitted output power is just about all sideband power with just a small amount of carrier sufficient for detector demodulation action. The re-establishment of the carrier during negative modulation as a cushion, which we shall hereafter refer to as the negative cushion, is not important with respect to the positive half cycle of modulation but is re-introduced only for the negative swing of the modulation or sideband power being received by the detector.

As we are transmitting a very small amount of carrier during positive modulation, and a full negative carrier cushion during the negative modulation half cycle, we find that a second separation of effective actions is possible. In conventional use, where the carrier is present in full for both the separate functions of positive and negative modulation, we can however, divide it with respect to time, so that we have carrier presence for positive modulation, and carrier presence for negative modulation. To go a bit farther, we have what we can call positive modulation carrier and negative modulation carrier, with respect to the intelligence transmitted. Each is separate as to time and operation so they may be divided with respect to modulation function and sideband power production.

Fig. 2. Transmitter and receiver waveforms obtained with "super-modulation."



Therefore, by transmitting separately the so-called negative carrier as used for the negative peak cushion, we have almost eliminated the transmission of the positive carrier. At this time, the output transmitted is about all sideband power, with the re-insertion of the negative carrier at a time where its average effective ratio as to heterodyne interference production at the receiver is far below that of the amplitude of the sidebands during positive modulation. Its filling in as the negative peak cushion in timing does not take any power away from the sidebands which are at maximum amplitude level during the positive modulation function.

Fig. 2 at *G* shows the transmitter modulated envelope output above, with the detector signal output below at *H*. The positive modulation half cycle is considerably extended, the carrier compressed during positive modulation, and the negative peak cushion re-introduced for the negative half cycle of modulation. Of course, if the positive peaks are allowed to flatten out on top, the same will appear in the detector output as distortion, the same as negative peak clipping.

Inspection of the patterns in Fig. 2 shows considerably more modulation or sideband power output from the transmitter as shown at *S* than that at *O*, normally available in standard practice. Detector reproduction at *H* is identical in linearity and waveform to the transmitter output.

We now find that the audio a.c. component reference level, which we shall hereafter refer to as the "Audio Zero," has been raised along the vertical lines between the positive and negative peaks of the modulated envelope from that at *I* to that as shown at *N*. The same effect is reproduced in the detector action with the new audio zero raised from that at *J* up to *R*. As mentioned before, where we raise the audio zero, we have at the same time lowered the r.f. reference level with respect to the new audio zero. This will be the amount from that at *N* down to *I* or the reverse of that of the elevated audio zero. Now with the incorporating of carrier compression and negative peak cushion, we find that the carrier reference r.f. level can be even further separated from the audio zero, down to about that at *M* from that at *I*. At the same time this allows the compressed carrier valley from *I* to *M* to be filled in with audio triggered r.f. during positive modulation,

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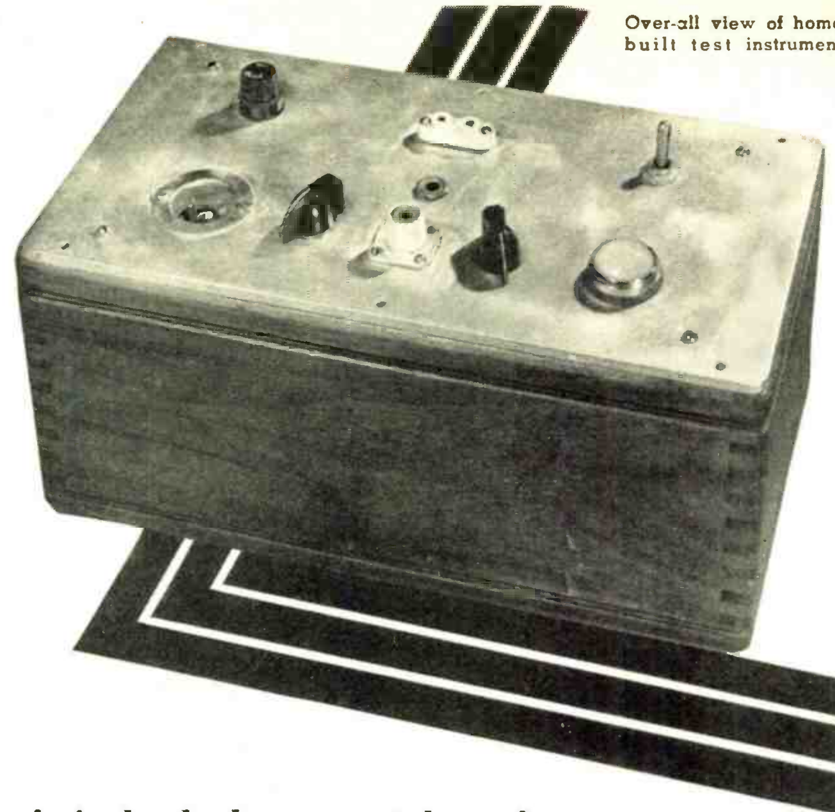
HOME-BUILT CRYSTAL SIGNAL GENERATOR



Over-all view of home-built test instrument.

By N. CHALFIN

A single, dual-purpose tube and crystals are the only major components needed to build this a.c.-d.c. test instrument.

ONE way to be certain that you have an accurate signal source for alignment purposes is to employ a crystal oscillator.

The circuit diagram of Fig. 1A covers a simple, single-tube instrument which can be easily built and will prove to be a useful tool in radio servicing. A 117P7 is used as a combined crystal oscillator and half-wave rectifier. The 117 volt filament eliminates the necessity for providing dropping resistors or other filament voltage reducing devices. Another feature of the unit is that it may be operated on either a.c. or d.c. This crystal controlled signal generator may also be used on 220 volt a.c. or d.c. lines if a suitable line dropping resistor is provided.

The pentode section of the 117P7 is employed as a Pierce grid-to-plate connected crystal oscillator. With this arrangement no tuned circuits are required and the screen acts as the crystal oscillator anode permitting the plate circuit to be used as an output connection in such a way that it reduces the loading effect on the oscillator.

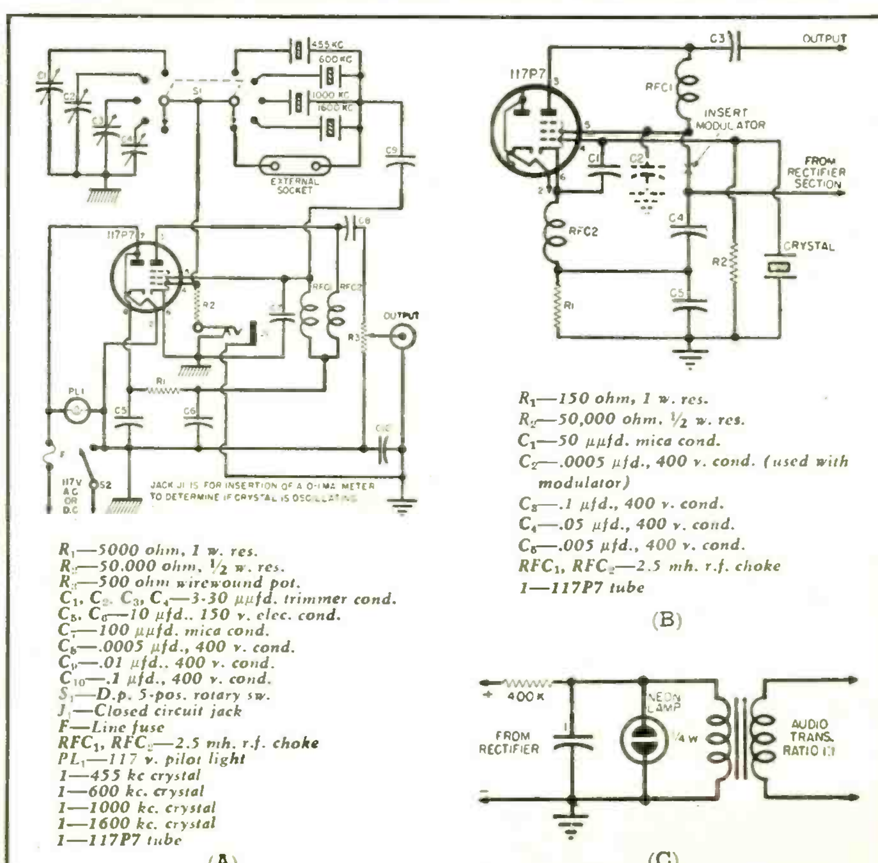
A rotary wafer switch is employed to select the desired crystal or the external crystal socket (which can be used for crystals other than those permanently incorporated in the crystal signal generator).

The following crystals were selected because they provide the most needed alignment frequencies; 455 kc. for broadcast receiver i.f. alignment, 600 kc. for the low end of the broadcast band, 1000 kc. to hit the middle of the band and provide harmonics over a wide range, and 1600 kc. to adjust the high end of the broadcast band.

Table 1 lists the harmonics of these frequencies from which the user can select frequencies for almost any alignment service. In the table several

(*Continued on page* 96)

Fig. 1. (A) Schematic diagram of crystal-controlled signal generator. (B) An alternative oscillator circuit that may be used. (C) Modulator circuit consisting of a neon-type relaxation oscillator which may be incorporated if desired.



R_1—5000 ohm, 1 w. res.
R_2—50.000 ohm, ½ w. res.
R_3—500 ohm wirewound pot.
C_1, C_2, C_3, C_4—3-30 μμfd. trimmer cond.
C_5, C_6—10 μfd.. 150 v. elec. cond.
C_7—100 μμfd. mica cond.
C_8—.0005 μfd., 400 v. cond.
C_9—.01 μfd.. 400 v. cond.
C_{10}—.1 μfd., 400 v. cond.
S_1—D.p. 5-pos. rotary sw.
J_1—Closed circuit jack
F—Line fuse
RFC_1, RFC_2—2.5 mh. r.f. choke
PL_1—117 v. pilot light
1—455 kc crystal
1—600 kc. crystal
1—1000 kc. crystal
1—1600 kc. crystal
1—117P7 tube

(A)

R_1—150 ohm, 1 w. res.
R_2—50,000 ohm. ½ w. res.
C_1—50 μμfd. mica cond.
C_2—.0005 μfd., 400 v. cond. (used with modulator)
C_8—.1 μfd., 400 v. cond.
C_4—.05 μfd., 400 v. cond.
C_6—.005 μfd., 400 v. cond.
RFC_1, RFC_2—2.5 mh. r.f. choke
1—117P7 tube

(B)

(C)

"S" METERS

By
DON M. WHERRY, W0LQS

Analysis of various "S" meters which can be easily incorporated in existing communications receivers.

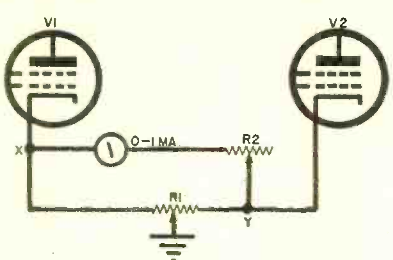


Fig. 1.

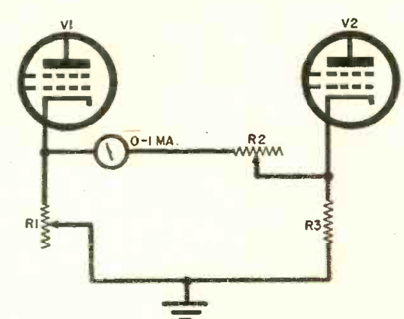


Fig. 2.

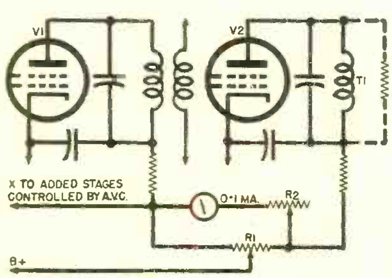


Fig. 3. Should T_1 be used as an audio stage, it should then have a resistance or impedance equal to the plate load of the tube instead of being an r.f. transformer.

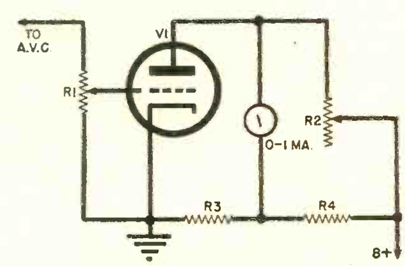


Fig. 4. Pot R_1 should have a large resistance to reduce loading of a.v.c. system.

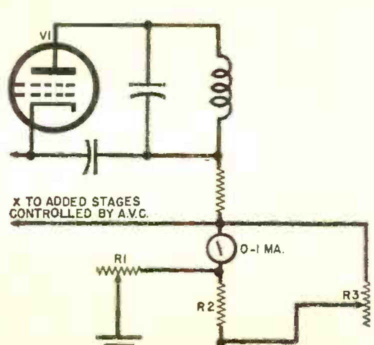


Fig. 5.

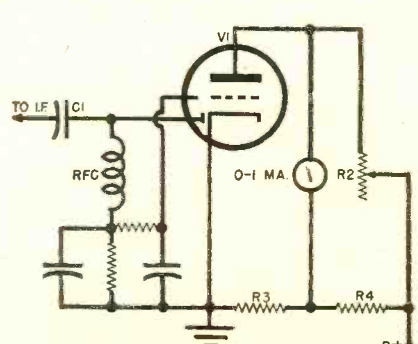


Fig. 6.

AN "S" meter, while of very doubtful practical value, is an exceedingly interesting little gadget to watch. It is questionable whether there is one of us who hasn't said, as he started to modify that new surplus receiver, "Guess I'll put an 'S' meter on this thing" and then just as promptly gone right ahead without installing it. Because of its dubious value on the lower frequency bands this omission isn't serious but up in the u.h.f. portion of the spectrum a signal strength meter, besides being interesting, does have a very practical value when it comes to adjusting your friend's beam as well as orienting your own for individual contacts.

The methods of incorporating a signal strength meter in a receiver are many and varied but they all can be grouped under two related heads—those which indicate in some way the a.v.c. voltage developed, or those which indicate the changes in receiver operation as the result of this a.v.c. A few circuits of both types will be described here in sufficient detail to either permit you to equip that new 420 mc. receiver with a signal strength meter or to start you off on the right track towards figuring out your own.

Fig. 1 shows a simple system whereby two tubes are used in a bridge circuit, one of which is controlled by the a.v.c. and the other is not. This usually means that the controlled tube (V_1) is an r.f. or i.f. tube and the other (V_2) is the converter or first audio tube. These tubes must of necessity have the same bias requirements, as both cathodes are the same potential at zero signal input. In this circuit R_1 is the zero adjustment, and should be approximately twice the value recommended for one tube (400 to 500 ohms in most cases). R_2 is the sensitivity adjustment and after it is once set can be ignored. It may be positioned at any convenient point on the chassis. With no signal input, and no a.v.c. voltage, it is clear that points X and Y are at equal potential and no current flows through the meter. With the appearance of a signal the a.v.c. action becomes effective causing V_1 to draw less current. As a result, the left hand half (in Fig. 1) of R_1 has a smaller voltage drop, thereby unbalancing points X and Y causing a current through the meter proportional to the amount of unbalance.

Fig. 2 is a slightly different approach to the same circuit and in some cases might prove a little more convenient to wire. In any event the same considerations prevail in each case. R_3 is the recommended value for the tube with which it operates and R_1 approximately twice the resistance value of R_3, this again depending upon the tubes. R_2 is the sensitivity control which can be set and forgotten.

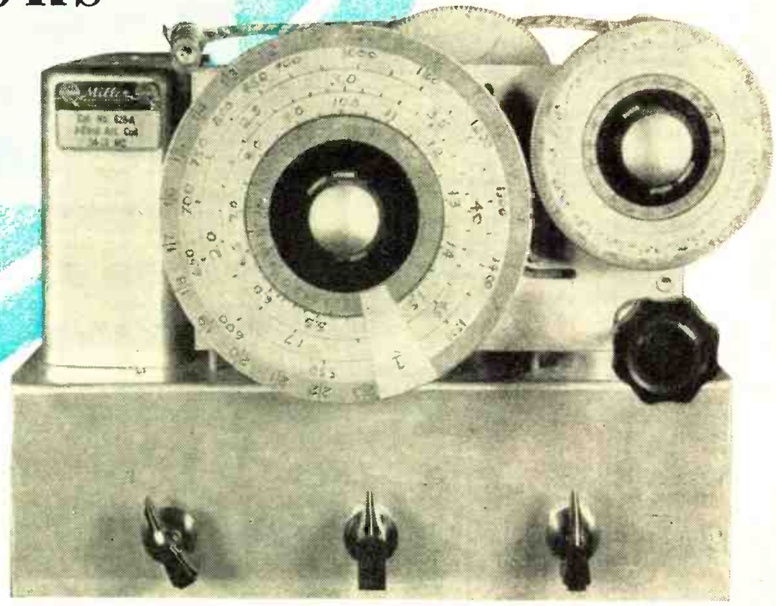
Fig. 3 shows the identical circuit to Fig. 1 with the exception that the meter is placed in the plate lead instead of the cathode. This circuit has the advantage that the cathodes of the

(*Continued on page* 104)

Build Your Own Communications RECEIVER

By
J. T. GOODE
Standard Coil Products Co.

Part 3. Design and construction of a multi-band r.f. tuner which covers 550 to 16,000 kilocycles.



Front view of home-built tuner with Croname dial.

THE design of a radio frequency tuner requires much consideration. Any radio design is a compromise. Since the tuner determines the frequency range of the receiver, the compromise is between frequency range and practical construction. The more bands that are added to a receiver, the more complicated it becomes.

Bandswitching requires long grid and plate leads. Below 18,000 kc. these leads are a small percentage of the total inductance of the tuned circuit. Above 18,000 kc. these leads contribute a sizeable portion of the total inductance, and as the frequency is increased the percentage is increased.

Long grid and plate leads at high frequencies cause a decrease in gain, possible regeneration, poor signal-to-noise ratio, decrease in stability, and very poor image ratio. All of these features are obviously undesirable.

Most communications receivers have continuous frequency coverage from 550 to 30,000 kc. Most of these receivers also are troubled by the lack of image rejection of the ten meter band. The image rejection increases as the frequency is lowered. The modern communications receiver of today requires considerable engineering effort. Engineering skill is definitely required in the design of high frequency multi-band receivers.

Almost every lead wire in the r.f. section becomes critical. This presents an engineering nightmare from a production standpoint.

Communications receiver manufacturers extend the frequency range of their receivers as competition dictates. As the frequency range is increased the engineering problems multiply.

Because of the outlined difficulties, the advisability of home constructing a bandswitching r.f. tuner with a frequency coverage above 18,000 kc. is debatable. The builder may lack both the necessary test equipment and engineering skill. If there is any question as to whether the construction will be satisfactory or not, it should not be attempted. Such an attempt can result in unnecessary expense and failure.

While the average radio enthusiast is not qualified to build a high frequency bandswitching tuner, he is perfectly qualified to construct a tuner which does not use bandswitching. Not only can he build it; but the result will equal or exceed the operating characteristics of most bandswitching high frequency tuners now on the market. It is only necessary to build a tuner for each band of frequencies required. Production engineering enjoys no such luxury as this.

By building individual tuners, each ham band calibration can be spread over the entire dial thus providing maximum bandspread and simplifying tuning. The variable condenser will be small and this, coupled with the limited number of parts required, will result in very compact construction. Therefore, very little space is required for several tuners.

Each tuner is a complete unit. The operation of one tuner will not affect the operation of another. Interaction of coils in bandswitching tuners is common. Overcoming such difficulties requires engineering skill and usually test equipment that may not be available to the home constructor.

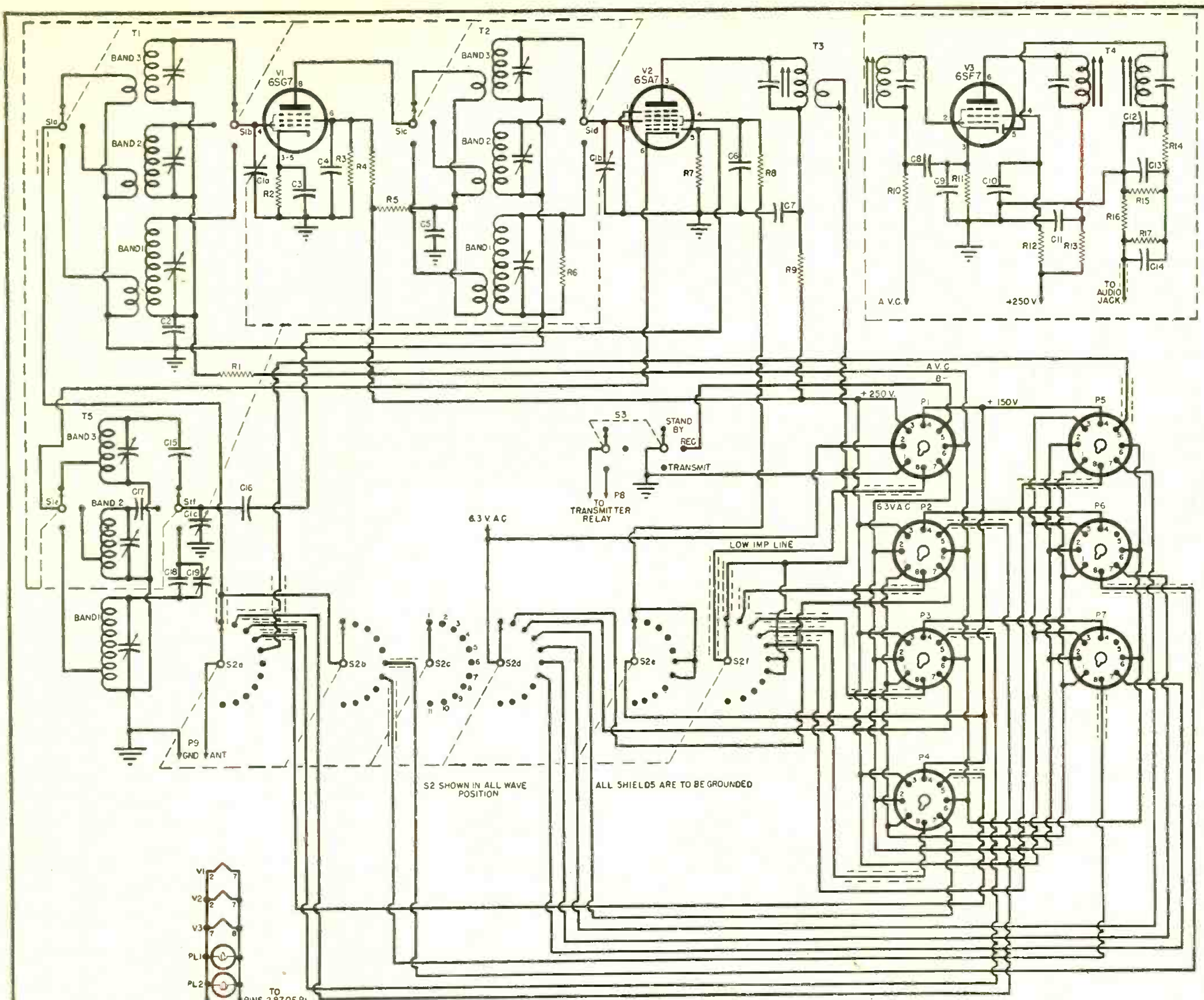
Multi-band coils covering a frequency range from 550 to 18,000 kc. are available at most wholesale radio stores. The r.f. tuner to be described is constructed from readily available parts. The availability of these coils determines the frequency range of the tuner.

Complete coverage of frequencies from 550 to 16,000 kc. is desirable. This covers the broadcast band, the three low frequency amateur bands, and practically all short-wave broadcast stations. Above this frequency range the average operator is only interested in certain bands of frequencies such as the 10, 6, and 2 meter ham bands.

The use of separate tuners for each band of frequencies requires a switching circuit. This switching arrangement is included in the multi-band tuner. This type of construction makes the addition of other tuners at a later date extremely simple.

The mechanical layout of the multi-band tuner allows adequate space for switches, tuner power sockets, dial, and space for an i.f. stage if the builder desires to omit the communications features of the i.f. channel chassis.

All main parts should be mounted on the chassis before the wiring is started. If the multi-band tuner is not



R_1, R_{10}—500,000 ohm, ½ w. res.
R_2—220 ohm, ½ w. res.
R_3—33.000 ohm, 1 w. res.
R_4, R_{12}, R_{14}, R_{17}—51,000 ohm, 1 w. res.
R_5, R_8, R_9, R_{13}—4700 ohm, 1 w. res.
R_6, R_{15}—100,000 ohm, ½ w. res.
R_7—20,000 ohm, ½ w. res.
R_{11}—180 ohm, ½ w. res.
R_{16}—240,000 ohm, ½ w. res.
C_1—365 μμfd., 3-sec. var. cond.
C_2, C_3, C_4, C_5, C_6, C_7, C_8, C_9, C_{10}, C_{11}—.02 μfd., 400 v. cond.
C_{12}, C_{13}—50 μμfd. mica cond.
C_{14}—500 μμfd. mica cond.
C_{15}—.005 μfd. mica cond.
C_{16}—25 μμfd. mica cond.
C_{17}—.001 μfd. mica cond.
C_{18}—350 μμfd. mica cond.
C_{19}—5-50 μμfd. ceramic trimmer
T_1—Miller 626A
T_2—Miller 626RF
T_3—Miller 912C1 (modified—see text)
T_4—Miller 912C4
T_5—Miller 625C
P_1, P_2, P_3, P_4, P_5, P_6, P_7—Octal tube sockets
P_8, P_9—Two-point terminal strips
S_1—Centralab 1425 sw.
S_2—6-deck, 6-pole, 11-pos. sw. (Centralab or equivalent)
S_3—Centralab 1415 sw.

Fig. 1. Circuit diagram of the home-built, multi-band r.f. tuner designed to be used with communications receiver.

to be used primarily for communications reception, the standard type slide rule dial will be satisfactory. Such slide rule dials are available at most wholesale radio stores. *Miller* has a complete dial assembly with a calibration to match their coils.

If the tuner is to be used for communications reception, a gear driven dial assembly is desirable. This type of dial offers mechanical bandspread which results in a more accurate calibration plus ease of operation. When the receiver is operated in the "sharp" position, bandspreading is absolutely necessary.

The dial shown in the photograph of the multi-band tuner is manufactured by *Croname, Inc.* of Chicago. Hand calibration of this dial is in no way difficult. The method of calibration will be described in the section dealing with the tuning procedure.

At first glance the circuit diagram may appear to be complicated. By visually breaking it into three sections, the complications diminish.

Consider all connections to S_2, P_2, P_3, P_4, P_5, P_6, and P_7 as one section. The i.f. stage is another section. The rest of the diagram is actually the r.f. tuner.

If the i.f. channel chassis is to be used with this tuner, disregard the i.f. stage in the circuit diagram.

Wire the r.f. tuner section first. This will necessitate the wiring of P_1, P_8, and P_9. Connections will be made to switch decks 1, 5, and 6 of switch S_2, but do not make all connections to this switch at this time.

The function of the switches is as follows. S_1 is a three-deck bandswitch. This switch selects bands 1, 2, or 3 of the multi-band tuner. S_2 is the tuner selector switch. This switch makes all necessary circuit changes for the operation of the separate tuners.

The decks of the switch are numbered. Number 1 deck is located nearest to the front of the chassis. Number 1 deck switches the antenna circuits. Number 2 deck makes connections for double superheterodyne operation at high frequencies. Number 3 deck is a spare. This is planning for the future. Number 4 deck switches the heater circuits. Separate dial lights are used on each tuner.

As S_2 is rotated the dial lights will indicate which tuner is in operation. The heaters of the multi-band tuner are on at all times, but only the heaters of the tuner selected will be in operation. This eliminates the necessity for the additional switching of "B plus" leads to the tuners not in operation and reduces heater drain.

Switch deck number 5 switches the

regulated 150 volt lead. By switching this lead the multi-band tuner becomes inoperative when other tuners are used, with the exception of double superheterodyne operation at high frequencies.

Switch deck number 6 switches the low impedance output lead from the various tuners to the input of the i.f. chassis.

Switch S_3 is the communications switch. One deck shorts the number 5 prong of power socket P_1. This grounds the center tap of the high voltage winding in the power transformer placing the receiver in operation. When the switch is rotated to the left the receiver is placed in "standby" position. When the switch is rotated to the right the two terminals of P_8 are shorted, and the power transformer center tap is opened.

Transmitter relay leads can be connected to P_8. When switch S_3 is rotated to the right the transmitter will be turned on and the receiver placed in standby. This eliminates the necessity of running leads from the receiver to a relay or switch in the transmitter.

Do not connect a high current circuit from the transmitter to switch S_3.

Connections to P_2, P_3, P_4, P_5, P_6, and P_7 should be made as construction is completed on each separate tuner. If desired the switching arrangement may be changed to meet individual needs. Those having individual antennas for each band may find it desirable to connect the antennas directly to the tuners rather than go through the switching network.

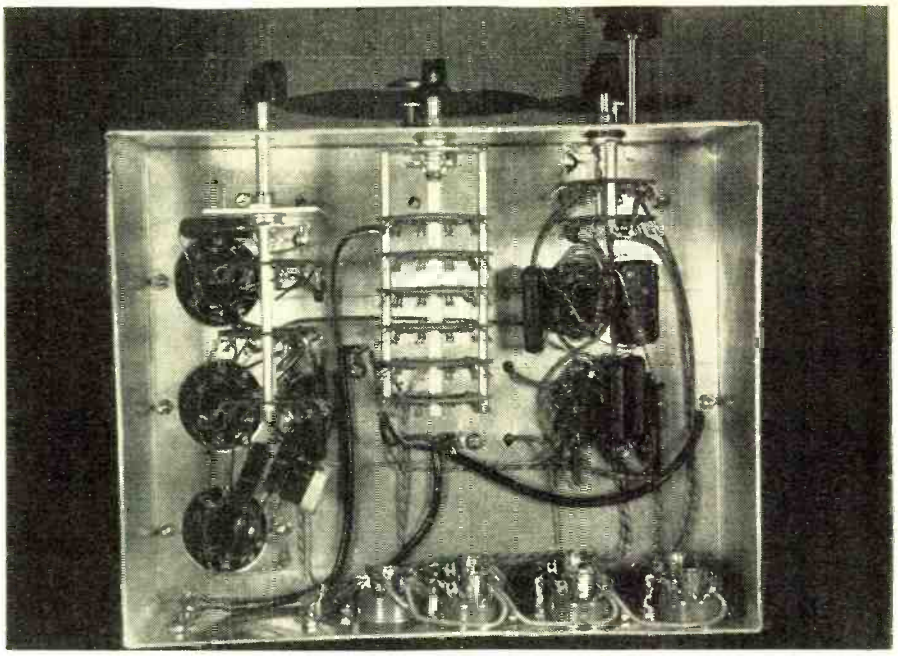
At high frequencies a certain amount of mismatch will result from using switch S_2 to change antennas. This can result in attenuation of the received signal. Actual tests will indicate the most satisfactory method of connecting the various antennas.

The i.f. frequency for the high frequency tuners will be 10.7 mc. The multi-band tuner will be tuned to this frequency and used as the i.f. channel. Later on a 10.7 mc. wide-band i.f. channel with limiter and discriminator can be constructed for broadcast FM reception. No change in the high frequency tuners will be necessary for wide-band FM reception.

The electrical design of the multi-band tuner is simple and straightforward. The r.f. stage is conventional using a 6SG7 type tube as an amplifier.

The mixer stage uses a 6SA7 type tube. The screen voltage is obtained from the regulated 150 volt lead. Since the screen is actually the plate of the oscillator circuit, frequency variations due to plate voltage change are minimized. Automatic volume control is not applied to this stage. The a.v.c. voltage applied to this stage would cause slight frequency variations with changing signal input levels.

Due to the high sensitivity of the receiver, local broadcast stations may tend to overload. This condition can be corrected by selecting the correct



Under chassis view of the r.f. tuner. This layout should be closely followed.

value of resistance for R_6. This resistor shunts the broadcast grid coil of the mixer stage but does not affect the other bands.

High sensitivity in the broadcast band is not desirable. Several broadcast stations are located on almost every frequency. The gain should be reduced so that the station with the loudest signal will be the only one heard.

It is impossible to correct this situation completely. The signal level of two distant stations may be approximately the same. The type of antenna used will affect this situation. It will be up to the individual to adjust the value of R_6 for satisfactory operation at his particular location.

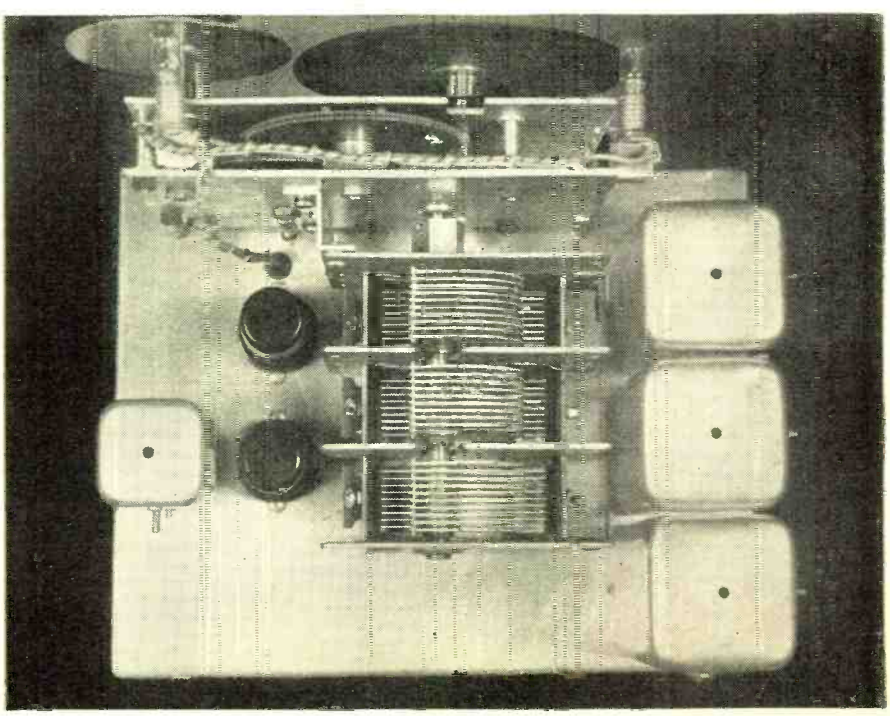
Actual wiring of the multi-band tuner should follow this pattern. One three-lug tie point is located near the 6SA7 tube and secured to the chassis by the mounting screw of transformer T_3. The 6SA7 screen, 6SA7 plate filter and 6SG7 screen resistors connect to this tie point. A single tie point is secured to the chassis by the 6SA7 tube mounting screw. The oscillator grid condenser connects from this point to the tube socket prong.

Another three-lug tie point is located under the bandswitch. The 6SG7 plate filter and a.v.c. filter resistors connect to this tie point.

The padding condensers connect directly from the multi-band oscillator

(*Continued on page* 110)

Top chassis view of tuner unit. Transformer T_3 may be seen at the left.



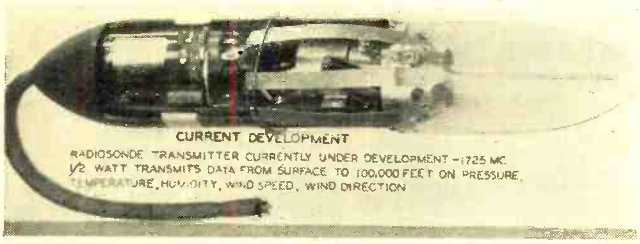
PARTS—Then and Now

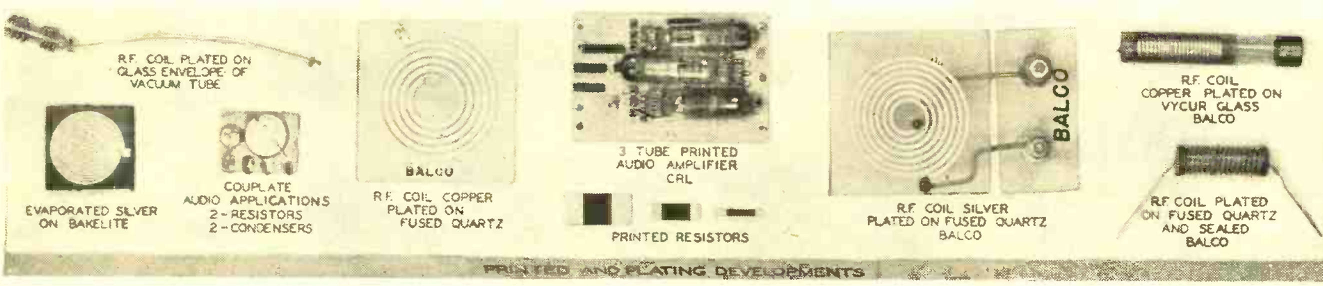
ONE of the truly great advancements to come out of the war was the impetus given to the miniaturization of the various component parts that go into the construction of various types of radio and electronic equipment.

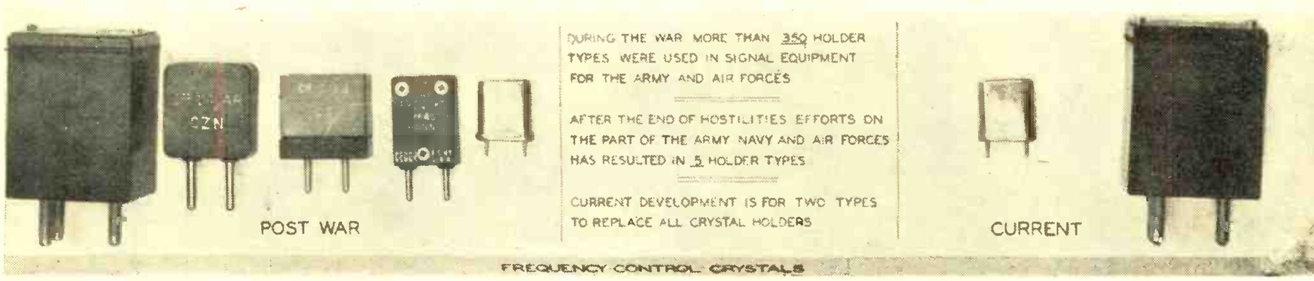
The use of the proximity fuze, radio controlled missiles, various navigational aids for all types of aircraft, as well as radio installations in jeeps, tanks, trucks, etc. and man-carried radio equipment stimulated research in the field of "putting up" big performing parts in small but thoroughly reliable "packages."

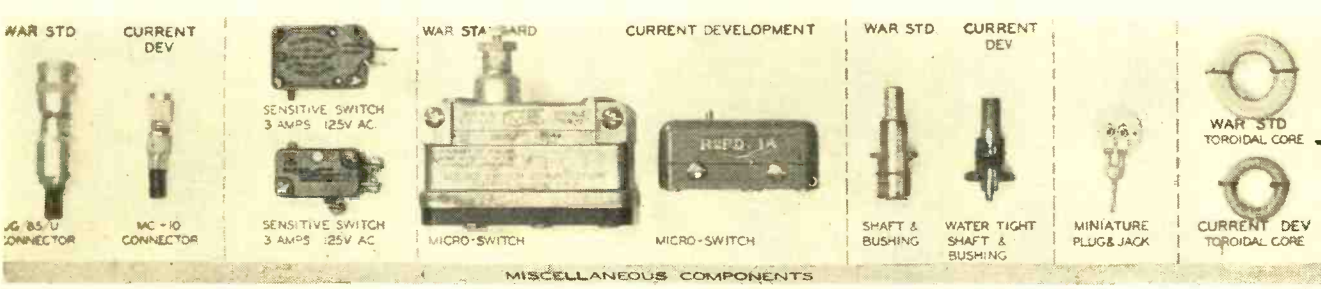
On these two pages are illustrated many of the radio and electronic components which were engineered in small "packages" during and since the war. Already these developments have been reflected not only in the adoption of more compact equipment for war but in the appearance of small-sized radio equipment for the civilian market.

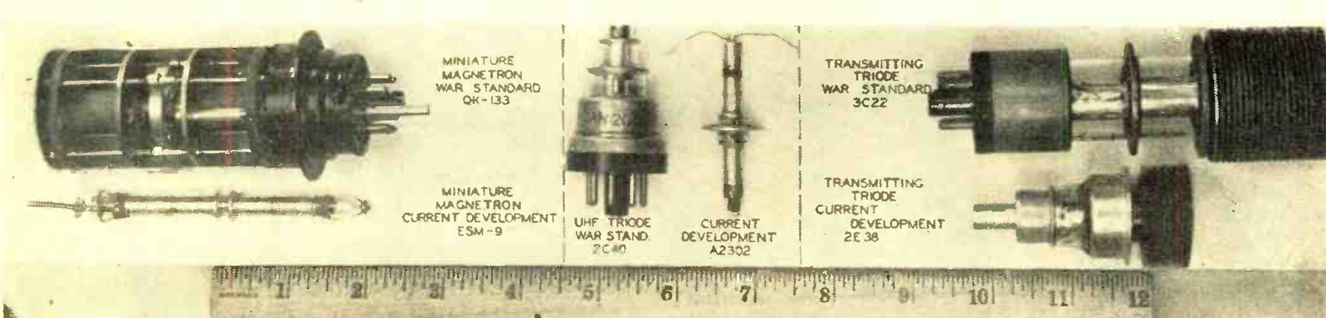
Most persons are familiar with the miniature portable receivers now on the market and as time goes by more and more equipment will be available in "small packages" through the use of miniature components.

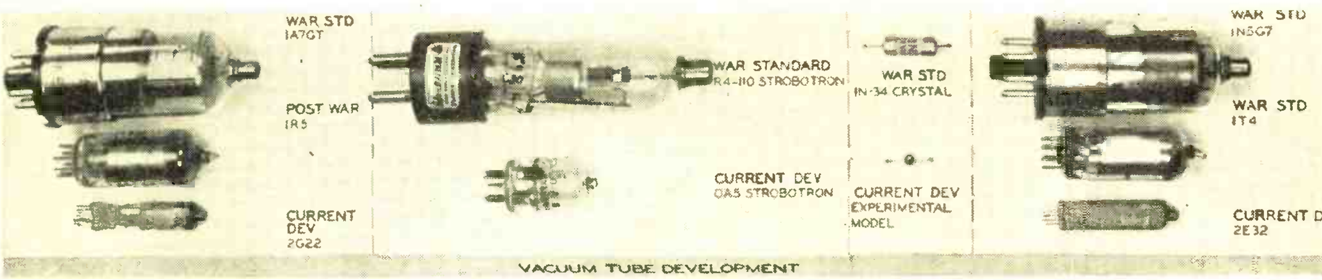


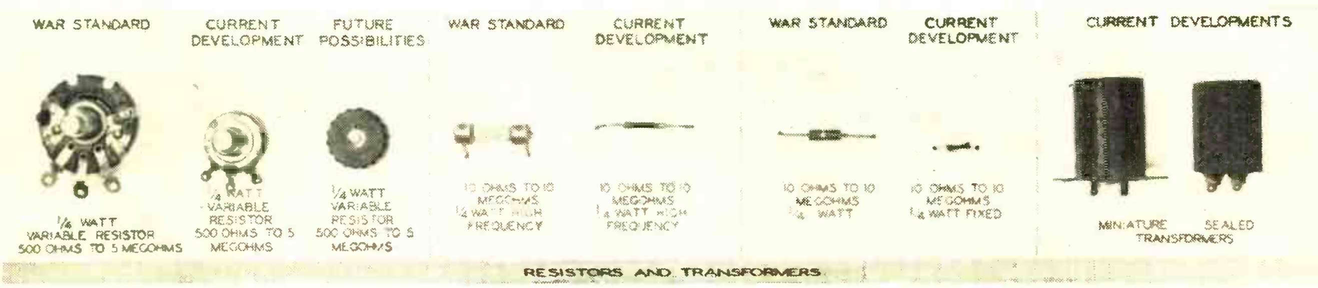












Hearing aids, two-way radio units, small-sized television receivers, compact mobile radio-telephone equipment, portable test equipment of all kinds, and numerous other items of electronic equipment are already available to the consumer and the list grows longer by the day.

The miniaturization of parts opens up new fields of science and experimentation in many categories. Measurements may be taken at high altitudes, data can be secured under conditions untenable to human beings simply because tiny indicating devices are now available to make these measurements and take such readings.

While some of these miniature parts are, at present, more costly than their larger counterparts, increased production and improved manufacturing techniques may soon bring them into line price-wise with their bigger "brothers." Although cost might prove a deterrent to some applications of the small parts, there are instances where the savings in space and weight far outweigh the difference in cost.

Component miniaturization, as depicted on these pages, is not the ultimate development. Radio parts manufacturers and government laboratories are constantly working on further reduction of over-all parts dimensions, along with improved performance. Tube manufacturers alone, since the war, have shown what can be done in the miniaturization of electronic tubes of all types. Reports emanating from the many laboratories indicate that along with this reduction in component size, the actual performance of most tubes has been improved. True, the assembly of such components must be done with watch-maker precision, however, employee training so far has proven that this phase will not be a serious problem to overcome.

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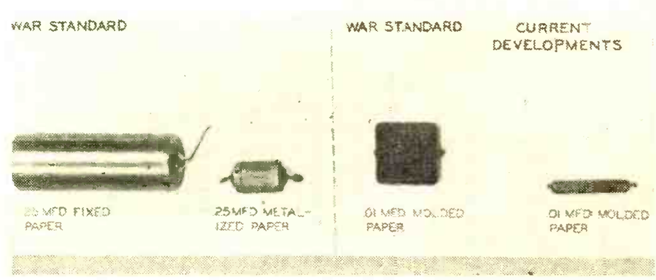
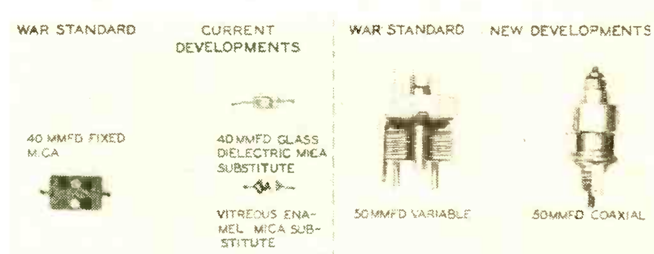
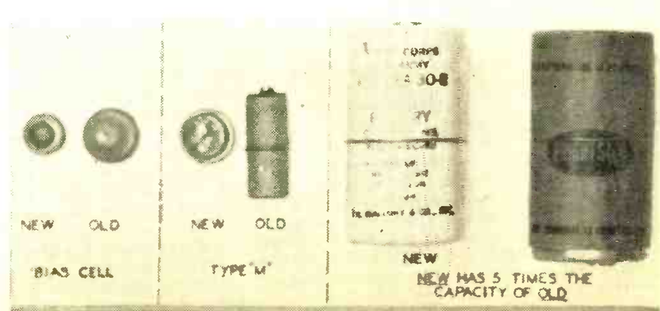
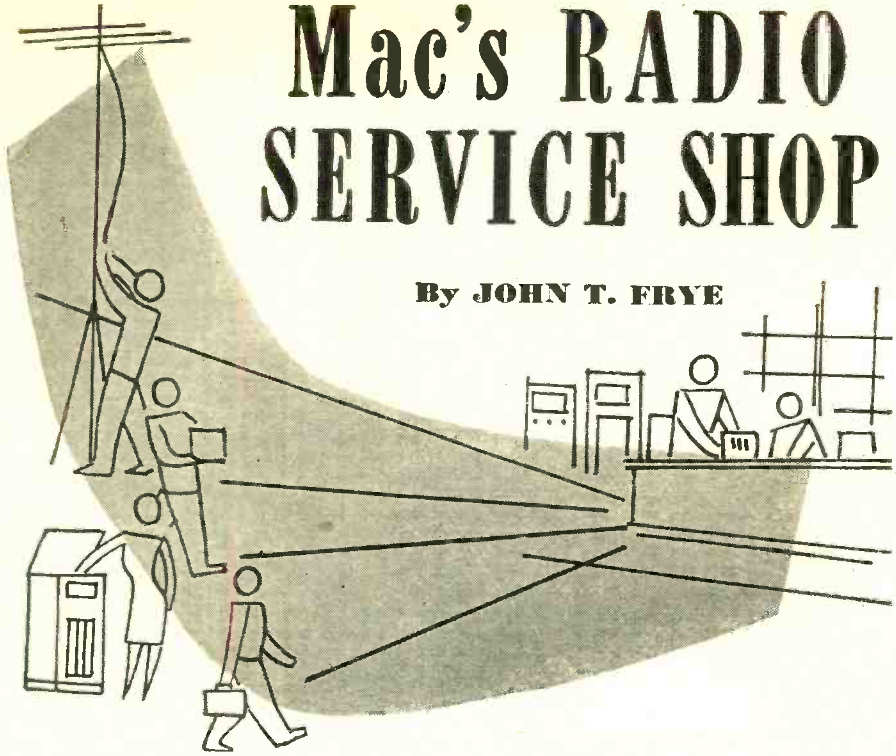






Mac's RADIO SERVICE SHOP

By JOHN T. FRYE



Barney, Beauty, and BCI

MAC, his chin clasped thoughtfully between thumb and forefinger, stood looking down at Barney, his redheaded assistant. For five minutes that worthy had been prodding away at a soldered connection on the set in front of him with a soldering iron whose cord-plug still trailed on the floor at his feet.

Stepping quietly to the door of the service department, Mac beckoned to Miss Perkins, the office force of Mac's Radio Service Shop. As the two stood there in the door watching Barney's continuing efforts to melt the solder with a stone-cold iron, the boy looked up, followed their amused gaze down to the plug that he had forgotten to put in, and then blushed furiously.

"Matilda," Mac inquired, "what would you say has come over our Barney?"

"We-l-l-l," Miss Perkins replied, "it just might have something to do with that pretty girl I saw him walking to work with this morning."

"Aw, it does not," Barney denied, if possible, blushing more furiously than ever. "That was just Margie, our new neighbor. Boy, was she mad at me last night!"

"Pray tell us more," Mac urged.

"Well, I was sitting there in the ham shack bumping my gums with a fellow down in the Canal Zone on ten meters, when all at once the final arced over, the circuit breakers kicked out, and Margie—I had never seen her before, because they just moved in two days ago—stuck her head in the open window and said that now perhaps she could listen to her 'Parade of Bands' program without having to put up with my going yackety-yackety right in the middle of it. She had taken a pair of pruning shears and had cut off the co-ax right where it comes through the wall on its way up to the beam," Barney explained admiringly.

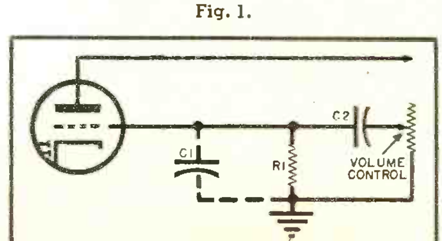
"After hearing you beef about your mother's daring to touch that beloved transmitter just to dust it, I have no doubt at all that you dived right through the window and cut the young lady's throat with the pruning shears," Mac guessed.

"You can't get mad at anyone who looks as pretty as Margie does when her temper is up," Barney explained patiently; "and I *was* blanketing her little radio. After I managed to cool her down a bit, we went over and got the little set and ran some tests. When my rig is on, you can hear me and not much else. I told her I would see if I could not do something about that; so I brought the set down to the shop this morning. That's it on the end of the bench."

Mac picked up the set, and Miss Perkins went back to her desk, explaining that if the conversation was going to descend to "just radio" she was no longer interested.

"Did you notice if the volume control had any effect on the signal from your transmitter?" Mac asked.

Fig. 1.



"Yes, when I turned the volume down, my signal disappeared."

"Then I think you can take care of this case of interference very easily. Whenever you have a case of a signal, especially a high-frequency signal such as ten meters, coming in all over the broadcast band with equal volume for all settings of the tuning control, you can be pretty sure that you are getting rectification of the signal at some point in the audio system. In these little sets using zero-bias high gain triodes, like the 12SQ7, the rectification is taking place in the grid circuit of the triode."

As he talked, Mac sketched Fig. 1 on the blackboard at the end of the bench.

"R_1 is often as high as ten megohms," he explained. "If very much of your ten meter signal appears on the grid of the tube, it is rectified and flows to ground through R_1. This biases the tube so that it operates on the 'detector-portion' of the curve, and your high-gain audio amplifier has become a good grid-leak detector that causes your ten meter signal to ride right in along with the regular signal being delivered by the i.f. channel."

"Couldn't that happen in the grid circuit of any tube?"

"Yes, but it usually happens in the very first audio stage for that is where you find the high-resistance grid resistor. I am sure it is there in this case, for you say that you can cut out your signal with the volume control. What actually happens is that when you move the slider of the volume control toward the ground, C_2 bypasses your ten meter r.f. to ground. Incidentally, that gives us our clue as to how to effect a cure. That is simply to install C_1 directly from the grid to ground. The capacity is around 250 $\mu\mu$fd.—enough to furnish a low-impedance path for the r.f. without being large enough to bypass any of the higher audio frequencies."

"Are there any other ways of doing the same thing?"

"Yes, you could lower the value of R_1, but that disturbs, in some degree, the efficiency of the triode amplifier. You can insert a small r.f. choke coil in the grid lead, or you can put a resistor of around 100,000 ohms right from the grid to the leads going to it; but I have found the use of the condenser the cheapest and most effective. I have, though, used the r.f. choke coil with gridcap tubes where it is not convenient to employ a condenser."

"When I work seventy-five meters, I notice that I can pick up my signal at two or three spots on the broadcast band. We call this 'image reception,' but to tell you the truth, I have never had a very clear idea of just what was happening."

Before answering, Mac attached his signal generator to the antenna and ground connections of the set on the bench and turned both on.

"First, we set the signal generator and the receiver both to 1300 kc.," he

(*Continued on page* 185)

Stagger Tuned VIDEO I.F. SYSTEMS

Basic principles involved in the design of stagger tuned i.f. systems—the simplest method of obtaining the wide bandwidth necessary in television receivers.

IN MANY of the present television receivers a form of coupling known as stagger-tuned coupling is being employed between stages in the video i.f. system. Since this type of coupling is relatively new to many radiomen, it might be instructive to examine the reason for using this form of coupling and its mode of operation.

In stagger-tuned systems, each separate tuning coil is resonated to a single frequency within the passband of the receiver. In television, this passband is generally 4.0 mc. in the video i.f. system although receivers having 7-inch screens have a passband of 3.5 mc. or even 3.0 mc. With each coil tuned to a different frequency, the total response of the system is then the composite of the individual responses. In the larger *RCA* television receivers there are as many as five coils, each peaked to a different frequency. By combining these individual responses, as shown in Fig. 1, we obtain the correct over-all response desired for video i.f. systems.

As a first step in analyzing the operation and design features of stagger tuning, let us define bandwidth. A typical resonance curve for a parallel tuning circuit is shown in Fig. 2. The response is not uniform, but varies from point to point. At the resonant frequency (labeled F_0 in the diagram) the response of the circuit is at its peak—or maximum. From this point, in either direction, the response tapers off until it soon becomes negligible. With a characteristic of this type, what would you say was its bandwidth? Obviously the answer to this question is arbitrary. We could say, for example, that all frequencies between the points *B-B'* on the curve should be considered as part of the bandwidth. Or we could choose points *C-C'* and say that all frequencies which receive an amplification equal to that of *C-C'* or greater should be considered as within the bandpass of the circuit. Note that this does not prevent other frequencies—those that receive less amplification—from passing through the circuit.

The arbitrary definition generally accepted for bandwidth is illustrated in Fig. 2. The bandwidth of a circuit is equal to the numerical difference in cycles between the two frequencies at which the impedance presented by the tuning circuit is equal to .707 of the impedance presented at F_0 (i.e., the maximum impedance). Thus, in the response curve shown in Fig. 2, the impedance at points *A-A'* is .707 (or $1/\sqrt{2}$) of the impedance offered by the circuit at F_0 or resonance. In this particular illustration, Fig. 2, the bandwidth is .4 mc.

A further note of importance is the fact that if the gain of the circuit is considered as equal to 1 at F_0, it is down 3 db. at points *A-A'*. That this is so can be seen from the following:

The definition of db. is given by: $db. = 20 \log (E_1/E_2)$ where E_1 is the voltage at F_0 and E_2 is the voltage at points *A-A'*. For the sake of simplicity, let us assign a value of 1 volt to E_1. At either point *A* or point *A'* the impedance offered to the same signal is $1/\sqrt{2}$ or .707 times as great. Hence, the voltage developed at either of these two points will be .707 volts. Substituting these values in the formula we have: $db. = 20 \log (1/.707)$ or $db. = 20 \log 1.414$ or about 3 db.

Points *A-A'* are also known as the "half power" points because $P = E_1^2/R$ and since $E_2 = 1/\sqrt{2}\,E_1$ then $P_{A\text{-}A'} = E_1^2/(\sqrt{2})^2 R$ or $P_{A\text{-}A'} = E_1^2/2R$ which is one-half the power developed across R at F_o, the peak of the curve.

With this concept of bandwidth in mind, let us consider two single-tuned amplifiers, both tuned to the same frequency. If these two amplifiers are in cascade (i.e., follow each other), then the over-all bandwidth is not equal to the bandwidth of either circuit, as one might expect, but to 64 per-cent of this value. The reason for the shrinkage in bandwidth will be apparent from the following.

The response curve of the first amplifier, shown in Fig. 3A. has a maximum value of amplification of 1 at F_0, its peak, and .707 at the ends of the bandpass. Let us say that the mid-frequency is 10 mc., while the end frequencies of the bandpass are 9 and 11 mc. respectively. If each of these

(*Continued on page* 143)

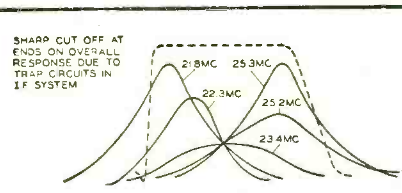


Fig. 1. In RCA receivers, five stagger-tuned coils are combined to produce an over-all bandwidth of 4 megacycles.

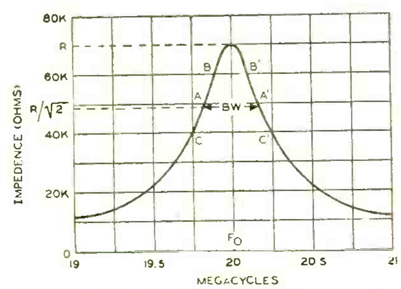


Fig. 2. The commonly accepted definition of bandwidth of a tuned system.

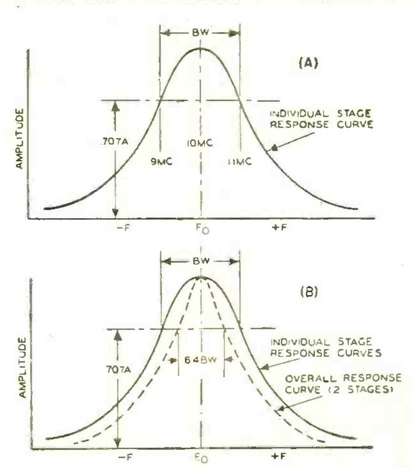
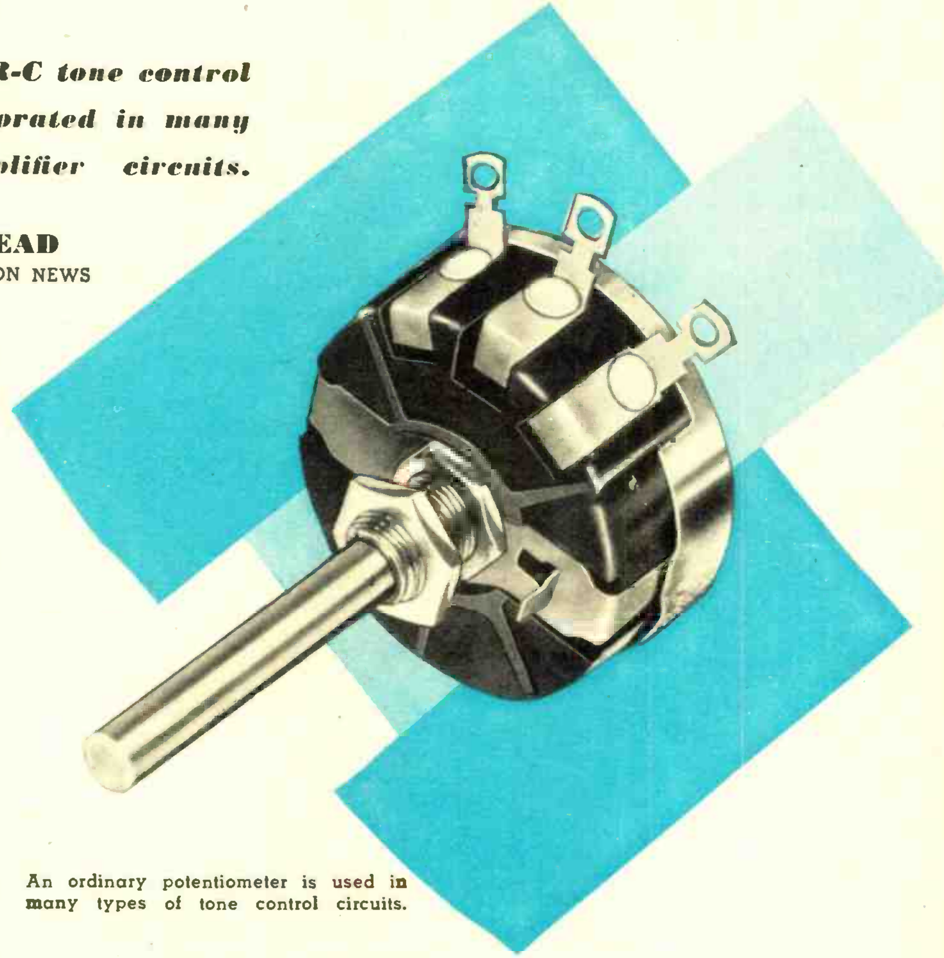


Fig. 3. Two tuned circuits, each peaked to the same frequency, produce an over-all response in which the bandwidth is .64 times the bandwidth of either curve considered independently of the other curve.

The RECORDING and REPRODUCTION of SOUND

Part 20. A discussion of R-C tone control systems which are incorporated in many conventional audio amplifier circuits.

By OLIVER READ
Editor, RADIO & TELEVISION NEWS



An ordinary potentiometer is used in many types of tone control circuits.

NEARLY all of the simpler means for tone control or shaping the response curve are based on simple high and low pass filter circuits. For example, the circuit of Fig. 2A is a simple high pass filter while that of Fig. 2B is a low pass system.

In operation, the output from the circuit of Fig. 2A will increase with increasing frequencies applied to the input, while that from Fig. 2B will decrease as the frequency is increased. This is caused by the fact that the reactance of *C* decreases with increasing frequency and therefore, a smaller portion of the applied voltage appears across the condenser as the frequency increases. Theoretically the above action is true from zero frequency (d.c.) to infinitely high frequency, but for all practical purposes the effect is restricted to a small section of the spectrum. The change in response is negligible beyond the frequency limits at which the condenser reactance is equal to 1/10 and 10 times the value of resistance in the circuit. There are many variations of these two simple circuits which are used for treble or bass attenuation.

Typical Tone Compensation Systems

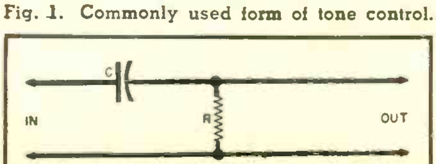
To evaluate any form of tone control used in connection with an amplifier it is necessary to establish a reference point for both gain and frequency. For this discussion we will consider the gain of the amplifier at 400 cycles-per-second as the reference point, and all circuits mentioned will be classified accordingly as low or high frequency boost or attenuation systems.

The circuit of Fig. 1 is perhaps the most commonly used form of tone control but is seldom recognized as such. It consists of nothing more than a coupling condenser and the following grid resistor. By proper selection of the values of *C* and *R* this circuit may be adjusted to give negligible attenuation at the reference frequency and increasing attenuation as the frequency is reduced.

Due to other design considerations in the amplifier, this form of tone control is made variable only on rare occasions.

The opposite of the action secured from the circuit of Fig. 1 may be obtained by the use of either Fig. 3A or 3B. Both of the circuits in Fig. 3 operate on the principle that the total impedance in the circuit increases as the frequency is reduced, thus forming a load impedance which varies inversely with the frequency. The circuit of Fig. 3A is most commonly used as the plate load for voltage amplifier tubes whose operating conditions are so adjusted that the stage gain increases as the plate load impedance rises. The circuit of Fig. 3B is commonly used with a tapped volume control and may be inserted as a second detector load impedance or as the grid return circuit of an amplifier stage. When the circuit of Fig. 3A is used as a microphone or pickup load impedance the dotted line shown is used as the high output lead. When connected in this manner the condenser shunts the output terminals and therefore increases the ratio of output to input impedance as the frequency decreases. This circuit could be considered high frequency attenuation just as well as low frequency boost since the operation is the same.

Fig. 1. Commonly used form of tone control.



Both circuits of Fig. 3 may be made variable in response by using different values of *C* selected by a switch or other means.

Fig. 4A and 4B show the most commonly used means of providing tone control on the upper portion of the audio spectrum. The most frequently used position for these circuits in an amplifier is the grid circuit of one or more of the amplifier tubes.

The circuit of Fig. 4A is used quite frequently by radio receiver manufacturers to give a smooth tone control which operates on the high frequency end of the audio passband.

Condenser C is usually selected so that when R_2 is zero the high frequency attenuation starts at a frequency near the reference point. As R_2 is increased C becomes increasingly less effective in bypassing the high frequencies, thus providing smooth control of the high frequency response of the amplifier. In the circuit of Fig. 4B both R_1 and R_2 are usually relatively high values of resistance and C a small capacitance. In this circuit the output at and below the reference frequency is approximately equal to $E_{in}R_2/(R_1+R_2)$ and increases to a value approaching E_{in} as the frequency increases. When properly designed, all the foregoing circuits attenuate certain frequencies while maintaining normal response from the reference frequency to the opposite end of the band.

Fig. 5A and 5B show circuits similar to the above but applied in a manner which gives a stage gain variation with frequency. This is accomplished by connecting the filter section into a feedback circuit. Fig. 5A will boost the higher frequencies when condenser C is chosen to have a value insufficient to provide an adequate bypass for cathode resistor R at the reference and lower frequencies. At the higher frequencies C becomes an effective bypass and thus removes degeneration from the tube circuit.

When properly chosen values of R_1, R_2, and C are used in the circuit of Fig. 5B, the stage may be made to have considerable inverse feedback at the high frequencies and relatively little at the reference and low frequencies. Condenser C should be so chosen that its reactance at the low frequencies is high with respect to the total impedance in the series-parallel combination of R_1, R_2, and R. Resistor R_1 is used to limit the amount of feedback at the high frequencies and R represents the impedance in the driving source or, in practice, the output impedance of the preceding stage (i.e., R_b and R_p of the preceding stage in parallel). The circuit of Fig. 5B must be carefully designed since the R-C network may give sufficient phase-shift to the feedback signal for the stage to become regenerative at an unwanted frequency.

A word about the position of tone control systems in an amplifier may be in order at this time. Since nearly all of the simple tone control circuits described may be classified as the opposite of the name applied, care must be taken that a low frequency boost circuit is not followed by a high frequency boost circuit which operates by reducing the reference and low frequencies. For example, the circuit of Fig. 3A or 3B should not be followed by the circuit of Fig. 2A since these two circuits will tend to cancel out and produce flat response. In most phono and microphone amplifiers some bass boosting and for high fidelity some

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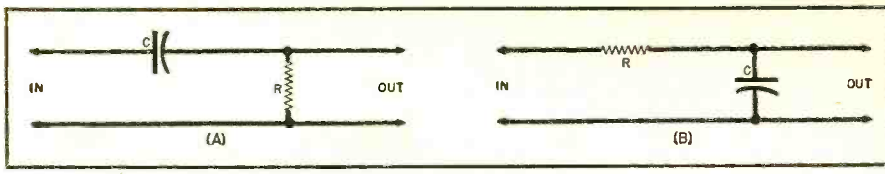


Fig. 2. (A) A simple high pass filter. (B) A commonly used low pass system.

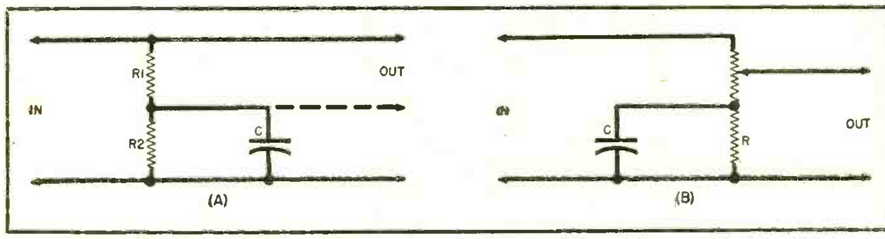


Fig. 3. (A) Circuit commonly used as the plate load for voltage amplifier tubes. (B) Circuit often used with a tapped volume control. This circuit may be inserted as a second detector load impedance in amplifier.

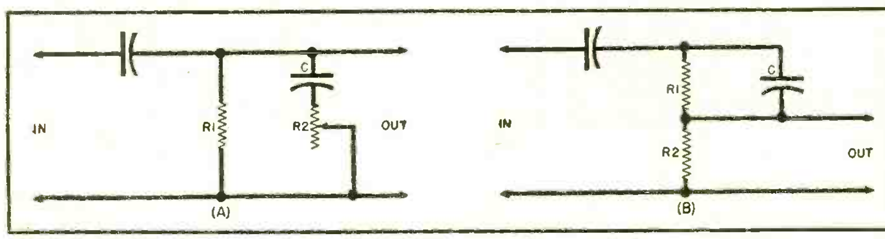


Fig. 4. (A) Circuit used in radio receivers to give smooth tone control on the high frequency end of the audio passband. (B) Another frequently used circuit which provides tone compensation for commercially-built receivers.

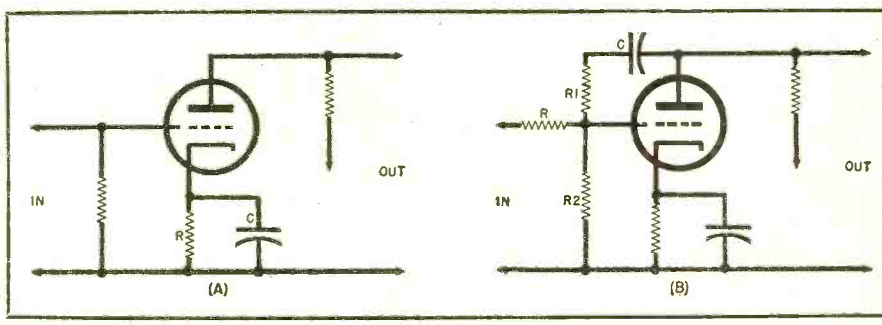
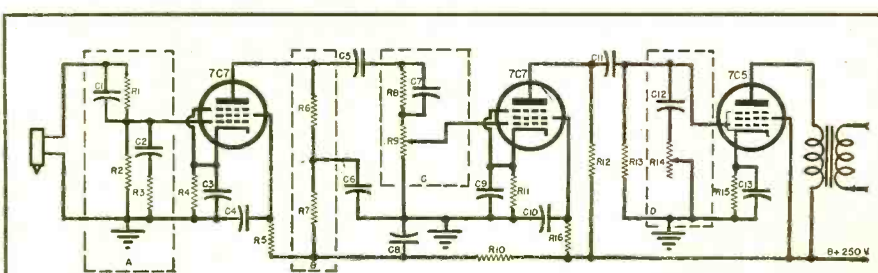


Fig. 5. (A) This circuit will boost the higher frequencies when condenser, C is of too low a value to provide an adequate bypass for the cathode resistor at the reference and lower frequencies. (B) By choosing component values, this circuit can provide inverse feedback on the highs.

Fig. 6. A pentode input amplifier which provides bass boost action. See Table 1.



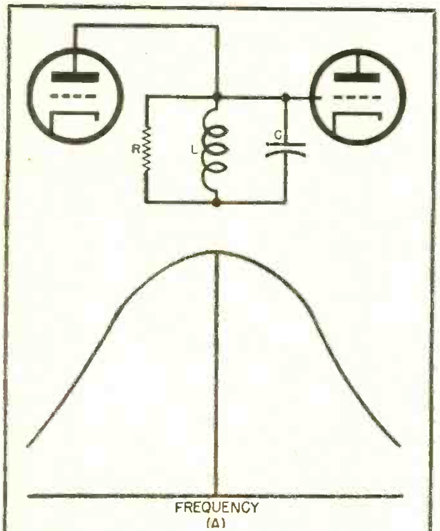
R_1—1.5 megohm, ½ w. res.
R_2—3.3 megohm, ½ w. res.
R_3, R_6—100,000 ohm, ½ w. res.
R_4—1000 ohm, 1 w. res.
R_5—1.2 megohm, ½ w. res.
R_7—150,000 ohm, ½ w. res.
R_8, R_{13}—250,000 ohm, ½ w. res.
R_9—250,000 ohm, var. res.
R_{10}—47,000 ohm, ½ w. res.
R_{11}—470 ohm, 2 w. wirewound res.
R_{12}—68,000 ohm, ½ w. res.
R_{14}—1 megohm var. res.
R_{15}—360 ohm, 2 w. wirewound res.
R_{16}—330,000 ohm, ½ w. res.
C_1—100 μμfd. mica cond.
C_2, C_7—.001 μfd., 400 v. cond.
C_3—25 μfd., 25 v. elec. cond.
C_4—.1 μfd., 400 v. cond.
C_5, C_{11}—.05 μfd., 400 v. cond.
C_6—.01 μfd., 400 v. cond.
C_8—8 μfd., 350 v. elec. cond.
C_9, C_{13}—50 μfd., 25 v. elec. cond.
C_{10}—.25 μfd., 400 v. cond.
C_{12}—.005 μfd., 400 v. cond.

Simplified WIDE BAND AMPLIFIERS

By F. L. BURROUGHS
Sylvania Electric Products Inc.

Complete analysis of the design of a high frequency wide-band i.f. amplifier. Stagger-tuning is required.

RADAR and television systems are designed to transmit and receive information at the rate of several million elements per second. To accomplish this the gain of the intermediate frequency amplifiers in the receivers of such systems must be uniform over a frequency band several megacycles wide. For example, the gain of the video i.f. amplifier used in a modern television receiver should be uniform over a band of frequencies about 3.5 megacycles wide. In a sensitive television receiver the gain of such an amplifier would be 10,000 times or higher. In addition to having the property of high gain over a wide frequency band it is desirable that the i.f. systems be relatively easy to align as an aid to quick adjustment in the factory and in the field. In this respect it would be most satisfactory to the test man in the factory and the serviceman in the field if the design could approach the conventional single peaked 455 kc. i.f. systems for ease of alignment.



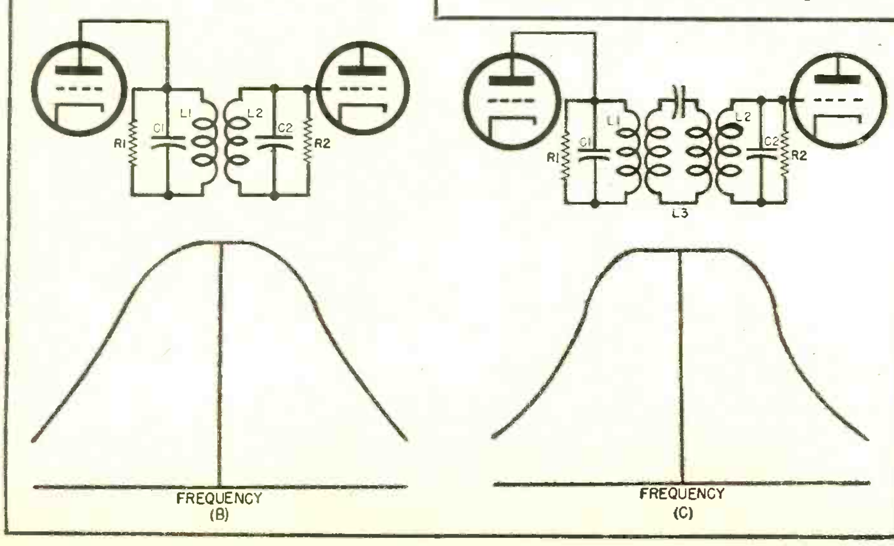


Fig. 1. A comparison of three conventional types of i.f. coupling networks. Curves show how bandwidth is affected by circuits.

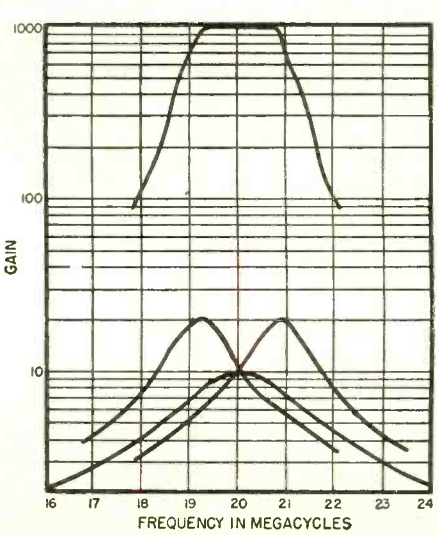
Coupling Networks

The two essential elements of a stage of video i.f. amplification are the amplifier tube and the coupling circuit. The amplifier tubes should have high mutual conductance and low input and output capacitances, the figure of merit being $G_m/(C_{in}+C_{out})$.

The simplest coupling network (Fig. 1A) is the single-tuned circuit. An amplifier incorporating several stages of single-tuned circuits is easy to align and was widely used in radar receivers during the war. Unfortunately, however, the over-all bandwidth of an amplifier of several synchronous cascaded stages (i.e., stages tuned to the same frequency) decreases quite sharply as the number of stages increases (Table 1). Not only would a large number of stages be needed to meet the gain and over-all bandwidth requirements of a sensitive video i.f. amplifier, but, in addition, the amplitude-frequency response curve of a series of synchronous single-tuned stages does not possess the flat top characteristic defined as "ideal" for video i.f. amplifiers.

Where many stages are required, the double-tuned coupling network with tuned primary and secondary, (Fig. 1B), is superior in many respects to the synchronous single-tuned networks. More gain-per-stage is obtainable since the input and output capacitances of the associated tubes are isolated. Also, as noted in Table 1, the

Fig. 2. Graph shows how three individual stages combine to form the over-all response of a staggered triple-tuned unit.



over-all bandwidth of several cascaded, transitionally-coupled (i.e., coupled to give a flat-top response curve) double-tuned stages decreases less rapidly than in the single-tuned case.

A still further advantage in gain-per-stage and over-all bandwidth may be obtained by designing individual stages incorporating triple-tuned coupling networks. See Fig. 1C and Table 1.

While the double-tuned and triple-tuned circuits meet the gain and bandwidth requirements of a good video i.f. amplifier of three or four stages, they are at a disadvantage inasmuch as special equipment must be used to align them properly. A wide-band sweep generator and oscilloscope are used to adjust the amplitude-frequency response curve of each stage, starting with the sweep generator connected to the grid of the stage nearest the detector, and working back to the input of the amplifier to obtain the correct over-all response as observed on the oscilloscope at the detector output.

Stagger-Tuned Circuits

The need for i.f. amplifiers having satisfactory gain and wide-band characteristics combined with ease of alignment led to considerable design work during the war on stagger-tuned amplifiers for radar receivers. It was found that a two-stage amplifier, one stage of which was tuned to a certain frequency higher than the center frequency, and the other tuned to a certain frequency lower than the center frequency, had the same over-all selectivity and transient response characteristics as a transitionally-coupled, double-tuned circuit. Such an amplifier —called a staggered pair—offered an improvement of more than 50 per-cent in gain, for the same over-all bandwidth, over a two-stage amplifier using two synchronous single-tuned circuits. Similarly, it was found that three stages, with their resonant frequencies properly staggered, would give the same selectivity and transient response characteristics as a transitionally-coupled, triple-tuned stage, and nearly twice the gain for the same over-all bandwidth as three synchronous single-tuned stages in cascade.

The design data for frequency and bandwidth of the individual stages for the staggered-pair, triple, quadruple and quintuple are listed in Table 2. Fig. 2 illustrates how the amplitude-frequency characteristics of three individual stages combine to form the over-all response of a staggered-triple amplifier.

Stagger-tuned amplifiers offer a real advantage when compared with those using double-tuned and triple-tuned transformer-coupled stages in that they can be aligned with a standard AM signal generator. The generator is connected to the input stage of the amplifier. Its frequency is then set in turn to each individual stage's center frequency and that particular stage is adjusted for peak response as

(*Continued on page* 76)

No. Stages	Single-Tuned	Double-Tuned Transitionally-Coupled	Triple-Tuned Transitionally-Coupled
1	1.00	1.00	1.00
2	.64	.80	.86
3	.51	.71	.80
4	.44	.66	.76
5	.39	.62	.73
6	.35		
7	.32		
8	.30		
9	.28		

Table 1. Comparison of the bandwidth of single, double, and triple-tuned stages.

Center Frequency = f_0 Over-all Bandwidth = Δf

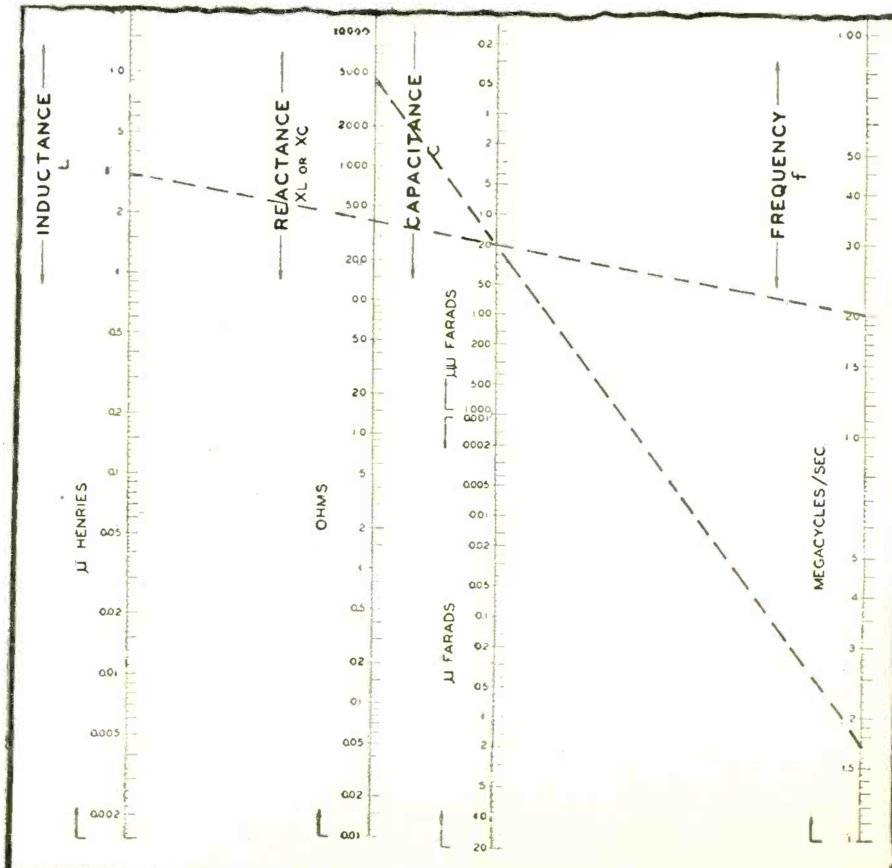
Individual Single-Tuned Stages

	Stages	Frequency	Bandwidth
Staggered-Pair	1	$f_0 - .35\ \Delta f$	$.71\ \Delta f$
	2	$f_0 + .35\ \Delta f$	$.71\ \Delta f$
Staggered-Triple	1	$f_0 - .43\ \Delta f$	$.5\ \Delta f$
	2	f_0	Δf
	3	$f_0 + .43\ \Delta f$	$.5\ \Delta f$
Staggered-Quadruple	1	$f_0 - .46\ \Delta f$	$.38\ \Delta f$
	2	$f_0 - .19\ \Delta f$	$.92\ \Delta f$
	3	$f_0 + .19\ \Delta f$	$.92\ \Delta f$
	4	$f_0 + .46\ \Delta f$	$.38\ \Delta f$
Staggered-Quintuple	1	$f_0 - .48\ \Delta f$	$.31\ \Delta f$
	2	$f_0 - .29\ \Delta f$	$.81\ \Delta f$
	3	f_0	Δf
	4	$f_0 + .29\ \Delta f$	$.81\ \Delta f$
	5	$f_0 + .48\ \Delta f$	$.31\ \Delta f$

From Wallman

Table 2. Design data for frequency and bandwidth of the individual stages of a staggered-pair, triple, quadruple, and quintuple i.f. wide-band amplifier.

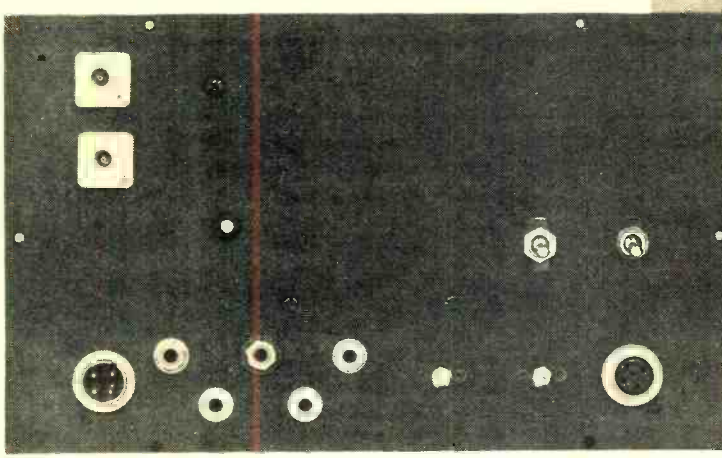
Fig. 3. A reactance calculator will eliminate unnecessary mathematics.



CQ MOBILE

Construction details covering a simple mobile rig using the war surplus PE-103-A dynamotor.

By F. L. McGRAW, W6STS



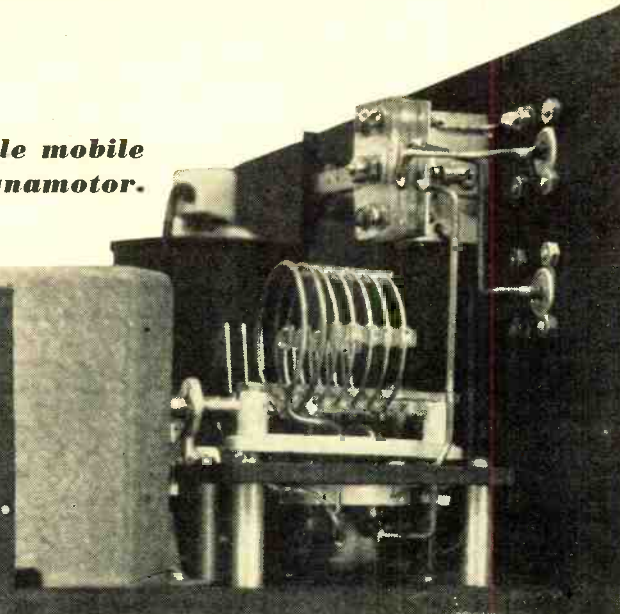


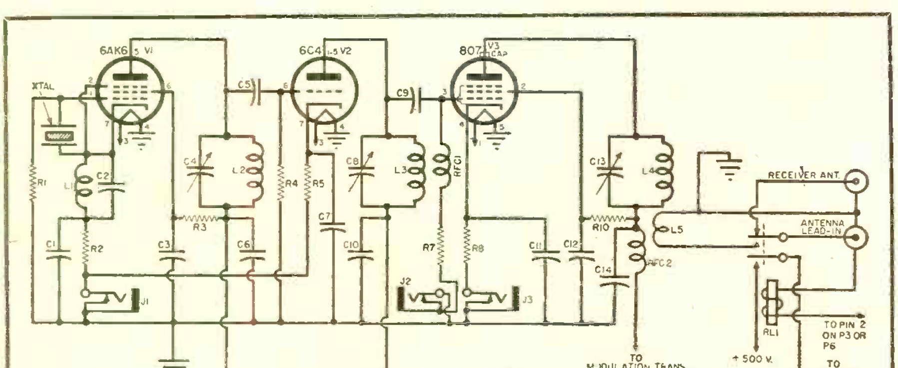
Fig. 1. Front and side views of the mobile rig. The final tank coil and antenna relay may be seen in side view.

FOR the first time in the history of amateur radio it is possible for the amateur mobile aspirant to secure an ideal power supply for his mobile rig. This power supply is known as the PE-103-A. It is a dynamotor unit with ideal power handling capabilities for amateur mobile use. It is still available at many surplus stores at a most reasonable price. The PE-103-A dynamotor unit contains all necessary filters, relays, and circuit breakers. By the flip of a switch you may have either 6 or 12 volt input. The output on 6 volts will run around 500 volts at 160 mils. On 12 volts the input current will be between 3.5 and 13 amperes as the load varies between 0 and 160 mils. On 6 volts the input will run around 20 amperes at full load.

The 10-meter mobile transmitter and control circuit described in this article was designed to be powered by the PE-103-A, using the 6 volt car battery as primary power. We have attempted to utilize full output capabilities of the dynamotor and at the same time keep battery drain at a minimum during standby periods. All parts and tubes were carefully chosen for their availability and low initial cost. Assuming that the transmitter is on half the time during a QSO, nothing would be gained by using quick-heating tubes, as any suitable line-up of quick-heating tubes available to the writer at this time would have run over twice the filament current drain, and the initial cost would have been many times that of the tubes finally chosen. A glance at a tube manual will show the total filament drain of this little transmitter to be only 2.15 amperes. A switch controlling a filament relay is placed handily in the driver's compartment, permitting the filaments to be switched off between QSO's or while you are waiting for that choice DX station to sign so you can give him a call.

The remote control box and microphone (a surplus T-17B) are the only parts of the transmitter system placed in the driver's compartment. This permits the transmitter and dynamotor to be installed in any convenient and out-of-the-way place. See Figs. 8 and 9. The trunk is the most logical location in most cars. Besides the filament relay control switch, the control box has a green pilot light indicating "Filaments On," and a red pilot light showing "Dynamotor On." A microphone plug was placed in the control box to permit the mike to be readily removed and plugged directly into the transmitter mike plug for testing and tune-up. The control box was placed near and just below the glove compartment (Fig. 7). Thus by cutting a small hole through the botton of the compartment for the mike cord, the mike may be kept inside the glove compartment when not in use. The compartment may be locked for safety and to prevent any unauthorized person from putting the transmitter "on the air." Only four wires are needed from the control box to the transmitter. Almost any type of wire may be used as only 6 volts d.c. for the filament relay and pilot lights and

Fig. 2. Complete schematic diagram covering the r.f. section of the transmitter.



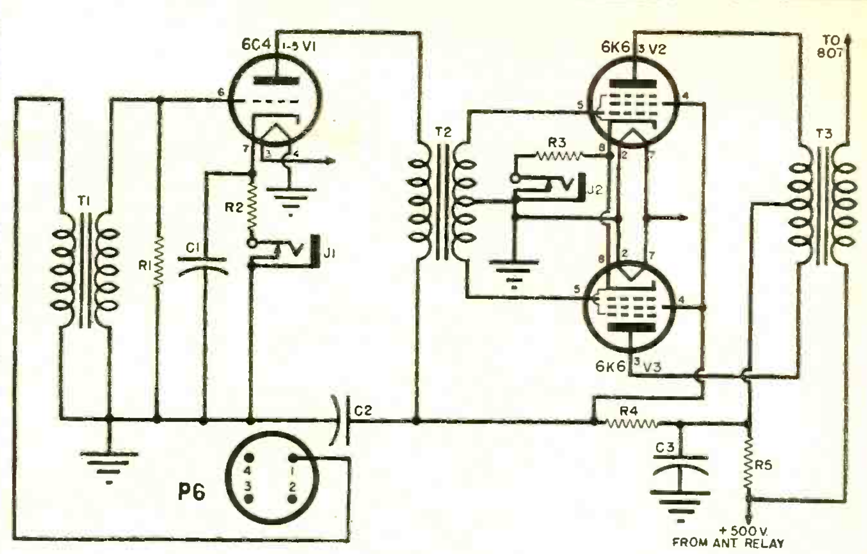
R_1, R_3, R_4—27,000 ohm, 1 w. res.
R_2—2700 ohm, 1 w. res.
R_5—470 ohm. 1 w. res.
R_6, R_9—10,000 ohm, 10 w. res.
R_7—15.000 ohm, 1 w. res.
R_8—400 ohm, 10 w. res.
R_{10}—30,000 ohm, 10 w. res.
C_1, C_3, C_7, C_{11}—.01 μfd., 400 v. cond.
C_2, C_9—100 μμfd. mica cond.
C_4, C_8—50 μμfd. var. cond.
C_5—10 μμfd. mica cond.
C_6, C_{10}—.002 μfd. mica cond.
C_{12}—.001 μfd., 600 v. cond.
C_{13}—50 μμfd., 1500 v. var. cond.
C_{14}—.005 μfd., 1500 v. mica cond.
J_1, J_2, J_3—Closed circuit jack
Xtal—40 meter crystal
RL_1—Ant. changeover relay
RFC_1, RFC_2—2.5 mh. r.f. choke
L_1*—27 t. #20 en. on 3/8" form
L_2*—21 t. #20 en. on 1/2" form
L_3*—17 t. #20 en. on 1/2" form
L_4*—B & W 10 MEL, cut to 5 t.
L_5*—2 t. #12 ant. coil
* All coils closewound.

the small audio microphone current is carried. In our case a four-conductor, shielded and rubber covered cable was used. The shield was grounded at both ends to prevent any possible pick-up of noise in the mike leads. A short three-conductor cable brings the power from the dynamotor to the transmitter power plug P_3. Care shoud be taken to use wire with adequate insulation for the high voltage lead.

The entire transmitter and modulator was built on a 7" x 11" x 2" chassis. With a little care in parts layout, plenty of space is available without overcrowding. The unit was housed in a spare parts cabinet from an MBF transmitter-receiver. This was a surplus item, however, any suitable cabinet may be used. The control box may be any small metal box large enough to hold a toggle switch, two pilot lights and the mike plug. The front panel of the transmitter measures 13$\frac{5}{16}$" x 8⅛". Looking at the front panel (Fig. 1) and starting at the upper left-hand corner; the upper coax fitting is for the antenna lead from the converter or receiver; the lower coax fitting is for the antenna lead-in cable; the screwdriver slot seen just to the left of center is the final tank condenser shaft. Dropping down now to the upper row of jacks, from left to right; the first is for final cathode current, the next is the insulated jack and is for reading final grid current, the third jack in this row is for reading cathode current in both the driver and oscillator tubes simultaneously. The lower two jacks, from left to right, are; modulator cathode current and driver cathode current. While the jacks for the audio tubes are not essential they will be found very useful during initial testing and as an aid to locating trouble quickly. The large *Amphenol* plug at the lower left is the power plug, designated as P_3 on the plug and control circuit diagram. The small lock-type condenser shafts just to the right of the jacks are; driver plate tuning and oscillator plate tuning. The other large *Amphenol* plug at the extreme lower right is the mike plug. Now we have the two switches located near the right center of the front panel. (See Fig. 1.) The single-pole, single-throw switch at the left is used to operate the filament relay when testing and tuning-up the transmitter from the trunk location only. It is normally left in the "off" position. This switch was added for convenience, making it possible for the operator to have complete control of the transmitter from the trunk location. The d.p.d.t. switch at the right was added so that the transmitter might be used as a fixed-station and operated from an a.c. power supply if so desired. Fixed-station use will be thoroughly explained under the paragraph "A.C. Operation."

R.F. Section

The r.f. section (Fig. 2) is placed along the front of the chassis. The



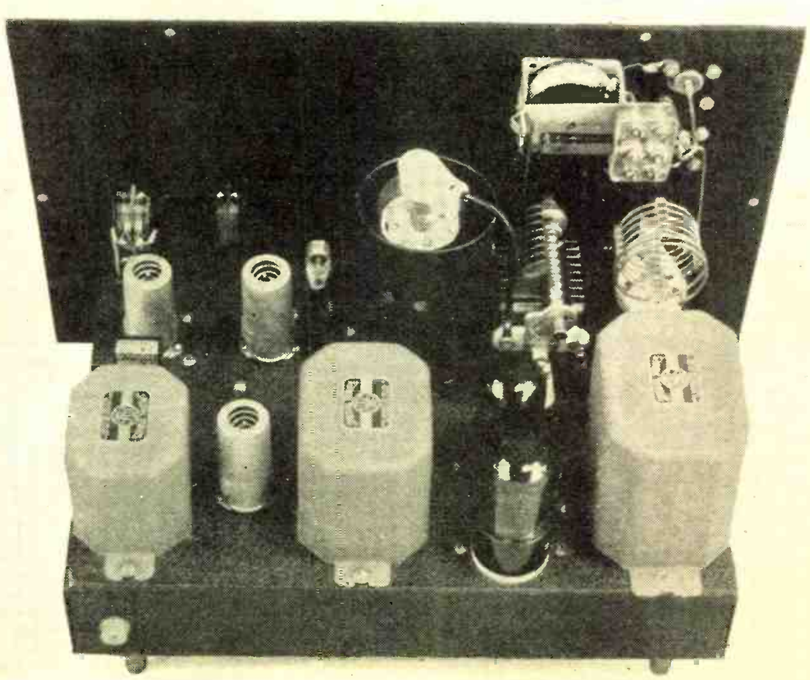
R_1—100,000 ohm, ½ w. res.
R_2—750 ohm, 1 w. res.
R_3—400 ohm, 10 w. res.
R_4—1500 ohm, 10 w. res.
R_5—3000 ohm, 20 w. res.
C_1—25 μfd., 25 v. elec. cond.
C_2—8 μfd., 450 v. elec. cond.
C_3—8 μfd., 450 v. elec. cond.
T_1—Mike trans. (UTC S-5 or equivalent)
T_2—Driver Trans. (UTC S-8 or equivalent)
T_3—Mod. trans. (UTC S-19 or equivalent)
J_1, J_2—Closed circuit jack
P_6—Mike plug

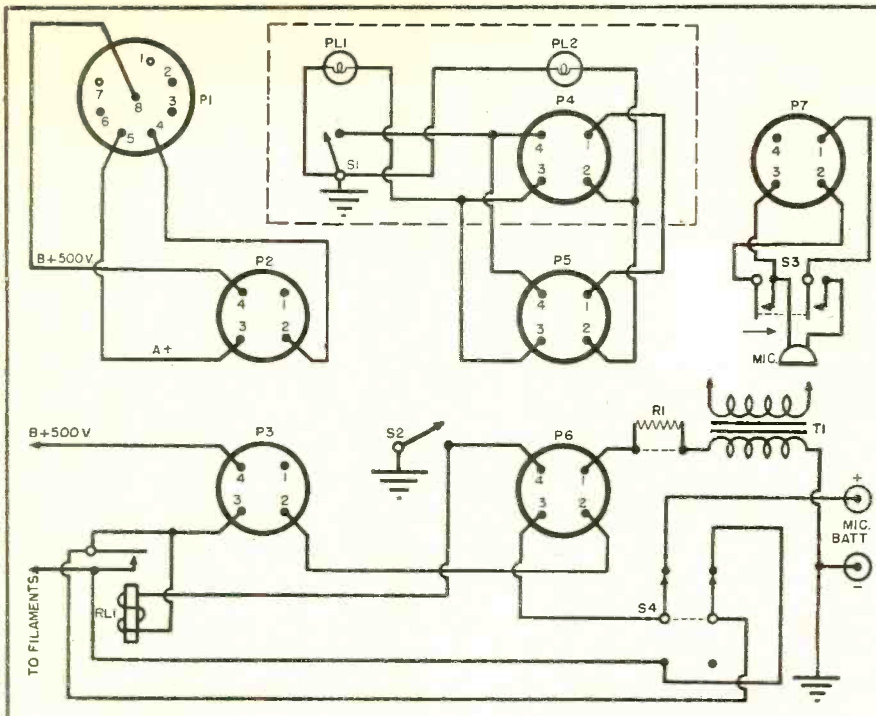
Fig. 3. Audio section of transmitter. Jacks are provided for metering plate current.

circuit is straightforward and the number of parts used was kept to a minimum. The oscillator uses a 6AK6 miniature pentode, in a standard tritet circuit. The oscillator uses a crystal the fourth harmonic of which falls within the 10-meter phone band. The oscillator plate circuit is tuned to the second harmonic of the crystal. The buffer-doubler stage uses a 6C4 miniature triode. With 230 volts on the plate this little tube supplies plenty of drive for the final, and the filament draws only 150 mils. The popular and readily available 807 was used in the final class C amplifier stage. As may be seen in the photograph of Fig. 6, the socket of the 807 was dropped as far as the 2" chassis will permit. The shield, as shown around the 807, is highly recommended. The final tank circuit is kept above the chassis, thus keeping the output completely shielded from the grid circuit. If this type of construction is closely followed no instability need be feared, even when running the tube at its full rated input.

The audio section (Fig. 3) is completely transformer coupled. A 6C4

Fig. 4. Rear view of completed transmitter. A shield encloses the 807 final stage.



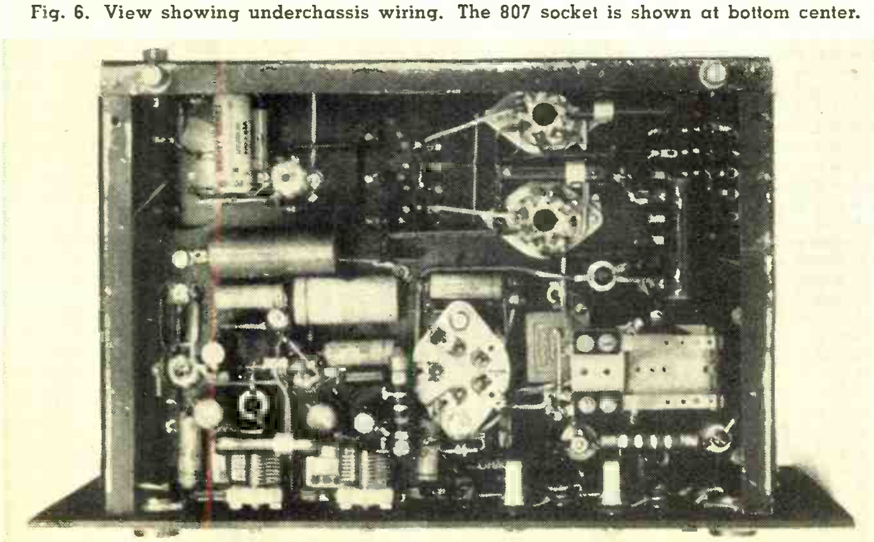


R_1—See text
S_1—S.p.s.t. remote relay sw.
S_2—S.p.s.t. relay sw.
S_3—D.p.s.t. mike sw. (on mike)
S_4—D.p.d.t. sw. (See text)
T_1—Mike trans. (See Fig. 3)
RL_1—Fil. relay
P_1—Dynamotor power plug
P_2—Power cord socket (female)
P_3—Power plug (male)
P_4—Remote mike socket (female)
P_5—Control cord plug (male)
P_6—Mike socket (female)
P_7—Mike cord plug (male)
PL_1—Filament pilot light (green)
PL_2—Plate voltage pilot light (red)

Fig. 5. Diagram of the control system for transmitter. In some models of the PE-103-A dynamotor, pin 3 on the power plug is the +500 v. terminal instead of pin 8.

was used as a class A driver. Here again we were able to get plenty of drive with a minimum of filament drain. The pair of 6K6's used as modulators are operated class A_1, giving an average power output of about 10 watts. As the peak power may run as high as 15 watts on voice peaks, 100% modulation may be realized up to around 30 watts final input. J_1 is wired into the cathode circuit of the 6C4 driver for reading cathode current. The 6K6 modulators were run class A_1 to eliminate the need for fixed bias. Bias batteries have a habit of failing at the most inopportune time. J_2 reads the cathode current in the modulator tubes. It was considered unnecessary to incorporate a variable gain control in the audio system. The mike gain may be set by varying the value of R_1 as shown on the control circuit diagram (Fig. 5) until the proper amount of modulation is obtained, when speaking into the mike. The writer found it unnecessary to use any resistance at R_1. The percentage of modulation should of course be checked on an oscilloscope or modulation monitor before putting the transmitter into actual service.

Fig. 6. View showing underchassis wiring. The 807 socket is shown at bottom center.



A.C. Operation

While this little transmitter was built primarily for mobile use it was so designed as to be readily removed from the car and powered by an a.c. power supply. As it is much easier to do the complete initial tune-up and testing on the workshop bench let us consider a.c. operation before proceeding with the details of tune-up and testing.

A power plug identical to P_2 may be soldered to the leads from the a.c. power supply and plugged into P_3. The mike is plugged directly into the transmitter mike plug. The mike battery is connected to the little plug at the rear of the chassis in Fig. 4. The minus side of the mike battery is grounded to the chassis or transmitter cabinet. An antenna is connected to the lower coax fitting. S_4, the d.p.d.t. switch, is thrown to the "on" position and we are ready to operate "a.c." When S_4 is in the "on" position it bypasses the filament relay and connects the microphone to the battery plug at the rear of the chassis. Any 6 volt battery may be used to supply microphone and antenna changeover relay current as only about 100 mils of current is needed. The antenna relay should perferably be one of the low current drain types. The one used here was made from an old 12 volt d.c. relay, rewound for 6 volts with the r.f. contacts insulated with polystyrene. The other set of contacts on the antenna relay are for breaking the "B+". This is necessary when operating a.c. to give the microphone press-to-talk switch complete control. The ease with which the transmitter may be changed from the car to fixed-station use makes it exceedingly versatile. Here at the home QTH we have removed the transmitter from the car and had it in operation from the shack in less than five minutes' time.

Tune-up and Testing

If the following method of tune-up is followed the "B+" from the power supply should be reduced to not more than 300 volts, to prevent accidental damage to tubes or crystal. First plug in the 6AK6 and the crystal. Plug a 0-100 mil d.c. test meter into J_1 (Fig. 2). Turn on the a.c. power switch and tune the crystal plate condenser for minimum plate current. Next plug in the 6C4 doubler and the 807 final into their respective sockets. Leave the plate cap off the 807 until the 6C4 is tuned to resonance. Resonance of the 6C4 is indicated by plugging the test meter into J_2, and tuning for maximum grid current in the 807. The grid current in the 807 should not be allowed to exceed 5 mils for any considerable length of time or the tube may be permanently damaged. J_2 is insulated from the panel and wired in reverse to

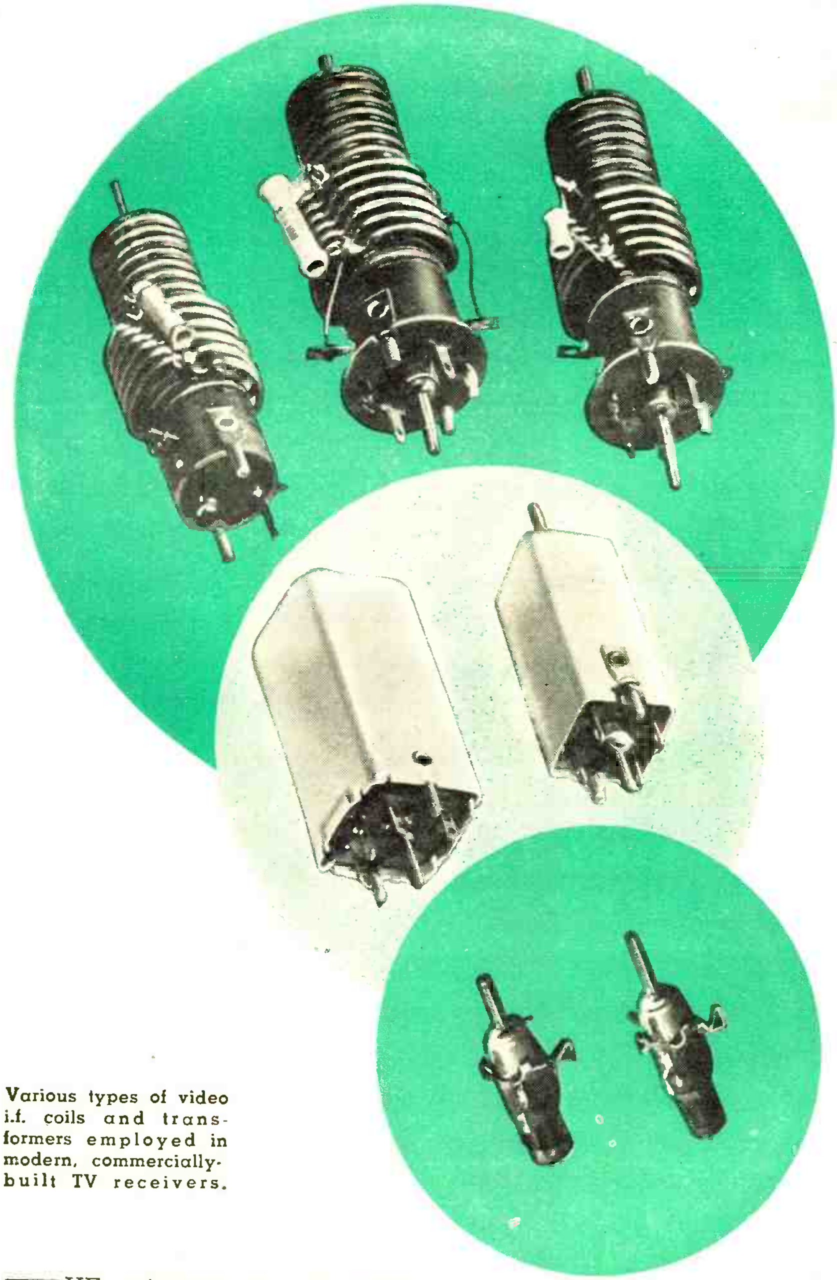
(*Continued on page* 178)

MODERN *Television* RECEIVERS

By

MILTON S. KIVER

Part 7. A discussion of various video i.f. systems found in commercially-built TV receivers.



Various types of video i.f. coils and transformers employed in modern, commercially-built TV receivers.

THE various stages of the modern television receiver which have been analyzed in this series, to date, are indicated in bold outline in Fig. 1. The remaining sections of the receiver deal exclusively with some portion, or all, of the video signal.

The stages which receive the full video signal (sync pulses included) are the video i.f. system, the video detector, the video frequency amplifiers and, finally, the cathode-ray tube. The synchronizing section of the receiver is subject only to the controlling pulses contained in the signal. For the present, we will confine our attention to video i.f. systems.

In any superheterodyne circuit, the major portion of the over-all gain and a small amount of selectivity is contributed by the r.f. amplifier, if used, and the mixer. For the most part, however, it is the i.f. system upon which the receiver has to depend. Consequently, it is most important for the servicema to be familiar with the shape of the i.f. response characteristic and to understand why this particular form was chosen. The reason, as we will now see, lies with the signal transmitted by the broadcast station.

A television signal, when broadcast, possesses the form shown in Fig. 2. It is amplitude modulated, but differs from conventional AM signals in having essentially only one sideband. The other sideband, of which some remnants are still present, has been effectively suppressed. This is known as vestigial sideband transmission and is the standard in modern television. When any carrier is amplitude modulated, an upper and a lower sideband forms automatically. However, because identical information is contained in each sideband, it is entirely feasible to suppress one sideband. The advantage gained is a decrease in the bandwidth of the signal, and an increase in the number of available channels. This is the principal reason for employing vestigial sideband transmission for television. Commercial television broadcast stations require 6 mc. allocations, as against 9 mc. if both sidebands were employed.

Complete suppression of the lower sideband is the ideal, but it is not economically achievable. It is impossible to completely eliminate one sideband using simple filters without, at the same time, distorting nearby portions of the remaining sideband. Hence, as a compromise between economy and easily adjustable circuits on the one hand, and minimum distortion and bandpass on the other, it was decided to remove all but 1.25 mc. of the 4.0 mc. lower sideband of the video signal. The transmitted signal, then, consists of this 1.25 mc. plus the carrier plus 4.0 mc. of the upper sideband. With the addition of the nearby audio carrier, and its sidebands, the full 6.0 mc. allotted to each television station is obtained.

Within the receiver we must take the upper sideband, together with the remnants of the lower sideband, and provide a response characteristic in which all sideband frequencies will have available an equal amount of amplification. In sound AM sets this presents no great problem because both sidebands are alike. But things are different in the television signal. Here, we have only 1.25 mc. of the lower sideband and 4.0 mc. of the upper sideband. The lower video frequencies (those having frequencies close to the carrier) are contained in both the upper sideband and the remnants of the lower sideband. On the other hand, all video frequencies above 1.25 mc. are present only in the upper sideband, having been sup-

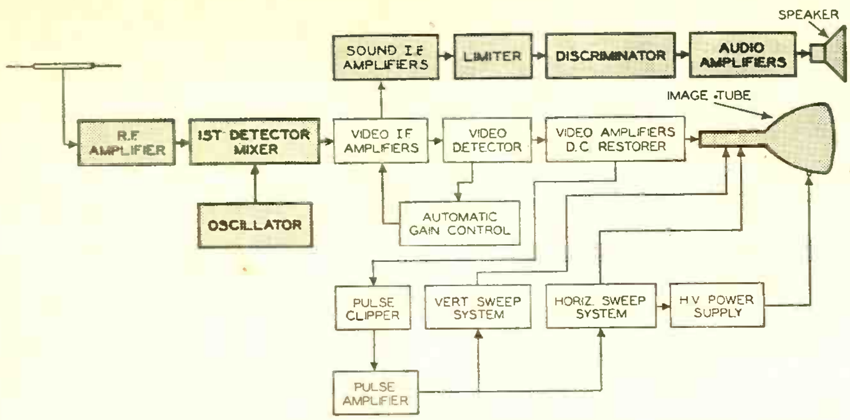


Fig. 1. The blocks in bold outline represent sections of the television receiver analyzed in previous parts of this series.

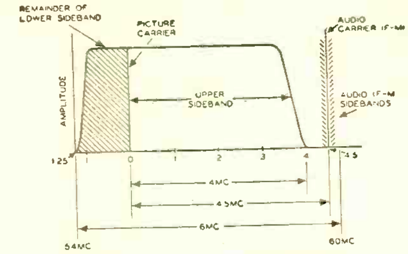


Fig. 2. Form of television signal broadcast by TV stations.

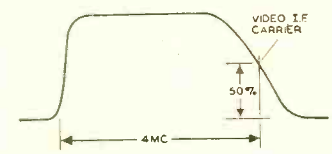


Fig. 3. Standard response for the TV set video i.f. systems.

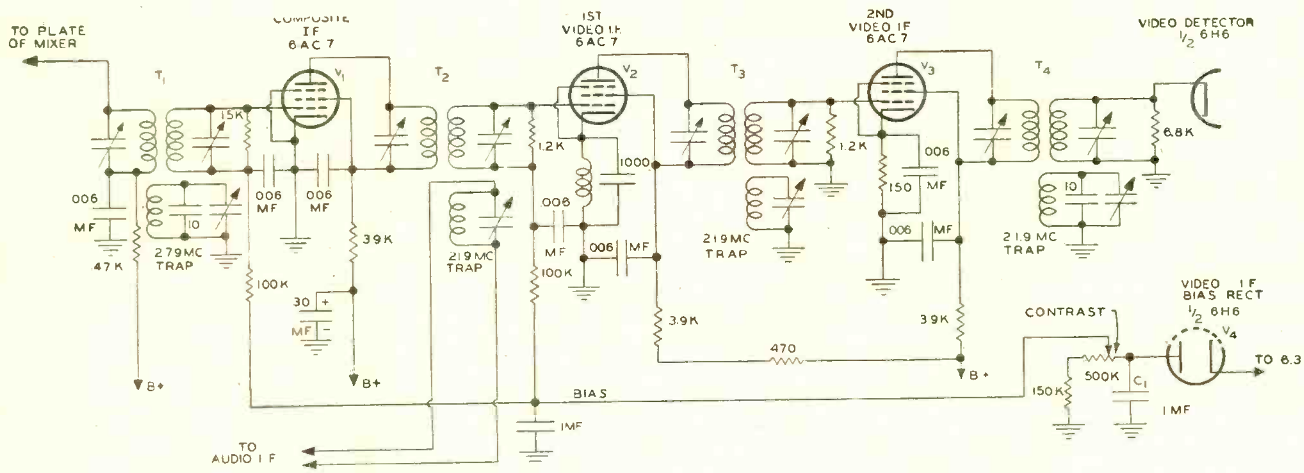


Fig. 4. The video i.f. system of General Electric and Stewart-Warner television receivers.

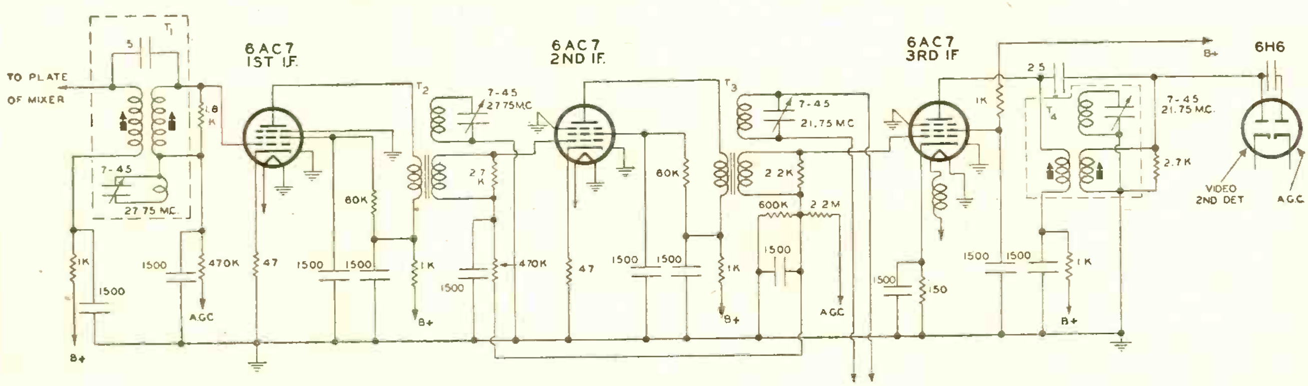


Fig. 5. The Farnsworth Model GV260 transformer-coupled video i.f. system.

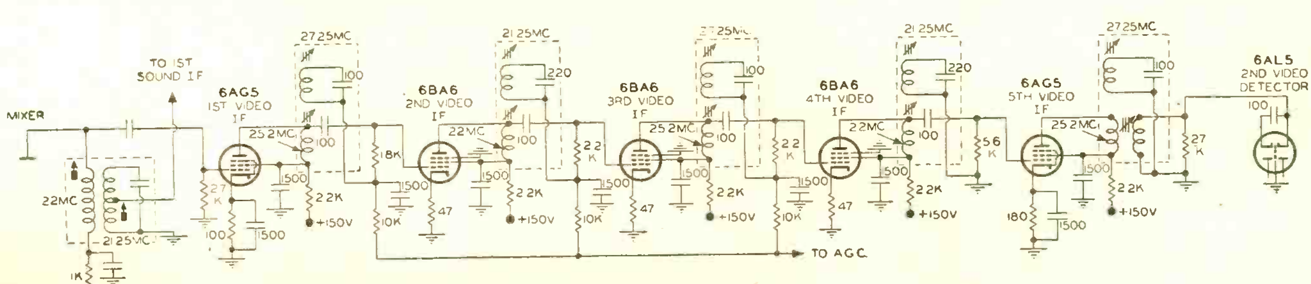


Fig. 6. Garod television receivers employ a combination of stagger-tuning and transformer coupling.

pressed in the lower sideband. If both the low and the high video frequencies are accorded equal amplification in the receiver, proportionately more low video frequency voltage will be developed at the second detector output than high video frequency voltage. It is to prevent this that the receiver response characteristic shown in Fig. 3 is employed. At the carrier frequency the response is 50 per-cent down, increasing linearly toward a maximum for the higher frequencies and decreasing for the lower frequencies. Roughly speaking, the lower video frequencies, for which there are two sidebands, receive half the amplification accorded all video frequencies above 1.25 mc. In this way, we equalize the response for the low and the high video frequencies. To the serviceman, the shape of this curve is important in his work on television receivers. When aligning the i.f. stages, he must be careful to place the video carrier close to the 50 per-cent point. At the same time, the circuits should be adjusted to provide the maximum bandpass. Detail in a television image is dependent upon the strength of the high video frequencies present. When the response curve droops at the upper end of the curve, fine detail becomes fuzzy and indistinct. Poor low frequency response gives rise to poor synchronizing action, smearing, and a generally darker image. To be successful in his work, the television serviceman must know the visual result of all deviations from the proper response of Fig. 3. An afternoon spent aligning the video i.f. systems of several television sets is the best method of learning the correlation between image distortions and improper i.f. response.

Occasionally the manufacturer's service manual will specify that the video i.f. carrier is to be placed 60 or perhaps even 70 per-cent of the way up the curve instead of the 50 per-cent noted previously. When this is requested, it is only because the video carrier is not receiving full gain in the r.f. section of the set and the loss occasioned here added to the reduced attenuation in the i.f. system produce the required 6 db. attenuation specified for the video carrier.

Commercial Video I.F. Systems

A convenient method of classifying video i.f. systems is to do so according to the type of interstage coupling employed. All systems can be placed into at least one of the following categories; some make use of two.

1. Transformer Coupling.
2. Stagger-Tuned Coupling.
3. Complex Coupling.

Belmont, General Electric, Farns-

(*Continued on page* 171)

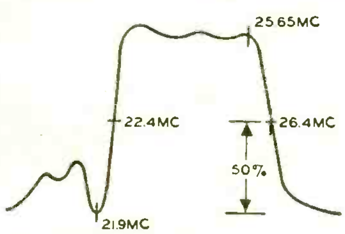


Fig. 7. Video i.f. response of G.E. and Stewart-Warner TV sets.

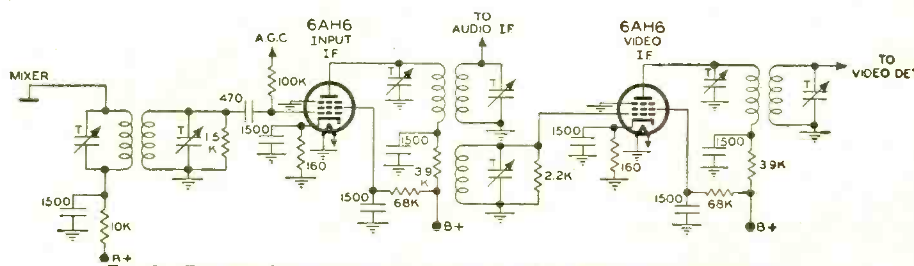


Fig. 8. The simple two-stage i.f. system used in Belmont television sets.

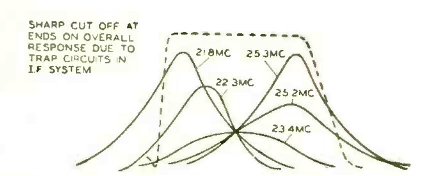


Fig. 9. In RCA video systems, five coils are stagger-tuned to give proper i.f. response.

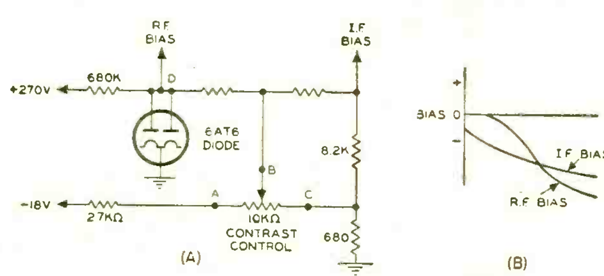


Fig. 10. Contrast control of Fig. 11 rearranged for simplicity.

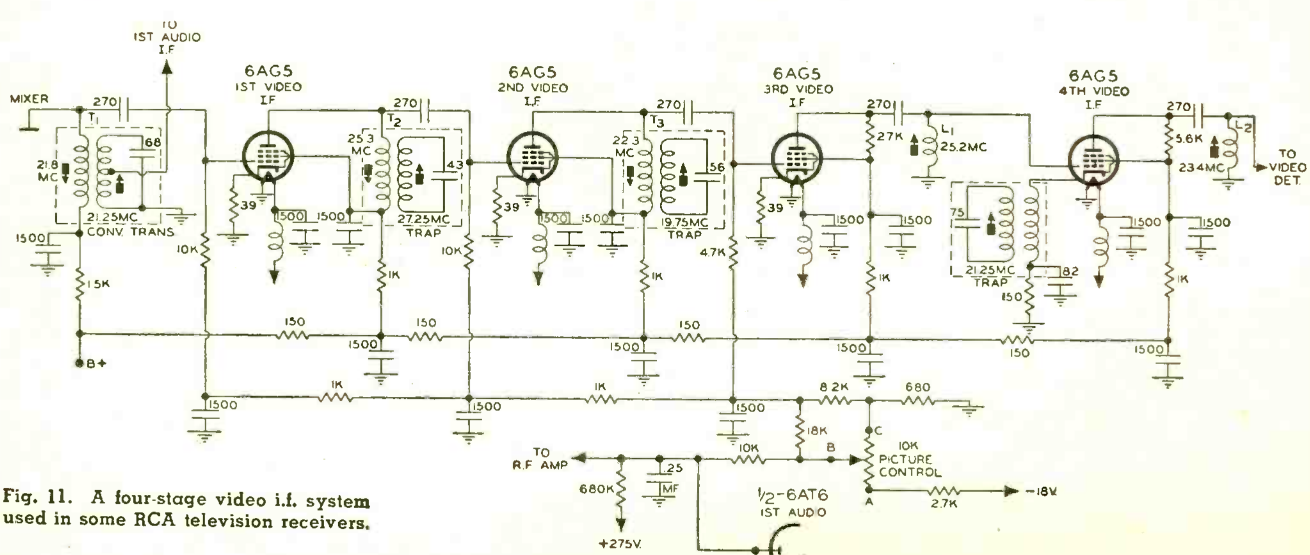


Fig. 11. A four-stage video i.f. system used in some RCA television receivers.

POWER SUPPLY OUTPUT VOLTAGE CONTROL

By
S. S. PESCHEL

Servicemen, experimenters, and hobbyists will find this continuously-adjustable d.c. supply useful.

THERE is frequent need for a simple and inexpensive continuously-adjustable d.c. power supply. The Variac controlled supply is, of course, ideal but is not inexpensive as, in addition to the Variac, separate plate and rectifier transformers are needed. A grid-controlled rectifier supply is adjustable (phase-shift, grid-control type) but here again is not inexpensive due to the several additional components required. When gas tubes are employed such a supply frequently requires hash filters in addition to the usual low-pass filters. An inherent characteristic of most grid phasing controls is the increase in power supply ripple as the output voltage is lowered. Except for the unsatisfactory rheostat type of control, other methods are more complex and more expensive than the two types mentioned above.

The simple and inexpensive control to be described employs the series tube of an electronically regulated power supply. The fundamental circuit, shown in Fig. 1A, employs a bias battery to control the grid-cathode potential of the series tube. This control varies the effective plate-to-cathode resistance of the tube thus making it possible to vary the output voltage from zero to full voltage. Tests on a 6Y6G tube showed that 62 volts of bias was needed in order to reduce the output voltage from 300 volts to 1 volt. The need for a bias battery or a separate grid power supply removed this method of control from the "simple and inexpensive" class.

In order to simplify the circuit, the bias battery was discarded and the grid bias obtained directly from an output potentiometer, as shown in Fig. 1B. The complete voltage control now consisted of a series tube and an ordinary potentiometer. However, this self-bias method does not permit complete plate current cut-off, particularly in the case of the average negative-grid power tube. Output voltage, therefore, cannot be reduced to zero. But, as shown in the data to follow, fairly adequate control can be obtained by the proper selection of the series tube or tubes.

Desirable characteristics for the series tube would include; high mu with zero bias, low tube drop, high current capacity, and high plate dissipation. As is usually the case, a compromise was necessary. The 811 transmitting triode seemed to be a good possibility, particularly for a high voltage (1500 volts) power supply. Since a simple control for the usual 400 to 500 volt, 150 to 200 milliampere lab power supply was all that was required, the 811 seemed unnecessarily large. A breadboard setup was made to check the selected tubes—an 829-B, 6L6G, 6Y6G, 6AS7, and 6AC5. The last mentioned tube,

Tube	Input Voltage	Range of Output Voltage	External Load Res.	Tube Drop @ Max. Eo	Voltage Control Range
829-B	450	65 to 440	0	10.	6.8 to 1.
	435	59 to 413	22,500	22.	7.1 to 1.
	430	60 to 405	15,000	25.	6.8 to 1.
	411	58 to 374	7500	37.	6.5 to 1.
6L6G	485	70 to 465	0	16.	6.6 to 1.
	460	70 to 415	22, 500	45.	5.9 to 1.
	448	70 to 395	15,000	53.	5.7 to 1.
	422	65 to 350	7500	72.	5.4 to 1.
6Y6G	450	85 to 442	0	8.	5.2 to 1.
	435	79 to 407	22, 500	28.	5.1 to 1.
	428	79 to 393	15,000	35.	5.0 to 1.
	412	77 to 364	7500	48.	4.7 to 1.
6AS7	486	210 to 484	0	1.6	2.3 to 1.
	460	190 to 455	22, 500	5.	2.4 to 1.
	453	187 to 445	15,000	8.	2.38 to 1.
	428	180 to 417	7500	11.	2.32 to 1.
6AC5	491	3.6 to 193	0	298.	53.5 to 1.
	491	3.2 to 67	22, 500	424.	21. to 1.
	491	3.0 to 50	15,000	441.	16.6 to 1.
	491	2.9 to 29	7500	462.	10. to 1.

Table 1. Circuit data on test results using 829-B, 6L6G, 6Y6G, 6AS7, and 6AC5 tubes.

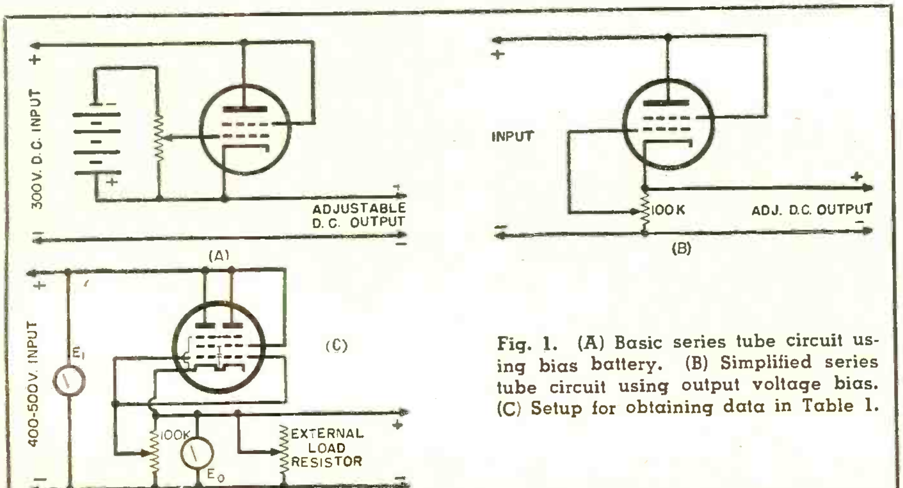
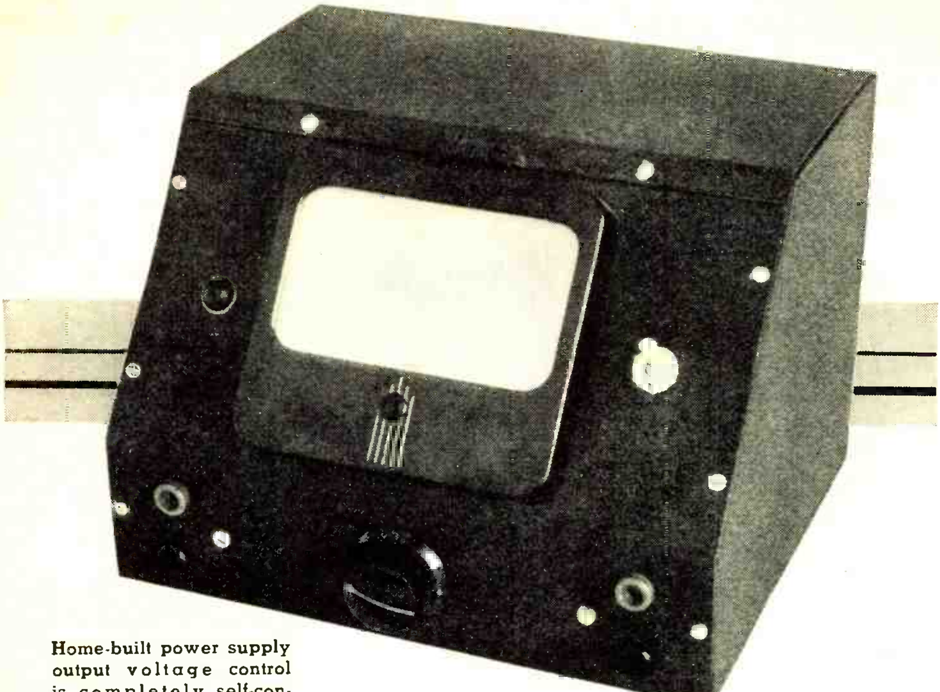


Fig. 1. (A) Basic series tube circuit using bias battery. (B) Simplified series tube circuit using output voltage bias. (C) Setup for obtaining data in Table 1.



Home-built power supply output voltage control is completely self-contained in a Bud cabinet.

although unsuitable, was tested to see what a positive-grid tube would do. As shown in Fig. 1C, the tubes were triode-connected. Circuit data on the test results is given in Table 1.

An inspection of Table 1 reveals that the performance of the 829-B is better than that of the other types tried, primarily because of the better control range. It also has a lower tube drop than the rest of the types tried, with the exception of the 6AS7 twin triode which has exceptionally low tube drop. In addition, the 829-B has greater plate dissipation. The 6L6G is the next best as far as control range is concerned. Its higher tube drop and lower plate dissipation may be partly offset by operating two or more in parallel. The 6AS7, currently used in many voltage regulated power supplies, requires too much grid swing for this application. This shows up as a small control range, approximately 2⅓ to 1. The 6AC5 appears to have a much better control range but since it is operating in the negative grid region, the plate current is practically cut off and the tube drop is excessive. As was anticipated the 6AC5 proved to be entirely unsuitable in this application. However, the results do point to the possibilities of using a high mu, zero bias tube like the 811 triode mentioned earlier. As this tube was not on hand at the time these tests were run, it could not be tried in the circuit.

The practical control unit may be of either the outboard or the built-in type. The outboard unit may consist of a small box with input and output terminals and one knob. The box need only be large enough to accommodate a tube and ordinary potentiometer. The control unit may thus be plugged into any existing bench power supply to convert it to an adjustable output supply. The heater supply for the control tube may be obtained either from the existing power supply or from a small filament transformer mounted within the box, whichever is more convenient. If a new rectifier-filter power supply is contemplated, an extra socket and a small potentiometer should be added along with an extra "B+" output terminal. A dual output supply will result; a fixed output plus an adjustable output. If warranted, several adjustable output channels can be provided from the one supply by installing several control tubes and potentiometers. See Fig. 3.

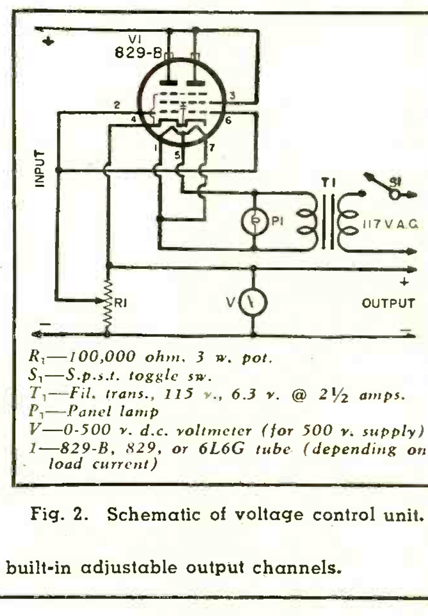
A "dressed-up" outboard unit is shown in the photograph. A small *Bud* cabinet with sloping front panel lends itself nicely to the use of a 4" square meter as the output voltage indicator. (At the time the picture was taken, a 1 ma. meter with a suitable multiplier resistor was being used as a 0-500 voltmeter.) A built-in filament transformer makes the unit self-contained. On one side of the meter is the toggle switch for the filament supply, and on the other side is the pilot light jewel. The vertical section of the cabinet front holds the input and output pin jacks and the potentiometer control knob. The inside construction is too simple to warrant pictures or sketches. A U-shaped piece of metal is fastened to the cabinet front by means of two screws and the potentiometer bushing nut. A tube socket and filament transformer occupy the U-shaped chassis. A line cord emerges from the back of the cabinet. The hinged top on the *Bud* cabinet facilitated tube changes during tests on the unit when three sockets were mounted within the cabinet.

The 829-B proved to be best suited in this unit and has since been used in several models of the control box. It has fairly good control range, adequate low tube drop, ample current capacity, and high plate dissipation. It has the added features of being both inexpensive and plentiful. Fig. 2 is the complete schematic diagram and its associated parts list.

The control unit has been found useful in instrument calibration work, amplifier tests, and general experimental work involving the use of either a definite voltage level, or a continuously adjustable input voltage.

When the control unit is not in use,

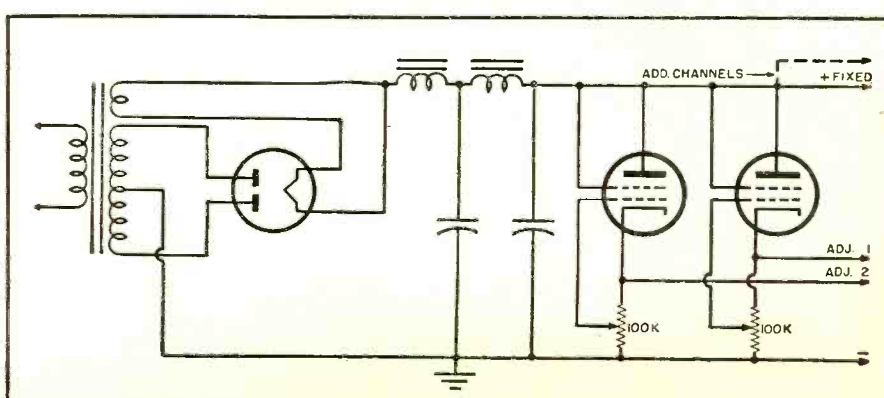
(*Continued on page* 100)



R_1—100,000 ohm. 3 w. pot.
S_1—S.p.s.t. toggle sw.
T_1—Fil. trans., 115 v., 6.3 v. @ 2½ amps.
P_1—Panel lamp
V—0-500 v. d.c. voltmeter (for 500 v. supply)
1—829-B, 829, or 6L6G tube (depending on load current)

Fig. 2. Schematic of voltage control unit.

Fig. 3. Standard power supply with built-in adjustable output channels.



STUDENTS of Today— TECHNICIANS of Tomorrow

By CHARLES EDWARD CHAPEL

Many schools stand ready and equipped to help you get basic training in television.

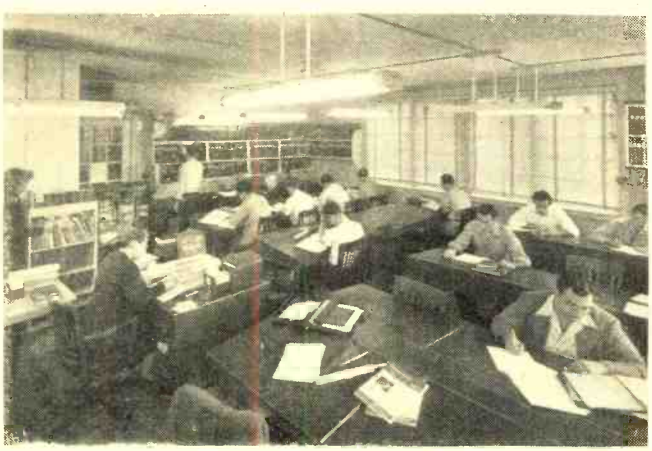
ONLY the uninitiated will contend that television is a subject that "anyone can pick up in his spare time."

The complexity of modern television circuits, the high voltages encountered, and the delicacy of many of the component parts puts television out of the reach of the kitchen-table tinkerer or the casual experimenter. Television is a job for trained men who know what they are doing and why. The cost of the equipment alone, either at the transmission end or in the home, is such that the tyro is excluded from servicing work. The test equipment used in the servicing and aligning of television receivers is of laboratory caliber and, as such, needs the touch of the trained man.

Of course, formal training in television is the only answer to the present problem of securing enough qualified technicians to service the hundreds of thousands of television sets already in use and to install the many thousands more receivers coming off the production lines.

There are today in this country many well-equipped and fully-accredited schools where embryo video technicians may acquire the necessary know-how to enable them to competently service television receivers. Each of these schools offers many advantages to the prospective student; trained faculty, well-equipped technical libraries, modern laboratories and workshops where up-to-date test and servicing equipment is available, in addition to em-

Commercial video broadcast equipment at American Television, Inc., includes the latest RCA image orthicon camera links as well as iconoscope cameras for studio use by the trainees.



This well-equipped technical library for students in residence at Capitol Radio Engineering Institute in Washington points up one advantage of formalized technical TV training.

Television studio and a partial view of the control room set up at the Electronics Institute, Inc., in Detroit. Here students study some of the practical problems encountered in TV.

Good laboratory equipment plays an important role in the training of future television technicians. At Central Radio and Television Schools these students check an RCA 630 TS receiver.

ployment placement services which assist the graduate to find his niche.

Many of these schools offer both day and evening courses for the benefit of students employed in other fields. Some of these courses are available to veterans under the G.I. Bill while still other courses can be pursued at home through "home study" or "correspondence" plans.

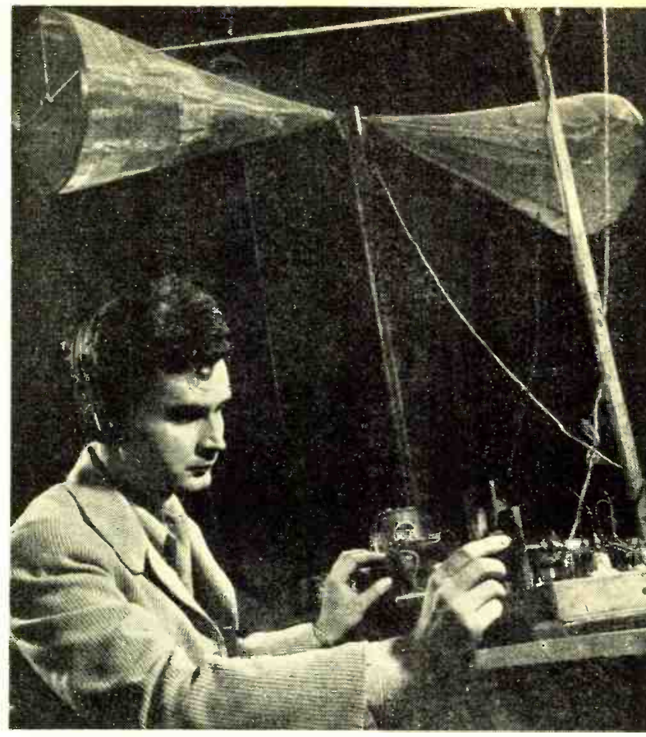
According to the catalogues of the schools, courses are varied in length or can be tailored to suit the requirements of the student. Curricula cover from one year to 6 year courses which qualify the student as a television serviceman or lead to a degree of Bachelor of Science in Television Engineering.

Many factors will enter into the student's choice of educational facilities; proximity to his home, length of course, type of training offered, availability for veterans' training, etc. In making any selection it is well to remember that the training received now will let you in on the ground floor of a new and growing profession. Investigate the courses that the various schools have to offer. Discuss your educational requirements with the registrars at the various schools.

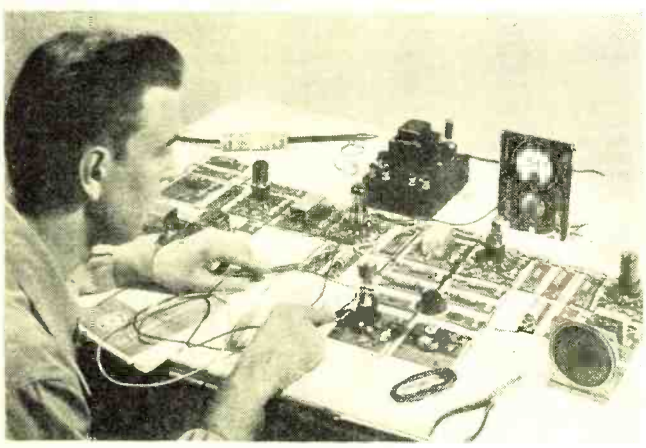
Professional advice on the selection of the proper school to meet your needs is available from Dr. J. S. Nofsinger, Director, National Council of Technical Schools, Washington, D. C.

The thing to remember, however, is that the time is very near when thousands of television technicians will be needed and what you do now toward getting adequate training in the field will affect your future in television. The bandwagon is rolling now—the decision is up to you!

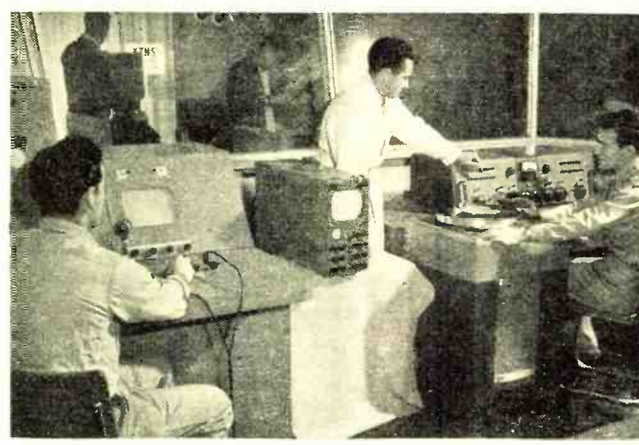
—30—



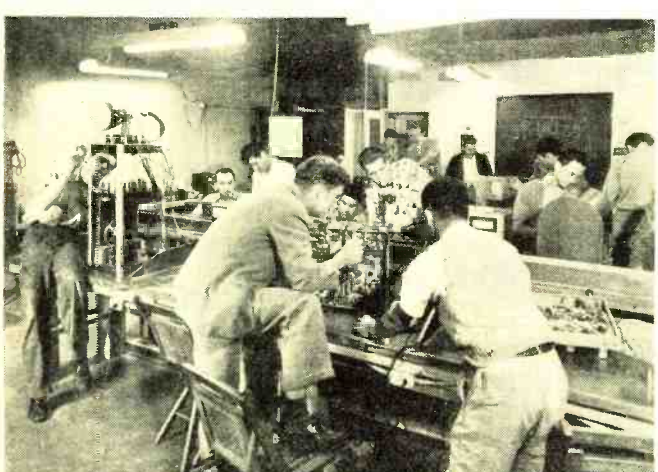
Television antenna equipment is no mystery to the student who can experiment with a variety of installations. American Television Laboratories of California provides such facilities.



Students unable to attend resident schools have a wide choice of correspondence courses. This DeForest Training, Inc., student can experiment with radio equipment in his own home.



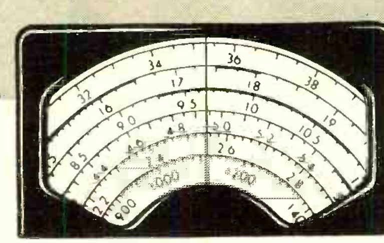
Control panels and other television studio equipment give students at the National Schools an opportunity to test their video knowledge under simulated TV transmission conditions.



"Learning by doing" is one of the best ways to acquire a working knowledge of television. Here students at the Hollywood Sound Institute test their theoretical training in the lab.

The demand for television servicing courses is at an all-time high. These students at Valparaiso Technical Institute work on commercially built receivers in the school's laboratories.

International SHORT-WAVE



***Compiled by* KENNETH R. BOORD**

THIS month we are pleased to dedicate the *ISW Department* to broadcasting in China and particularly to XGOY, "The Voice of China" in Chungking. We are grateful to Fung Chien, director of XGOY, for this article, in his own words, which he prepared for use in this *Department* at the request of Paul Kary, Penn. Says the Director:

"Broadcasting began in China in the spring of 1928 when the Northern Expeditionary Forces of the Kuomintang had just completed their mission in stabilizing the southeast provinces and the National Government established its capital in Nanking. Before that time, although broadcasting stations were found in places such as the northeast, the northern provinces, and Shanghai, they were all poorly equipped and weakly powered and were unable to make a nationwide coverage.

"The National Government saw that broadcasting was the most effective tool for introducing culture, explaining Government policy, increasing the people's educational standards, and providing appropriate entertainment for society in the quickest and most widespread manner.

"Hence, on August 1, 1928, a 500-watt Central Broadcasting Station was built in Nanking. With this station—although of low power—much had been accomplished. It aroused the people's interest in broadcasting and it firmly established their belief in the fact that the most pressing need of China was to put into operation Dr. Sun-Yat-Sen's *Three Principles of the People (San Min Chu I)*.

"Under the direction of Central authorities and with the careful design and hard work of many pioneers, three years later the powerful 75 kw. transmitter formally radioed its Voice in the national capital on November 12, 1932, the 66th birthday anniversary of the Father of the Republic of China, Dr. Sun-Yat-Sen. At that time this transmitter was the only high-powered one in East Asia and it dealt a heavy blow to the Japanese on its aggressive programs.

"But the Japanese were progressing rapidly also. Plans for future developments should be quickly settled. Due to financial reasons, and others, we could only progress gradually under the existing conditions. Short-wave transmitters of the Central Broadcasting Station, and the broadcasting stations in Changsha and Canton were installed successively. Then the Foochow Broadcasting Station was taken over, and a new station was established in Hopeh province, which was removed later to Siam.

"With the few stations under the auspices of various provincial and municipal governments and the small stations in Shanghai and Soochow operated by private concerns all taken into consideration, the total radiated power rose to more than 100 kw., with a total number of listeners—excluding those in foreign countries—of approximately 4 to 5 million. This progress was really quite rapid compared with any other enterprises in China, although still lagging far behind in comparison with other nations. We petitioned various circles to afford us suggestions and propositions—but only 10 to 20 per-cent of them were we able to put into operation.

"Then the Sino-Japanese war came.

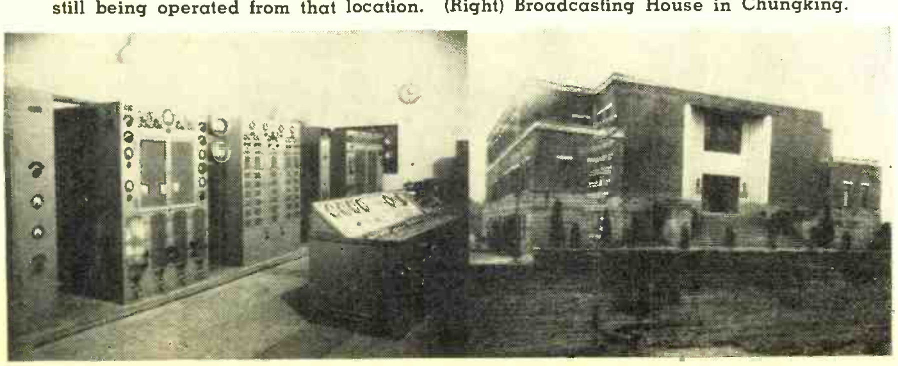
"In order to carry out the national policy of long-time resistance, the National Government proceeded to move the national center to Chungking in the west. The civil broadcasting stations—mostly concentrated in the Nanking-Shanghai areas—were all stopped by the war. Due to reasons of national defense, no privately-owned stations were permitted to be established in the rear provinces. The inferiorly-equipped broadcasting business in China, under the direction of the Central Broadcasting Administration, just as were the armed forces, faced an unprecedented serious difficulty. It must, on the one hand, be prepared for the offensive on the Fourth Front—call all our fellow-countrymen to arms, and encourage their fighting spirit. At the same time, it must move the broadcasting equipment which had been built up in the past decade, from the coastal cities to the interior.

"At the end of 1937, when the Chinese troops on the East Front were forced to retreat, the equipment of the 75 kw. station in Nanking was either automatically destroyed or moved westward. The duties of the Central Broadcasting Station were taken over by the stations in Hankow and Changsha and the new short-wave station in Hankow. A 60 kw. medium-wave outlet was quickly put into operation in Kunming and another 10 kw. short-wave outlet was put into use in Kweiyang. The Central Broadcasting Station resumed its service in Chungking with one re-designed 10 kw. medium-wave transmitter and two short-wave transmitters of 4 and 7.5 kw., respectively. In addition, in order to conduct more effective broadcasting warfare against the enemy and to win more sympathy from abroad, the establishment of a 35 kw. short-wave station in Chungking was planned early in the autumn of 1936. This work continued day and night, notwithstanding the seriousness of the battles. All electrical installations were completed in the winter of 1938 and the station began to operate in conjunction with the Central Broadcasting Station. Since 1940, from its transmitters underground, it has been broadcasting independently under the same name of Chinese International Broadcasting Station, and has won good fame all over the world as *"The Voice of China."*

"Other Government-owned stations near the front were moved back one

(*Continued on page* 159)

Transmitter panels at XGOY, "The Voice of China," in Chungking. When war with the Japanese broke out, the transmitters were located in caves underground and are still being operated from that location. (Right) Broadcasting House in Chungking.



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15-INCH PERMANENT MAGNET SPEAKER SCOOP OF ALL TIMES

Pre-War or Post-War, you never bought a speaker like this, for such a scoop price. Made by a nationally known builder of fine speakers. A full 15" 12½ oz. Alnico V magnet speaker of juke box quality. Has standard 8 ohm voice coil. Will take up to 18 watts average or 25 watts peak. Here is a speaker that will bring out those low notes. Latest 1948 production: not line through-outs. Every speaker is guaranteed new and perfect. We may not be able to continue this offer for long, so place your order now. Stock No. 15-KR. Weight 11 lbs. A $35.00 value for only $10.95.

SUPER 15" P.M. $19.95 — Model 15-LS 15" PM speaker: same as 15-KR except has 21½ oz. Alnico V magnet and will take 30 watts peak audio. Fine for public address use. Weight 15 lbs. Net price, $19.95

THE SPEAKER FOR HIGH FIDELITY

Designed by one of America's finest speaker builders, for FM high fidelity radios, record players and P.A. systems. This speaker is incorporated in radios selling in the $500.00 bracket. It is especially designed 12" Alnico V magnet PM with built-in 3" Alnico V tweeter. The high-pass filter is concealed under the pot cover. Just hook to any 8 ohm voice coil. (Will hook in place of any house radio speaker, as most speakers have 8 ohm voice coils), only two wires to connect. Will handle approximately 18 watts. This co-axial PM speaker should sell for $35.00. Why buy an ordinary speaker, when we are offering a co-axial Alnico V PM for only $10.95? Latest 1948 production, not surplus. All speakers are guaranteed new and perfect. Stock No. 4-12X. Weight 8 lbs.

COAXIAL 12-INCH ALNICO V P.M. SPEAKER

TWO IN ONE
FREQUENCY RESPONSE 50 TO 10,000 CPS
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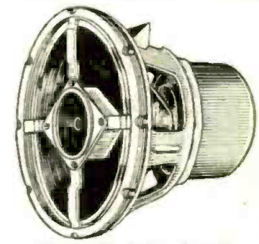

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Nationally known 12" 6.8 oz. Alnico V PM, with 1" 8 ohm voice coil. Will take 15 watts. Grey finish with pot cover. Stock No. CH-12. Net, $5.95; two for $11.00.

12" 12 OZ. MAG. WILL TAKE 20 WATTS $8.95

Super heavy duty 12" 12½ oz. Alnico V magnet PM with 1¼" with 8 ohm voice coil. This speaker is equal to 60 oz. of old type magnet. Will take 25 watt peak. Stock No. CH-13—$8.95; two for $17.00.

WALNUT SPEAKER BAFFLE $19.95

Walnut floor type speaker baffle. Size 12 x 22 x 26 inches. Will accommodate either 12 or 15 inch speakers. Air relief cut-outs in corner of grill. Weight 30 lbs. A $25.00 value for only $19.95. Stock # L-25. Net $19.95. Why not order one of these with any of the speakers listed in adjacent copy?

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5U4G	6SC7	6AB7	1T4	35Z5 GT
5Y3G	6SF7	12AT6	1R5	35W4
6AC7	6SQ7	12BA6	1S5	50B5
6C5	6SH7	12BE6	6R7	
6H6	6SJ7	12H6	6L7	
6J5	6SK7	12J5 GT	7Z4	

1N5, 1H5, 1A7, 1A5, 3Q5—59c each. 0Z4—69c each; 10 for $6.50.

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50A5	14C7	7B6	7Z4
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14A7	7E7	7F7	1201
14Q7	7H7	7N7	

The above loctal tubes were made by the originator of loctals. 1st grade and guaranteed, full replacement. A purchase of 50,000 enables us to offer these $2.20 list tubes to you for only 49c each; $45.00 per hundred.

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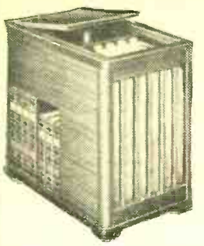

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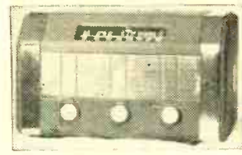

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STATUE-RADIO $26.95

BRONZE HORSE WITH 5-TUBE RADIO IN BASE

Globe Model 559 Statue-Radio. An artistic achievement in design. An authentic reproduction of a horse, in gleaming bronze. Mounted on a dark mahogany base containing the powerful AC-DC superhet radio Tunes broadcast 540 to 1620kc. Full 5 tubes, with Alnico V PM speaker. Height 13½ inches. Net Price $26.95, 3 for $24.95 ea.

COMPLETE WIRE RECORDER $69.95

Portable Wire Recorder Model GN-11

Has ready wired and tested 5 tube AC type amplifier with push-pull 6V6 tubes. Built-in eraser circuit. Input for crystal mike or phono pick-up. Diagrams show how you can record from any radio receiver. 3 position switch enables you to quickly change from record to playback or conventional P. A. system. This amp delivers 12 watts of good clean audio. Here is what you get: Webster 79 recording mechanism, with 15 minute spool of wire, attractive leatherette covered case. 6" heavy duty PM speaker and wired and tested 12 watt AC wire recording amplifier. All you do is mount the amp, recording mechanism and speaker. Simple instructions furnished. Portable Recorder Model GN-11 Net $69.95. Crystal mike $4.95 extra.

Deluxe Portable Wire Recorder Model GN-12. Has same features as the model GN-11, as well as a larger split type leatherette covered case and a heavy duty 10 inch PM speaker. Deluxe Portable Wire Recorder Model GN-12. Net $79.95, Crystal Mike $4.95. extra.

Recording Wire. 15 minute spool $1.30, 30 minute spool $1.95. 1 hour spool $3.25.

COMPLETE DISC RECORDER $39.95

78 RPM Disc Recorder. The best value in America, today. Makes records from mike or radio. Has beautiful tan case, leatherette covered. Size 8x13x16 inches. 78 RPM. R-70L General Industries record playback mechanism and wired and tested recording amplifier (Push-pull 50L6 output, 4 tubes plus rectifier), 5 inch Alnico V PM speaker. You get all material for recorder; nothing else to buy. Only a few minutes time required to mount the amplifier, R-70L and speaker in the case. A $70.00 value with easy to follow instructions. Net Price $39.95.

This recorder offered as single speed (78 RPM) only. The case will not accommodate the dual speed mechanism. 33 1/3 RPM is not successful on this type of unit.

SCOOP — WIRE RECORDER $59.95

Scoop. A complete portable wire recorder and playback offered in the same case as the disc recorder model KD-3 described above. Has all the features of model GN-11 except is furnished with a wired and tested push pull 50L6 amplifier. This unit has the same features as nationally advertised wire recorders selling for twice our price. Shipped with major components unmounted. Model TR-49 net $59.95.

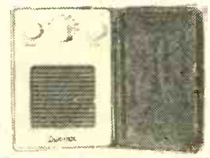
RECORD PLAYER $12.95

Deluxe single record player Model DV/14. Beautiful tan leatherette covered case. Latest rim-drive 78 RPM phono motor. Light weight crystal pickup, wired and tested 3 tube, beam power AC-DC amplifier. Has tone control and 5" Alnico V PM speaker. This is a beautiful record player. All you do is mount the amplifier, motor and pickup in the case. Only a few minutes required. Scoop price $12.95.

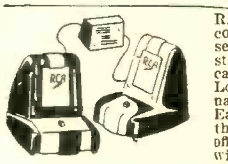
HIGH POWERED PORTABLE PLAYER $19.95

Same style case as our Mode DV-14, shown above, but with heavy duty speaker and push-pull 7C5, wired and tested transformer type amplifier. Kit Model DV-75. Net $19.95.

DYNAVOX—3-WAY PORTABLE $16.95



Dynavox. A small personal 3-way portable radio. A full superhet circuit 4 tubes plus rectifier. Housed in an attractive leatherette case. Has hinged lid. An exceptional value at only $16.95. Requires 67½ B and flash lite cells for A.



R.C.A. Two-Station Intercom. It has Amplifier made separate, to reduce size of stations; housed in plastic case, trimmed with chrome. Low distortion produces natural voice reproduction. Ease of installation makes this unit ideal for home, office or store. Complete with amplifier, two stations and 100 ft. wire....$19.95

ELECTRIC BLOWER HAIR DRYER

$5.95

Handy Hanah Blower driven hair dryer. Twin switches and diaphram control. An indispensable item for every home. Scoop price $5.95.

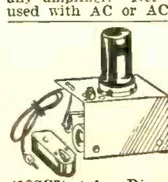
$59.50 VALUE MUSICAL AMPLIFIER WHILE THEY LAST $24.95

8 watt musical amplifier, 4 tube AC type. Inputs for crystal or dynamic mike and phono or instrument pick-up. 2 gain controls and tone control. Has heavy duty built-in 8" speaker. Attractive leatherette covered case. Made by a large manufacture to sell at $59.95. Brand new, fully guaranteed. For 110 volt AC operation. Our scoop price, $24.95. Stock No. XR-3. Contact instrument pick-up, $6.95 extra. Deluxe instrument pick-up; with volume control, $8.95 extra. Crystal mike and desk stand $4.95. Shipping weight, 20 lbs.

3-TUBE MUSICAL AMP. $19.95

In same deluxe case as the model XR-3 shown above. Has same features except it is designed for instrument pickup only. No input for mike. Stock No. XR-22. Net $19.95.

SUPERHET BROADCAST TUNER for connection to phono amp. or P.A. system. Compact chassis 5x3½x3 inches. May be mounted inside the record player cabinet. Requires only three connections to amplifier. Uses 6SA7 or 12SA7; 6SK7 or 12SK7 and crystal diode. Complete with tubes, loop antenna, dial and instructions for connecting to any amplifier. Net $7.95. Specify if tuner is to be used with AC or AC-DC type amplifier.



G.E. VARIABLE RELUCTANCE PICK-UP AND PRE-AMP $6.95

Scoop—Pre-amplifier for General Electric Variable Reluctance pick-up. Easily connected to any AC or AC-DC amplifier. Wired and Tested with 6SC7 or (12SC7) tube. Diagram for connections is furnished. Specify whether you want pre-amplifier for AC or AC-DC use. Net price, Pre-amp. with Tube and G. E. Pick-up—$6.95.

G.E. Variable reluctance pick-up cartridge with permanent needle. Net, $3.95.

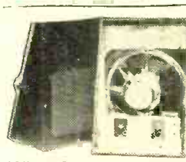
DETROLA CHANGER

$12.95 2 for $25.00

Detrola Changer, Base size 11½x12 inches, $12.95, Two for $25.00. Aero Changer, Base size 12x13 inches, $12.95. VM-800 Changer, Base size 13x14 inches, $14.95.

General Instrument changer, base size 10½x12". $16.95. Seeburg, triple post, World's best, base size 14x14 inches, $37.95. Made to fit leatherette bases for above changers, $1.95. Specify type of changer for base.

Heavy Duty Vibrator — Made for 6-110 volt amplifiers. Freq. 60 CPS. Scoop price..........$1.99
135 ma 6-110 volt conventional power transformer, with all windings; will run phono motor..$5.95
(Use with above vibrator)



PORTABLE P.A. $39.95

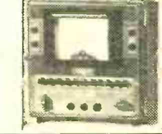
18 watt complete portable public address system. Has inputs for a crystal or dynamic mike and phono pick-up. Has push-pull 7C5 tubes in output. Attractive leatherette covered split type case. Priced complete with two 10" PM speakers. This is a complete public address system wired ready to play. Stock No. RC-18. Net $39.95. Priced complete with crystal mike and desk stand.

Amplifier chassis only with tubes, less speaker, case and mike; in kit form. Diagram furnished. Stock No. AC-18 Net $10.95. AC-18 amplifier wired and tested. Net $14.95.

8-WATT AMPLIFIER WITH P.P. 50B5 $9.95

4 tube, plus rectifier, AC-DC amplifier. Push-pull 50B5 output tubes, with 12SJ7 (Gain for mike or G.E. variable reluctance pickup), 12SL7 (Gain for conventional crystal pick-up) and phase invertor. This is a nice small audio amplifier, with tone and fader control, plus inverse feed-back. Furnished wired and tested, complete with tubes. 8 watts output. Ready to play. Weight 6 lbs. Model TM-5. Net price $9.95. Crystal mike and desk stand $4.95 extra. 8" PM speaker $2.95 extra. G.E. variable reluctance pick-up cartridge $4.69 extra.

VOLT-OHM-METER $29.95

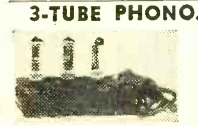


Jackson Model 643, new condition, push-button type Volt-Ohm-Meter. 1000 ohms per volt sensitivity. Measures volts AC or DC to 1000 in 5 steps. Ohms, low medium and high ranges. 3 mil scales. A scoop at only $29.95.

1948 MODEL—MIKE-BROADCASTER ONLY $7.95

Broadcasts 800 to 1500 KC from either a phonograph pick-up or a crystal or dynamic mike. Makes any radio receiver a P.A. system, record player or recording amplifier. Gives broadcast quality. Has fader control from mike to record, simulating a regular broadcast station. This is a powerful model; using 2-35L6, 12SJ7 and 35Z5 tubes. Priced with tubes and connecting instructions. Works on 110 volts AC-DC. Crystal mike and desk stand $4.95 extra. Model DE-5 truly a de-luxe mike-phono oscillator.

3-TUBE PHONO. OSC. ONLY $4.95



Model DE-4—Phonograph oscillator. Broadcasts from 800 to 1500 KC. Gain for any crystal pick-up. A new powerful circuit is used to assure plenty of power. Has variable gain control for proper modulation. Priced with tubes ready to operate, two 50B5 and 34W4.
Model DE-4 Net..............................$4.95

McGEE RADIO COMPANY

WRITE FOR CATALOG
PRICES F.O.B. K. C.

SEND 25% DEPOSIT—BALANCE C.O.D.
1225 McGEE ST., KANSAS CITY, MISSOURI

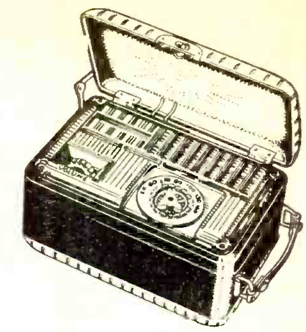
BUILD THIS PERSONAL RADIO

KIT
Complete with Batteries

$14.95

Size: 6½"x 3¼"x 4⅛" Weighs Only 3½ Lbs.

- Two-Tone Ivory, Red Plastic Cab.
- Loop Aerial, Built-in Lid
- 4-Tube Superhet
- AVC.
- Looks like and is a Commercial Radio Kit
- Two-Gang Cond., Lucite Dial
- Simple Assembly and Wiring Instructions



This kit is ready for immediate delivery. The same nationally known factory that manufactures tens of thousands of this radio, is line-producing this radio kit for us. Every part, from the cabinet down to the last resistor, is matched. The chassis is ready punched: all you do, is mount the parts and wire. This radio kit will assemble into a beautiful personal radio for you just the same as it does for the factory. We furnish you a diagram, photograph of the completed chassis and full assembly instructions so that those with a minimum knowledge of radio may wire this kit. The beautiful case is made of metal with plastic hinged lid and snap-on back. The lucite face of the receiver has an inlaid gold design. The circuit is the conventional two gang superhet type, with A.V.C. Receives the broadcast band, 540 to 1650 KC. Uses miniature tubes: 1R5 converter, 1S5 detector A.V.C., 1T4 amplifier and 3S4 power amplifier. Alnico V PM speaker. The loop antenna is built in the lid. Radio comes on automatically when lid opens. Operates on self-contained batteries. Priced complete with tubes and 67½ volt "B" battery and flash cell (Not AC-DC). Nothing else to buy. Model X-45. Price $14.95. Include Postage for 6 lbs.

SCOOP MODEL X-45 PERSONAL PORTABLE KIT WIRED AND TESTED WITH BATTERIES. NET $17.95

8-TUBE RADIO KIT WITH COAXIAL SPEAKER, $37.95

A COMBINED BROADCAST SUPERHET RADIO CHASSIS AND 15 WATT P. A. SYSTEM
HEAVY DUTY 12" P.M. SPEAKER
CROW 8" SLIDE RULE DIAL. 2 GANG COND.
REC. BROAD. 550 TO 1700 KC AND 19 TO 49 METERS
PUSH PULL 6V6—TONE CONTROLS
INPUTS FOR CRYSTAL OR DYN. MIKES AND PHONO-PICKUP. WE FURNISH EVERYTHING TO BUILD THIS DELUXE CHASSIS

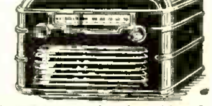
- WHY NOT ORDER THE ARMCHAIR CABINET WITH THIS KIT
- HAS INPUT GAIN FOR THE G.E. VARIABLE RELUCTANCE PICKUP
- CHASSIS SIZE 9½ x 11 x 8" HIGH

Here is something new in radio. A real 15 watt power amplifier with bass and treble controls. Has extra gain stage for crystal or dynamic mikes. And on the same chassis, a standard superhet radio receiver. We furnish all parts, knobs, escutcheon plate and tubes: 6SA7, 6SK7, 6SR7, 6SN7, 6SJ7, two 6V6 and 5Y3. No cabinet. Extra care in designing the power supply section assures low hum level, making this unit ideal for recording as well as P.A. use. We furnish everything as well as schematic diagram and photos of the completed chassis. Weight 35 lbs.

PRK-24 Radio-Amp. Kit with 12" P.M. speaker. With tubes ....Net **$29.95**

CPR-15. Exactly the same kit as the PRK-24 kit, except it is furnished with a 12" Cinaudagraph wide range speaker. (Has built-in high frequency tweeter.) This is our finest kit..............Net **$37.95**

4 TUBE RADIO KIT $6.95



4 tube AC-DC. TRF radio kit. Ideal for students and beginners. Every part furnished to build this kit, including tubes, diagram and photos. Has Alnico V PM speaker and tubes 12SK7, 12SJ7, 50B5 and 35W4. Plastic cabinet with slide rule dial. Receives broadcast 550 to 1600 KC. This is the easiest type of radio to build. Kit Model TF-4 Net $6.95. Weight 6 lbs.

BUILD A RADIO Like you would buy 5-TUBE KIT ONLY $9.95

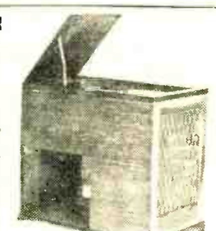
Made from Detrola Components

Attractive 13" blond cabinet AC-DC radio kit, with illuminated slide rule dial. Incorporates a standard 2 gang superhet circuit. Loop antenna, ready-punched chassis. This is another one of our line production radio kits. Every part is furnished. Includes tubes: 12SA7, 12SK7, 14A7, 35Z5 and 50L6. Diagram, photos and instructions are included. Has ful 5" Alnico 5 PM speaker. Receives broadcast 550 to 1650 KC. Shipping weight 9 lbs. Model TF-6. Net $9.95.

Model TF-6 wired and tested..........$14.95

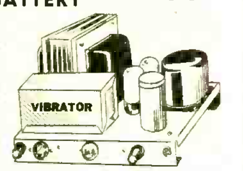
Kit Model DT-5. Same style radio as the TF-6 kit; except it is in a grey metal case. Covers Broadcast band 550 to 1600 KC and foreign shortwave, 6 to 18 MC. Kit Model DT-5, Net $14.95.

BLOND ARMCHAIR CABINET $34.95 Will House PRK-24 or CPR-15



Beautifully made blond armchair cabinet. Outside dimensions 24" high, 16½" deep, and 27" wide. Ample room for radio receiver 14" long, 9" high and 10" deep. Will hold a changer up to 14" square. Will accommodate speaker up to 12". Has record album storage compartment. Hinged lid covers changer compartment. Cabinet AR-18 Net $34.95. Detrola automatic changer $12.95 extra.

6-110 VOLT POWER SUPPLY KIT MAKES ANY AMP. WORK ON A STORAGE BATTERY $14.95



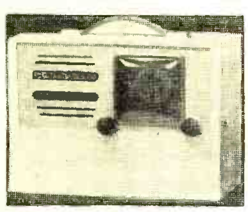
New Power Supply Kit adapts any amplifier to 6-110 volt operation. Kit includes all parts, tubes, transformer, vibrator, ready-punched chassis and diagrams necessary for you to build this 6 volt DC or 110 volt AC power supply. The average radioman should wire this unit in an hour or less. Supply furnishes from 110 volts 60 cycle, 350 volts DC at 135 mills, 6.3 volts AC. Also, from 6 volts DC it produces 110 volts 60 cycle AC to run a phono motor, record changer, or small AC-DC radio; 350 volts DC at 135 mills. Instructions are furnished, to show you how this supply can be adapted to make any P.A. systems, up to 25 watts, operate on 6 volts DC or 110 volts AC. Switching is done in the power supply. Everything complete, including 2-6X5 rectifiers. Kit 6-110KR. Net $14.95. Spare heavy duty vibrator, $1.95 extra.

1949 MODEL AC-DC KIT $12.95

This is our latest and finest AC-DC radio kit. Receives Broadcast, 540 to 1650 KC. Has full length illuminated slide rule dial. Choice of Ivory or Walnut plastic cabinet. Full high efficiency 2 gang superhet circuit, with loop antenna. Ready punched chassis, full 5" PM speaker. Every part fits. Everything furnished, including tubes, 12SA7, 12SK7, 12SQ7, 35Z5 and 50L6. This kit will go together just like it would on the production line. Diagram, photos and instructions are furnished. Shipping weight 9 lbs. Kit model XA-49. Net $12.95.

3-WAY PORTABLE KIT $16.95

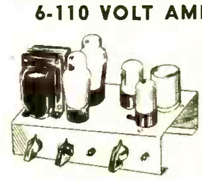
- 4 Tubes Plus Disc Rectifier
- 300 Hour Battery Pack Included
- Beautifully Built Portable Case



Build this powerful, 4-tube, 3-way portable kit. Operates on 110 volts AC or DC or self contained batteries. Receives broadcast 550 to 1650 K.C. Incorporates a standard superhet circuit with AVC and loop Ant. Has Alnico 5 PM Speaker, 2 gang condenser. All parts and batteries are furnished including tubes. Disc Rectifier, 1R5, 1T4, 1S5 and 3S4. Has attractive leatherette portable cabinet size 7x9x9. Weight 14 lbs.

Kit Model 3-ZA..............................Net $16.95

6-110 VOLT AMPLIFIER KIT, $29.95



Model 22-KR—A complete kit of parts to build a 25 watt, 6 volt DC and 110 volt AC amplifier, utilizing the above power supply. Has push-pull 6L6 output tubes, with universal output transformer, 4-8-16-500 ohm line to voice coil winding, dual tone controls, inputs for crystal or dynamic mike and phono pick-up. Every part and tube, as well as diagrams and ready punched chassis furnished. You get the above 6-110 volt power supply kit and the amplifier kit pictured. Net $29.95.

AMERICAN AND FOREIGN KIT $14.95

550 to 1600 KC and 6 to 18 MC

This radio kit is housed in an attractive grey opalescent finished metal cabinet. Incorporates a standard 2 gang superhet circuit. Receives Broadcast (550 to 1600 KC) and foreign short wave (6 to 18 Megacycles). This kit is complete, nothing else to buy; just as all our kits. Ready-punched chassis. It will go together just as it would down a production line. Has full 5" PM speaker. Complete with tubes: 12SA7, 12SK7, 12SQ7, 35Z5, 50L6. Diagram, photos and instructions are furnished. Shipping weight 10 lbs. Kit model DT-5. Net $14.95.

12 WATT AMPLIFIER KIT, $10.95

Push Pull 6V6's Gain for Mike

KIT MODEL AC-12. 12 watt amplifier kit. Ideal for high quality record player as well as public address or recording amplifier. Matched component parts, ready punched chassis pan. One control fades from phono to microphone. Gain enough for crystal or dynamic microphone. 100 mil power transformer, for 110 volt AC 60 cycle operation. Priced complete with tubes: 2—6V6, 6SN7, 6SH7 and rectifier. Diagrams and photos furnished. Kit AC-12. Net $10.95. 12" Alnico 5 PM speaker $6.95 extra; crystal microphone and desk stand $4.95 extra.

The above AC-12 amplifier wired and tested ready to operate net $14.95. Specify Stock No. AC-1125. 12-inch Alnico V PM speaker $5.95 extra. Crystal mike and desk stand $4.95.

SMALL PORTABLE KIT, $10.95

- 4-Tube Broadcast Superhet
- Priced Complete with Batteries
- Dynamic Speaker
- Slide Rule Dial

PORTABLE KIT MODEL K-PX. Small size leatherette covered case 9x5½x5. Easy to build. Operates on self contained B and A batteries. Rec. Broadcast 550 to 1600 K.C. Incorporates a standard superhet circuit with avc. Has 3 inch Alnico five PM speaker. Priced complete with batteries, pictorial diagram and tubes 1R5, 1S5, 1T4 and 3S4. Not AC-DC, but straight battery operated. Has 2 gang cond. Everyone should have one of these personal portables. Everything furnished.

Kit K-PX ....Net $10.95

20-WATT UTILITY AMP. KIT, $17.95

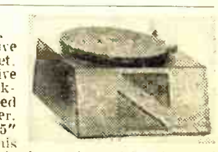
Build this 20 watt utility 110 volt AC, 20 Watt power amplifier. Ready punched chassis, size 12 x 6 x 2½ inches. Has two input circuits, one mike and one phono. Mike stage has 135 DB gain, for crystal or dynamic mike. Has bass and treble controls. Designed for use with PM speakers; has 8-16 ohm output transformer. All parts and easy-to-follow diagram furnished, including tubes: 2—6SN7, 6J5, 2—6L6GA, 5Z3 Kit Model 20-LX......Net $17 95

INTER COM KITS $7.95

Inter-com kit. All parts furnished to build a small two-way call system (Master and one sub-station speaker). Has 3" speaker and tubes 70L7 and 12SL7. Has separate 3" speaker for sub-station. Ready punched chassis. Everything complete, less cabinet. Diagrams and photo furnished. Kit TB-3.

Net Price $7.95.

POWERFUL SINGLE RECORD PLAYER Z-26.



Housed in an attractive leatherette covered cabinet. Latest 78 RPM rim drive motor and light weight pick-up. Ready wired and tested 70L7 type tube amplifier. Tone and volume control, 5" PM speaker (Alnico V). This kit easily slips together. Priced complete with tubes and hook-up instructions. Kit Z-26..............Net $9.95

Colleges, High Schools and GI Training schools. We have supplied hundreds of kits for student needs, any further information desired on any McGee kit will be gladly furnished.

McGEE RADIO COMPANY

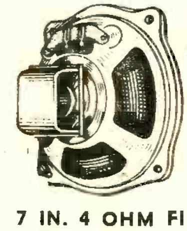
WRITE FOR CATALOG
Prices F.O.B. K.C.

SEND 25% DEPOSIT—BALANCE C. O. D.
1225 McGEE ST., KANSAS CITY, MISSOURI

RADIO SERVICEMEN PAY LESS FOR PARTS AT McGEE

CRYSTAL CARTRIDGES AT UNBEATABLE PRICES

MLP-2 Replaces MLP-1 Astatic. Has interchangeable needle same as used in the QTM-3. Buy this cartridge at near cost of the needle only. Regular $8.00 list. Scoop price, complete with needle **$1.95.**
L-72A Crystal cartridge, high output. 5 to 7 volts. Put the punch in these record players with this cartridge. L-72A net **$1.69.**
L-26 or L-40 cartridge. Scoop price **$1.39.**
L-70 or L-75 cartridge. Scoop price **$1.39.**
American crystal cartridge, best value in America. Normal output voltage. Mounts like L-72, L-26, L-40, L-70 and L-75. Our leader **$1.29** each. 10 for **$11.00.**
Our leader G.E. variable reluctance cartridge. Scoop price **$3.95.**
NJ-1 Nylon cartridge with permanent, but changeable needle. **$3.29.**
RCA Magic-tone cell, with permanent sapphire needle. Modernization kit replaces 95% of old cartridges in RCA radio phonographs, built during 1938 and later. 4 page instruction book included. A scoop at only **$1.95.**



MAGNAVOX

6-7-8 INCH AUTO SPEAKERS

A red hot McGee special. Latest production field coil type auto radio replacement speakers. Just made available by Magnavox. Every speaker guaranteed. These will stay put and take the wallop in car sets.

6 IN. SQUARE 4 OHM FIELD $2.49

7 IN. 4 OHM FIELD $2.98 **8 IN. 4 OHM FIELD $2.98**

Complete crystal pickup with Astatic L-70 or L-26 cartridge. Scoop price	$1.98
Complete crystal pickup with Shure crystal cartridge. Scoop price	1.98
Astatic curved arm, with MLP-1 cartridge and permanent needle. Scoop price	2.49
Choice of D-9 or O-7 pickup with Astatic cartridge. Scoop price	1.98

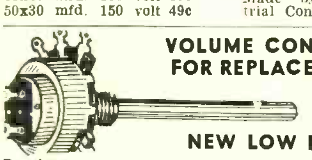
G. I. RM-4 $5.95

G. I. RM-4 Heavy duty phono recording motor, with turntable. A scoop at	$5.95
Deluxe 78 RPM rim-drive phono motor, with turntable. Special	2.95
Standard 78 RPM phono motor, with turntable. Special	1.95
Replacement motors for 90% of all automatic record changers. $1.49, 2 for	2.79

SALE ON STANDARD TUBULAR ELECTROLYTICS

Standard type nationally known brands of every day replacement tubular electrolytics with pig tail leads. All fresh stock. Guaranteed one year.

16 mfd. 150 volt	29c	50x30 mfd. 150V. 25 V	59c
40 mfd. 150 volt	39c	40x40x20 mfd. 150 volt	59c
8 mfd. 450 volt	29c	Scoop. 10x10x10 mfd. tubular 450 volt. Long leads. Made by Industrial Cond. Co.	49c
16 mfd. 450 volt	39c		
30 mfd. 450 volt	49c		
20x20 mfd. 150 volt	39c		
40x20 mfd. 150 volt	39c		
50x30 mfd. 150 volt	49c		



VOLUME CONTROLS FOR REPLACEMENT

SAVE!

NEW LOW PRICES

Regular manufacturers' type with 1½ inch split knurled shaft. These controls fit 90% of all radio sets.

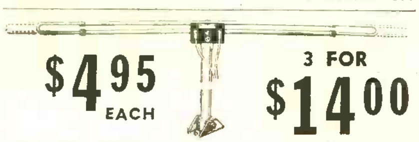
500,000 ohm with spst switch	39c	10 for $3.50
500,000 ohm with dpst switch	39c	10 for 3.50
1 meg. ohm midget with spst sw.	39c	10 for 3.50
½ meg. or 1 meg ohm less switch	29c	10 for 2.50

Regular 3 inch shaft jobbers stock controls at scoop prices.
500,000 ohm with dpst switch for battery radio sets and portables. **49c** each, 10 for **$4.50.**
One meg, tapped with spst switch **49c.** 10 for **$4.50.**

SAVE 75% ON F.P. CONDENSERS

Sale of name brands small fabricated plate electrolytic condensers. Aluminum can with twist mounting. All fresh stock. One year guarantee.

20 mfd. 450 volt, F.P.	39c	20x20 50 volt	19c
40 mfd. 450 volt, F.P.	49c	20 150V. 25x25 25 volt	19c
10x10x10 450 volt, F.P.	49c	50 mfd. 25 volt	14c
30x15x10 450V. 20x 25V.	69c	20x20 150 volt	39c
30x15x30 450V. 30x 50V.	69c	40x20 150 volt	39c
8x8 450 volt	49c	50x50 150V. 20-25 volt	49c
40x20, 450 volt	69c	30x30 300V. 25-25 volt	49c
40x40 450 volt	69c	30 at 350 volt	29c
		40x20 150 volt 200-15 volt	59c



$4.95 EACH **3 FOR $14.00**

Super value. Folded Di-pole antenna, for FM and Television. Complete with 60 feet of twin 300 ohm line and 4 low-loss stand-off insulators. This folded di-pole covers frequencies 42 through 108 megacycles. Trombone action makes exact tuning to any one weak station. Furnished with adjustable mounting bracket. Has 5 foot mast. Made for Stromberg-Carlson. Stock No. Mt-300—Net $4.95. Weight 4 lbs. Individually packed.

A SPEAKER FOR YOUR EVERY NEED AT A BIG SAVING

POPULAR FIELD COIL AND PM's

10" 4 oz. Alnico V magnet PM speaker	$3.95
10" 7 oz. Alnico V magnet PM speaker	4.45
12" 7 oz. Alnico V magnet PM speaker	4.95
For radio set and amplifier replacement use. 12" 15 watt, 8 ohm voice coil Alnico V PM a scoop for **$4.95.** 5 for **$22.50.**	
4" 450 ohm field speaker	1.89
5" 450 ohm field speaker	1.89
4" 4 ohm field speaker for auto sets	1.89
5" 4 ohm field speaker for auto sets	1.89
5" 450 ohm field speaker, with output transformer to match single 50L6 tube	1.98
8" 450 ohm field Utah speaker, with output transformer to match single 6V6 tube	2.25
8" 1000 ohm field dynamic speaker	2.95
6" square 1000 ohm field speaker, with 7000 ohm output transformer	1.95
12" R.C.A. 1000 ohm field speaker, ideal for console radio replacements	4.95
12" R.C.A. 450 ohm field speaker	4.95

3½" 1 oz. Alnico V magnet PM speaker	$ .99
4" 1 oz. Alnico V magnet PM speaker	.99
5" 1 oz. Alnico V magnet PM speaker	.99
5" 1.5 oz. Alnico V magnet PM speaker	1.19
6" 1.5 oz. Alnico V magnet PM speaker	1.49
6" 2.15 oz. Alnico V magnet PM speaker	1.98
4x6" 1.5 oz. Alnico V magnet PM speaker	1.49
6x9" 3.16 oz. Alnico V magnet PM speaker	2.98

PM's WITH ADJUSTABLE CONES

6½" 2.15 oz. Alnico V PM, with adjustable cone	$2.49
6" 3.16 oz. Alnico V PM, with adjustable cone	2.98
8" 2.15 oz. Alnico V PM, with adjustable cone	2.98
8" 3.16 oz. Alnico V PM, with adjustable cone	3.98

PM's WITH OUTPUT ATTACHED

6½" 1.47 oz. Alnico V PM, with PP50L6 output	$1.95
5" 1.47 oz. Alnico V PM, with PP50L6 output	1.95
5" 1.47 oz. Alnico V PM, with 50L6 output	1.49
5½" Utah 2.15 oz. Alnico V magnet PM speaker, with output transformer to match 3Q5 tube	1.95

GENUINE GENERAL ELECTRIC YGS-3 FM-AM SIGNAL GEN.

$195.00 VALUE FOR ONLY $99.50

General Electric Signal Generator Type YGS-3. For FM and AM servicing. **An** RF oscillator with fundamental frequency range of 100 kc. to 150 mc. An FM oscillator with center frequencies of 1, 20 and 50 mc's, and frequency deviations of plus or minus 20, 300 and 750 kc., respectively. **A** 1 megacycle crystal calibrator and variable-frequency audio oscillator. These four units may be used independently or in any logical combination by switching the front panel controls. Tube complement: 4-6AK6, 1-6AG5, 1-6SL7, 1-6AF6, 1-6SN7, 1-6J6, 1-9006 and 1-5Y3. Scoop price regular **$195.00** YGS-3 Signal Generator. Net **$99.50.**

600 VOLT FAMOUS MAKE TUBULAR COND.

AT LESS THAN HALF REGULAR NET

These tubular by-pass condensers are second to none. All molded plastic. Made by a nationally known builder of condensers. Branded and marked 600 volt. You can't go wrong on these. Take 10% off these prices in lots of 100 assorted.

TAKE 10% OFF IN LOTS OF 100

.001 600 volt	7c	.05 600 volt	9c
.005 600 volt	7c	.1 600 volt	10c
.01 600 volt	8c	.25 600 volt	15c
.02 600 volt	8c	.5 600 volt	18c

1600 volt for buffer condensers. .005, .008, .01, .02 .... 17c each

SURPLUS BARGAINS—NEW LOW PRICES

R.D.F. RECEIVER $19.50

MN-26C Compass receiver. Brand new factory cartoned. This unit covers from 150 to 1500 kc., inclusive; in three bands. Complete with eleven tubes of the 6 volt type 6SA7, 6SK7, 6F6, etc. Has a 28 volt dynamotor built in. This unit does not have a dial included. MN-26C Net price $19.95. Only a few available.

CATHODE RAY TUBES

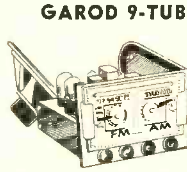
5BP4	$2.95	7BP7	2.95
White Screen.		5FP7	2.95
9LP7	2.95		

PE-101C DYNAMOTOR $2.95

Dynamotor PE-101C. Input voltage 13 or 26 volts DC. at 12.6 or 6.3 amps. Output voltage 400 volts DC at 135 Mils and 800 volts at 20 Mils. 9 volts AC at 1.2 amps. Brand new factory cartoned. Shipping weight 13 lbs. PE-101C Net $2.95

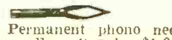
MONTHLY SPECIAL

GAROD 9-TUBE AM-FM CHASSIS



WITH 12" SPEAKER $59.95

McGee's monthly special. Garod 9 tube broadcast and FM chassis. Powerful transformer type. Twin lited plastic dial. Full 12 in. dynamic speaker. This is not a cheaply built chassis but a full grown radio. The same chassis is incorporated in receivers selling for $300.00. Why not install this in your old cabinet.
Compact construction makes this chassis adaptable to most all console or chairside cabinets. Stock No. LA-91 net with tubes and 12 in. speaker. $59.95.

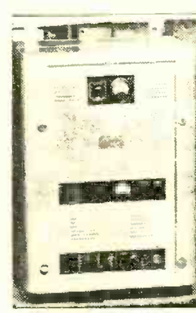


12 FOR $2.39

Permanent phono needles. Save 75% on permanent needles. Regular $1.00 retail seller. We bought 50,000 from a phono manufacturer, at a great loss; your gain 2,000 play precious point needle. 12 for $2.39. Worth $6.00.

NEW APN-1 ALTIMETER ..$9.95

APN-1 Radio Altimeter. A complete transmitter and receiver in one package; for the 420 megacycle region. These units are new and in perfect condition; complete with tubes VR-150, 5-12SH7, 2-12SH7, 2-12H6. Only 100 to sell. Instructions are available for a few units. Weight 25 lbs.



RCA M 2545

Ship board master amplifier. 23 tubes including 2 6L6 and other 6 volt type tubes. D B Meter. Built-in tube checker. Designed for 110 volts AC 60 cycle use. Has spare parts kit of trans and chokes. Only those who have worked with this amplifier will know its terrific value. Brand new with tubes, only $89.50. Cost the gov. up in the thousands.

Brand New

ELECTRONIC MEGAPHONE

SCOOP PRICE

$34.95

Only 100 of these Brand New Electronic Megaphones to sell. You may see these listed at a lower price, but ours are new and guaranteed to work. Amplifier straps on shoulder, then just hold megaphone and speak into mike, mounted on rear of projector. Pull switch to turn on dry battery operated amplifier.

McGEE RADIO COMPANY WRITE FOR CATALOG PRICES F.O.B. K. C.

SEND 25% DEPOSIT—BALANCE C.O.D.
1225 McGEE ST., KANSAS CITY, MISSOURI

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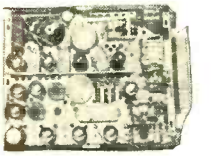
GENERAL ELECTRIC BC-645A



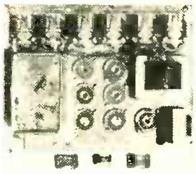
450 MEGACYCLE TRANS-RECEIVER
With Citizen Band-Conversion Schematic

1000 TO SELL AT LESS THAN THE WORTH OF THE TUBES
BRAND NEW

A small complete Transmitter and superhet receiver, for the 450 megacycle band. Diagrams for building AC power supply and conversion furnished. Ideal for MCW, CW or phone. The tubes (4-7F7, 4-7H7, 2-7E6, 2-6F6, 2-955 and WE-316A) are worth more than our sale price. BC-645 I.F.F. unit $9.95 each. Two for $19.00. Extra WE-316A tube 99c. 12 volt DC dynamotor (furnished all power) $2.95. BC-645 shipping weight 25 lbs.

BC-645A $7.95 EACH TWO FOR $15.00

AUTO PILOT, SALVAGE SCOOP



$1.49 EACH TWO FOR $2.49

HAS 6 HIGH RESISTANCE RELAYS

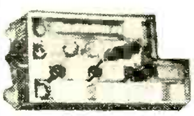
Auto pilot amplifier salvage scoop. Has 6 high resistance relays that operate in tube plate circuits on less than 8 mills. Also 4 controls. Choke cond., etc. Less tubes. Used but in good condition. Weight 12 lbs. Stock No. C-1T. Net $1.49; two for $2.49.

SCR-518 RADIO ALTIMETER, $24.95
Complete, New, with 29 Tubes

Famous SCR 518 A Altimeter. Brand new factory cartoned. Worth over $900.00. Made by RCA. Complete as pictured. Has 29 tubes. Works in the 500 MC region. This is the complete unit. Transmitter, receiver, power supply and 3" scope indicator. Reads altitude up to 30,000 ft. Operates on 28 volts. D. C. Complete with tubes, 6SK7, 2 8012, 2 6SJ7, 6C8, 6SN7, 6F8, 23D4, 6V6, 10 6AC7, 3 2X2, 954, 955, 956, 6J5 and 3 in. CR tube 1808P. A RED hot scoop at only $24.95 complete. Weight 70 lbs.

2-METER TRANS-REC. ARC-4 $12.95

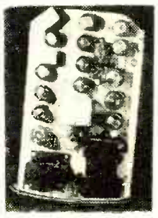
FOUR CHANNELS CRYSTAL CONTROLLED. ARC-4 for VHF frequencies 140 to 144 megacycles. There are 7 tubes in the transmitter: 832, two 1614, two 6V6 and two 6L6. The receiver section has 13 tubes: two 6AC7, four 6N7, three 12SJ7, two 12SQ7 and two 12A6. The unit is actually two receivers and one transmitter in one piece. One receiver is for standby use. Has built on dynamotor for 24 volt DC operation. Priced complete with tubes and four crystals and dynamotor. Hams convert this for two meter operation. It's a scoop at this price. Used, but good condition. Weight 30 lbs.



SCOOP 110 Mega-cycle Rec. .733D $6.95

BC-733 D Localizer Receiver

Freq. 108-110 Mc; Tube complement; 10 tubes—1—12SQ7, 2—12SR7, 1—12A6, 1—AH7GJ, 2—12SG7, 3—717A. Now only .... $6.95 BRAND NEW. A RED HOT VALUE.



AM-61 INDICATOR AMPLIFIER
Has 15-Tubes A SCOOP at Only $9.95

BRAND NEW

AM 61A Indicator Amplifier. Brand new factory cartoned. Has 28 volt DC Blower motor and fan. 2 2mfd 1000 volt cond. 2 2X .5 mfd. 1000 volt cond. and many other parts. Complete with 15 tubes. 7 6SN7, 3 VR 105, 5Y3, 3 6SL7, 8016. As a salvage item this is a RED Hot Buy. The tubes are worth more than our price. Weight 30 lbs. Net $9.95.

CRYSTAL CALIBRATOR For Collins Auto Tune, etc. $1.00

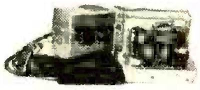
3 tube crystal calibrator; gives 50 KC beat notes for transmitter dial calibration. Requires 200 KC crystal and 2-12SL7 and 12SA7 tubes. A handy item to have. The coils are worth more than our sale price. Wt. 4 lbs. A scoop price for $1.00.

BC-310 B RECEIVER
While They Last, $20.00

Bendix Radio Compass Receiver only. 3 Band. 150 to 1500KC; has 14 volt dynamotor, 12 6 volt type tubes and "S" meter. All in good condition. Scoop price $20.00. Can be easily changed for 110 volt operation.

PACKARD BELL Pre Amp $1.00

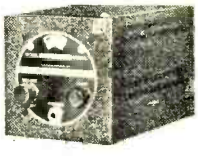
BRAND NEW



Brand New Packard Bell re-amplifier, with tubes 6SL7 and 28D7. In handy size case 5" x 4" x 7". With instruction book. Weight 4 lbs. A scoop at only $1.00.

BC-1206 $4.95

BRAND NEW RECEIVER 195 TO 420 KC



Designed to receive A-N beam signals. 24-28 vdc. Tube complement: 14H7, 14A7, RF. 14H7, 14J7, 14A7, 14H7, IF amplifier; 14R7, detector and 1st audio; 28D7, output. 195 to 420 KC 4" high x 4" wide x 6⅝" long. Weight 4 lbs.

NAVY-GLIDE PATH $1.00

Salvage SCOOP BRAND NEW

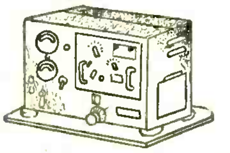
Navy Model ZA Glide Path Receiver. Requires 3-6C6 tubes. A real salvage scoop. Transformer, controls and handy aluminum case, 6" x 7" x 12". All in good condition. Weight 7 lbs. Scoop price $1.00.

INTERPHONE AMP. $1.00

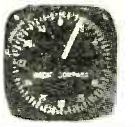
ONLY 250 TO SELL Brand New

AM 26 interphone amplifier. This unit is nice for parts salvage and the aluminum case is usable for receiver building etc. Size 9½x4½x5". Has two transformers, four tube sockets, three filter condensers, three position panel switch, toggle switch, and many small parts. All are in perfect condition.

SCOOP IF THERE EVER WAS ONE
250 ONLY BC-223 BRAND NEW TRANSMITTERS $3.95



Brand new BC-223 army transmitters for phone or CW. Requires 3-46 and 2-801 tubes, which are readily available in war surplus. Shipped less plug-in tuning unit; that should be easy to get for a dollar or two. These transmitters are new in wood crates. The 2" 3 ampere RF current meter is worth our sale price. You should not pass up this transmitter scoop; even to tear up for parts, its a buy. Only 100 to sell. Shipping weight 65 lbs.



3" SELSYN INDICATOR
Works on 16 to 25v. 60 cycle

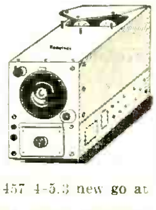
$2.45 EACH Two for $4.45

CARBON HAND MIKE, 89c

Army carbon hand mike with push-to-talk switch, cord and plug. Brand new and factory cartoned. While they last. **89c** each; two for **$1.59**; ten for **$6.50**.

80 METER COMMAND REC. $4.95

BRAND NEW 454—3 TO 6 M.C. REC., $4.95



We have a few of the popular 80 meter 3 to 6 mc command receivers in factory cartons. Brand new complete with all 6 tubes. Better place your order now. Weight 8 lbs. New BC-454 $4.95, each.

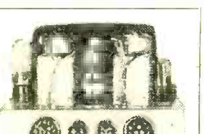
BRAND NEW 458 TRANSMITTER, $5.95

Only a few hundred brand new BC-458 5-7 mc command transmitters, complete with tubes, to sell at $5.95 each. Weight 11 lbs. A few BC-457 4-5.3 new go at $5.95 each.

Used command triple receiver rack with shock mounting .99 each.

Used command twin transmitter rack with shock mounting .99 each.

NEW BC-456 MODULATORS $2.49 A SCOOP



Brand new modulators with tubes, VR-150, 12J5 and 1625. Built for the BC-457 and BC-458 command transmitters. Less dynamotor $2.49. Used BC-456 modulator with tubes and 28 volt dynamotor $2.95.

SALVAGE RECEIVERS $1.79

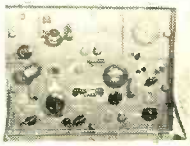
Scoop. We have a few hundred BC-453, 454, 455 less tubes; used and cases bent, but still good for parts. Sorry, no choice of frequencies. $1.79 each.

PULSE FORMING NETWORKS

Used in small radar modulators, available in three sizes, 67 ohms impedance, 7.5 Kilowatt rating.

H-603, one micro second, 200 pulses per second.. $1.00
H-601, three micro seconds, 200 pulses per second.. 2.00
H-602, 16 micro seconds, 60 pulses per second..... 3.00

BC-654 TRANS-REC $12.95 TWO For $25.00



BC-654 Portable Transmitter and Receiver. 7 tube superhet receiver and 6 tube transmitter. Covers from 3800 to 5800 KC. Furnished with all 13 tubes (low drain battery type). Units have been used but are in good condition. BC-654 weight 50 lbs. One of our best surplus values. $12.95 each, two for $25.00. Vibrator pack for 6 or 12 volt operation $4.95, extra.

WHEN ORDERING—Send 25% deposit, with C.O.D. orders. Send full remittance with order less than $5.00. On parcel post orders, include ample postage. Any extra amount will be refunded.

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Wide-Band Amplifiers
(*Continued from page 59*)

indicated on an oscilloscope or voltmeter connected at a point following the video detector. In a properly designed amplifier free from regeneration there is no interaction between stages during tuning, and the alignment is accomplished with ease.

It should be noted that in the stagger-tuned amplifier the over-all bandwidth is determined only by the response characteristics of the individual stages, and is not affected by the gain of any stage. Therefore, as the mutual conductance of the amplifier tubes changes during use, or as the gain of any stage or number of stages is varied by a manual gain control or a.g.c., there is no change in the over-all response characteristic provided there is no change in the bandwidth of each individual stage.

Design Procedure

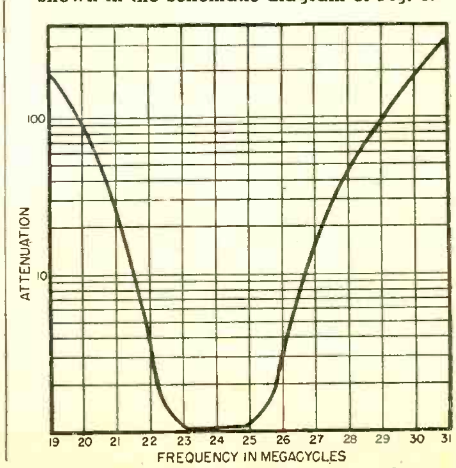
The first step in the design of a stagger-tuned amplifier is to estimate the over-all gain and bandwidth required. The available gain for each single-tuned stage is then calculated by:

$$\text{Gain bandwidth product} = \frac{G_m}{2\pi C} \quad \ldots (1)$$

G_m is the mutual conductance of the amplifier tube, expressed in micromhos, and C is the total tuning capacitance of the circuit in micromicrofarads. The gain bandwidth product is expressed in megacycles. The bandwidth referred to here and throughout this article is the frequency interval between points 3 decibels down from maximum gain.

The minimum tuning capacitance obtainable in a carefully designed stage is about 5 $\mu\mu$fd. more than the combined input and output capacitance of the amplifier tube. Therefore, a stage using a tube which has a G_m of 5000 micromhos, and a combined input plus output capacitance of 14 $\mu\mu$fd. would have a gain bandwidth product of $5000/(2\pi \times 19) = 42$ mc. The stage gain

Fig. 4. Attenuation curve of the amplifier shown in the schematic diagram of Fig. 5.



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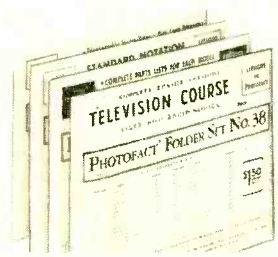

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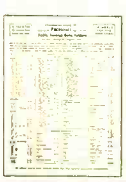

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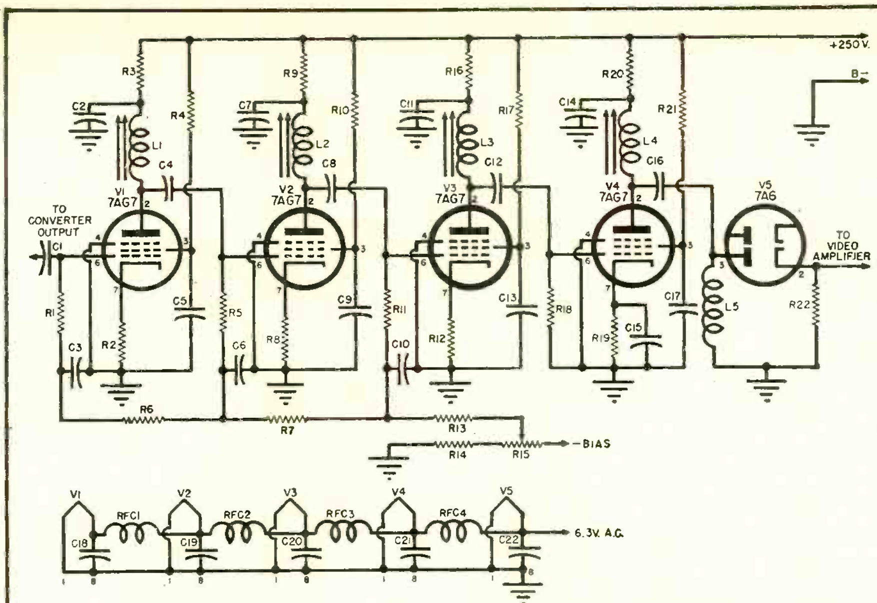


R_1—100.000 ohm, ½ w. res.
R_2, R_8, R_{12}—47 ohm, ½ w. res.
R_3, R_9, R_{16}, R_{20}—1000 ohm, ½ w. res.
R_4, R_{10} R_{17}, R_{21}—4700 ohm, ½ w. res.
R_5, R_6, R_7, R_{13}, R_{14}, R_{18}—10,000 ohm, ½ w. res.
R_{11}—3300 ohm, ½ w. res.
R_{15}—100,000 ohm pot.
R_{19}—220 ohm, ½ w. res.
R_{22}—2700 ohm, ½ w. res.
C_1, C_4, C_8, C_{12}, C_{16}—470 μμfd. mica cond.
C_2, C_3, C_5, C_6, C_7, C_9, C_{10}, C_{11}, C_{13}, C_{14}, C_{15}, C_{17}, C_{18}, C_{19}, C_{20}, C_{21}, C_{22}—1500 μμfd. mica cond.
L_1—2.1 μh. slug-tuned i.f. coil (25.4 mc.)
L_2—2.6 μh. slug-tuned i.f. coil (23.1 mc.)
L_3—2.9 μh. slug-tuned i.f. coil (22.1 mc.)
L_4—2.8 μh. slug-tuned i.f. coil (22.4 mc.)
L_5—100 μh. r.f. choke
RFC_1, RFC_2, RFC_3, RFC_4—.3 μh. r.f. choke
4—7AG7 tubes
1—7A6 tube.

Fig. 5. Schematic diagram of a video i.f. amplifier based on a staggered-quadruple design. The attenuation curve for this amplifier is shown in Fig. 4.

would be 14 for a 3 mc. bandwidth, 10.5 for a 4 mc. band, etc. From this it follows that an over-all gain of 1000 can be obtained with a bandwidth of 4.2 mc. using a staggered-triple amplifier made up of three such individual stages.

If it is desired to use several staggered-pairs or triples in cascade it is necessary to take into account the narrowing effect of many pairs or triples on the over-all bandwidth. For example, if in the design of a 6 stage amplifier made up of 3 staggered-pairs in cascade, the over-all bandwidth is to be 2 mc., then, from Table 2, each staggered-pair must be designed to have a bandwidth of 2/0.71 or 2.8 mc.

After determining the number of stages necessary to obtain the desired over-all gain and bandwidth, the frequency and bandwidth of each tuned circuit is found (Table 2). The inductance for each stage is calculated from the resonant frequency equation:

$$f = \frac{1}{2\pi\sqrt{LC}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Table 3. Data for use in designing amplifiers in which the ratio of over-all bandwith to center frequency is from .1 to .3.

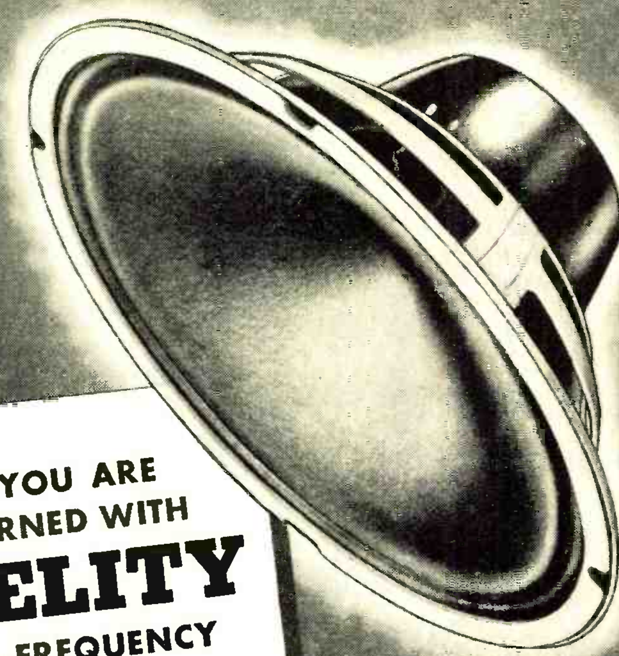
Center Frequency $= f_0 = \sqrt{f_1 f_2}$ where f_1 and f_2 are the lower and upper frequency limits of the passband.
Over-all bandwidth $= \Delta f$, and $\Delta f / f_0 = \delta$ (dissipation factor).

	Individual Single-Tuned Stages		
	Stages	Frequency	Dissipation Factor
Staggered-Pair	1	$f_0\ (1 + .35\delta)$	$.71\delta$
	2	$f_0/(1 + .35\delta)$	$.71\delta$
Staggered-Triple	1	$f_0\ (1 + .43\delta)$	$.5\delta$
	2	f_0	δ
	3	$f_0/(1 + .43\delta)$	$.5\delta$
Staggered-Quadruple	1	$f_0\ (1 + .46\delta)$	$.38\delta$
	2	$f_0\ (1 + .19\delta)$	$.92\delta$
	3	$f_0/(1 + .19\delta)$	$.92\delta$
	4	$f_0/(1 + .46\delta)$	$.38\delta$
Staggered-Quintuple	1	$f_0\ (1 + .48\delta)$	$.31\delta$
	2	$f_0\ (1 + .29\delta)$	$.81\delta$
	3	f_0	δ
	4	$f_0/(1 + .29\delta)$	$.81\delta$
	5	$f_0/(1 + .48\delta)$	$.31\delta$

From Wallman

Specify the GE 1201

DELUXE ALNICO 5 LOUDSPEAKER



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POWER

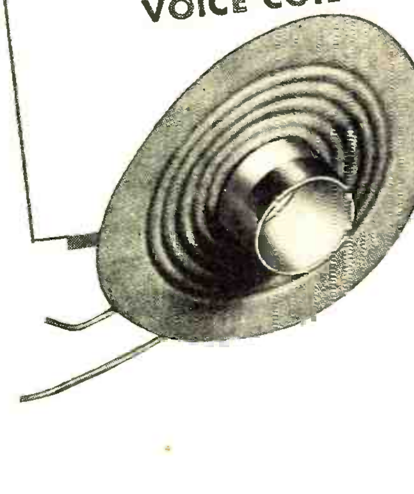
25 WATTS POWER HANDLING CAPACITY

WHEN YOU ARE CONCERNED WITH

FIDELITY

BROAD FREQUENCY CHARACTERISTIC 50—13,000 CYCLES

EQUIPPED WITH THE FAMOUS GENERAL ELECTRIC ALUMINUM FOIL BASE VOICE COIL



POWER, fidelity and a price that will amaze you for a speaker of this exceptionally high quality—it's the G-E 1201.

It's a wide range speaker with the frequency response stretched out at both ends of the curve to give intense realism, smooth, full lows and "high fidelity." A curvilinear cone is employed to provide this extended frequency response. Alnico 5, 14½ ounces of it, gives high sensitivity and smooth response.

The moving parts in the speaker assembly are ruggedly designed to take high power without damage to the speaker in any way.

Note: Frequency response 50—13,000 cycles.

For complete information on this outstanding speaker write: *General Electric Company, Electronics Park, Syracuse, New York.*

GENERAL GE ELECTRIC

169-G5

One of the many commercially available reactance calculators (e.g., Fig. 3) will prove useful in determining the values of L, X, and R which are necessary to complete the design. An example shown on the chart is for an individual stage in which the resonant frequency is 20 mc., C is 20 $\mu\mu$fd. and the desired bandwidth is 1.7 mc. The value of inductance read on the chart is 3.1 μh. The resistance load for a single-tuned stage of specified bandwidth is independent of the center frequency (from Eqt. 1) and is calculated as equal to the reactance of the tuned circuit capacitance at a frequency equivalent to the bandwidth. Referring to the chart, the design bandwidth is 1.7 mc. and, since $C = 20$ $\mu\mu$fd., R $(= X_c$ at 1.7 mc.) is 4500 ohms. The load resistor used in the tuned circuit will be higher in value than the calculated R because there are coil and tube losses in parallel with it which must be taken into account. If equipment is not readily available to measure coil *"Q"* and tube losses, they can be estimated, and the exact value of the resistor load determined by measuring the bandwidth of each stage after the amplifier is completed.

Staggered-Quadruple Video I.F. Amplifier

The circuit schematic for a video i.f. amplifier based on a staggered-quadruple design is shown in Fig. 5. The attenuation curve of the amplifier is shown in Fig. 4. The amplifier has a gain of more than 10,000. It was designed for an experimental television receiver using the intercarrier system of sound reception, and no traps were used at the adjacent and associated channels. The use of resonant traps tuned to frequencies near the pass-band of a stagger-tuned i.f. amplifier may necessitate slight changes in the design frequencies and resistor loads.

Gain control is applied to the first three stages of the amplifier by varying the control grid bias applied to the amplifier tubes. When the control grid bias of a high G_m tube is changed from its normal operating point to a point nearer cut-off, the input capacitance of the tube decreases and its input resistance increases. Since the tube input capacitance and input resistance are factors in determining the resonant frequency and bandwidth of each stage, the over-all bandwidth of the amplifier will change to some extent as the grid bias is varied to effect gain control. In order to minimize this change, unbypassed cathode resistors are employed in the stages to which gain control is applied.

Regeneration in the amplifier is reduced to a negligible amount by shielding each coil, and by inserting filter elements in the power leads to prevent feedback from stage-to-stage and overall. Small chokes are used in the filament leads in combination with bypass condensers at each socket to prevent feedback through filament circuits. Resistor-capacitor elements make up the filters in the plate, screen and grid bias leads.

The design outlined in Table 2 is not applicable to amplifiers in which the over-all *"Q"* is lower than 8 or 10. The staggered-quadruple described has a bandwidth of about 3 mc. and a center frequency of 24 mc., and this represents about the practical limit of usefulness of the design data listed in Table 2. More accurate data for use in designing amplifiers in which the ratio of over-all bandwidth to center frequency is from .1 to .3 is listed in Table 3.

REFERENCE

Wallman, Henry: M. I. T. RADIATION LABORATORY REPORT No. 524.

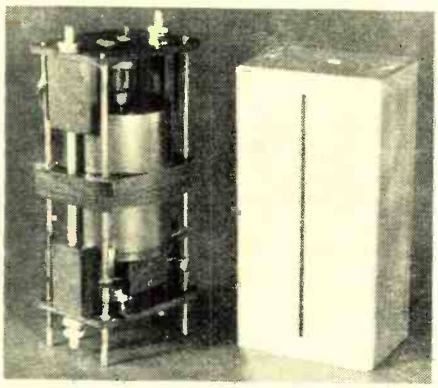
—30—

What's New in Radio

I. F. TRANSFORMER

The Hammarlund Manufacturing Company, Inc. has introduced the Type SS-50 double permeability tuned i.f. transformer which is designed to be operated in the region of 50 kc.

Because of its small size and extreme selectivity, the new transformer is especially suitable for use on an "outboard" i.f. strip. In conjunction with almost any reasonably stable communications receiver, it provides



razor sharp tuning and freedom from interference, according to the company.

A single i.f. stage using two of these transformers will provide the following attenuations: 6 db. at .8 kc. bandwidth; 20 db. at 1.4 kc. bandwidth; 40 db. at 2.8 kc. bandwidth; and 60 db. at 5 kc. bandwidth.

The transformer utilizes a pillar-type construction with heavy bakelite mounting platforms to support the coils rigidly. The coils are wound with litz wire and are encased in a powdered iron cup, assuring maximum "Q" and gain. The unit is shielded by an extruded aluminum shield can of special design. Over-all dimensions are 1 7/16" x 1 7/8" x 3 3/4".

The Hammarlund Manufacturing Company, Inc. will supply additional information on the Type SS-50 upon request. Address the company at 460 West 34th Street, New York 1, New York.

ROTARY BEAM CALCULATOR

A boon to amateurs has been provided by *Gordon Specialties Company* of Chicago in the form of a Rotary Beam Antenna Calculator which takes all the guesswork and mathematical computations from the job of figuring beam elements.

The calculator is in the form of a slide rule and operates easily. The frequency is set on the "A" scale and then on the "B" scale is read wavelength, director length, driven element length, and reflector length. On scale "C," the correct values for half wavelength and wavelength are given while scale "D" provides data on element spacing in feet opposite chosen wavelength spacing on scale "E."

These handy calculators are moderately priced. Further details can be secured by writing *Gordon Specialties Company,* 542 South Dearborn Street, Chicago 5, Illinois.

STACKED ARRAY

Ward Products Corporation has announced the new Model TV S-6 stacked array for television applications.

The new antenna is said to provide an improved signal for TV reception in remote installation and at poor signal locations. The improved signal strength is due to the stacking of two of the company's popular antenna models into a single unit with the correct half-wave spacing.

A special feature permits complete adjustability for orienting even though the bays are stacked. Pre-assembly of component parts saves installation time and expense.

Ward Products Corporation, 1523 East 45th Street, Cleveland 3, Ohio, will supply complete information on the TV S-6 upon request.

SIMPSON WAVEMETER

Simpson Electric Co. of Chicago has introduced a pocket-size instrument, the Model 380, wavemeter and modulation indicator.

Designed for use by hams, ships, police radio, etc., it is an all-purpose instrument that makes possible accurate monitoring of quality of transmission, spotting a transmitter at any point on the band desired, and keeping constant check on percentage modulation.

Durably encased in cast aluminum, the wavemeter also serves to plot antenna field patterns, indicate changes in actual radiated power output, and search the region between bands for harmonics and parasitics. Separate coils for the 10, 20, 40 and 80 meter bands, and hand-drawn calibration curves are supplied.

For coverage of all possible field strength conditions, the two foot long antenna provided with the instrument can be plugged into the panel jack provided. Range of the instrument covers bands up to and including 420 megacycles.

Simpson Electric Co., 5208 West Kinzie Street, Chicago, Illinois, will supply additional information on request.

"TELE-MARKER"

Of interest to television servicemen is *Vision Research Laboratories'* new "Tele-Marker" TM-100.

This unit is hand calibrated and furnishes a marker signal for use with a sweep generator in FM and television alignment.

Operating on the principle of an absorption trap, it requires no power

connections and provides a steady marker "pip" from 9.5 to 28 mc. The "Tele-Marker" can be used with any sweep generator and covers all FM and TV i.f. bands.

The unit is housed in a grey crackle cabinet with etched aluminum front plate and large dial with transparent pointer.

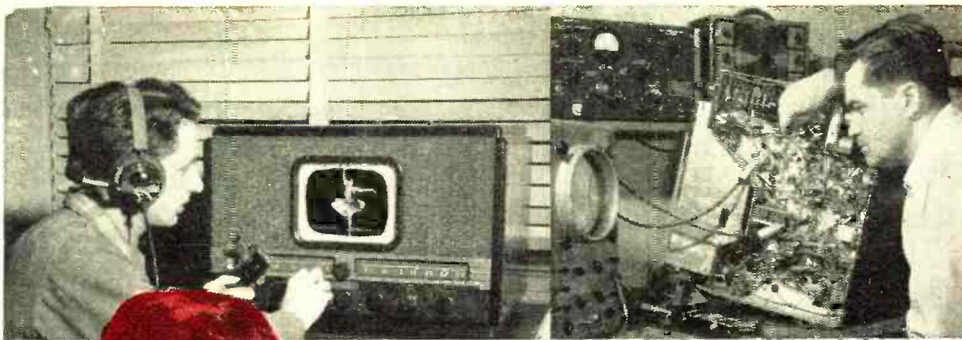
Further data on the TM-100 is available from *Vision Research Laboratories,* 87-50 Lefferts Boulevard, Richmond Hill, New York.

E-V SPEECH CLIPPER

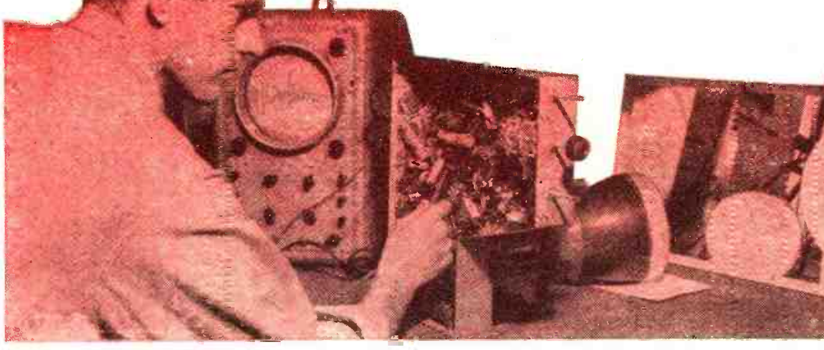
Electro-Voice, Inc. of Buchanan, Michigan is currently offering the *E-V* Model 1000 Speech Clipper for amateur and other communications applications.

The new unit is designed to increase the ratio of consonant-to-vowel intensity by clipping the peaks of the vowels while limiting the peaks of the consonants to that of the preset modulation percentage. This is said to add greatly to intelligibility in speech transmission, especially in the presence of high QRN or QRM.

The Speech Clipper operates directly from any high impedance microphone into the microphone input of a conventional speech amplifier. The gain of the speech clipping preamplifier is purposely held to unity at an average clipping value so no overload will occur in the main amplifier input stages.



DON'T BE A "PRE-WAR" MODEL!



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With CREI's Brand-New 100% Practical "On-the-Job" Course

"Television and FM Servicing"

For Every Serviceman Who Realizes He Must Keep Pace—or Be Left Behind

Don't Put it Off! Get Going Now with this "Down-to-Earth" Course that Will Equip You to Forge Ahead in the Servicing Field

The next twelve months will produce some of the greatest opportunities that have ever been offered to alert men in the Servicing Field.

It is the year for you to make the big decision. Either you are going to catch up with the new developments in the industry, or you are going to be passed by.

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Now . . . with the help of this new CREI streamlined Service course you can move ahead to unlimited opportunities in your chosen field. CREI has again taken the lead by offering a course so entirely new that for the first time in our twenty-one year history we can offer a down-to-earth course of training for servicemen. In offering this course at a popular price, CREI is enabling thousands of the "top third" now engaged in service work to enter the ultimate profitable field of television and FM installation and service.

This can be your big year! Don't waste another day. CREI has the answer to your future security in this new servicing course. Write today for complete information. The cost is *popular*. The terms are *easy*. The information is *free*. Write today.

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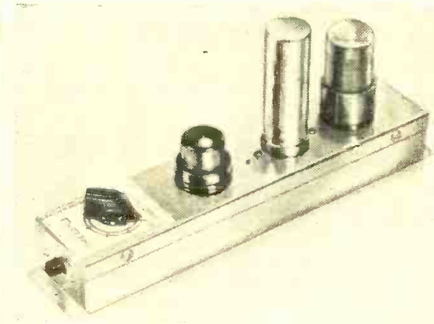
☐ I AM ENTITLED TO TRAINING UNDER G. I. BILL.

The filament and plate power is obtained from the main amplifier.

As clipped frequencies tend toward a square-wave output, it is necessary to suppress the generated harmonics. This is accomplished by a pi low-pass filter which provides attenuation of 24 db. on the upper skirt of the curve above 3000 c.p.s. The low frequencies, below 200 c.p.s., are reduced to give further improved speech energy distribution on the carrier. An "on-off" switch is provided for selection of conventional or clipped operation.



For further information write *Electro-Voice, Inc.,* Buchanan, Michigan, and ask for the "Speech Clipper Bulletin."

LOW-COST SCOPE

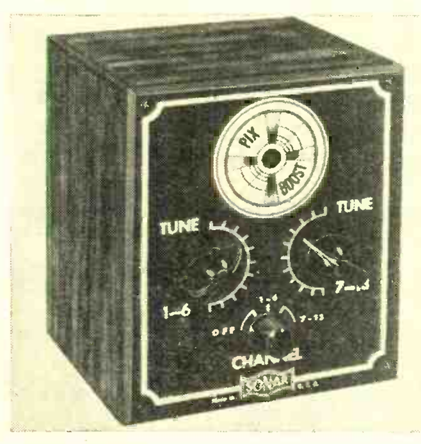
Telemark Electronics Corp. of Brooklyn is in production on a low-priced 5" oscilloscope which has been designed for radio and television servicing in addition to general laboratory work.

Vertical and horizontal amplifiers have a range from 5 cycles to 450 kc. with 50% attenuation at 800 kc. Deflection sensitivity at full gain is .18 r.m.s. volts per inch.

For complete details and prices write *Telemark Electronics Corp.,* 325 Troy Avenue, Brooklyn, New York.

"PIX BOOST"

Sonar Radio Corp. of Brooklyn, New York, has just introduced a high gain preamplifier, the "Pix Boost," designed to improve television reception in fringe areas and in locations where outdoor antennas are prohibited.



The unit uses three tubes, including rectifier, and provides coverage of all television channels in two steps—1 to

(*Continued on page* 149)

It's Only Natural
FOR RADIO MEN TO ASSEMBLE THEIR OWN

Heathkit ELECTRONIC SWITCH KIT
DOUBLES THE UTILITY OF ANY SCOPE

Gives two separately controllable traces with individual inputs on any scope.

See both the input and output traces, locate distortion, phase shift, etc., immediately.

Individual gain controls and positioning control. Coarse and fine sweeping rate controls. Complete Heathkit matches others, with 5 tubes, All metal parts are punched, formed and cadmium plated. Complete with tubes, all parts, detailed blueprints and instructions. Shipping Wt. 13 lbs.

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$34.50

- ★ Save ⅔ the cost.
- ★ Gain valuable knowledge.
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Heathkits are regular factory quality test equipment unassembled but with all forming, punching, calibrating and printing already completed.

HEATHKIT CONDENSER CHECKER KIT

A condenser checker anyone can afford to own. Measures capacity and leakage from .00001 to 1000 MFD on calibrated scales with test voltage up to 500 volts. No need for tables or multipliers. Reads resistance 500 ohms to 2 megohms. 110V 60 cycle transformer operated complete with rectifier and magic eye indicator tubes.

Easy quick assembly with clear detailed blueprints and instructions. Small convenient size 9" x 6" x 4¾". Weight 4 pounds. This is one of the handiest instruments in any service shop.

$19.50

Nothing ELSE TO BUY

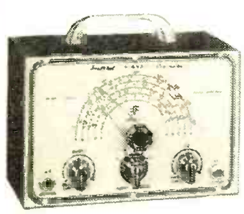
THE NEW HEATHKIT VACUUM TUBE VOLTMETER KIT

The most essential tool a radio man can have, now within the reach of his pocketbook. The Heathkit VTVM is equal in quality to instruments selling for $75.00 or more. Features 500 microamp meter, transformer power supply, 1% glass enclosed divider resistors, ceramic selector switches, 11 megohms input resistance, linear AC and DC scale, electronic AC reading RMS. Circuit uses 6SN7 in balanced bridge circuit, a 6H6 as AC rectifier and 6 x 5 as transformer power supply rectifier. Included is means of calibrating without standards. Average assembly time less than four pleasant hours and you have the most useful test instrument you will ever own. Ranges 0-3, 30, 100, 300, 1000 volts AC and DC. Ohmmeter has ranges of scale times 1, 100, 1000, 10M and 1 megohm, giving range .1 ohm to 1000 megohms. Complete with detailed instructions. Add postage for 8 lbs.

$24.50

Nothing ELSE TO BUY

HEATHKIT SIGNAL GENERATOR KIT



Every shop needs a good signal generator. The Heathkit fulfills every servicing need, fundamentals from 150 Kc. to 30 megacycles with strong harmonics over 100 megacycles covering the new television and FM bands. 110V 60 cycle transformer operated power supply.

400 cycle audio available for 30% modulation or audio testing. Uses 6SN7 as RF oscillator and audio amplifier. Complete kit has every part necessary and detailed blueprints and instructions enable the builder to assemble it in a few hours. Large easy to read calibration. Convenient size 9" x 6" x 4¾". Weight 4½ pounds.

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Reduces service time and greatly increases profits of any service shop. Uses crystal diode to follow signal from antenna to speaker. Locates faults immediately. Internal amplifier available for speaker testing and internal speaker available for amplifier testing. Connection for VTVM on panel allows visual tracing and gain measurements. Also tests phonograph pickups, microphones, PA systems, etc. Frequency range to 200 Mc. Complete ready to assemble. 110V 60 cycle transformer operated. Supplied with 3 tubes, diode probe, 2 color panel, all other parts. Easy to assemble, detailed blueprints and instructions.

Small portable 9" x 6" x 4¾". Wt. 6 pounds. Ideal for taking on service calls. Complete your service shop with this instrument.

$19.50

Nothing ELSE TO BUY

HEATHKIT SINE AND SQUARE WAVE AUDIO GENERATOR KIT

The ideal companion instrument to the Heathkit Oscilloscope. An Audio Generator with less than 1% distortion, high calibration accuracy, covering 20 to 20,000 cycles. Circuit is highly stable resistance capacity tuned circuit. Five tubes are used, a 6SJ7 and 6K6 in the oscillator circuit, a 6SL7 square wave clipper, a 6SN7 as a cathode follower output and 5Y3 as transformer power supply rectifier.

The square wave is of excellent shape between 100 and 5,000 cycles giving adequate range for all studio, FM and television amplifier testing.

Either sine or square wave available instantly at a toggle switch. Approximately 25V of sine AC available at 50,000 ohm output impedance. Output ± 1 db. from 20 to 20,000 cycles. Nothing else to buy. All metal parts are punched, formed and cadmium plated. Complete with tubes, all parts, detailed blueprints and instructions.

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TEST EQUIPMENT

New! HEATHKIT FM and TELEVISION SWEEP GENERATOR KIT

THE BASIC FM AND TELEVISION SERVICE INSTRUMENT . . . .

Features – ★ 5 Tube Circuit

★ Covers 2 Mc. to 226 Mc.
★ 110 V 60 cy transformer.
★ Supplies either RF or FM.
★ Variable sweep width 0 to App. 10 Mc.
★ Large calibrated dial.
★ Variable phasing control.
★ Sweep output for scope.
★ No band switching necessary.
★ Uses new miniature HF tubes.

At the lowest cost possible, anyone can now service FM and television receivers. The Heathkit sweep generator kit operates with oscilloscope and covers all necessary frequencies. A few pleasant hours assembling this kit puts any organization in position to share the profits of the FM and TV boom.

Every part supplied – grey crackle cabinet, two color calibrated panel, all metal parts punched, formed and plated. 5 tubes, complete detailed instructions for assembly and use. Shipping weight 6 lbs.

$24.50

Enjoy the profits now of this new field

HEATHKIT HIGH FIDELITY AMPLIFIER KIT

$14.95

Build this high fidelity amplifier and save two-thirds of the cost. Push pull output using 1619 tubes (military type 6L6's), two amplifier stages using a dual triode (6SN7), and a phase inverter give this amplifier a linear reproduction equal to amplifiers selling for ten times this price. Every part supplied; punched and formed chassis, transformers (including quality output to 3-8 ohm voice coil), tubes, controls, and complete instructions. Add postage for 20 lbs.

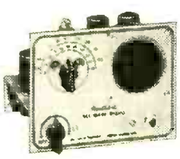
12" PM speakers for above $6.95

HEATHKIT 3-TUBE ALL-WAVE RADIO

110-volt AC operation

$8.75

An ideal way to learn radio. This kit is complete ready to assemble, with tubes and all other parts. Operates from AC. Simple, clear detailed instructions make this a good radio training course. Covers regular broadcasts and short wave bands. Plug-in coils. Regenerative circuit. Operates loud speaker.



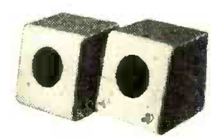
Add postage for 3 lbs.

HS 30 Headphones per set $1.00

2½" permanent magnet loudspeaker $1.95

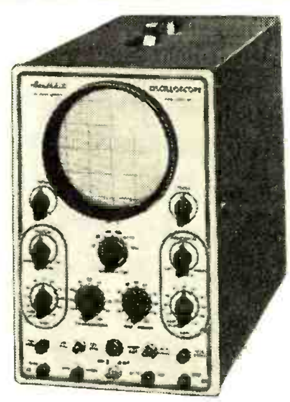
INTERPHONE 2-WAY CALL SYSTEM KIT

Ideal call and communication system for homes, offices, factories, stores, etc. Makes excellent electronic baby watcher, easy to assemble with every part supplied including simple instructions. Distance up to 1/5 mile. Operates from 110 V.A.C. 3 tubes, one master and one remote speaker. Shipping Weight 5 pounds.



$14.50

$39.50 *Nothing* ELSE TO BUY



NEW 1948 HEATHKIT 5" OSCILLOSCOPE KIT

A necessity for the newer servicing technique in FM and television at a price you can afford. The Heathkit is complete, beautiful two color panel, all metal parts punched, formed and plated and every part supplied. A pleasant evening's work and you have the most interesting piece of laboratory equipment available.

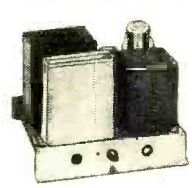
Check the features – large 5" 5BP1 tube, compensated vertical and horizontal amplifiers using 6SJ7's, 15 cycle to 30 M cycle sweep generator using 884 gas triode, 110V 60 cycle power transformer gives 1100 volts negative and 350 volts positive.

Convenient size 8½" x 13" high, 17" deep, weight only 26 pounds.

All controls on front panel with test voltage and ext. syn post. Complete with all tubes and detailed instructions. Shipping weight 35 pounds. Order today while surplus tubes make the price possible.

110 V. A.C. MILITARY RECEIVER POWER SUPPLY KIT

Ideal way to convert military sets. Supplies 24 Volts for filament – no wiring changes inside radio. Also supplies 250 V. D.C. plate voltage at 50-60 MA. Connections direct to dynamotor input. Complete with all parts and detailed instructions. Ship. Wt., 6 lbs. $5.95



$14.50

110 V. A.C. TRANSMITTER POWER SUPPLY KIT

For BC-645, 223, 522, 274N's, etc. Ideal for powering military transmitters. Supplies 500 to 600 Volts at 150 to 200 MA plate, 6.3 C.T. at 4 Amps, 6.3 at 4 Amps and 12V at 4 Amps. Can be combined to supply 3-6-9-12 or 24 Volts at 4 Amperes. Kit supplied complete with husky 110V 60 cycle power transformer, 5U4 rectifier, oil filled condensers, cased choke, punched chassis, and all other parts, including detailed instructions. Complete – nothing else to buy.

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DEPT. N . . . BENTON HARBOR, MICHIGAN

Buy HEATH SURPLUS *Now!*

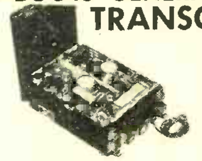
ALL QUANTITIES LIMITED SUBJECT TO PRIOR SALES

APN/1 RADIO ALTIMETERS

NO. 200. The last chance to get a complete new 14 tube radio altimeter. Contains 420 Mc. transmitter and receiver, power supply, range switches, two antennas, meter indicator, all plugs and instruction manual. This unit makes excellent amateur station as it is right in the band. Shipped in original export crate. Weight 87 lbs.

$34.50

BC 645 GENERAL ELECTRIC TRANSCEIVER



NO. 201. Complete 15 tube transmitter-receiver. Ideal for new citizens band 460 Mc. for communication between office and car, home, boat, etc. Conversion article in August ELECTRONICS Magazine. Brand new in original G.E. cartons with tubes. Add postage for 25 lbs.

$19.50 . . . 2 for $35.00

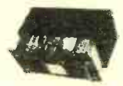
ACCESSORIES FOR BC 645
PE101C Dynamotor for car use .... $ 3.95
110V 60 Cycle Power Supply for home or office use ... $14.50

RCA NAVY COMMUNICATION RECEIVER

NO. 202. The last of these beautiful RCA sets. Covers 195 Kc. to 9.1 Mc. continuously. Supplied complete with tubes, control box, tuning unit, 24 Volt dynamotor, band change motor, plugs and circuit diagram. Superheterodyne circuit covers aircraft, broadcast, short wave, marine, foreign broadcasts. Has sharp or broad I.F.'s B.F.O., etc. Shpg. Wt. 30 lbs.

$29.50

G.E. BC 375 TUNING UNIT



NO. 203. Model TU10B covers 10 Mc. to 12.5 Mc. New complete with aluminum cabinet. The best buy of surplus. Over $30.00 worth of new variable condensers, coil, dials, switches, etc. Add postage for 20 lbs.

$2.49

PE 125 TRANSMITTER POWER SUPPLY

NO. 223. Operates from 12 to 24 Volts and supplies 500 Volts at 160 MA. Extremely rugged construction used in Army tanks. Complete with fuses — relays — filters, etc. Ideal for boats. Shipping Weight 73 lbs.

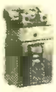
$12.95

T32 TABLE MICROPHONE

NO. 210. One of the Army's best. Built by Kellogg, ideal for factory call system, public address, amateur use. Brand new in original cartons. Add postage for 5 lbs.

$2.95

G.E. 50 AMP CIRCUIT BREAKER



$2.95 EACH— 3 FOR $7.50

NO. 204. New General Electric 50 Amp 220 Volt AC circuit breakers. 100 Amp when used on 110V. Add postage for 4 lbs.

MINIATURE ELECTRIC MOTOR

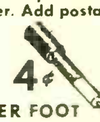
NO. 211. Tiny Delco motor only 1" x 1¼"x2" 10,000 RPM. Operates from 6 to 24 V. Excellent for models. Add postage for 1 lb.

$2.95

FM PUSH BUTTON TUNER

NO. 224. Brand new ten push button tuning assembly from Army FM receiver. Contains 4 gang 100 MMF silver plated tuning condenser. Add postage for 10 lbs. **$2.50** EACH

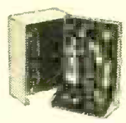
RG 8/U FLEXIBLE COAXIAL CABLE



4¢ PER FOOT

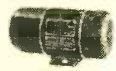
NO. 225. Standard television lead in 52 ohm. Any length up to 1,000 ft. Add for postage.

BC 347 AIRCRAFT INTERPHONE AMPLIFIER



NO. 205. Interphone amplifier contains 6F8 tube, Ouncer transformers, diagrams, etc. in aluminum cabinet. Add postage for 4 lbs. **$2.95**

P. E. 103 6 VOLT DYNAMOTOR



NO. 212. Dynamotor only from PE 103 power supply. Input 6 or 12 Volts, output 500 Volts at 160 MA. Brand new original cartons. Shipping Weight 29 lbs.

$5.95

POWER TRANSFORMER *Specials*

NO. 226. Primary 117V. 60 cycle. Secondaries supply 746 V.CT at 220 MA, 6.3V. at 4.5 A., and 5V. at 4A. Will handie 13 tube radio receivers. Supply is limited, order early. Shipping Weight 11 lbs. each.

$3.95 . . 3 for $9.95

274N COMMAND SET ACCESSORIES

NO. 238. 5" PM Speaker with output transformer matching headphone output $2.80
NO. 239. Dual receiver rack FT277A with connecting plugs $1.00
NO. 240. Single transmitter rack FT234A $1.00
NO. 241. Spline shaft for tuning command receivers. Allows use of regular tuning knob on BC 453-4-5 receivers .... $ .39

G. E. 1,000 VOLT 350 MA DYNAMOTOR

NO. 213. An ideal dynamotor for mobile operation in taxicabs, police cars, sound systems and amateur stations. Supplies above voltage from 12 Volts or 500V. at 350 MA from 6 Volts. Complete with starting relay, and fuses. New. Our Dynamotor A. Shipping Weight 72 lbs.

$5.95

OUTPUT TRANSFORMER

NO. 227. Push pull 6V6's to 6 - 8 ohm voice coil excellent characteristics, ... **3 for $1.95**

DM-36 DYNAMOTOR

NO. 215. Western Electric 24 Volt input, 220V. at 60 MA out. With filter assembly. Shipping Weight 6 lbs. **$2.95**

TRANSMITTER TRANSFORMER

NO. 228. The transformer for Transmitter Power Supply, 600 Volt at 200 MA and 4 Amp. filaments of 3 to 24 Volts. Also 5 Volts at 4 amperes for rectifier Shipping Weight 12 lbs. **$9.50**

BC 451 CONTROL BOX

NO. 236. Control box for 274N transmitters. Contains proper cw-voice switch, 4 channel switch, power switch, mike jack and telegraph key.
Add postage for 2 lbs. $1.95

G.E. BC 306 ANTENNA TUNING UNIT

NO. 231. Matches any aerial to 150 Watt transmitter, used on BC 375. Brand new. Add postage for 20 lbs.

$2.95

MILITARY POWER TRANSFORMERS

NO. 229. Convert your military receivers without rewiring the filament. "A" type supplies 500 VCT at 50 MA, 5V. at 2A. and 24V. at ½ A. "B" type supplies 500 VCT at 50 MA, 5V. at 2A. and 12V. at 1 Amp. State whether A or B type desired. Shipping Weight 4 lbs. **$2.95**

METER SPECIAL

NO. 237. Brand new DeJur Model 312 0-800 M.A. D.C. Square 3" 0-10 M.A. basic meter with built in shunt. Probably the best buy ever offered in a surplus meter. Shipping Weight 1 lb. **$2.95**

W.E. BC456 MODULATOR

NO. 217. Modulator from 274N command transmitters contains 3 husky relays, 3 tubes, VR150, 12J5 and 1625. Brand new. Add postage for 11 lbs.

$3.95

A-62 ARMY PHANTOM ANTENNA

NO. 206. Contains tuning condenser, coil, resistors, tuning dial, tuning indicator, binding posts, steel case, useful for building amateur transmitter. Add postage for 8 lbs. **$1.95**

BE 77 TELETYPE TEST SET

NO. 218. Contains zero center volt-milliammeter, switches, relays, voltage divider resistors, neon indicator, etc. Excellent foundation for radio tester. Shipping Weight 10 lbs.

$7.95

HOME WORKSHOP GRINDER KIT

NO. 230. Easily assembled 110V AC or DC ball bearing fully enclosed motor from Army surplus dynamotor. Purchaser to make simple changes and shaft extensions, detailed instructions and all parts supplied. Motor approximately 5,000 R.P.M. Ideal for tool-post grinder, flexible shaft tool, model drill press, saw. Shipping Weight 6 lbs.

$3.95

BENDIX MN 20E DIRECTION FINDER LOOP

NO. 219. Ring type loop excellent for use on boat or aircraft. Extremely rugged construction. Low impedance manual type. Add postage for 8 lbs. **$9.95** EACH

BENDIX MR9C COMPASS CONTROL UNIT

NO. 207. Tuning and control unit for Bendix MN 26 radio compasses contains tuning dial, band switch, crystal switch, AVC switch, volume control, fuses, phone jacks, etc. Shipping Weight 5 lbs. **$9.50**

HEARING AID HEADPHONES

NO. 216. The Army's best — eliminate flat ears and outside noise. Complete with transformer for conversion from low to high impedance. With cord and plug complete.
Add postage for 1 lb. **$1.00**

LP 18C DIRECTION FINDER LOOP

NO. 220. Motor driven streamline pod type loop used on automatic direction finders. Has Selsyn transmitter and motor, fits most military direction finders. Add postage for 20 lbs. .... **$14.50** EACH

BC731 CONTROL BOX

with Weston Model 476 AC Voltmeter

NO. 208. Excellent buy in motor control box. Size 8"x10"x5½". Contains Weston 0-150V. AC 3½" voltmeter, motor starting switch, 28 fuses all 30 Amp 110V. and 8 fuse holders. Fuses and holders alone worth the price. Shipping Weight 18 lbs. **$7.95**

KIT SPECIALS

POTENTIOMETERS
NO. 232. Kit of 10 excellent shaft type potentiometers good variety. **$1.95**

SOCKETS
NO. 233. Kit of 20 high quality sockets several different types. **$1.00**

TELEVISION CONDENSERS

NO. 221. Tobe triple .2 MFD 4000 V.D.C. Filter used on Army radar. Ideal filter for H.V. television set. Add postage for 3 lbs. **$3.95**

NO. 222. G.E. Pyranol capacitor .25 MFD 6000 V.D.C. Porcelain insulated, an outstanding buy for high voltage filters. Add postage for 3 lbs. **$3.95**

HOW TO ORDER • • • GIVE PART NUMBER AND DESCRIPTION . . . ADD POSTAGE FOR WEIGHT SHOWN. NO ORDERS UNDER $2.00 . . . WE WILL SHIP C.O.D.

The HEATH COMPANY

★ ★ ★ **DEPT. N . . . BENTON HARBOR, MICHIGAN**

Recording of Sound

(*Continued from page* 57)

treble boost is desirable. Bass boost may be obtained by using the circuit of Fig. 3A in the input grid circuit (with the dotted line connected to the input grid) or the same circuit in the plate load for a pentode input amplifier as shown in Fig. 6. Treble boost may be obtained by using the circuit of Fig. 4B in the following grid circuit or the circuit of Fig. 5A in the cathode circuit of the following tube. If treble attenuation is desired, the circuit of Fig. 4A may be used in the grid circuit of the output tube. With push-pull output stages the condenser C and resistor R_2 of Fig. 4A may be connected from grid to grid. These circuits are also shown in the schematic diagram Fig. 6.

In designing an amplifier having any of the bass or treble boost circuits described it must be remembered that the over-all gain of the amplifier is reduced at the reference frequency. Therefore, sufficient additional gain at the reference frequency must be included in the design to make up for that lost in the tone control circuits. The design of the amplifier must also provide for the additional gain which occurs at the boosted frequencies so that overloading, with resulting distortion at these frequencies, does not occur.

In the circuit of Fig. 6, a slight modification has been added in section *A* which was not covered in the description of Fig. 3A. In Fig. 3A the low frequency boost is obtained at the cost of high frequency attenuation which becomes quite extensive as the frequency approaches the high end of the audio band. The addition of the 100 μμfd. condenser and the 100,000 ohm resistor in the circuit limits the high frequency attenuation of this circuit to approximately the attenuation at the reference frequency. The resistor and condenser values used in this circuit are found by calculation of admittances and impedances at each of several frequencies in the band desired, including the reference frequency.

These calculations, using the values assigned, indicate that the signal applied to the grid of the input tube, assuming constant voltage from the pickup, will be approximately 61% at 50 c.p.s., 33% at 100 c.p.s., 21.5% at 400 c.p.s., and 21.8% at 4000 c.p.s.

Table 1. Attenuation of Section D in Fig. 6

Frequency (in c.p.s)	Over-all Gain	Attenuation of Sec. D. Max.	Min
50	.61 x 164 x .5 x 80 x 1		4000
100	.33 x 159 x .503 x 80 x 1	2115	2115
400	.215 x 145 x .542 x 80 x 1		1352
400	.215 x 145 x .542 x 80 x .95	1287	
4000	.218 x 120 x .865 x 80 x 1		1810
4000	.218 x 120 x .865 x 80 x .35	633	

Sections *B* and *C* in Fig. 6 both affect the impedance of the plate load and therefore the gain of the input Type 7C7 tube. The gain at each of several frequencies in the desired band was obtained by calculating the plate load impedance at each frequency and interpolating the gain from the *R-C* data given in the new *Sylvania* Technical Manual. At frequencies of 50, 100, 400, and 4000 cycles-per-second the gain of the input stage (assuming constant grid signal) will be approximately 164, 159, 145, and 120 respectively.

Section *D* has been used in the circuit of Fig. 6 to illustrate the most common form of high frequency attenuation circuit. The condenser value has been chosen to give a negligible effect at the reference frequency when the resistance, R_{14}, is set at zero. The plate resistor, R_{12}, for the second amplifier has been assigned a relatively low value so that the tube operation approximates a constant current generator. Under these conditions the voltage across the total plate impedance consisting of C_{12}, R_{12}, R_{13}, and the tube R_p in parallel is equal to IZ with Z variable with frequency. Using the values assigned, the signal reaching the output tube grid will approximate 100%, 100%, 95%, 88%, and 35% of the low frequency value at the frequencies of 50, 100, 400, 800, and 4000 cycles-per-second when the 1 megohm control is set for maximum high frequency attenuation. When the 1 megohm tone control resistance is all in the circuit no appreciable high frequency attenuation will be introduced and the response will be that caused by sections *A*, *B*, and *C*.

By summarizing the results described above it is possible to plot the approximate response curve of the circuit in Fig. 6 from the pickup to the grid of the output tube from calculations of the over-all gain at the several frequencies. See table above.

With 400 c.p.s. as the reference the response with minimum attenuation in section *D* would be + 9.4 db., + 3.9 db., 0, and + 2.54 db. at frequencies of 50, 100, 400, and 4000 cycles per second. With section *D* set for maximum high frequency attenuation the response at the same frequencies would be + 9.83 db., + 4.32 db., 0, and —6.127 db. respectively.

In all of the above calculations and results reported, all effects of tube and stray capacities have been neglected and it has been assumed that the output from the pickup is constant over the frequency range. Since these conditions do not exist in actual practice the circuit shown in Fig. 6 should be accepted as a basic illustration of the circuits used for tone compensation and control systems, and may require some modification if these exact characteristics are desired in a practical design.

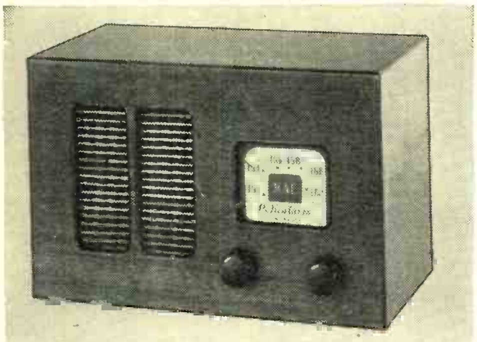
REFERENCE

Sylvania News, Vol. 15, No. 1.

(*To be continued*)

IT'S SATISFACTION— or YOUR MONEY BACK at— R & M RADIO

Policalarm FM RADIO



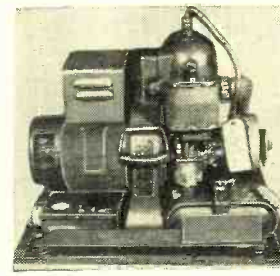
152 mc to 162 mc FM

$39.50

Here's what you've been looking for. Ideal table or desk model radio that receives 152 mc to 162 mc FM, covering police, fire dept., radio telephone, inter-urban telephone and taxi two-way radio. Makes a swell monitor for cab operation.

The Famous "PUTT-PUTT"

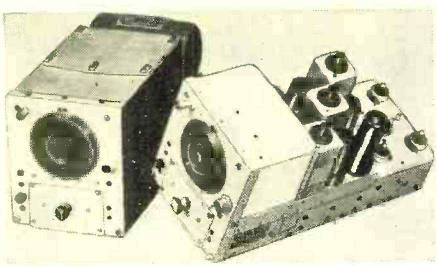
Gasoline Generator (HRU-28)



28 - 32 volts D. C.

YOUR PRICE ONLY................ $74.50

Single cylinder, 2-cycle gasoline engine with generator that is rated at 2,000 watts direct current, 70 amps. Has unlimited use around a farm; useful as field day power supply. More literature upon request.

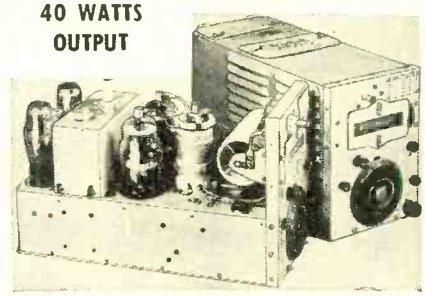


SUPER-HET RECEIVERS

These receivers are used but in excellent condition. Hurry, only a few left. Makes a FB with our 6 volt dynamotor for mobile use, etc. Ideal stand-by or companion for your shack.

75 meter receiver BC-454
40 meter receiver BC-455 **$6.95**

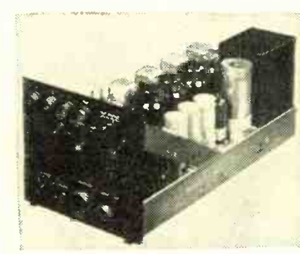
40 WATTS OUTPUT



These famous VFO Drivers available:

BC-457 75 meters with slight conversion........$7.95 ea.
BC-458 40 meters with slight conversion........$7.95 ea.

These transmitters are used but in good condition. Only a few left, so order TODAY WHILE THEY LAST.

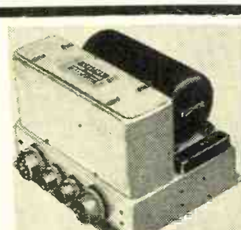


APN-4 RCVR — 'SCOPE POWER SUPPLY

4 switch-selected screw-driver tuned RF channels; IF freq. 1050 kc, band-width 45-60 kc; RF freq. 16 2000 kc. Tubes: (2) 2Y2, (3) 6B4, (4) 6SK7, (1) ea. 5U4, 6SU7, 6SA7, 6H6, VR150. Makes fixed tuner for med. freq. police calls or PA system. Has power supply for 5" scope, with 400 cycle trans. Electronic-controlled low v. supply; delivers 260 vdc. 150 mils reg. to .01%. Power supply alone worth more than price........ **$12.50**

SPEECH AMPLIFIER

Modulator for Transmitter



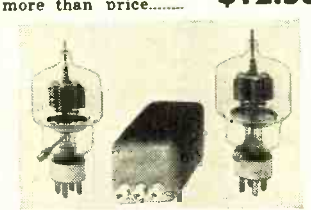
High Volt. DC Power Supply Model unit, BC-456-A or V with dynamotor DM-33-A, plugs and tubes. Approx. wt. 17 lbs. Tube line-up, 12J5GT, 1625, VR150, and many other parts make this ideal purchase for spare parts alone. Diagram furnished. **$3.75**

HEADPHONE EXTENSION CORDS..........25c

Approx. 72" long, rubber cov., with JK-26 & PL-55 plugs

HEADPHONE ADAPTERS MC-385..........30c
(4 for $1)

From high to low impedance, 4000 to 600 ohms; contains matching transformer.



GOOD FOR 2 KW.

SPECIAL COMBINATION

Two 304-TL's; 1 filament transformer, primary 115 VAC, secondary No. 1, 5 v. at 12 amps; secondary No. 2, 5 v. at 12 amps. Use filaments in series or parallel.

Individual Price:

304-TL $2.95
304-TL 2.95
Fil. Transformer.......... 9.95

ALL FOR $14.50

COMBINATION BROADCAST RECEIVER & INTERCOM SYSTEM

LIMITED QUANTITY

Price includes radio-master station, 1 remote, and 50 feet of wire

BRAND NEW $29.95

Standard broadcast (6 tube superhet) receiver, plus home or office *intercommunication system*, walnut finish, modern design table model; high quality components; uses one to four remote stations. Any station can call the master while radio is playing; call can be returned to any remote. 115 v. AC; original list was $84.50 (with 4 remotes). Additional remote stations, $3.95 each.

6-VOLT DYNAMOTOR

Ideal for Mobile Operation

(300 VDC 80 mills) 6 vol DC input
(250 VDC 100 mills) 4 to 5 amps.

$7.95

Just the dynamotor for that glove compartment 10 meter job. Sturdy, well made. 4"x 4"x 5" mounting space.

Write for Dynamotor Listing

TUBES! TUBES! TUBES!

BRAND NEW! ORIGINAL CARTONS!

12A6	69c	OD3-/VR150	75c
12SR7	69c	6AK5	79c
12K8	69c	12SA7	69c
12SK7	69c	77	59c
12SF7	69c	78	59c
1625	89c	89	59c
1626	79c	38322	$1.19
1629	89c	6SN7	89c
12J5-GT	69c	6SL7	89c

TUBES IN BULK

6SJ7	39c	10-Y	39c
6SJ7	39c	211	49c
6K8	39c		

Write for quantity discount on purchases of 50 or more tubes. MINIMUM TUBE ORDER. $3.00

RACKS & MOUNTS

SCR-274

Dual Trans. Rack FT226 and Mount $2.25
Triple Receiver Rack FT220 and Mount $2.75
BC348 Rec. Rack, Mount and Plug $2.00

WIRE

Hook-up Wire J-ANC-48

	per ft.
# 4 Stranded	.095
#14 Stranded	.015
#16 Stranded	.013
#18 Stranded	.01
#20 Stranded	.01
#16 solid. with insulation	.015
#14 bare copper. 1 lb. spools. per lb.	75c

52 Ohm *Coax Cable*
RG5U and RG8U, $48.00 per M or $5.50 per C.

RARE METER BARGAIN

Three inch double 100 microamp meter, two separate 100 microamp movements, each needle has 50° arc. Scale reads 0 to 3.5 each measured division subdivided into ten parts. **$7.50**

High Voltage FILTER CONDENSER

For Television Set Builders

3000 VDC tested. 3 section 1 mfd ea. Paper and oil dielectric. Separate connectors for pos. or neg. on top of can. Bottom bracket mounts attached.
2½"x3¼"x4¾" mounting space. **$4.89**

We Agree With WARE-MALLORY!

It's easier to tune the inductance.

We have a continuously tuning inductance coil, when used in conjunction with a 50 mmfd vacuum condenser, which will tune the entire range from 3500 kc to 30,000 kc. This coil uses a running tap controlled from a knob on the front, a vernier logging dial and isolantite insulation.

- Variable inductance tuner
- 2 ea. 50 mmfd vacuum condensers—series for 10 and 20 meters, parallel for 40 and 80 meters.
- Continuous tuning without changing coils.
- 10 through 80 meters. • Efficiency PLUS!
- Eliminate costly parts. • Reduce trans. bulk.

KIT of 1 inductance tuner and 2 vacuum condensers, ONLY **$4.95**

MOBILE WHIP ANTENNA

(for dipole) **$2.89**

Solid spring steel; nickel plated; has broad response, antenna matching base.
TWO for **$4.50**

BEAM ROTOR & SELSYN INDICATOR

FOR 2 or 6 METER **$12.95** *both for*

Plenty of torque for 2 or 6 meter beam; 360 degree indication with selsyn ind.; slip rings and loop assembly to connect feed line for 360 degree rotation; instructions for wiring and parts list FREE with each set.

LP-21 loop only, $8.95   1-82 selsyn indicator, $4.90

• SAVE C.O.D. CHARGES and speed your order by remitting in full or 25% deposit. Please don't send money for postage; we ship "transportation charges collect". These prices supersede all previous prices. Write every month for BARGAIN BULLETIN.

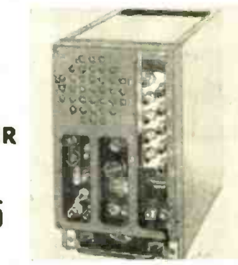
ALL EQUIPMENT F.O.B.

25 WATT FM-TRANSMITTER-RECEIVER

$29.50 ***for special combination***

For mobile or fixed station use; easy conversion to 10 and 11 meters.

Schematic diagram and information—how to convert to 110 v. AC and amateur use.



BC-603 RECEIVER *(alone)*

$14.95

10 tube, superhet FM receiver; Foster Seely discriminator, 10 channel; pretuned, push-button selector; optional manual tuning; adjustable squelch control; speaker mounted in receiver; freq. range 20 to 27.0 mc. Small change in RF trimmers will cover 10 & 11 meter bands. POWER REQUIREMENTS — Receiver 260-280 v. at .08 amps DC, 14 v. at 3.5 amps. AC.

BC-604 TRANSMITTER

(alone) **$19.50**

10 channel, crystal controlled, selected by push button. Xmtr. has 7 1619 (2.5v 6L6's) for exciter and FM modulator; 1 1624 (2.5v. 807): final amplified 35 watts; crystal oven for 10 crystals, freq. range 20—27.9 mc. 1 0-100 MA meter measures grid, plate, and ant. current. Price excludes crystals.
POWER REQUIREMENTS — Transmitter 500 VDC at .22 amps. DC, 14 VAC at 4 amps. AC.

12 v. Dynamotor for receiver $9.95
12 v. Dynamotor for Xmtr. $12.50

1 box of 80 crystals for above, when purchased with trans., $10.00 per set.

TRANSFORMERS

for conversion of SCR-274-N trans. & Rec. to 115v. AC

#1 POWER XMTR: Pri—115v 60 cycle; sec—500 CT @ .06 amp.; 24v @ ½ amp. Your cost only $3.90
#2 FILAMENT: Pri—115v 60 cycle; Sec. 1—14v @ 7½ amp.; sec. 2—14v @ 7½ amp. Series 28v @ 7½v.; parallel 14v @ 15 amp. Your cost only $4.50
#3 FILAMENT: Pri—115v 60 cycle; Sec. 24v. @ 2 amp. Your cost only $2.25

BE SURE TO WRITE FOR BARGAIN BULLETIN

Name ....
Address ....
City ....
Zone .... State ....

R & M RADIO COMPANY

1426 N. QUINCY ST. DEPT. RN-108 ARLINGTON, VIRGINIA

AFCA NEWS

ARMED FORCES COMMUNICATIONS ASSOCIATION

Annual Meeting

Secretary of Navy John L. Sullivan has informed AFCA President David Sarnoff that the Navy will sponsor the 1949 annual meeting of the Association and that it prefers Washington, D.C. as the site. In all probability, side trips to the Naval Air Station at Patuxent and to the Naval Academy, and their radio station at Annapolis, will be featured. This meeting is expected to be the best the Association has had and should attract members from all over the country to see the exhibition of the latest in Naval communications equipment. In order to be eligible to attend, individuals must join the Association before April 1, 1949, and be members of good standing on that date.

Publicity Chairman

Orrin E. Dunlap, Jr., Vice President in Charge of Advertising and Publicity for *RCA*, has been named Chairman of the AFCA National Advisory Committee on Publicity.

British CSO Visits AFCA

Major General C. H. H. Vulliamy, CBE, DSO, Director of Signals, British War Office, conferred with officials of AFCA at national headquarters in Washington. He praised the work and purposes of the Association and expressed hopes of forming a similar association in Britain.

Chapter Notes

Seattle

A dinner meeting of the Seattle Chapter was held on June 3rd at the American Legion Hall. The program featured two speakers: Mr. D. M. Ward, Communication Radar Engineer, who spoke on "Development in Micro-Wave Radar Equipment"; and Mr. Phil Duryee, of the *Radio Telephone Service Company,* whose subject was "Application and Operational Characteristics, High Frequency Mobile Equipment."

Washington

A program designed to make the Washington chapter a robust model for the entire association has been outlined in an aggressive proposal by the chapter's president, Frederick G. Macarow, general manager and vice-president of the *Chesapeake & Potomac Telephone Company.*

At a luncheon meeting of the chapter's officers and executive committee, Mr. Macarow presented for consideration definite steps to be taken toward stimulating chapter growth, and toward developing types of meetings which would attract present members. The chapter president pointed out that with the flow of industrial representatives through Washington, and with the proximity of the Services' communications headquarters, and other government communications agencies, the Washington AFCA chapter is in a naturally strategic position to be the leader in AFCA promotion.

One of the chapter's vice-presidents, A. K. Mitchell, Washington *Western Union* superintendent, enlivened the meeting with a vigorous attack on the overemphasis of the military in the association. As an example of that trend, he said, the national meetings have been virtually Service shows with industry playing a very minor role.

A suggestion that AFCA meetings be combined with meetings of other communications groups, such as the IRE, came from a guest at the luncheon, Roland Davies, editor and publisher of *Telecommunications Reports,* and chairman of the AFCA's publicity committee. Mr. Davies held that by so combining meetings good turnouts would be practically assured for invited speakers, and at the same time the other groups would become better acquainted with AFCA.

State College of Washington

A Student Chapter has recently been formed at the State College of Washington. Chapter officers have been elected as follows: President—Terrence S. Meade; First Vice President—Robert C. Nealey; Second Vice President—Jay W. Atherton; Secretary-Treasurer—Stuart W. McElhenny.

Other student chapters of AFCA are located at Cornell University, New York University, Oklahoma A&M College, Texas Tech, and the University of California.

—30—

"But Lady, you take my sign too literally!"

Follow the "ARROW" to TOP VALUES!

T-26/APT-2

Radar jamming transmitter, 450-710 mc. Heising amp.-mod. by noise from 931A photo-tube. Output 3 to 7 watts. All controls on front panel. 2—6AC7 and 1—6AG7 video circuit supply random noise, with pass band of 20 kc. to 4 mc. to the 807 mod. 2—368AS tubes in a push-pull ¼-wave transmission-line osc. circuit supply the RF. Power furnished by 2—5R4GY and 1—2X2 tube. Contains 27vdc blower. Input 27vdc and 75-85v or 105-125v. 400 to 2600 cy. Brand new in original export case, with all tubes and handbook. Don't let this get away from you—Order today! At only **$9.95**

T-27/APT-3

Another noise-modulated radar jamming transmitter, companion to the APT-2. 85-135 mc. Power output 9 to 12 watts. M.O.P.A. type transmitter. Built with 4 demountable sub-chassis: R.F. Osc.; R.F. Amp.; photoelectric noise source, video amplifier and modulator; power supply. Tubes are: 1—829B RF Amp., 1—832 RF Osc., 1—931A phototube, 2—6AC7 video amp. 1—6AG7 mod., 1—5R4GY rectifier. Brand new, in original export case, with all tubes and handbook **$10.95**

AN/APT5 ULTRA HIGH-FREQUENCY TRANSMITTER
Brand New

400-1500 Megacycle Transmitter, made for U.S. Govt., complete with the following tubes: 2—6AC7, 1—6L6, 2—829, 1—931A, 1—6AG7, 1—522 Ultra high freq. tube. Complete with high freq. cavity, 1 blower to cool the 522, 1 time delay relay, 2 filament trans. cond. and many other component parts for ultra high frequency work. It has a frequency checker, complete Lecher wires, with slider and sensitive bulb for checking the wave length. Operates on 115V. AC for filaments only. Does not include any plate supply. The tubes alone are worth many times more than what we are selling the complete transmitter for. Packed in original case—contains instruction book. Wt. 118 lbs. ONLY **$49.95**

MOBILE—VHF—RECEIVER
Brand New

Self-contained HF radio receiver and homing equipment used for the reception of a double AM carrier in the freq. range of 234 to 258 mc: operates on 26VDC; includes 10 tubes such as 9001 and 6AK5. A REAL BUY........ **$6.95**

ALTIMETER TRANSCEIVER RT-7/APN-1

Frequency 418-462 Mc FM, with 14 tubes: 3—12SJ7; 4—12SH7; 2—12H6; 1—VR150; 2—955 2—9004; 27 V. Dynamotor, used in working condition **$7.95**

RECEIVER-POWER SUPPLY UNIT

For the APN-4 indicator; complete with 16 tubes, 110 V. 400 cycles. BRAND NEW **$10.95**

AN18/APT-10

Pre-amplifier Model K-1, designed to raise output level of magnetic type microphone, complete with 2 tubes 6SL7GT and 28D7 and hand switch, brand new in original cartons.

Each **$1.95** 3 for **$5.00**

TORQUE AMPLIFIER AM 19/APA-14

Provides amplification of information from Flux Gate Compass to drive torque unit and differential gear of azimuth differential unit CN-4/APA-14. Input 26 VDC and 115 V; 400 cy. Part of stabilization assembly AN/APA-14. With plugs, 3—6SN7-GT; 2—6H6, transformer, oil-filled condensers, pots, etc. EXCELLENT CONDITION **$2.95**

SELSYN INDICATORS

For use with beam rotators for indication of direction of beam. Operate from 15-24V. 60 cycle AC supply. Small model, 3 inch diameter, only **$2.45**

Large model, 5 inch diameter, only...... **4.95**

400 CYCLE AUTOSYN MOTOR

Ideal for indicating direction of antenna systems—BRAND NEW .... each **$2.95**

COMMAND SET SCR-274 MEDIUM FREQUENCY

Excellent condition **$29.95**

Complete installation with 2 transmitters, 3 receivers, racks, tubes, crystals control box and plugs.

COMMAND RECEIVERS and TRANSMITTERS
(274N Series)—Complete with Tubes

T-20/ARC-5 Same Freq. BC-457 .... NEW **$5.95**

BC-456 MODULATOR. Brand New.... **2.95**

REMOTE CONTROL BOX

BC-450—Triple receiver control box, can be modified to a FT-260 local control for command receivers, NEW **$1.95**

RADIO RECEIVER

Designed to receive A-N beam signals. 24-28 VDC 21.6 watts. Tube complement: 14H7 or 14A7, RF amplifier; 14H7 or 14J7, mixer; 14A7 or 14H7, IF amplifier; 14R7, detector and 1st audio amplifier, 28D7, output amplifier. 195 to 420 kc. 4" high x 4" wide x 6⅝" long—wt. 3 lbs., 4 oz. BRAND NEW in original carton........ **$5.95**

ANTENNA THERMO-COUPLE METER

BC-442; 0-10 amps. with extra relay and 50 MMFD 5000 Volt condenser . . . used with command transmitters. BRAND NEW........ **$1.95**

C-1 AUTO PILOT AMPLIFIER

The complete amplifier includes one rect. 7Y4, 3—7F7's for amplification and control, 3—7N7's for signal discrimination, 1 power transformer, 6 relays, 4 control pots, chokes, condensers, etc. Convert for use on radio controlled models, doors, etc. Operates from 24 V. DC. Size: 9¼x6¼x7-5/7". Complete. Used—good condition ONLY **$4.95**

SELSYN METER TO INDICATE POSITION C-71A/APQ-13

Contains 2" meter, FS-100uA, Weston 506, 0-300 V, 0-30 MA, with 6 precision resistors, as external multipliers and shunts; toggle switches, push switches, rotary switch, pots, knobs, etc. GOOD CONDITION **$4.95**

SCR-522 CONTROL UNIT

BC-602-B, brand new, export packed, 1 "off" push-button switch, 4 channel-selecting push-button switches, 5 pilot lamp assemblies with pilot bulbs and film dimmer and lever switch with locking control. With Schematic **98c**

R-5/ARN-7 COMPASS RECEIVER

Very late model ADF receiver. Includes broadcast band. Frequency 100 to 1750 kc. in 4 bands. 5-gang tuning capacitor. With 15 tubes: 4—6K7, 1—6L7, 1—6J5, 2—6B8, 2—6F6, 1—6N7, 1—6SC7, 2—2051, 1—5Z4. SCHEMATIC FURNISHED. Like new, SPECIAL **$29.95**

A KIT BUY!

Photoflash kit and power supply includes all 12VDC and two Stroboflash lamps and reflectors. BRAND NEW.... **$49.95**

Stroboflash lamps and reflectors, brand new—2 for $15.95

RECEIVER-TRANSMITTER BC-620

FM Mobile Transmitter-Receiver operates from 6 volt vibrapack, 20.0 to 27.9 Mc; easily converted to 10-meter freq. 28-29.7 Mc.

New $14.95
Used 9.95

OUTPUT TRANSFORMER: 10 assorted ouncers for $1.89

2-METER TRANSMITTER SCOOP!

The famous AN/ARC-5 VHF Transmitter (T-23/ARC-5), brand new 100-156 mc but less tubes, crystals, and the holders for the 832A tubes. Furnished with complete schematic. 4 Xtal-controlled channels selected by 3 motor-driven turrets. Motor can be spun by hand for manual band switching or driven by low-power rectifier power pack. Tubes required are 2—1625 and 2—832A. Don't pass this up at ONLY........ **$4.95**

ARC 4 TRANSMITTER and RECEIVER

For operation VHF frequencies in range of 140-144 mc. Four channel crystal controlled, manufactured by Western Electric—24V operation. Complete with crystal and dynamotor. Used. Good condition........ **$19.95**

PE-117 UNIVERSAL POWER SUPPLY

6 or 12 volt input; output 145 volts and 90 volts; less vibrator, voltage regulator and rectifier tube; ideal mobile power supply unit; excellent condition, each **$2.95**

DYNAMOTORS AND INVERTERS

BD-77, Dyn. Unit 14v in, 100v, 350 ma out, with relay fuse box and filters........ $5.75
DM-21 Dynamotor; Part of BC-312 and BC-314 14v in, 235v, 100 ma out........ $2.47
PE-101-C Dyn. Unit: 12 or 24v in, outputs 800v, 20 ma, 400v, 135 ma, 9v, 1.1A........ $2.75
PE-55Dyn. Unit: 12v or 24v in, either 16 or 25 amp, 500v out, either 200 or 400 ma....$3.75
PE-206 Inverter Unit; rotary converter, 28v in, 80v at 500 VA, 800 cy. out........ $3.95
PE-103 Dynamotor, used $6.95
DM32A—each........95c 3 for $2.00

OUTPUT TRANSFORMER

Hi-Fi; used is Scott-made Navy receiver. Fully potted. Pri. 5000 ohms, output secondary 600 ohms CT, inverse-feedback secondary 60 ohms CT. ONLY **$1.49**

GE METER

0-10 amps., DC .... each **$2.29**

R-89/ARN-5A

Glide path receiver. Crystal control of local oscillator. 332-335 mc, complete with relays, 7—6AJ5, 1—12SR7, 2—12SN7, 1—28D7, and 3 crystals: 6497 kc, 6522 kc, 6547 kc. 90-cycle band-pass and 150-cycle band-pass filters, excellent for making an intermodulation checker. Beautiful cabinet and chassis as foundation for many interesting experimental and construction projects. Broad pass band on 20.7 mc IF's ideal for television. Schematic furnished.

Used, excellent. Only........ **$6.45**
New $12.95

BC-733-D

Localizer receiver of the blind landing system. Companion to the glide path receiver. Also contains 90 and 150 cycle band-pass filters. 108.3 to 110.3 mc. by relay selection of crystals in the local oscillator. Wide pass-band on 6.9 mc IF's ideal for FM. Has a wonderful AVC system using rectified output of an RF oscillator as power supply for 100 volt DC bias. With relays, crystals, and 10 tubes: 3—717A, 2—12SG7, 1—12SQ7, 1—12A6, 1—12-AH7, 2—12SR7. Schematic furnished!

Condition: Used, excellent, only........ **$3.95**
New $9.95

VEEDER-ROOT METER AND CASE

Counts up to 1000. Each **59c**

HAND-TYPE MICROPHONE RS-38

Carbon type, with PL-68 plug, brand new...$1.95
Used 1.00

BC-645 TRANSMITTER-RECEIVER

BRAND NEW . . . 15 tubes interrogator-transmitter designed for airborne use. 435 to 500MC frequency range. With some modifications the set can be used for 2-way communication, voice or code, on the following bands: ham band: 420-450mc; fixed and mobile: 450-460mc; citizens radio band: 460-470mc; television experimental: 470-500mc; complete with all tubes, including WE Doorknob tube. Size 10½x13½x4⅜". Net wt. only 25 lbs. Your cost........only **$9.95**

DYNAMOTOR FOR ABOVE Model PE-101-C $2.75

RADIO PARTS

Assorted Bypass Condensers, 400-600WV ....100 for **$4.29**
100 Resistors ⅛ to 1 watt........ **95c**
Electrolytic condensers 50-30, 150 Volt........10 for **$2.89**
½ and 2 Meg. Volume Controls 1" shaft with switch, each 39c 10 for.. **3.00**
½ Meg. Volume Controls 1" shaft without switch. 10 for.... **1.95**
Crystal Pick-up. new light wt........each **1.79**
Heavy Duty 12" PM Speaker. NEW ....each **5.95**

All shipments F.O.B. Chicago or Los Angeles. 20% Deposit required on all orders. Minimum order accepted $5.00.
California and Illinois residents, please add regular state sales tax to your remittance.

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Follow the "ARROW" to TOP VALUES!

BLOWER MOTOR

24V AC or DC, small portable with fan, ideal for defroster or ventilator unit, 17,000 RPM, BRAND NEW........ **$1.95**

THE LAZIEST Q-5'er

FL-30, used when flying radio range. RANGE-VOICE-BOTH switch selects 1020 pass ONLY, or voice freq. minus 1020 cps. or by-passes filter completely. Put in series with low impedance headset when listening to 1 kc MCW........ **95c**

AUTOMATIC FREQUENCY CONTROL UNIT

Western Electric type used for controlling frequency for teletype and telephone work, complete with 3—6SJ7 and 2—6H6 tubes. Complete unit, brand new in original box... **$4.95**

BC-604 FM 35 WATT TRANSMITTER

A-1 condition, complete with tubes, 10 channel push buttons, less crystals and power supply, 19.6-27.6 Mc **$10.95**

FILTER CHOKES—All Fully Enclosed

3.7 H. @ 145 MA. DC., 125 ohms DC. Res. 4 MTG. Studs, each........ **59c**
100 mi 10H........ 59c

APN-1 RADIO ALTIMETER

Complete 420 MC transmitter-receiver unit, complete with all plugs, indicators. BRAND NEW........ **$34.50**

AN/PRS-1 MINE DETECTOR—BRAND NEW........ $9.50

BC-929-A

Contains power supply 110 V. 400 cycles, has 7 tubes such as 3CP1, brand new, complete with tubes. Each $17.95; Used, ea........ $14.95

R-78/APS-15

Has 45 tubes, one 5" scope tube, one 2" scope tube, has 3 meters, 4 power supply units 110V 400 cycles, complete with tubes. Each........ **$39.50**

COMPASS RECEIVER MN-26

Remote control commercial type navigational receiver. Indicates direction of any desired transmitting station. 3 bands—frequency range: 150 Kc to 1500 Kc; has 12—6 V. type tubes. Brand new, original cost $600. Now........ **$24.95**

Accessories for Above:

Loop MN-20	$9.25
MN-28 Control Box	7.25
MN-52 Loop Control Unit	4.45
Loop Transmission cable—168" long	9.95
MC-124 Flexible Shaft	2.45
IN-40 Left-right Indicator	9.95
Set of 3 plugs	4.60
MN-40 Navigators Indicator	12.95

176 HAND MIKE

BRAND NEW . . . perfect carbon hand mikes, light wt., 200 ohms single button press to talk switch, 5 ft. rubber cord, plug, dust cover. ONLY........ **89c**

OIL-FILLED CONDENSERS

.25 MFD at 1500 VDC	59c
2 MFD 220 VAC	29c
.25 MFD at 6000V DC	$1.49
.5 MFD at 750V AC	.29
2 X .25 at 2000V DC	.29
3000 MFD at 3V DC (electrolytic)	.19

COAXIAL CABLE BUYS

RG-8/U: 52 ohm coax. cable, brand new, cut to length, min. quant. 100 ft.... **$2.95**

REMOTE POSITION INDICATING SET

6-12 V. 60 cycles. 5 inch indicator with 0-360° dial. Heavy duty transmitter.

Indicator	each $4.95
Transmitter	each 2.95
Set	7.95

HS-33 (Red plug), low impedance. Used, almost like new. With rubber cushions 8000 ohms or 200 ohms........ **95c**

BRAND NEW! TUBE SPECIALS BRAND NEW!

304TL..............ea. 90c—four for $3.00

3B24	95c	869B	$19.95	837	$1.95	9001	$0.49
3B24W	95c	872A	1.95	838	2.95	9002	.49
3B26	95c	2C26A	.69	839	2.95	9003	.49
6G6G	69c	1N5GT	.69	5BP4	2.95	9004	.49
6H6GT/G	49c	211	.69	5BP1	1.39	9005	.49
6SS7	72c	12SN7	.49	5FP7	1.39	9006	.49
25L6GT/G	49c	12A6	.39	864	.49	7193	.39
28D7	69c	12C8	.49	954	.49	4AP10	1.95
250R	$7.95	12J5	.39	RK34	.39	110 VAC Neon Light	.39
705A	2.95	12K8	.69	35W4	.39	Amperite 10T1	.39
726A	14.95	12SR7	.59	1625	.39		
801A	95c	12AT6	.49	1629	.39		
5BP4	2.95	832A	2.95	2051	.39		

W.E. 700A Magnetron. 680-710 mc, 100 KWPk Pwr. Output..................$24.95

Write for lot prices!

SPECIALS from WEST COAST BRANCH!

POWER YOUR RIG FROM AC.

RA-34 RECTIFIER. Makes a ground xmtr of BC-191, the 12V version of BC-375-E. Convert BC-375-E to 12V by changing heater link switches and relay connections, power it with RA-34. Input 105-125 or 210-250V, 60cy. Outputs: For plates, 100V filtered dc at 350 ma; for relay and mike, 12V filtered dc at 2.4 A; for heaters, 12V ac at 14.25 A. With tech. manual. Used, excellent condition... **$59.75**

POWER FOR MOBILE OR MARINE RADIO

PE-237 Vibrator Power Unit. 6, 12, or 24V dc input as selected by switch. Outputs for standby or transmit. Very low power drain on standby. Transmit outputs are 515V at 160 ma, 105V at 40 ma, 6.5V at 2A, 6V at 500 ma, and 1.4 V at 450 ma. Start-stop switch on unit, schematic pasted inside cover. New units have spare tubes and vibrator; used units may have them. Shock mounted. Sturdy, heavy duty for continuous service. Waterproof gasketing and glands for the generous battery cables provided.
New, in original packing........ **$19.65**
Used, excellent condition........ $13.95

SCR-522-A

Transmitter, receiver, rack and case. 100-156 mc. 4-channel, xtal controlled, easily converted for variable tuning. Used, excellent condition. With schematic........ **$24.95**

ARB RECEIVER

Famous Navy ARB (CRV46151) receiver, 195-9050 kc. in four bands, 6-tube, 3 microvolt sensitivity, CW or MCW, MVC or AVC. Sharp or Broad selectivity. With 28V dynamotor. A NATURAL FOR MARINE USE or for adaptation to AC power supply. Used, excellent condition. Each........ **$19.95**
Remote control boxes........ Each $2.95

SOCKET FOR 5BP1 or 5BP4

2Z8681.2 For magnal-based CR tubes. With leads attached. New. Each........ **$1.50**

BD-71 ARMY TELEPHONE SWITCHBOARD

Magneto monocord, the simplest type, 6 trunks (loops). Each loop has a cord, a jack, a drop, and a 2-way lever key. Has built-in ringer and head and chest set for operator. Ringing from distant end of a loop operates the drop. Operators phone is connected to loop by snapping key switch in one direction. Snapping the key in the other direction connects the hand generator to the loop. Establish connection between the two loops by connecting the cord of one to the jack of the other. Ideal for camps, motels, oil-field or timber operation, etc. Condition: used, good. Price is ridiculously low, only........ **$12.95**
Special connection offer: BD-71 and six EE-8 field telephones, one for each trunk, only **$59.85** set.

BD-72 ARMY TELEPHONE SWITCHBOARD

Same as BD-71 described above, except larger; for 12 trunks. Condition used, good. Only........ **$19.75**
Special combination offer: BD-72 with 12 EE-8, only........ $89.95

SCR-625 MINE DETECTOR

Portable, in sturdy suitcase container. Detects metallic objects to a depth of approx. 6 ft. Find outboard motors on the bottom of resort lakes, locate underground piping, etc.
New, in original packing........ **$39.95**
Used, excellent condition........ $29.95

DYNAMOTORS

ATTENTION: MARINE AND 12V AIRCRAFT. Dynamotor, DS-12, 12V in, 170V, 100 ma out, snaps on back of and plugs onto the Command Set receivers of SCR-274-N and AN/ARC-5; BC-453, BC-454, etc., and R-23/ARC-5, etc. Each........ **$6.95**
EICOR TYPE: 14V in, 400V, 200 ma out, with mtg. rack. Brand new........ $14.95
DM-34, 12V in, 220V, 80 ma out, as used on the tank receivers BC-603 and BC-683. Brand new........ **$2.95**

A CATHODE-RAY HONEY

AN/APN-4 Indicator: Uses 5CP1. Loran, convert to test scope, panadapter, etc. Contains extremely accurate 100 kc xtal to time sweeps and marker pips at 2, 20, and 100 kc. Two parallel horizontal sweeps, obtain time differences between signals, between half-power points on pass-band curves, and numerous other scope uses. Experimenters' delight! Use the counter circuits to try the new system of FM demodulation (July Proc. IRE), or to time camera shutters, 25 tubes. Condition: used, excellent. With schematic........ **$39.95**

EE-8 ARMY FIELD TELEPHONE

Sturdy, highest quality telephone at less than price of a better-class toy. With ringer. Requires only two flashlight batteries for each phone and two wires between each phone. Excellent condition, used. Each........ **$7.95**

PLUGS YOU NEED

PL-103 For your BC-348 receiver. Fits all models........ 69c ea.
PL-59, 60, 61, 62, 64. For BC-375-E or BC-191........ 50c ea.

ANTENNA MASTS

Mast sections used with the famous BC-610. Make as long as you like in multiples of 38¼". End up with sections MS-49, 50 and 51 (from the top down). We have a few MS-52, but when we are sold out on MS-52, it doesn't matter because MS-51 fits into MS-53. Put as many MS-53's together as you please; this is the section that is designed to fit into itself for height increase.

MP-48 Vehicular-mounting base with ceramic insulation, spring section for flexing, fits MS-53. Each........ **$3.95**

10-METER FM

BC-923: 27-38.9 mc. with 12V dynamotor. Tank communications, superhet with squelch and BFC. 4-channel band switch. BUILT-IN XTAL-CONTROLLED HETERODYNE FREQ. METER UNIT with 100-kc check points, used to set both receiver and accompanying transmitter to exact frequency. Very easy to tune variably; just turn a knob. Use this receiver as exact freq. monitor or simply as a supersensitive FM receiver. Has built-in speaker, schematic pasted to case. Condition: used, excellent, only... **$12.50**

HEADSET SPECIAL LOW-IMPEDANCE UNIT R14

Convert your low-impedance headset to high-impedance. HS-23 by switching to R14 receiver units. New, per pair........ **69c**

A SWEET OSCILLOSCOPE DEAL

ASB-7 Radar Indicator Unit: For conversion to test scope or for use as modulation monitor. Has standard test-scope CR tube, H Cent, V Cent, Bril, Foc, Gain, and range selection switch. External power source was used. Tubes: 4-6AC7, 3-6H6, 1-5BP1. Condition: used, excellent. LOOK AT THIS PRICE: ONLY........ **$9.95**

RADAR TRANSMITTERS

ASB-7 Airborne search unit, 0-70 miles, 515 mc. External power supply was used. Condition: used, excellent........ $12.95

BC-702-A: 175 mc using hollow tuned lines in push-pull circuit. Fan cools the hollow lines, forces air through them. Lengthen lines and you're on 2 meters. Including Weston meter, and at a price which justifies experimenting. Brand new. Only........ **$9.95**

PREAMPLIFIER BUY

External source of power supplies this compact aluminum case only 5¾"x4"x2½", containing dual triode power tube 6F8G, inside the case, not standing out from it, and all brand new, in original packing, for only........ **$1.29**

MICROPHONE BUY

T-24: Hand-held mike, carbon, with push-to-talk switch, brand new, far superior to older styles. SPECIAL........ **79c**

24,000 OHM HEADSET

P-16: Has long cord, needs no extension, ends in standard plug PL-55. Very high impedance. Brand new, SPECIAL........ **95c**

MISCELLANEOUS BARGAINS

Condenser, Pyranol 2 MFD, 4000 V........ **$4.95**
Command Transmitter BC-457, brand new, 4 to 5.3 mc........ $7.95

RA-87: Rectifier, selenium, input 95—125V or 190-250V, 50/60 cy. Output 115V dc, 400 ma and 115V ac, 4.35 A. Used, excellent........ $14.95

CD-307: Extension cord, 6 to 8 feet long, for headsets HS-23, HS-33 etc. PL-55 on one end, JK-46 on other end. Brand new........ **69c**

ANB Receiver: Low-impedance, magnetic type, use as under-pillow speaker. New, each........ **39c**

All shipments F.O.B. Chicago or Los Angeles. 20% Deposit required on all orders. Minimum order accepted $5.00. California and Illinois residents, please add regular state sales tax to your remittance.

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Signal Generator

(*Continued from page 47*)

frequencies appear in bold face type. These frequencies are so designated because they are particularly adapted for specialized uses. For example—1800 kc. may be used to peak the low end of a police band receiver and the 6000 kc. utilized to align the high end. The 5000 and 10,000 kc. are frequencies of the WWV standard frequency transmissions against which a 1 mc. crystal can be adjusted for zero beat. Then, the harmonics of 1 kc. are useful as markers. The 16,000 kc. can be used to peak the high end of a s.w. broadcast band receiver while the 6000 kc. can be used at the low end.

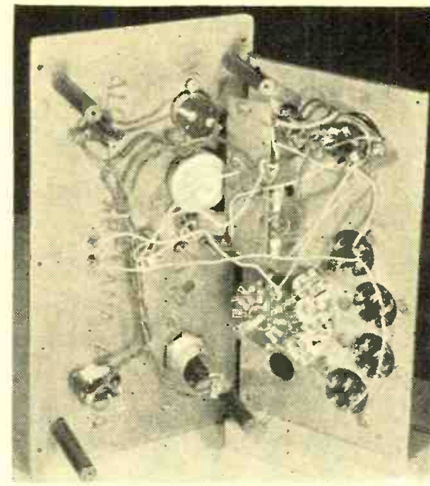
A 3-30 $\mu\mu$fd. ceramic trimmer is provided from grid to ground for frequency adjustment on each crystal. The more capacity in the grid circuit the lower the frequency of the crystal oscillator.

The output attenuator for the signal generator is a 500-ohm wirewound potentiometer.

In wiring the signal generator no particular precautions need be taken. It may be necessary, however, to provide additional capacity in the crystal oscillator anode circuit (condenser C_7) because the crystal must look into a capacitive load for a grid-to-plate connected Pierce oscillator. A capacity of from 50 to 100 $\mu\mu$fd. should be sufficient for C_7.

An alternative oscillator circuit wherein the crystal can be grounded is shown in Fig. 1B.

The two photographs of the signal generator show the unit as built by the author. Any variation of the layout is permissible however in order to adapt the instrument to the requirements of

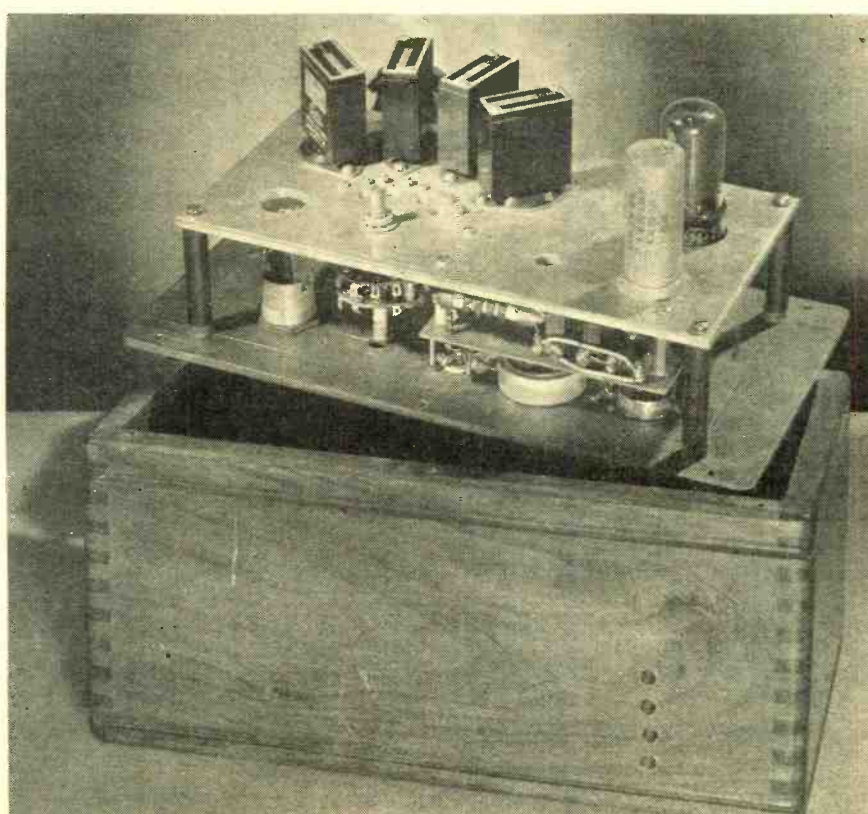


Details of sub-assembly construction.

Harmonic	455 kc.	600 kc.	1000 kc.	1600 kc.
2	910	1200	2000	3200
3	1365	**1800**	3000	4800
4	1820	2400	4000	6400
5	2275	3000	**5000**	8000
6	2730	3600	**6000**	9600
7	3185	4200	7000	11,200
8	3640	4800	8000	12,800
9	4095	5400	9000	14,400
10	4550	**6000**	**10,000**	**16,000**

Table 1. Tabulation of fundamentals and all the harmonic frequencies obtainable from this home-built test instrument.

Under chassis view of signal generator shows position of crystals and other components.



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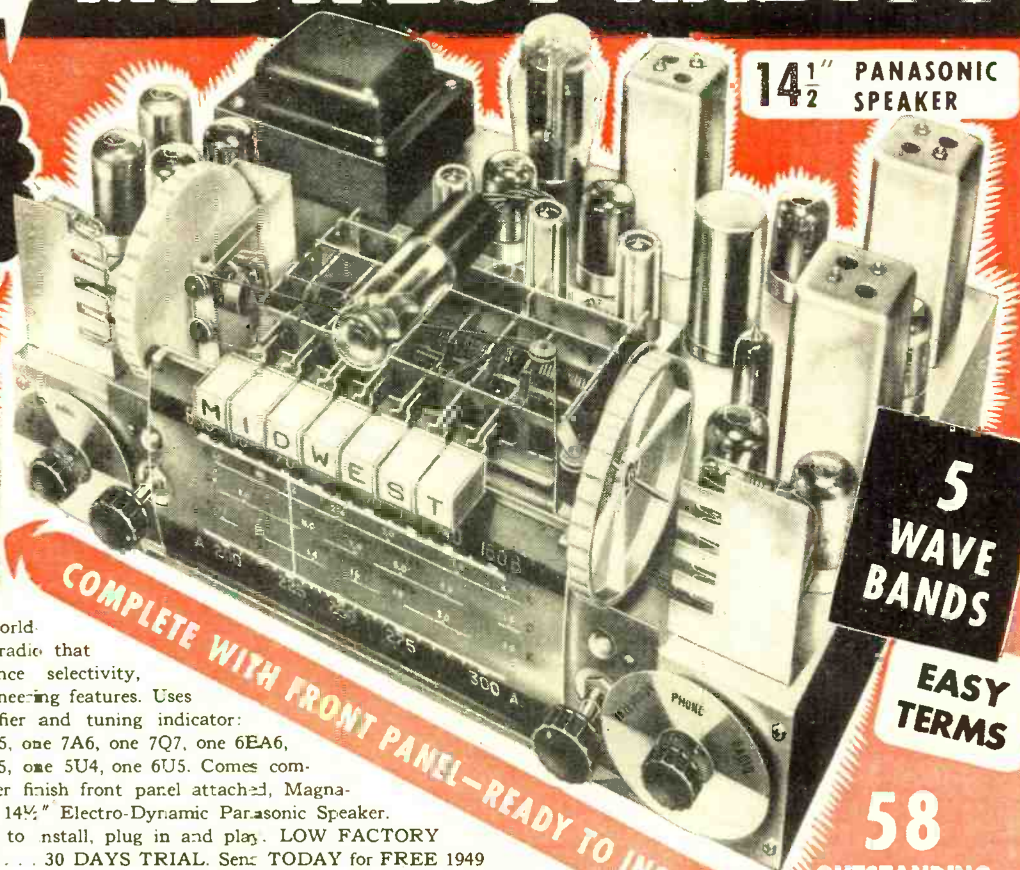

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the individual builder who may require a different size or shape cabinet.

In order to simplify the construction the rotary switch may be eliminated and a single socket mounted on the panel instead. Thus, any crystal can be connected into the circuit as needed.

No external audio modulation was incorporated in this unit as enough hum modulation was present to give an audible signal. A simple modulator can be made with a neon type relaxation oscillator connected as shown in the circuit diagram of Fig. 1C.

Crystals suitable for use in this instrument are available on the surplus market at low cost. The type of crystal to be used in the unit will, of course, determine the type of crystal sockets which will be needed. Where a variety of crystal holders are available, several sockets to fit the different types of holders can be wired in parallel in order to increase the versatility of the signal generator.

—30—

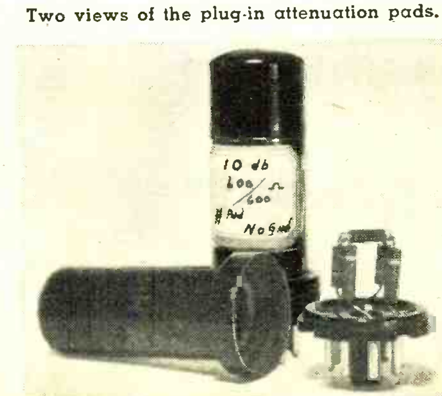
PLUG-IN PAD

THERE are frequent applications in audio input equipment in broadcast stations and in recording equipment, which demand a pad which is quickly changeable, yet is not changed frequently enough to justify the expense of a variable pad. In such cases the system described here can sometimes be used to advantage.

The line is opened at the place where the pad is to be inserted and terminated on four terminals of an ordinary octal tube socket. Then a series of pads are built up as shown in the illustration, in the shells of old metal tubes. They may be made in whatever values the particular application calls for, and changed in a matter of seconds simply by plugging in the one needed at the moment.

The pads are easily constructed. The four indentations at the base of the tube are bent out and the base removed. Then the glass seal is smashed and the insides cleaned out. The pad is built up on the base, carefully insulated, then the shell of the tube is reassembled. The pad is then labeled, and it is a good idea to stick the label over the old tube type markings to prevent it from accidentally being inserted as a tube. A little Scotch tape over the label will insure its staying put. A convenient rack can be built to hold the whole series of pads ready for instant selection and use. . . . . C. H. W.

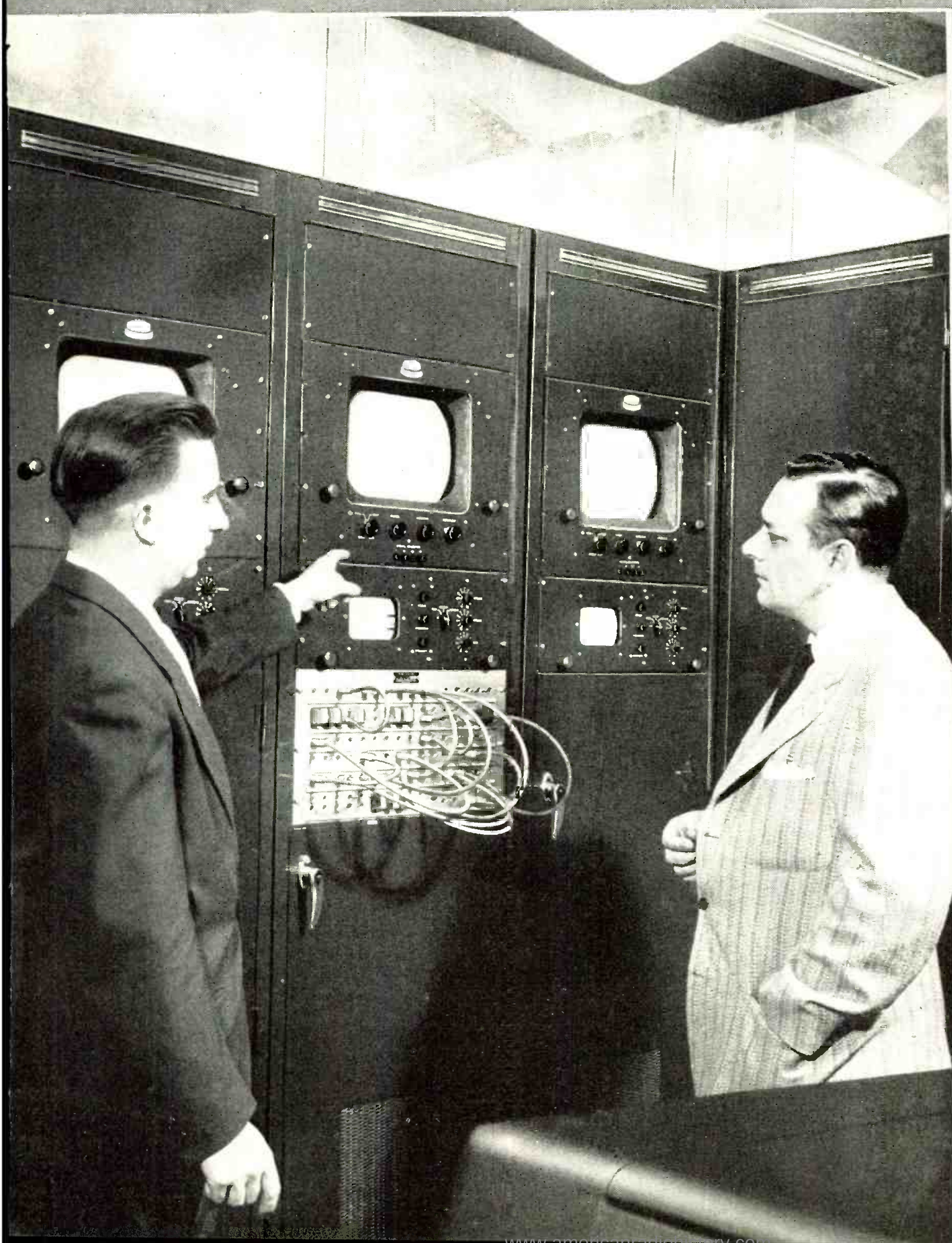
Two views of the plug-in attenuation pads.



OCTOBER, 1948

RADIO & TELEVISION NEWS

RADIO-ELECTRONIC Engineering



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DEPARTMENTS

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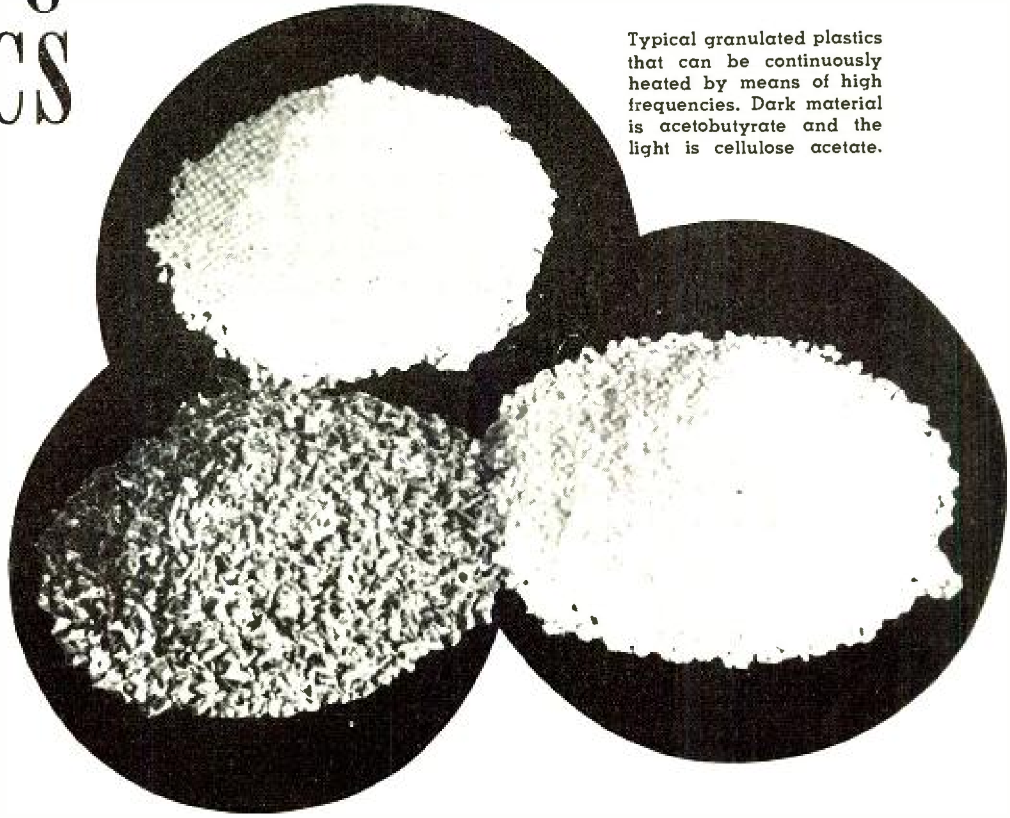
COVER PHOTO—Courtesy of Allen B. DuMont Labs., Inc.

New DuMont Master Control equipment installed in DuMont network station WTTG, Washington, D.C. This equipment serves as the nerve center for the broadcasting operation, provides synchronizing signal facilities for all studios, and serves as a terminating point for the picture signals from the live-talent and film studios and remote and incoming network programs.

H. F. Heating of GRANULATED DIELECTRICS



Typical granulated plastics that can be continuously heated by means of high frequencies. Dark material is acetobutyrate and the light is cellulose acetate.

By R. A. WHITEMAN
Consulting Engineer

A discussion of such factors as frequency, voltage, power and cost in applying h.f. heating to dielectrics.

THE heating of granulated dielectrics has attained practical importance recently in mass production processes. This, of course, includes resistance heating, steam heating and high-frequency heating. In the processes using aluminum, silicon and magnesium oxides, many drying methods have used indirect electrical resistance heating. However, with dielectrics such as the thermoplastic and thermosetting groups, both resistance and steam heating have been used for preheating as well as mold heating for injection and compression molding. Since electrical resistance and steam heating methods depend upon the conduction of the heat energy from the outer surface to the inner structure of the granular particles, the speed of heating as well as the uniformity of heating cannot compare with the results obtained using high-frequency heating. On a cost basis, however, the high-frequency method is generally more expensive when initial installation costs are considered and cheaper when unit operating costs are the basis of comparison. This fact simply means that the total costs for a particular application must be carefully considered for each method before a definite comparison can be made to justify any one of the available heating methods.

A typical example will illustrate how the high-frequency heating method can be economically justified when applied to granulated dielectrics. Such thermosetting or thermoplastic dielectrics facilitate continuous production and therefore the ultimate speed of production depends upon the maximum mechanical speed of the molding machine and the speed of the heating cycle. A continuous feed of the plastic material eliminates many time consuming operations, permitting a considerable pickup in production speed with a decreased heating cycle. By installing a high-frequency generator so that the granulated plastic could be preheated during the continuous feed process the heating cycle within the mold could be decreased approximately 20 per-cent. The speed of the molding machine was increased 20 per-cent, thereby increasing production by the same percentage. This limit of 20 per-cent was not a characteristic of the preheating method used, but actually the limitation was the maximum safe speed of the molding machines.

The key to the success of this operation was the technique of applying the high-frequency energy to the moving granulated thermosetting material. A sketch of the heating electrodes, Fig. 5, provided the basic approach to this type of problem.

A number of very important questions generally arise when considering the high-frequency heating of dielectric material. They are the selection of operating frequency, the h.f. voltage to apply to the capacitor electrodes, the power required to preheat one pound of material per minute and finally the approximate cost of the dielectric-heating unit to do this job or a multiple of this quantity. The factors influencing the answers to these questions will be included in this article.

Before such a system can be constructed and applied, it is necessary to have a clear understanding of the principles involved with adequate experimental h.f. data relating to the dielectric as a function of frequency. It is only with this understanding and information available that a satisfactory selection of power, frequency, and coupling circuit can be made for the particular heating problem at hand. This fact applies whether the high-frequency energy is used for the heating of plastics or the drying of dielectric material.

The fundamental relations of h.f. dielectric heating depend upon the theory that nonmetallic solid materials have few free electrons and the effect of the electric fields on the dielectric molecules becomes very important. These fields cause a definite displacement of the electrons with respect to the nucleus of the atoms and also a displacement of the atoms within the molecules. These displacements have translational as well as rotational components and are most important in the range of frequencies used for radio-frequency heating. As the electric components of the molecules are rotated to line up with the electric field a displacement of charge within the material takes place. As a result of this

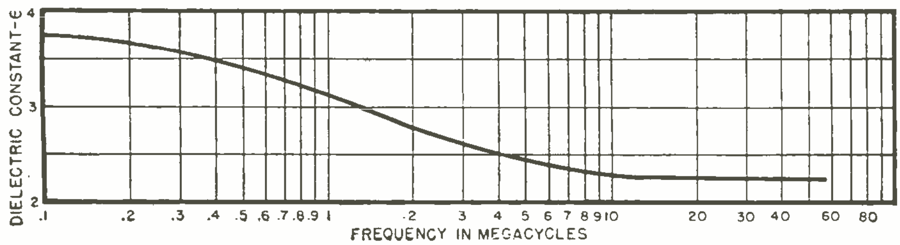


Fig. 1. A typical curve of ε vs. frequency showing how the dielectric constant decreases with an increase of frequency.

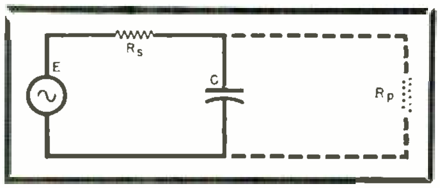


Fig. 2. Circuit of dielectric heating showing relative position of equivalent series or parallel resistance.

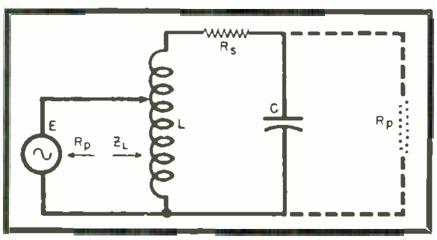


Fig. 3. A useful method of attempting to obtain an impedance match between a power oscillator and a dielectric load.

effect, the displacement current in the circuit is greater due to the presence of the dielectric than that occurring due to free space. The ratio of the former to the latter displacement current for a given electric-field intensity is defined as the dielectric constant of the material.

As the molecular configuration changes due to an applied electric field, the molecules are acted upon by the fields of the adjacent molecules. This action imparts kinetic energy to the thermal motion with an accompanying temperature rise of the material. Since the increase in molecular-kinetic energy must be derived from the impressed electric field, an equivalent displacement current must flow into the material. This simply means that some of the current flowing into the material must be in phase with the voltage impressed on the material.

From this point of view, the power delivered to a one-centimeter cube when the electric field intensity of E volts per centimeter is impressed on the cube is:

$$P = E^2 \sigma \quad . . . . \quad (1)$$

where σ is the effective conductivity of the centimeter cube. In the case of a dielectric, the conductivity is generally a complicated function of frequency and not a constant.

In applications, where the conductivity and therefore the power factor p is very small, the expression for conductivity may be expressed as:

$$\sigma = 2\pi f \varepsilon p \quad . . . . \quad (2)$$

where ε is the dielectric constant at the operating frequency f. By substituting Eqt. (2) in Eqt. (1), the expression for the power dissipated in a centimeter cube becomes:

$$P = 2\pi f \varepsilon E^2 p \quad . . . . \quad (3)$$

It has been implied but not specifically stated in this article that the capacitance of the load circuit increases due to the insertion of the dielectric medium between the conducting plates. From this property of the dielectric material, it follows that the charge on the conducting plates is greater for a given steady voltage than without the dielectric material. Furthermore, this charge cannot be instantly recovered and produces a loss similar to the hysteresis loss of magnetic materials. This loss is referred to as the dielectric loss and is expressed in a number of different ways. One quantity which is a measure of this loss is the power factor, while another is the loss factor which is generally defined as the energy loss per cycle per voltage gradient squared per unit of volume, and also as the product of the dissipation factor and the dielectric constant, and finally, as the imaginary part of the complex dielectric constant.

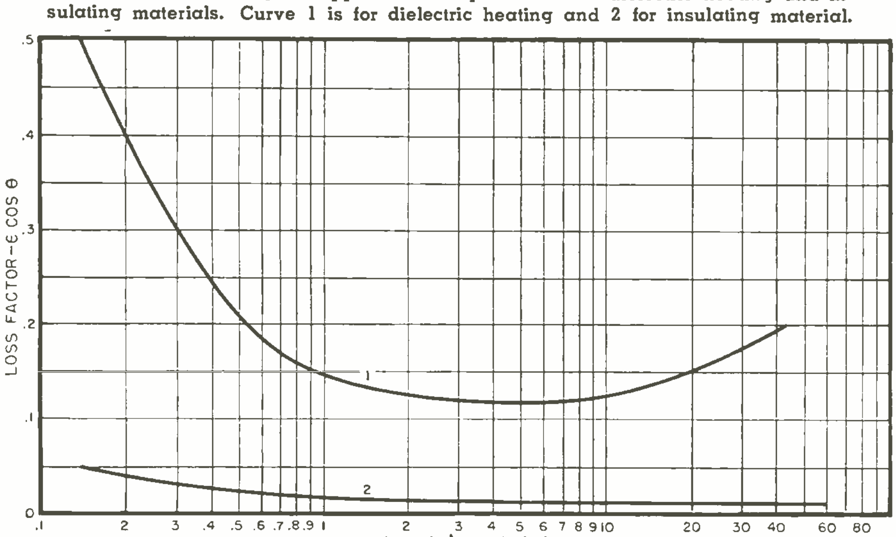
The effect of frequency upon the dielectric constant or factor is very important, as may be observed by referring to the experimental results in Fig. 1. These results are best explained with the aid of the concept of polarizability. The concept of polarizability is as fundamental to dielectric theory as that of free electrons to the theory of electrical conduction.

There are a number of subdivisions of the theory of polarization as it is applied to the molecular structure of any dielectric material. There is an electronic polarization due to the displacement of electrons with respect to the positive nuclei within the atom; an atomic polarization due to the displacement of the atoms with respect to the other atoms within the molecule; dipole polarization due to the dielectric moment of the molecule within an electric field; and in a few cases an ionic polarization produced by the accumulation of free ions at the faces between dielectric materials having different dielectric constants.

If the electric field is reversed with sufficient rapidity to make the time of the reversal less than that required by some of the types of polarization, complete polarization will not be possible and a reduction in the dielectric constant will result. This phenomenon causes the dielectric polarization and dielectric constant to decrease as the frequency of the applied field increases.

Simple experiments applied in a qualitative manner to dielectrics indicate very clearly that the charging or discharging may be classified into two groups — one in which the charging or discharging occurs almost instantaneously and the second in which a very noticeable time interval is required in order to complete the charging or polarizing process. These two different types of polarization shall be classified as instantaneous and absorptive.

Fig. 4. Curves showing the approximate requirements for dielectric heating and insulating materials. Curve 1 is for dielectric heating and 2 for insulating material.



By referring to Fig. 1 it may be observed that the dielectric constant has its maximum value at the low-frequency end of the spectrum. This value is called the static or zero-frequency dielectric constant. Under this condition, all of the polarizations have time to form and affect the electric field to their maximum amount. With an increase in frequency, however, there is insufficient time for all types of polarizations to become complete and the dielectric constant ε necessarily decreases and attains an approximately constant value in the upper radio-frequency spectrum.

The foregoing theory of polarization indicates that the equilibrium positions of the electric charges within the atoms and molecules are determined by the equilibrium forces. Furthermore the electric charges do not revert instantly to their initial position, thereby causing some of the potential energy of the charges to appear as heat.

An expression for the heat developed in a dielectric by the application of an alternating electric field may be derived with the aid of the equivalent circuit of the load capacitor. This equivalent circuit is shown in Fig. 2. The load capacitor with the dielectric material between the plates may be considered as a capacitance with either a series resistance R_S or a parallel resistance R_P. These resistances may be computed algebraically by:

$$R_s = \frac{\cos\theta}{\omega C} \quad . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \quad (4)$$

$$R_p = \frac{1}{\omega C \cos\theta} \quad . \; . \; . \; . \; . \; . \; . \; . \quad (5)$$

where:

$\cos\theta$ = power factor = p
C = capacitance of load
V = applied voltage

Using the concept of the effective series resistance, the power dissipated in the capacitor may be determined by considering a vector diagram of voltage and current where I is the current vector, V the voltage and R the total resistance. The power dissipated in the total resistance R may be expressed as:

$$P = \omega C V^2 \cos\theta \sin\theta \quad . \; . \; . \; . \; . \; . \; . \quad (6)$$

If the effective resistance of the capacitor plates may be neglected, then the quantity R reduces to the resistance R_S.

Eqt. (6) may be modified in order to obtain a slightly different point of view of the phenomenon of dielectric heating. This may be accomplished by considering the effective resistance in parallel instead of in series with the capacitive load. The numerical value of the power absorbed by the dielectric becomes:

$$P = \omega \; C \; V^2 \; \cos\theta \quad . \; . \; . \; . \; . \; . \; . \; . \quad (6')$$

and is the same relation obtained by computing the power absorbed by the equivalent series resistance R_S. It is from this equation that the formula for power absorption may be derived for plane parallel electrodes. The result of this derivation is:

$$W = 0.55 \, \varepsilon f \left(\frac{V}{d}\right)^2 \cdot 10^{-12} \cos\theta \quad . \quad (7)$$

where:

W = power in watts per cc.
ε = dielectric constant
$\cos\theta$ = power factor
f = frequency in c.p.s.
V/d = voltage gradient in volts per cm.

Eqt. (6) may be evaluated numerically for any electrode shape whose capacitance may be either calculated or measured. In general, the heating effect will be uniform only where the electric field is uniform.

Eqts. (6) and (7) clearly indicate that the magnitude of the power dissipated is dependent upon the following parameters; (a) the geometrical configuration of the load; (b) the high-frequency electrical properties of the dielectric load and (c) the characteristics of the high-frequency generator.

The factor C in Eqt. (6) shows the dependency of the heating upon the load geometry. Eqt. (7) was derived for the plane electrodes and includes the dielectric constant and power factor which are, of course, high-frequency electrical properties of the dielectric load. It is important to note that both equations contain voltage and frequency which are determined by the high-frequency generator.

From a superficial observation of Eqt. (7) one might reason that an increase in frequency will permit a lower voltage to accomplish an equivalent heating or that the time of heating varies inversely with the frequency if the voltage is maintained constant. It would then appear that any higher frequency would gain these advantages for industrial dielectric heating. These

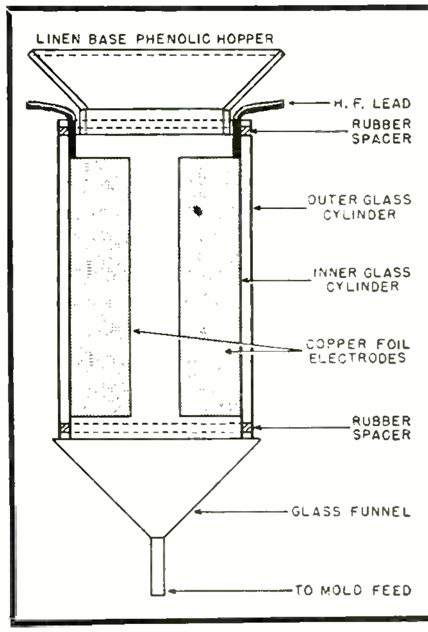
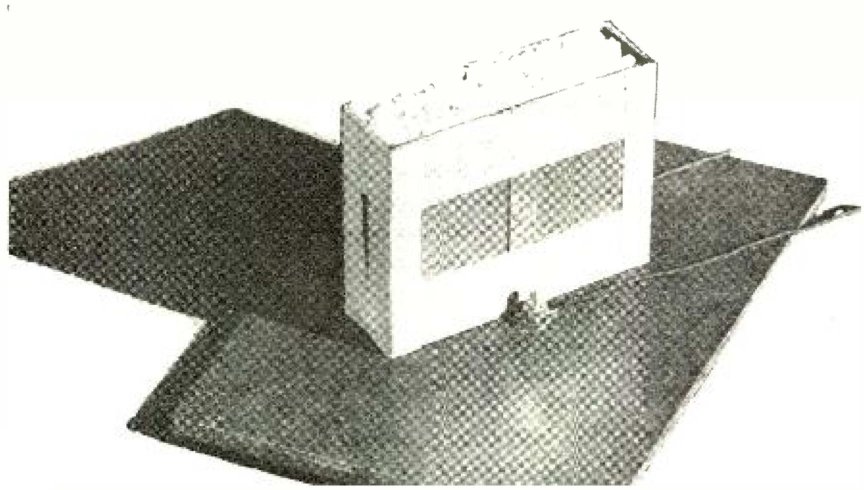


Fig. 5. Fixture for continuous heating of granulated dielectrics showing the position of the high frequency leads between the glass cylinders.

conclusions are not generally correct, since the remaining terms in the heat equation are not independent of frequency. Furthermore an increase in the frequency may cause serious limitations due to the shorter wavelength obtained.

Eqts. (5), (6), and (7) have parameters which are functions of frequency and therefore introduce a more involved relation between heating and frequency than that originally mentioned. The dielectric constant as well as the power factor are involved functions of frequency and therefore their product, which is the loss factor of the dielectric material, must also be a corresponding function of frequency. These quantities have been plotted as graphs in Fig. 4 where the parameters have been plotted along the ordinate and frequency along the abscissa. Al-

Fig. 6. Fixture used for obtaining Q-meter measurements showing short leads.



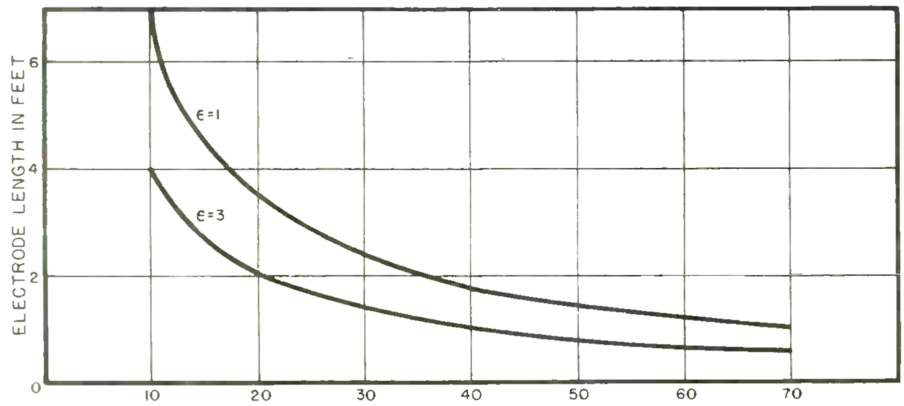


Fig. 7. Maximum permissible electrode length allowing ten per-cent voltage variation as a function of frequency.

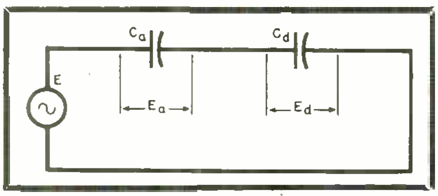


Fig. 8. Equivalent series circuit of the sum of air and dielectric capacitors in a mass of granulated dielectric material.

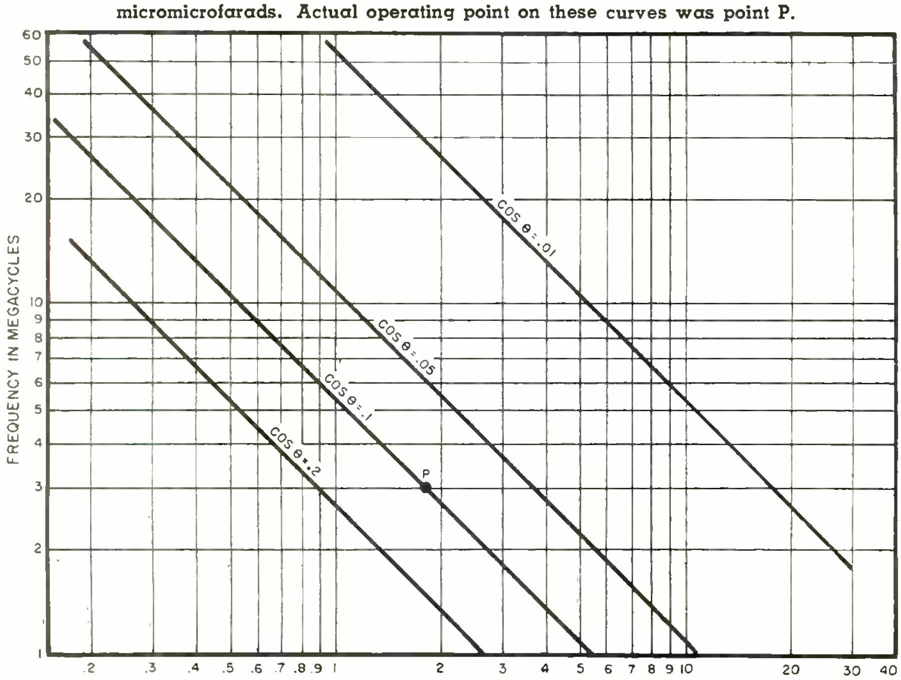
though variations of the loss factor due to frequency seldom require a choice of a particular frequency to increase the heating effect, large differences in loss factor for different materials may require higher frequencies to heat the "low-loss" material.

A parallel resonant circuit with an imperfect condenser tuned to resonance presents an impedance approximately equal to $1/\omega C \cos\theta$. This impedance may be considered as the equivalent parallel resistance of the parallel resonant circuit since the impedance of an ideal inductance and capacitance in parallel at resonance is infinite. Then the value of R_p may be equated as in Eqt. (5).

The graphs plotted in Fig. 9 are for Eqt. (5) with the power factor as a parameter and a load capacitance of 300 micromicrofarads. The load impedance, evidently, varies inversely with the frequency.

It is important to realize that the transfer of power as well as the voltage drop across the dielectric load necessary for heating purposes depends upon the impedance match between the output of the oscillator and the load circuit. From Eqt. (5), it is evident that an increase in frequency will reduce the load impedance and consequently a lower voltage will exist across the load. Assuming special adjustments of the circuit parameters have not been made, it is known that the power transfer to the load will decrease. Therefore the voltage may not be maintained constant across a load to shorten the heating cycle as the frequency is increased unless special methods are applied to maintain the impedance match. If the oscillator has an output impedance of 1800 ohms and the load is to be coupled to the oscillator with a high Q circuit, Fig. 9 shows that an impedance transforming network is required if the operating frequency is below or above 3.1 mc. when the power factor is 0.10.

Fig. 9. Dielectric load impedance with a capacitive branch of 300 micromicrofarads. Actual operating point on these curves was point P.



Assuming that a ten per-cent voltage variation may be tolerated along the greater dimension of the rectangular electrode, the maximum permissible electrode length may be obtained from Fig. 7 with the frequency plotted as the independent variable. The oscillator output should be connected to the mid-point of the shorter edge of the rectangular electrode in order to apply the results obtained from the graphs of Fig. 7.

In order to obtain numerical values of the dielectric parameters required for design purposes, the granulated material was measured from 1 to 50 megacycles with the aid of a Q meter and a special fixture shown in Fig. 6. This fixture consists of two sheets of high quality glass with Mycalex ends and base. The two electrodes of aluminum foil were cemented to the inner sides of the glass plates with external leads connected. The leads were made as short as possible for the Q meter measurements. To make these measurements, a coil was selected which would resonate with the fixture and Q meter capacitor and connected to the inductance terminals of the instrument. The fixture was then connected to the capacitance terminals without the granular dielectric material. For a specified frequency setting, such as 1 mc., the capacitor C was adjusted to give a maximum deflection of the output meter and the corresponding values of Q and C were recorded. This provides Q equal to Q_1, or the value of Q for the empty fixture. Likewise the corresponding value of C is C_1.

The granular dielectric material was then placed in the fixture and the new values of Q and C were recorded as Q_2 and C_2 respectively. These measurements were repeated for a number of frequencies in the frequency scale from 1 to 50 mc.

From these measurements, the dielectric constant of the granular dielectric was computed by using the formula:

$$\varepsilon = 11.3 \frac{d}{A}(C_1 - C_2) \quad . \; . \; . \; . \; . \; . \quad (8)$$

where d is the distance in centimeters

(Continued on page 31)

Controlled Voltage Divider

By SAMUEL FREEDMAN

Description of a new circuit which eliminates rather than limits AM during FM reception, and vice versa.

THE controlled voltage divider produces a voltage output which depends only upon the ratio of two separate voltages applied to the input, no matter what their actual value may be. It suggests a large number of useful applications including the following:

1. To provide a means of comparing the amplitude or frequency of two different signals.
2. To provide a means of comparing the amplitude or frequency of one signal to the average value of another signal.
3. To provide a means of comparing the average value or frequency of two signals.
4. When employed in connection with a frequency discriminator, i.e. any pair of circuits tuned to two slightly different frequencies, it will eliminate or remove all or practically all amplitude interference and distortion as well as provide a.v.c. during reception of frequency modulated signals.
5. If employed in connection with a pair of tuned circuits tuned to the same frequency, it will eliminate or remove all or practically all frequency interference and distortion and provide a.v.c. during reception of amplitude modulated signals.
6. If employed in connection with a twin amplitude modulated oscillator, it will provide a means of comparing the values of two d.c. voltages or the values of two signals changing on a wide range of frequencies.
7. It may be used on low frequencies, including power frequencies such as 60 cycles per second, by substituting low frequency or common power line transformers in lieu of tuned radio circuits. This will permit comparison of currents or voltages between different power lines, loads, sources or phases.
8. It has innumerable possibilities in both the fields of radio-electronics and electrical power where the values are otherwise too great or, conversely, too small for convenient handling or determination but where ratio determinations are convenient.

This is accomplished by means of two vacuum tubes V_1 and V_2 in Fig. 1A. These tubes are connected in series, the cathode K_2 of V_2 connected to the plate P_1 of V_1 while the cathode K_1 of V_1 is connected with the negative side of a d.c. source and the plate P_2 of V_2 is connected with the positive side of the same source. B_1 and B_2 in this example are batteries or some other d.c. source to give the proper negative bias to the grids G_1 and G_2 of the tubes. The input voltages EI_1 and EI_2 are applied to the grids as shown, provided that a d.c. connection exists between the d.c. sources B_1 and B_2 and the grids, to transmit to the grids the voltage of the d.c. sources B_1 and B_2. These connections are indicated with dotted lines in Fig. 1A.

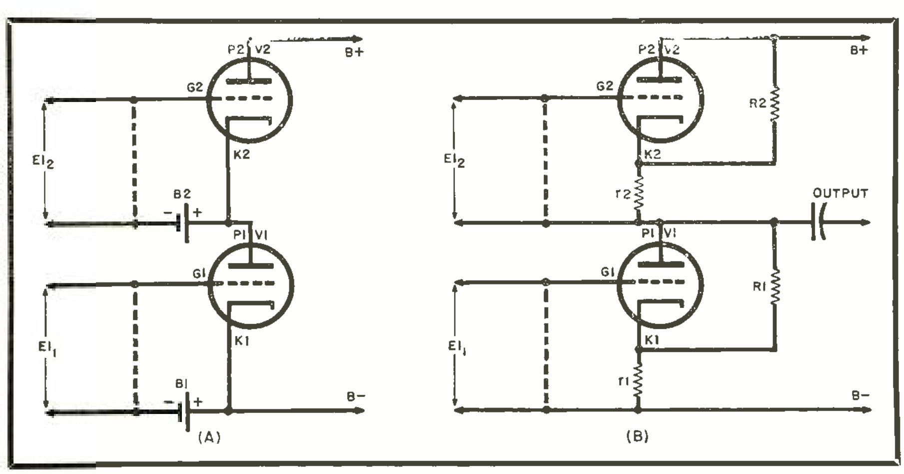
Each of the triodes has the grid kept by the battery B at the cutoff voltage. If the tube has a sharp cutoff and a constant μ, the current crossing the tube will be nearly proportional to the voltage V_g applied to the grid above cutoff. It will depend also upon the plate voltage as shown in Fig. 2A which is a typical family of characteristic curves for a sharp cutoff triode.

However, in the case of Fig. 1A, the current must be the same in both tubes because they are connected in series. Then, the voltage of the junction P_1-K_2 in Fig. 1A must change in order to carry the same current in both tubes although the grid voltages are different. Since the sum of the plate voltage drops across the tubes is constant and equal to the voltage of the external d.c. source, a graph can be shown in Fig. 2B which is obtained by combining two of the graphs shown in Fig. 2A, one of them inverted to take care of the fact that while the voltage drop V_{p1} in one tube increases, the voltage drop V_{p2} decreases in the other tube.

The operating point with no signal will be at point A in Fig. 2B. This is the point that shows zero current because the grids are biased at cutoff (example shows -6 volts) while the voltage drop is equally divided between the tubes. If a signal of plus one volt is applied to G_1, carrying it to -5 volts; and a signal of plus 3 volts is applied to G_2 carrying it to -3 volts, then the operating point shifts to point B. An equal current flows in both tubes and the voltage drop is divided in such proportion as to draw this equal current, even though the grids G_1 and G_2 are not of equal voltage.

If the signal voltage is doubled in both grids, becoming 2 volts at G_1 (making V_{g1} equal to -4) and plus six at G_2 (making V_{g2} equal to zero), the

Fig. 1. (A). Basic circuit of controlled voltage divider. (B) Resistors added to basic circuit to compensate for deficiencies in existing tubes.



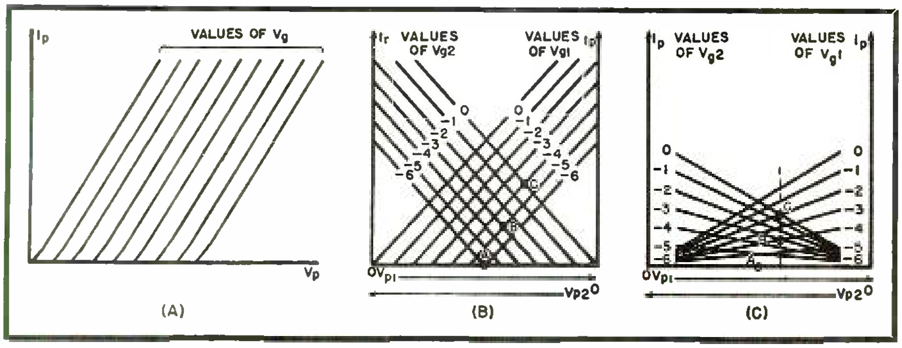


Fig. 2. (A) Family of I_p-V_p characteristic curves. (B) Graph formed by combining two of the curves of (A). (C) Desired characteristics for making points B and C fall on the same vertical line.

operating point becomes point C in Fig. 2B. This shows what the characteristic curves should be in order to have B and C remain on the same vertical line. It means that a change in signal strength, while maintaining the same voltage ratio, should not alter the voltage drop across the tubes. It can be seen that this would be obtained if the characteristics were as shown in Fig. 2C. Here, the cutoff bias line coincides with the zero current line of the graphs for either tube and all the curves of the same family have a common point at the zero plate voltage point of the tube concerned. Points A, B, and C represent the same values in Fig. 2C as in Fig. 2B but now B and C are on the same vertical voltage line. Existing triodes do not have such characteristics as shown in Fig. 2C.

It is possible to design a new type of tube to provide this operation. In the absence of such tubes, the actual characteristics may be made to approach the theoretical ones required by adding the proper values of resistors in series and in parallel with the tubes. Then, the circuit of Fig. 1A becomes as shown in Fig. 1B.

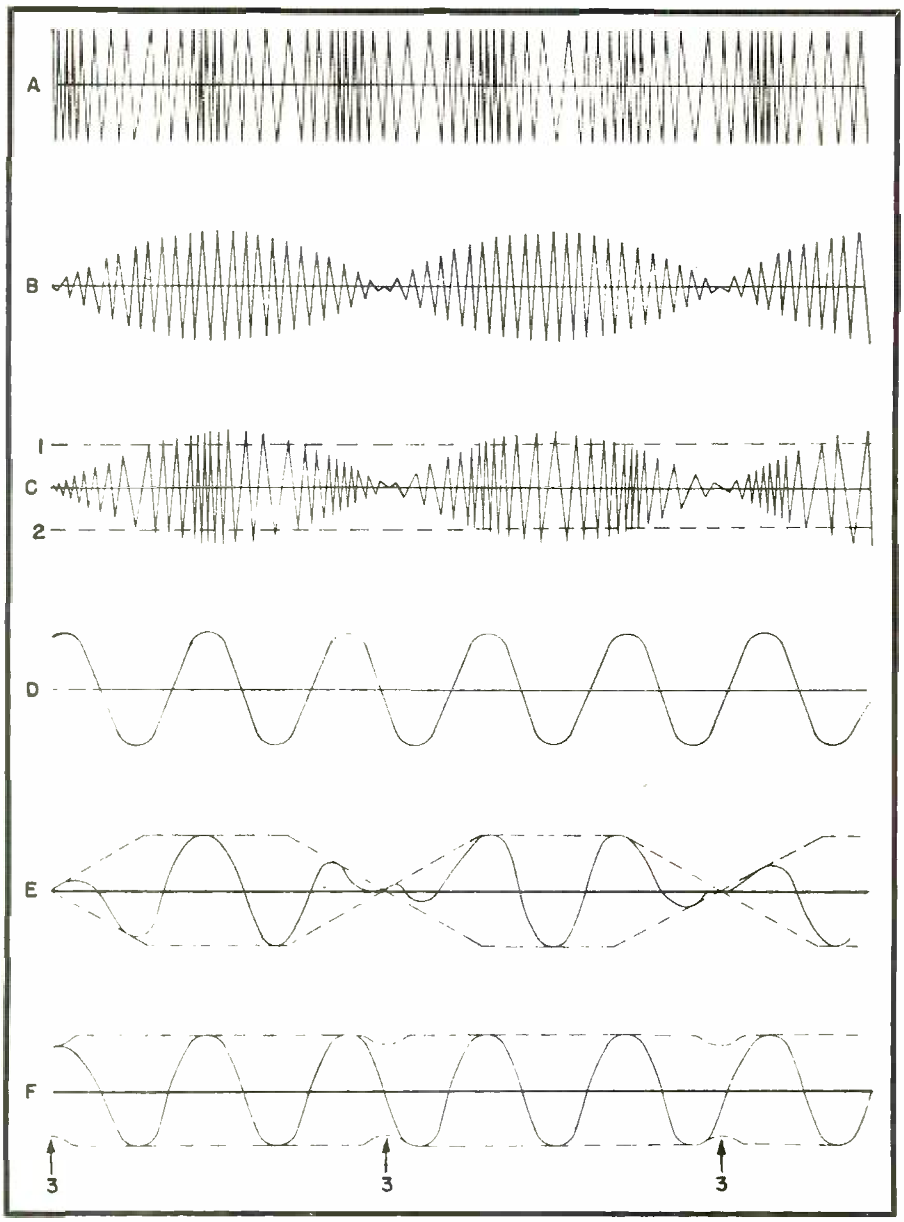
In this case, the grid bias may be taken directly across the resistors r_1 and r_2. Then, the current that the voltage drop across the tubes draws through R_1 and R_2 must be such as to produce across r_1 and r_2 exactly the bias necessary to cut off the tubes with no signal applied, the total voltage drop being divided between the tubes. The ratios R_1/r_1 and R_2/r_2 may be derived from the study of the characteristic curves given by the manufacturer or by experimentation.

The presence of these resistors also has two secondary effects. These have been designated effects (a) and (b). Effect (a) is due to r_1 and r_2 which provide a negative feedback because they are in the cathode circuits and therefore decrease the slope of the curves in Fig. 2C. Effect (b) is due to R_1 and R_2 which provide a shunt conductance that raises all the curves above the position shown in Fig. 2C because current can flow through these resistors also when the tubes are biased at cutoff and no signal comes to the grids.

Effect (a) is larger when the resistances of r_1 and r_2 are larger, while effect (b) is larger when the resistances of R_1 and R_2 are smaller. Effect (a) by itself is inconsequential since the voltage output does not depend upon the amplitude of the useful signals, but upon their ratio. Effect (b) however, is important since it tends to oppose the correct functioning of the circuit because when it is present, the output is no longer completely dependent on the ratio of the signals alone.

In order to decrease effect (b), R_1 and R_2 must be as large as possible. r_1 and r_2 should be kept small because effect (a) while not important by itself, does increase the effect (b). This makes the ratio R/r large. This in turn leads to the choosing of tubes with a μ as high as possible, because the ratio R/r

Fig. 3. Comparison of the effect of a conventional limiter and of the controlled voltage divider. (A) is a pure FM wave, (B) a pure AM wave of same carrier frequency but different modulation frequency; (C) is a combination of (A) and (B). Response of conventional limiter discriminator to (A) wave is shown in (D) and (C) wave in (E). (F) Response of controlled voltage divider circuit to (C).



increases with increasing μ. The residual (b) effect makes the device not completely independent of changes in amplitude. However, it does prevent the possibility of oscillation of the entire circuit when no signal is present at the grids to provide control of the circuit. In any case, the (b) effect is smaller if the input signal is comparatively large. From this point on the small residual (b) effect is not under consideration.

This circuit is particularly suitable for AM/FM detection with the possibility of complete AM elimination during FM detection and FM elimination during AM detection. In this case, the signal comes to the controlled voltage divider from the last i.f. or r.f. stage of a receiver. The input at the grids is determined by tuned circuits which together with the plate tuned circuit of the last i.f. or r.f. stage make up the last i.f. or r.f. transformer. During the FM detection, the circuit is as shown in Fig. 4, T_1 and T_2 are the grid circuits tuned to frequencies slightly different than the center i.f. or r.f. frequency, namely, T_1 tuned on a frequency slightly higher and T_2 slightly lower, or vice-versa, as is generally known in the theory of the FM discriminator. T_3 is the plate i.f. or r.f. tuned circuit of the last i.f. or r.f. stage, tuned on the center frequency. R_3, C_3, R_4, C_4, C_5 provide filters to eliminate interaction between the B supply voltage and the drop through the controlled voltage divider. These filters may have any other suitable structure. C_1 and C_2 are i.f. or r.f. bypass condensers, so that the i.f. or r.f. rectified by the tubes V_1 and V_2 is filtered out while only the audio output is present at C_6. The triodes then function as conventional plate detectors as well as a controlled voltage divider.

A change in input signal strength in an upper-and-lower tuned discriminator such as that of Fig. 4, yields only a change of signal strength in the output of the two tuned secondary circuits, leaving the ratio of the voltages unchanged. The output of the controlled voltage divider then will show no change for such a change in the input signal. This provides complete elimination of any AM interference and distortion. If the input signal has both FM and any amount up to 100% amplitude modulation present, the controlled voltage divider will completely eliminate the AM component, whereas a common limiter tube would have only little effect on such signal.

Fig. 3 shows the compared effect of a conventional limiter circuit and of the controlled voltage divider. Here, letter A shows a pure FM wave. Letter B shows a pure AM wave of the same carrier frequency but with a different

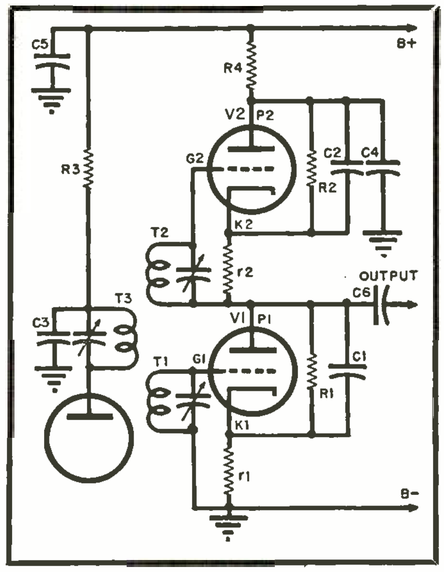


Fig. 4. Circuit of an FM detector, using the controlled voltage divider, which completely eliminates all amplitude modulation during the reception of frequency modulated signals.

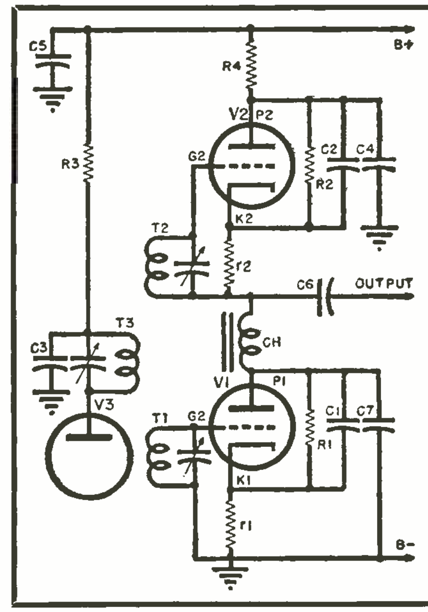


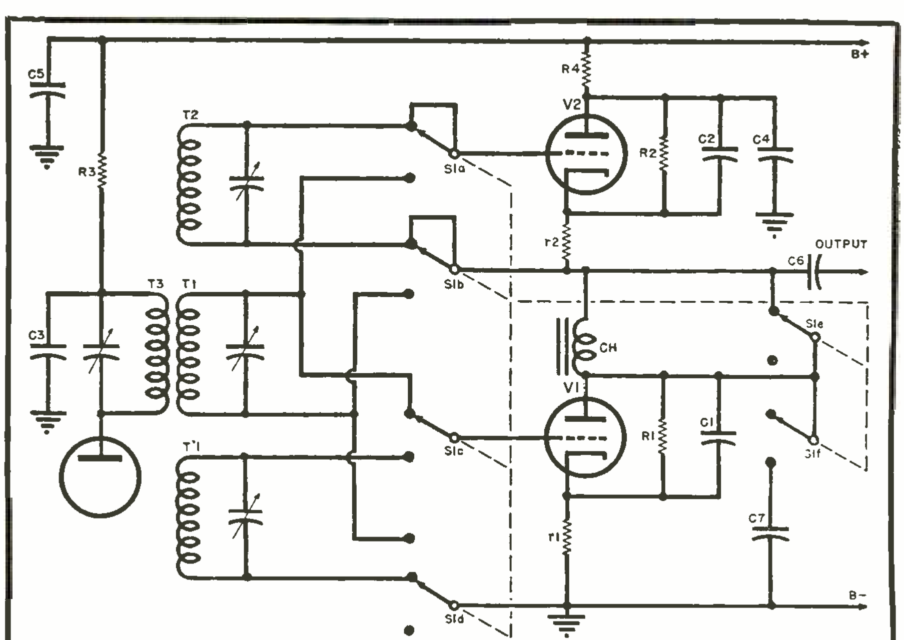
Fig. 5. Circuit of AM detector which completely eliminates FM during the reception of AM signals.

modulation signal frequency. Letter C shows a wave where both the modulations of A and B are present. Here numbers 1 and 2 show the limiting effect of a conventional limiter. Letter D shows the response of a conventional limiter-discriminator to the A wave. Letter E shows the response of the same circuit to the C wave. Letter F shows the response of the controlled voltage divider circuit to the same C wave. Number 3 numbers the residual (b) effect on the output of the controlled voltage divider. The controlled voltage divider circuit with two tubes, or its equivalence in a single tube envelope, substitutes with much better efficiency the limiter-discriminator compound. This also insures a complete a.v.c. effect, since changes in signal strength are nothing other than a slow AM superimposed on the FM.

Condensers C_1 and C_2 in Fig. 4 besides being bypass condensers, also maintain the voltage of the center point at the last given value when the AM modulation superimposed on the FM signal passes through the zero amplitude point. At this point, the output voltage would be undetermined except for the residual (b) effect which always tries to carry the output voltage to the center value in absence of signal. This

(Continued on page 28)

Fig. 6. Complete circuit of AM-FM detector with changeover switch.



ELECTRONIC DIGITAL COMPUTERS

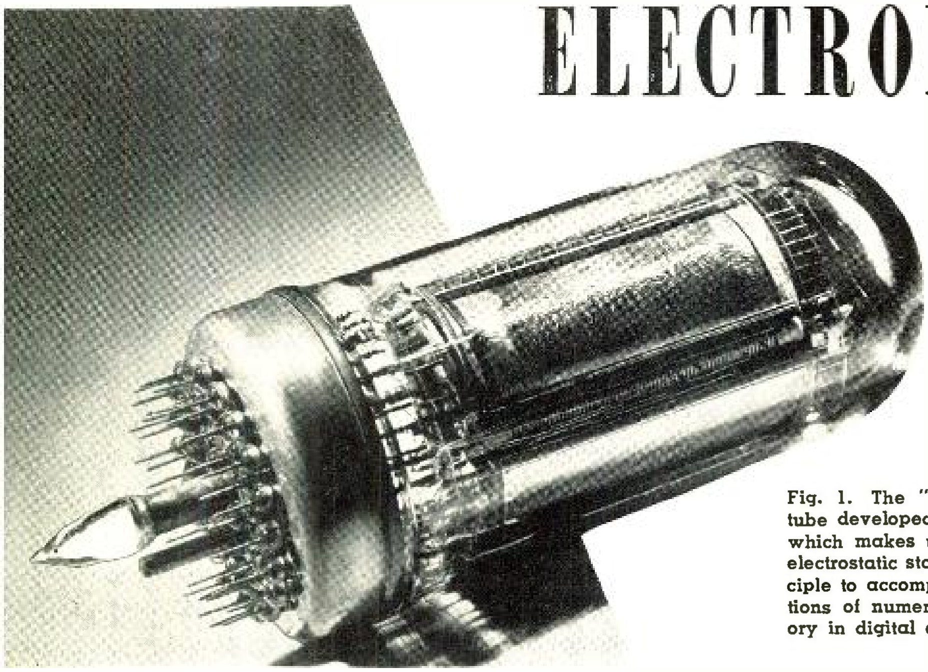


Fig. 1. The "Selectron" tube developed by RCA, which makes use of the electrostatic storage principle to accomplish functions of numerical memory in digital computers.

By **DAVID FIDELMAN**

Part II Discusses Electronic Counting Methods and Operation, Memory Devices, and Control Circuits.

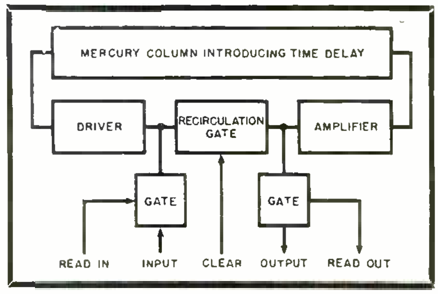
THE fundamental basis of electronic digital calculators is precisely the same process of counting which has been described in Part I as the basis for all arithmetic and mathematical processes. The electronic computer consists essentially of a series of counting circuits and circuits which automatically sequence the counting operations according to the mathematical operations which are to be performed.

The electronic counter circuit, which makes possible all the various types of electronic digital calculators, can be any circuit with more than one state of equilibrium. If these different states of equilibrium can always be reproduced in the same order under the same conditions, then the circuit can be used as a counter. A number of such circuits are known, and have been widely used in many other applications where counting circuits are required.

The basic element in any circuit of this type is a tube or circuit having two states of equilibrium that are readily identified and repeated, and which is capable of being transferred from one state to another by simple means such as a single pulse signal. The most obvious circuit which achieves this result is the simple thyratron. However, although thyratrons are widely used in this manner, they are not sufficiently reliable over long periods of time to permit their use in critical circuits required in calculating equipment. High-vacuum triode amplifiers also have the on-off current characteristic, depending upon the grid voltage, but they do not possess the necessary trigger action, characteristic of thyratrons, which maintains the circuit in its selected state after the exciting voltage has been removed. But this result can be achieved with the vacuum-tube by making use of the well-known two-tube circuit.

In this type of trigger circuit, the grid and plate voltages of each tube are so interconnected and related that only one tube can conduct current at any one time and when one tube conducts, it controls the voltage on the grid of the other tube so that the second tube is biased beyond cut-off. The first tube continues to conduct until a voltage pulse is applied to the input. This pulse causes the second tube to conduct and the first tube to be cut off. The circuit remains in this condition until another pulse transfers the current to the original condition again. The circuit thus has the two stable states which are necessary for use in counter circuits. Two variations of this type of vacuum-tube trigger circuit were shown in Fig. 2, Part I. Both have been used in practice and operate satisfactorily.

Fig. 2. Method of using mercury delay line to obtain pulse storage.



For use in equipment design, a two-tube trigger circuit will, in general, consist of a dual triode in a single envelope (such as the 6SN7, 6J6, etc.); therefore for all practical purposes a trigger circuit may be thought of as a single tube.

The manner in which the trigger circuit forms the basis for the electronic counter is shown in Figs. 3 and 5. The basic principle of operation is an arrangement of the trigger circuits so that their stable states are all interrelated. Operation can be a cycle which corresponds exactly to the cycle of ten of the ordinary decimal system. Thus, the decade counter circuit in Fig. 3 uses ten trigger circuits to form a decimal system in which each trigger circuit corresponds to one of the digits from 0 to 9. With this circuit in its initial (or reset) state, trigger circuit 0 is triggered and circuits 1 to 9 are in their untriggered states. The application of the first pulse triggers circuit 1 and at the same time causes circuit 0 to return to its steady state; each succeeding pulse causes the next succeeding circuit to be triggered and the preceding one to return to its steady state. At the tenth input pulse, circuit 9 returns to its steady state and triggers circuit 0, at the same time sending an output pulse which indicates that ten input pulses have been counted. This output pulse can then be applied to the next decade counter. This represents the process of "carrying" ten in the ordinary arithmetic operations. Thus the operation of this circuit corresponds exactly with the arithmetic processes of the ordinary decimal system.

Another form of counting circuit, which has the advantage that it uses fewer tubes to accomplish the same purpose, is shown in Fig. 5. The operation of this circuit is based on the "binary" or scale-of-two system. In this system the second impulse applied to each trigger circuit causes it to return to its initial state and trigger the following stage. Thus, a four-tube binary counter is capable of counting $2x2x2x2 = 16$ impulses before returning again to its initial zero state. By a modification of the circuit shown in the schematic it is possible to cause the four-stage circuit to reset itself after the tenth impulse. In this way four trigger circuits may be used to accomplish the same function as the ten-circuit decade counter and can be used in digital computers which make use of a decimal numerical system.

The counter shown in Fig. 5 can also be used to give a numerical system having a base of 16. This system would be slightly more economical of components, since $(16)^5$ is approximately equal to $(10)^6$. In many applications, this slight advantage in efficiency is balanced in the use of the base 10 instead of 16 by the advantages gained by making the system coincide with the more familiar decimal system. The four-stage binary counter can easily be converted to a decimal counter; the only requirement is that the tenth input pulse resets the circuit to its zero state. If this requirement is met, it does not matter in what manner the circuit has reached the state representing the count of 9.

The method by which the binary counter is reset to zero at the tenth impulse is illustrated in Fig. 5. At the first impulse, tube 1 is triggered. At the second impulse, tube 1 is reset and the pulse which results from the resetting of tube 1 triggers tube 2. At the fourth impulse, tube 1 is again reset and the resulting pulse resets tube 2, which applies a pulse to tube 3 and triggers it. At the eighth impulse, tubes 1, 2 and 3 are reset and tube 4 is triggered. At the ninth impulse, tube 1 is triggered, tubes 3 and 4 remain in the reset state, and tube 4 remains triggered. Normally in this circuit, without forced resetting, the tenth impulse would cause tubes 2 and 4 to be in the triggered state, and 1 and 3 to be reset. However, in order for the circuit to be a decimal counter the tenth impulse must return all four tubes to the reset (or zero) condition. This is accomplished in the circuit by means of the two condensers C_a and C_b. By means of C_a the pulse resulting from the resetting of stage 1 is applied to stage 4 to cause resetting of that stage. The pulse resulting from the resetting of stage 4 is then applied through condenser C_b to stage 2 in order to cause forced resetting of that stage. Through proper choice of condenser and voltage divider values, the feedback will cause the desired forced resetting at the count of ten, and will at the same time not interfere with the normal operation of the circuit up to the count of ten.

In almost all calculations there is a necessity for remembering the results of certain preliminary and intermediate computations until they are needed in further computations toward obtaining the final desired result. As the calculations become more complex, the memory requirements become increasingly complex.

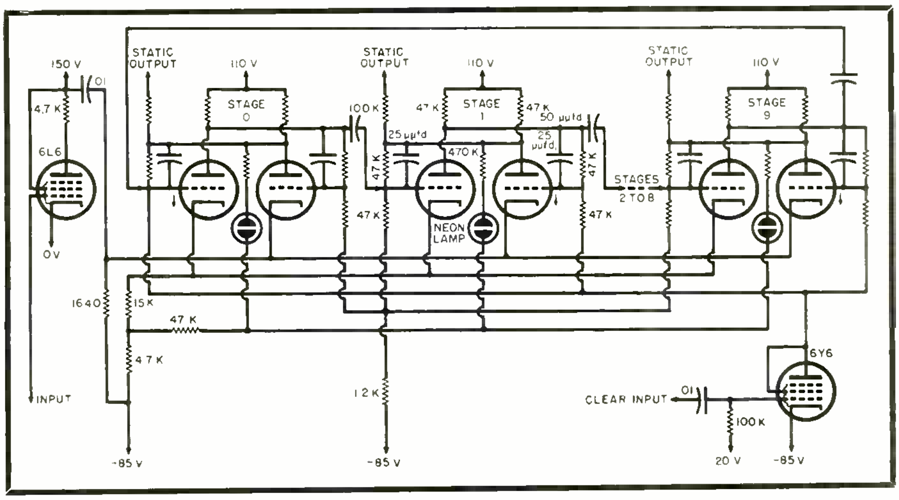


Fig. 3. Schematic of ten-trigger circuit decade ring counter.

When computations are performed manually, the memory process takes the form of writing down the intermediate results as they are obtained and referring back to them as they are needed at later steps in the calculation. The most direct method of accomplishing the memory function in electronic calculators is by using a method which is analogous to the manual process of writing down the number. Thus, the result would be registered in an electronic counter of the type shown in Fig. 3, and then the counter would be permitted to remain at this setting until the number is needed for further computation.

Since this procedure may require that a complete counter (and whatever other sequencing the control circuits are associated with it) remain inactive for long periods of time during complicated calculations, it would be more efficient to record the reading of the counter on an auxiliary memory device until

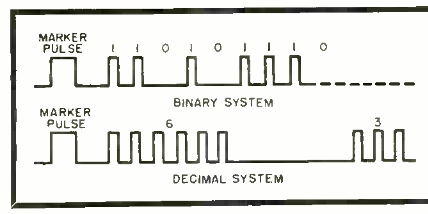


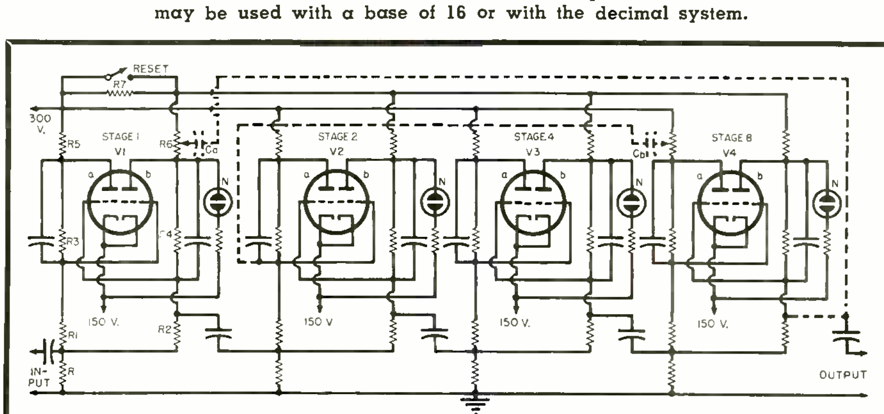
Fig. 4. Pulse systems which can be recirculated in a mercury delay line.

needed, so that the counter may be free for further use in the calculation.

A type of electronic device which has memory properties suitable for use in electronic digital computers is a recently developed special-purpose tube called the selectron. A photograph of this tube is shown in Fig. 1. The selectron makes use of the principle of electrostatic storage to store the on-off signals which accomplish the memory function. It is particularly suitable for binary counters, since a binary system uses only two digits—one and zero—which correspond to on and off in the selectron.

In this tube, two sets of spaced parallel wires at right angles to each other are located between an extended source of electrons and an insulating surface, so that they can intercept the flow of electrons. The two sets of wires create a checkerboard of windows which can

Fig. 5. Schematic of four-trigger circuit binary counter which may be used with a base of 16 or with the decimal system.



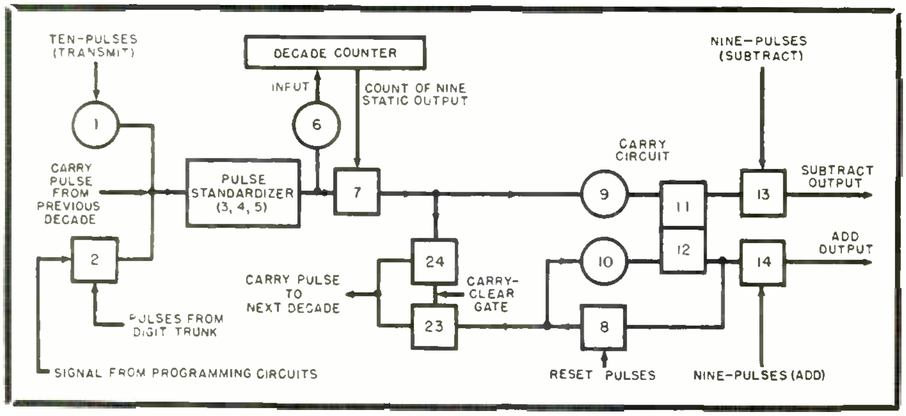


Fig. 6. Block diagram of a complete decade counter circuit of the type used in the ENIAC digital computer.

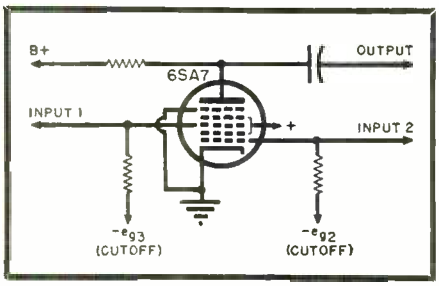


Fig. 7. Method of operating pentagrid tube as a gating circuit, so that there is output signal only when both input signals are present.

be closed or opened to the passage of electrons. The wires are internally connected in such a way that by applying on-off voltages to a relatively small number of sealed-in leads, the flow of electrons can be controlled through individual windows. The selection of the particular window through which the electrons are to flow represents the number registered by the selectron. The storage of electrons on the insulating surface represents the memory characteristics of the tube.

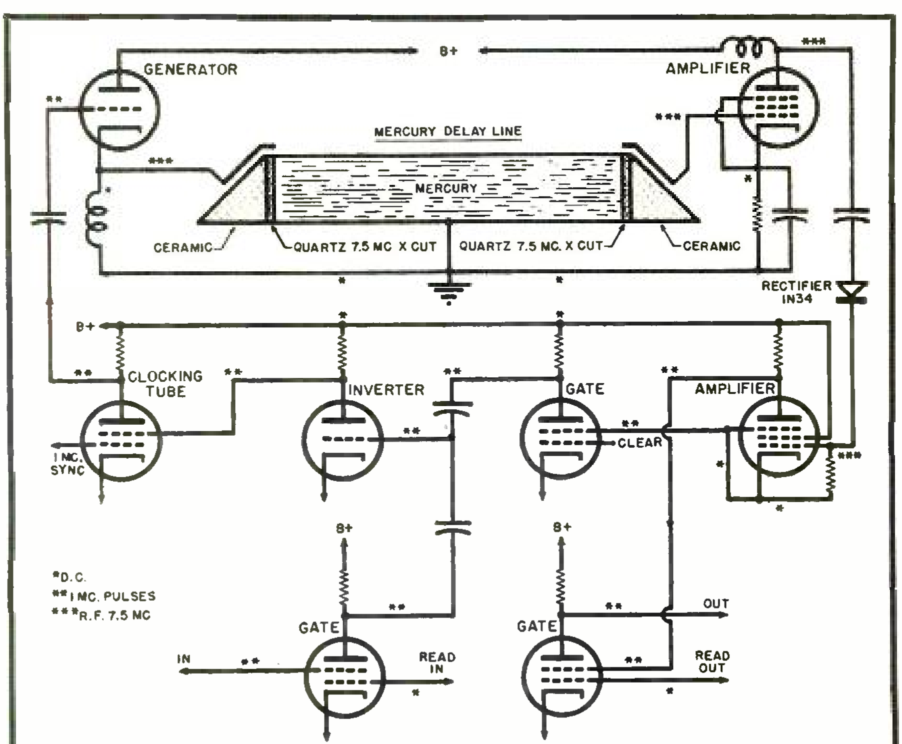
Storage is accomplished by allowing electrons to pass through all the windows in the open condition, forcefully maintaining the potential of subdivided areas on the insulator. To register a signal, during the bombardment of electrons a specific window is opened to the exclusion of all others and a voltage pulse is applied to a metallic plate backing the insulating surface. This pulse, positive or negative depending on the polarity of the signal, overpowers the local electronic locking mechanism. Immediately following this registration, all windows are opened again, and the registered potentials are locked in. The signal can be read by opening the proper window and obtaining a signal from the backing plate. The registration of a signal is completed in a few microseconds and requires no previous erasing, and the reading is also achieved in a few microseconds and can be repeated indefinitely.

A single selectron tube of this type is capable of registering 64x64, or a total of 4096 on-off signals. Thus, two such tubes are capable of registering approximately 10^7 signals. To register this same number of signals by using the counter circuits described in Fig. 2 would require 70 tubes if the ten-tube decade counters were used, or 28 tubes if the four-tube (binary) decade counters were used.

Another method of registering and storing signals which is finding wide use in the design of modern electronic digital calculating machines is the mercury delay line, which originally found many applications in the timing of sweep oscillators in radar equipment. The delay line consists of a column of mercury through which pulses may be transmitted from a transmitting crystal at the sending end to a receiving crystal at the other end, so that the pulses take an appreciable amount of time to travel through the mercury. When the pulses arrive at the receiving crystal, they are amplified and applied to the transmitting crystal so they are again sent through the mercury. This process can be repeated as long as desired. By this method, once the pulses have been introduced into the chain at the input, they may then be recirculated in the mercury column almost indefinitely and are thus stored for future reference. In a system of this type the number of pulses which may be stored is the number of pulses which can travel through the mercury column at any given time, and is proportional to the length of the mercury line.

The operation of this circuit may be more clearly understood by reference to the diagrams in Figs. 2 and 4. The system depends primarily upon the time distribution of pulses, Fig. 4, and the absence or presence of a pulse are the only indications possible in each time position. A pulse system of this type can be used with either a binary or a decimal number system. If used with a binary system, each pulse would represent 0 or 1 by its absence or presence in the corresponding time-position which that pulse would occupy. If it were desirable to use the pulses to represent a decimal system, the chain of pulses would be divided into separate groups, each capable of containing any number of pulses from 0 to 9—then the number of pulses present in each group represents a decimal digit. In either system, it is necessary to introduce suitable spacing between various groups

Fig. 8. Circuit details of mercury delay line storage system shown in Fig. 2.



of pulses to preserve their identity, and to introduce a suitable marker pulse to serve as a reference point for the entire storage system.

The details of a complete system for obtaining pulse storage by use of a mercury delay line are in the diagram in Fig. 8, which shows how the data is constantly circulating until the time when it may be needed. By the use of special circuits to keep the pulse timing constant with small variations in temperature, and to otherwise minimize the effects of temperature variations, delay lines can be constructed which are capable of holding as many as 384 one-microsecond pulses.

Control Circuits

The counter is the basic component in any computation system. However, other types of components are required in addition to the basic counter, in order to control the counting and adding circuits so that they can perform the different arithmetic operations and for sequencing and programming the various operations required in the specific problem. A few simple types of circuits can be combined to give quite a wide variety of different control circuits.

A "gating" circuit, such as the one in Fig. 7, will give an output signal only when inputs 1 and 2 are both present. This type of circuit represents the logical concept of "and" (i.e., both 1 and 2 inputs are present). In the circuit of Fig. 7 this operation is performed by a pentagrid tube with the first and third grids used as the control elements. The tube draws current only when both grids are not biased to cutoff, therefore either grid switches a signal applied to the other grid in and out of the plate circuit.

A "buffing" circuit, such as Fig. 10, gives a signal in the output circuit when either signal 1 or 2 is present in the input circuit. This type of circuit may be said to represent the logical concept of "or." In the circuit of Fig. 10 the buffing operation is performed by two or more normally nonconducting tubes with a common load resistor in either the plate or the cathode circuit. A positive input signal which causes any one or more of the tubes to conduct will be transmitted to the output without affecting any of the other inputs. (Since signal amplitudes do not affect the operation of digital computers, the presence of two or more signals in the output has the same effect as one signal.)

Operation of Electronic Counting Circuits

A close study of the various design considerations and previous experience with digital computers indicate that

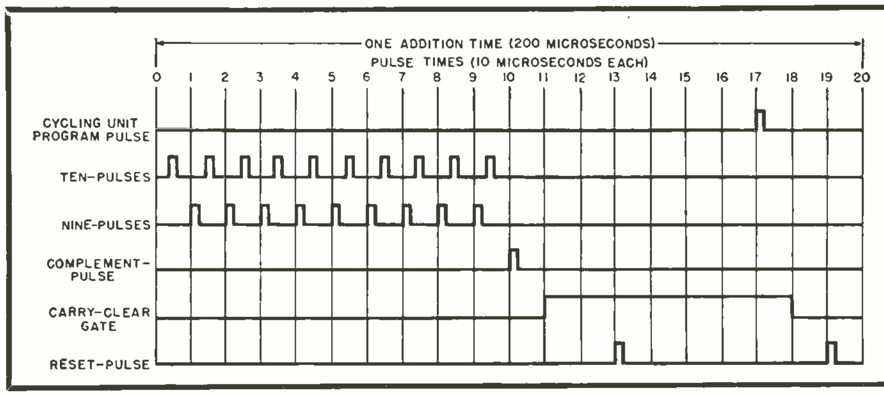


Fig. 9. Various pulses produced by the cycling unit of the ENIAC computer.

the most efficient and most reliable operation is attained when the various counting and programming systems are used just to control the transmission of pulses which originate in a central cycling unit. The counters and program control circuits have no part in generating or shaping the pulses, and act only to transmit or reject the pulses which originate in the pulse generator and cycling unit. This method of operation has a number of advantages. Best efficiency and most economical use of tubes is obtained since in the counters which require the greatest number of tubes each tube is used only as an on-off switch. Thus only as many tubes are used as there are switches required, and no additional amplifiers or oscillators are needed. Greatest reliability of operation is also attained through this type of design. By operating the tubes in the various units as on-off switches rather than as amplifiers, the pulses are always obtained from the central pulse generator and suffer a minimum amount of amplitude and phase distortion.

The manner in which counting and

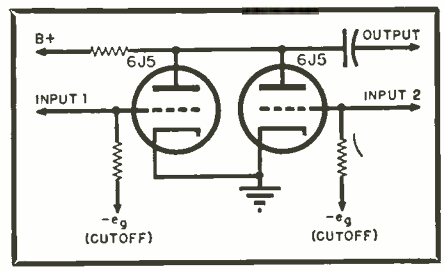
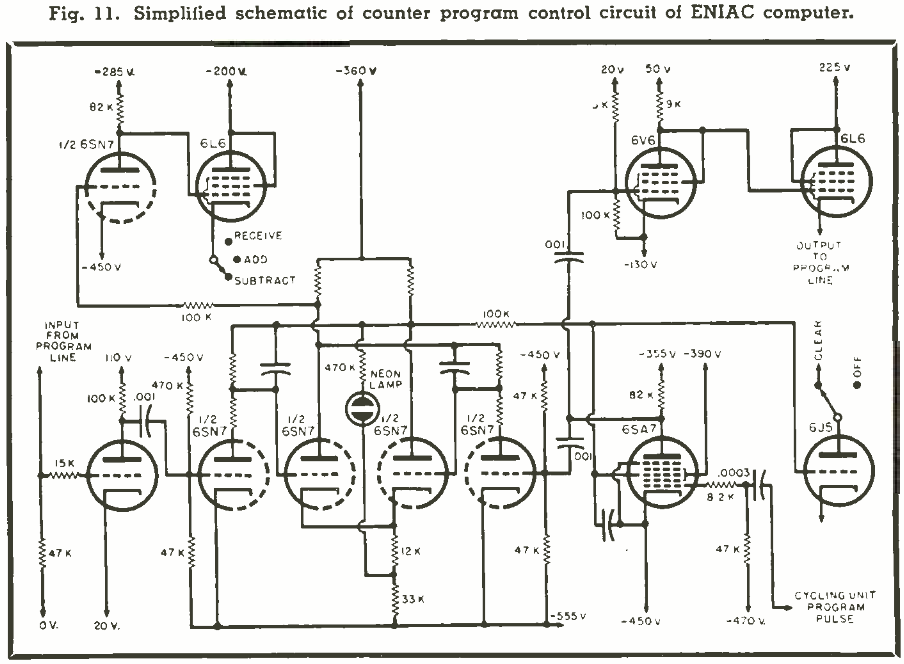


Fig. 10. Method of operating two normally nonconducting tubes with common load resistor as a buffing circuit, so that there is output signal when either input signal is present.

programming circuits work in conjunction with a pulse generator and cycling unit to perform arithmetic operations may best be understood by reference to the manner in which they are realized in an existing digital computer. Fig. 6 shows a block diagram of a complete decade counter circuit of the type used in the ENIAC (Electronic Numerical Integrater And Computer) built at the University of Pennsylvania, and Fig. 9 shows the various pulses produced by the cycling unit.

(*Continued on page* 26)

Fig. 11. Simplified schematic of counter program control circuit of ENIAC computer.



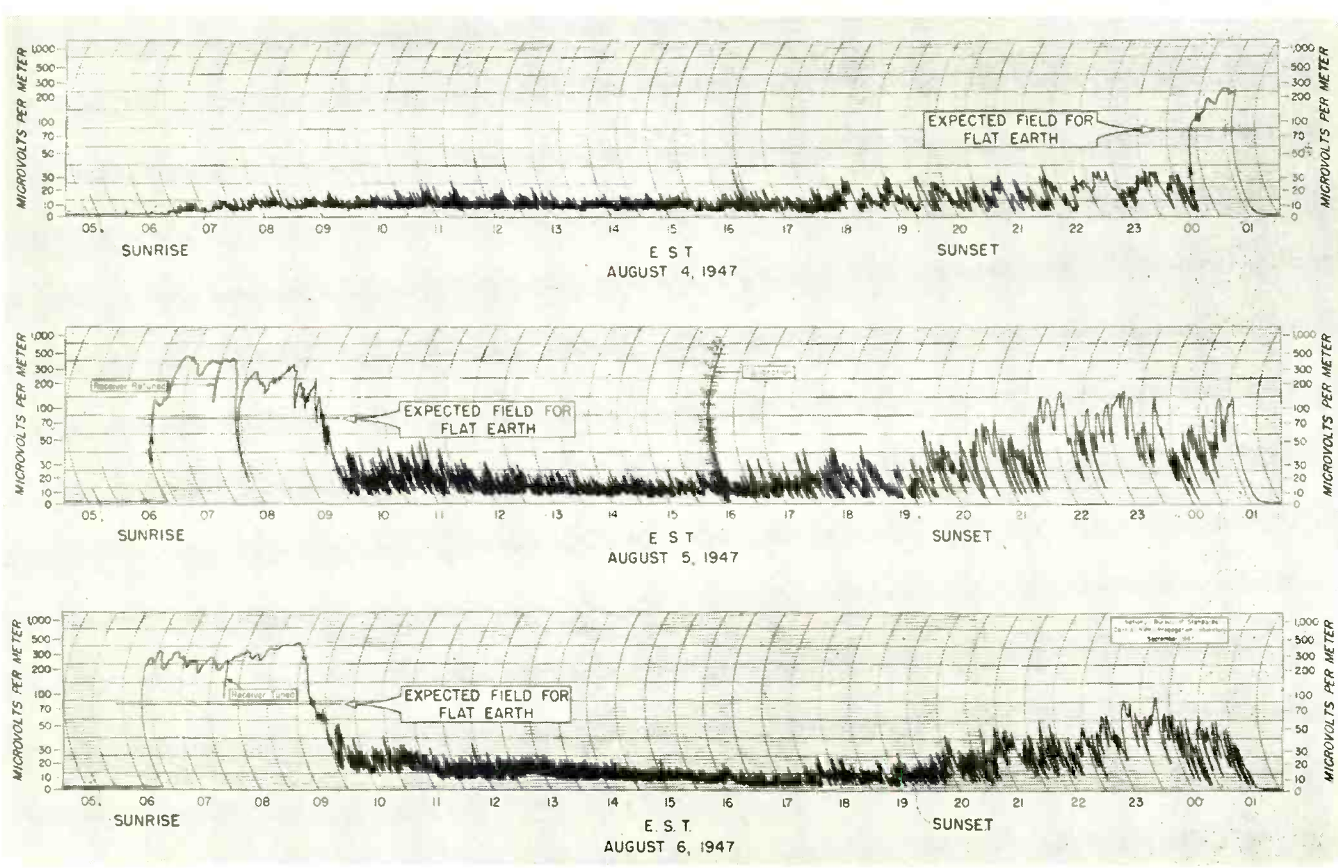
Extension of FM BROADCAST RANGE

Tests by NBS indicate that the service area of FM stations may be extended beyond the horizon.

EXPERIMENTAL research conducted by K. A. Norton of the *National Bureau of Standards* indicates that the reliable service areas of frequency-modulation (FM) broadcasting stations using transmitters now available may be extended far beyond the horizon. Analysis of the time variation of intensities received during the past year from FM stations has shown that atmospheric "ducts" and boundary layers in the lower troposphere both have the effect of reducing the attenuation of high-frequency radio waves with distance at points beyond the line of sight. These results are expected to provide a firmer basis for the prediction of the service and interference ranges of FM broadcasting stations; they should also aid in the solution of problems that may occur in connection with other uses of the spectrum above 30 megacycles.

The increasing use of frequency modulation for broadcasting is a result of such obvious advantages as the almost complete freedom from interference between stations and from static due to atmospheric or man-made disturbances. The transmission of a much greater volume range and a wider audio frequency range than is possible with amplitude modulation thus becomes feasible. However, a limitation on the distance range has been imposed by the necessity of employing very high carrier frequencies (from 88 to 108 megacycles per second). At such high frequencies long-distance propagation by means of alternate reflection of the

Fig. 1. Field intensity of FM station WCOD at Richmond, Va., recorded at Washington, D. C. Frequency is 96.3 mc.; antenna power, 2.3 kw.; antenna gain, 2; distance, 96.6 miles; transmitting antenna height, 360 ft.; receiving antenna, 30 ft.



waves from the ionosphere and the earth no longer occurs, and the range of a station has been ordinarily limited by the earth's curvature to 100 miles or less. Although the distance range is thus restricted, this is in some respects an advantage in that far-distant stations do not interfere with reception within the service area.

Variations in the density of the atmosphere within a few hundred feet of the ground provide differences of refractive index which can increase the curvature of a radio wave by an amount equal to or greater than the curvature of the earth. Known as "ducts", these characteristic changes in the refractive index of the air near the surface of the earth become more and more effective in bending radio waves as frequency increases.

For the over-land propagation paths which are usually involved in frequency-modulation broadcasting, effective atmospheric ducts are to be expected after the sun sets and the earth begins to cool the atmosphere. Under favorable circumstances this cooling may continue throughout the night with the formation of a duct of great width. The received fields would then be expected to reach their peak values early in the morning before the sun has had opportunity to destroy the duct by warming the earth.

This general behavior has been observed for the fields of FM broadcast station WCOD at Richmond, Virginia, as received at the *National Bureau of Standards* in Washington, D. C. On August 4, 1947, the station began broadcasting about 6:25 in the morning. Throughout the day the fields gradually increased until a little after midnight. At this time the received field increased markedly, and the fading, which had occurred at a fairly rapid rate during the day, decreased both in amplitude and frequency of occurrence. The calculated field intensity corresponding to propagation in a vacuum over a flat earth was exceeded for the half hour just prior to 1 a.m., when the station went off the air. Presumably this favorable propagation condition lasted throughout the night since the fields were again very strong on the following morning when the station began broadcasting at 6:25 a.m.

One of the outstanding characteristics of FM broadcasting is the very low field intensity required for satisfactory reception. During most of the time in rural areas where weak fields are the only ones available for broadcast reception the only interference to such reception arises from the radio noise generated in the high-frequency circuits of the receiver itself and the cosmic radio noise originating in the stars and interstellar space. Studies of such noise sources at the *National Bureau of Standards* indicate that received fields as low as 5 microvolts per meter provide a satisfactory grade of FM broadcast service when a very good radio receiver is employed in the absence of man-made noise or local thunderstorms; and not more than twice this value is required with typical receivers now available to consumers. Thus, the most effective way to increase the service range of an FM broadcast station is to increase the transmitting antenna height rather than the power, since such a change, by lengthening the line of sight, increases the service range more rapidly than the interference range, resulting in a more efficient utilization of the channel. An analysis of field intensity recordings made of station WCOD for the entire period between June 10 and August 8, 1947, inclusive, showed that 5 microvolts per meter was exceeded for 99.3 per-cent of the time. The signals from this station were observed to be of broadcast quality during most of this period, even when received in the presence of the rather high man-made noise level at the Bureau.

During the middle of the summer day or in the winter, when atmospheric ducts are less effective in bending radio waves around the earth, received fields are weaker and are usually characterized by somewhat more rapid fading. The rapid variation in intensity of the waves is attributed to reflection at nearly grazing incidence from a multiplicity of horizontal tropospheric boundary layers at heights up to 10,000 or 20,000 feet. These layers are caused by comparatively sharp gradients in the refractive index of the atmosphere. As the total energy in the waves reflected from the atmospheric discontinuities may be comparatively constant for several hours, the observed intensity fluctuations are believed to be due simply to phase interference between wave components which have been reflected at various points in the troposphere. Under such circumstances the time variation of the instantaneous intensity of the received waves would be expected to follow the Rayleigh distribution. The intensities recorded at the Bureau fit

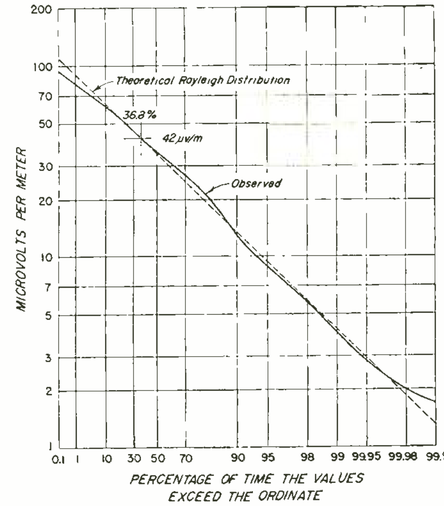


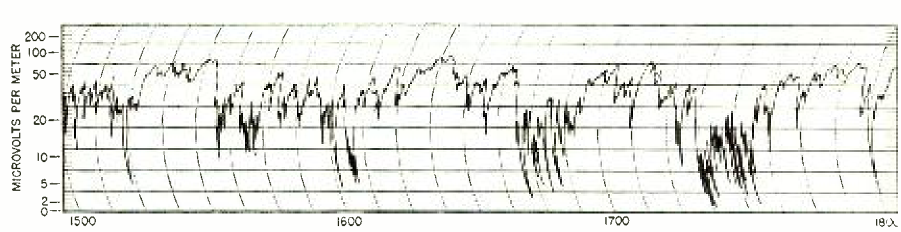
Fig. 2. Distribution of the intensities of the received waves for the three-hour period of recording shown in Fig. 3. Solid line gives observed field intensities exceeded for various percentages of time. The graph paper has been especially designed so that data distributed in accordance with the Rayleigh distribution will be on a straight line with a slope of —1.

this distribution closely, providing strong support for an explanation in terms of phase interference.

From analysis of the field-intensity data obtained by the Bureau, it appears that external receiving antennas may be used with considerable advantage for reception of FM broadcasts at points far beyond the horizon of the transmitting antenna. The FM fields from stations at large distances may be expected to reach their maximum levels in the early morning hours during the summer months, when effective ranges up to several hundred miles may be expected.

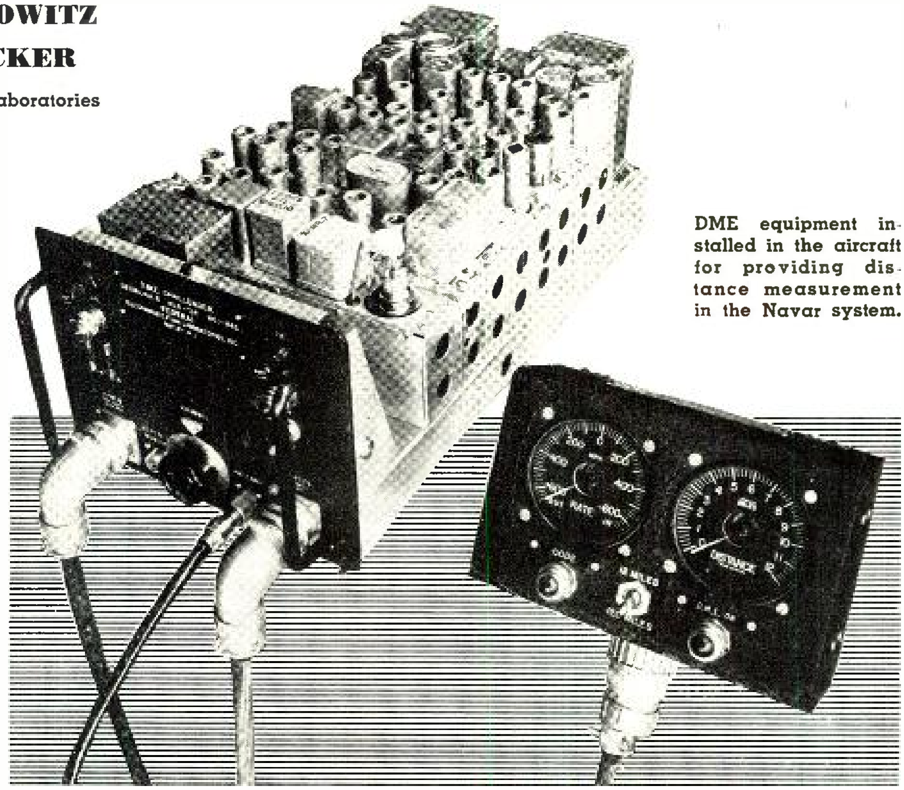
With increasing frequency the effectiveness of atmospheric ducts becomes greater while the boundary layer reflection coefficients decrease. Since these two tendencies affect attenuation of radio waves in opposite ways, it seems probable that there exists, for a particular set of conditions in the lower troposphere, an optimum frequency for propagation to large distances beyond the horizon. However, experimental data now available are not sufficient to locate these optimum frequencies in the spectrum.

Fig. 3. Three-hour record of field intensities received at NBS from FM station WSAP in Portsmouth, Va. This record was made at a rate 3 times that of Fig. 1 to illustrate rapid fading at points far beyond line of sight in the absence of effective bending of the waves to the earth's curvature by atmospheric refraction.



Aerial Navigation Aids Using Pulse Techniques

By SIDNEY MOSKOWITZ
and JOSEPH RACKER
Federal Telecommunication Laboratories



DME equipment installed in the aircraft for providing distance measurement in the Navar system.

Part 8 discusses the application of pulses in such navigation equipment as radar, Navar, and Loran.

AIR transportation in recent years has grown spectacularly in quantity, range, and speed of service, and is already showing signs of approaching saturation with a rapidity that has aroused the concern of all agencies interested in the promotion of safe, efficient air service. Future growth, especially of overland intercity traffic, is limited less by the characteristics of the airplane as a machine than by the congestion on airways, particularly around major airports. This congestion is caused by limitations of air navigation and traffic control facilities. Since airways and approach areas surrounding the airports are clearly defined by navigational charts, it is not the lack of available space but the inadequacy of facilities to control the aircraft that causes congestion.

During a period of war, the problem of aerial navigation is further complicated by the necessity for 'blind' or instrument flying, direction over a particular target, recognition of friendly aircraft, detection of enemy aircraft, and other allied services. Under the pressure of this last war many new applications of radio and electronics have been developed along these lines. Whereas these developments, which in general employ pulses, have done much to overcome some of the problems cited above, there is still room for a great deal of advancement in the design of aerial navigational equipment — this advancement also, in general, arising from the application of pulse techniques.

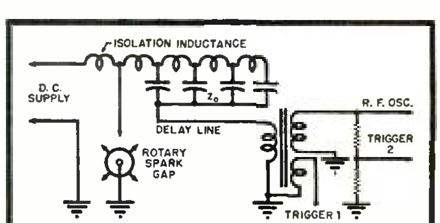
Probably the most publicized electronic contribution of the last decade is radar. It will subsequently be shown that the use of radar is one of the basic elements of virtually any navigation system. As is well known, pulse radar operates on the principle of forwarding an r.f. pulse of energy through space which strikes an object, is reflected, and picked up by a receiver at the initiating point. The interval of time between transmission and reception is measured, and knowing that electromagnetic waves travel at a speed of 3×10^8 meters per second, the distance between the object and radar set can be determined. Since highly directive antennas are employed, the direction of the object is also known.

Fig. 2 shows the block diagram containing the basic elements of a pulse radar system. These components are:

1) A timing unit which serves to synchronize the operation of all components and provide proper timing

2) An r.f. transmitter which emits a narrow pulse of r.f. energy

Fig. 1. Self-synchronous rotary spark gap timer and modulator showing two alternate means of obtaining triggering pulse.



3) An antenna system which is highly directive so that azimuth indication can be obtained. The same antenna is usually used for both transmitting and receiving

4) A transmitter-receiver unit which prevents the transmitted signal from injuring the receiver, and the transmitter circuit from absorbing the reflected signal

5) An electromechanical system, known as a servomechanism, which coordinates the speed and direction of the antenna with the indicating and controlling apparatus located at the scope

6) A receiver which amplifies the reflected signal

7) A cathode ray tube indicator which in coordination with the timing unit indicates the range and in some cases the azimuth of targets within view of the radar

It is beyond the scope of this article to cover the design of all of these units and discussion will be limited to those circuits requiring the use of pulse techniques. Those elements that will not be covered, such as the antennas or the servomechanism, do not, in general, deviate much from their design as part of c.w. systems and hence do not require special pulse techniques.

Before considering the design of the individual elements, the over-all characteristics of the system must be determined from maximum, minimum, and accuracy of range indication required.

The repetition rate or pulse repetition frequency, *PRF*, as it is usually referred to in radar terminology, is primarily a function of the maximum range of the system. After the pulse is transmitted, a period of time is required—known as null period—for the pulse to reach the target and be reflected back to the receiver. During this period, no other pulse should be transmitted, otherwise a target indication on the scope could be due either to a nearby or far off reflection—hence the range could not be readily determined. To overcome this effect, radar systems are usually designed to withhold transmission of a succeeding pulse until the preceding one has had sufficient time to reach the point of maximum range and return.

A typical example of how the maximum range is determined would be helpful in clarifying the previous paragraph. Assume that the *PRF* is 1000, then the time available for the pulse and the null period is 1/1000 of a second or 1000 microseconds. Assuming that the pulse width is negligible (usually of the order of 2 microseconds), the maximum range of the system is therefore the distance the pulse travels in 500 microseconds—since it must also return. The speed of the pulse is 300 meters per microsec., hence the range of a system using a *PRF* of 1000 is approximately 15 x 10^4 meters or 93 miles.

On the other hand, the pulse repetition rate should be as high as possible for two reasons. One is to improve the scope indication since the more frequently the signal is applied to the scope, the clearer it becomes. Secondly a high rate is required to make sure that no 'blind' spots exist in the system. This latter statement can best be understood by means of an example. Assume that the beam width of the antenna is 1°, the antenna rotation speed is 300 microseconds per degree, and the pulse interval is 1000 microseconds. In this case, the antenna rotates approximately 3° between successive pulses and hence there will be some areas towards which a pulse was not directed—known as 'blind' spots. It is therefore necessary to design the *PRF* and antenna rotation frequency such that the maximum range will be attained, with no blind spots.

The pulse width is limited by the fact that the transmitter must be turned off in time to permit the receiver to amplify reflections from the nearest target of interest. Obviously if the pulse width exceeds the null period required for the pulse to strike and return from the nearest target of interest — in other words the minimum range specified — then the reflected signal can not be distinguished from the transmitted signal. Thus if a 1 microsecond pulse is utilized, targets closer than 150 meters cannot be detected. Actually the minimum detection distance of a 1 microsecond pulse system is somewhat greater than 150 meters since additional time is required to permit the receiver to recover from the effects of the transmitted signal.

A narrow pulse is also essential in any system that must specify the distance of the aircraft with precision. This is true since it is impossible to determine whether the indication obtained is due to the beginning or end of the transmitted pulse. Hence if a 1 microsecond pulse is employed, a range accuracy of better than 300 meters cannot be attained. It should also be noted that, in all of the discussion thus far, the assumption has been made that the shape of the pulse is not altered by the receiver.

As previously indicated the function of the timing unit is to synchronize the operation of all elements of the radar system. Specifically the timing unit performs the following operations: It establishes the pulse repetition rate of the transmitted pulse by initiating each pulse; initiates or generates the sawtooth voltage applied across the indicator tube; controls the receiver gain by 'gating' pulses; and produces intensifier pulses for brightening the indicator beam during the active portion of the sweep.

Two types of indicator circuits may be utilized. One, known as the master-oscillator system, generates a master sine wave which is then passed through appropriate shaper and delay circuits to develop the proper waveforms. The second is known as the self-synchronous system in which the timing unit produces a triggering pulse which is then employed to actuate 'one shot' pulse generation circuits, thereby obtaining the necessary waveforms.

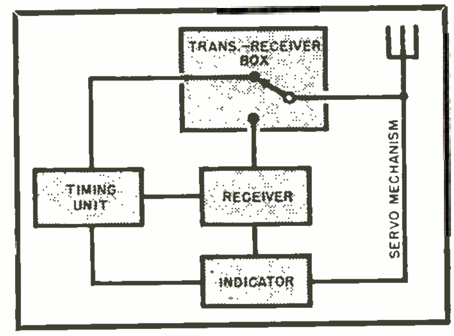


Fig. 2. Block diagram showing essential components of a pulse radar system.

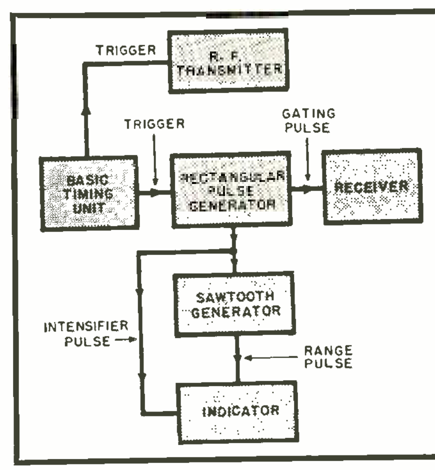
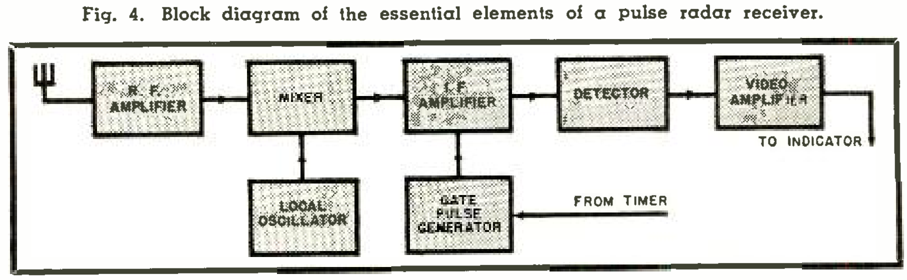


Fig. 3. Functional block diagram of a radar timing unit.

Of the two, the self synchronous system is much simpler from a circuit viewpoint, though not as accurate, and is therefore used in lightweight equipment, especially when high power must be combined with portability. The master-oscillator system is, on the other hand, used in equipment where a high degree of accuracy is required at the expense of weight and complexity.

The basic timing in a self-synchronous system is usually obtained by means of a rotary spark gap, though an r.f. blocking oscillator or a squegging oscillator is also employed. Fig. 1 is a simplified schematic diagram of a rotary spark gap timer and modulator. The rotary gap consists of one or more fixed electrodes and a number of moving electrodes spaced on the periphery of the rotor, which is driven by a synchronous motor connected to the primary power source. When the rotor electrode and a fixed electrode come

Fig. 4. Block diagram of the essential elements of a pulse radar receiver.



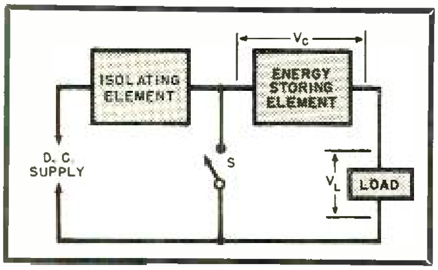


Fig. 5. Basic circuit for pulses using electrostatic energy storage.

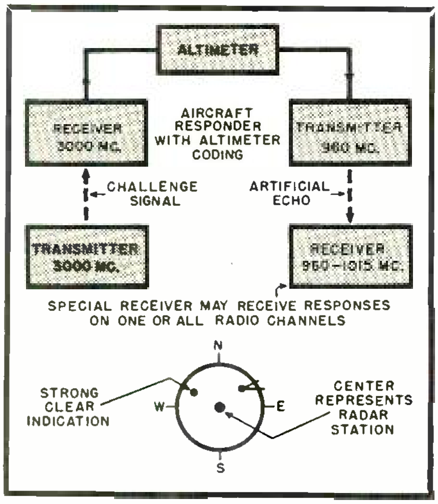


Fig. 6. Block diagram showing the principle of Beacon (unassisted) radar.

sufficiently close, the high voltage between them breaks down the air in the gap and provides a low impedance path to ground. The current flow through the circuit forms the modulating pulse. Coincidentally, a small portion of the modulating pulse is obtained from either a voltage divider circuit or through an additional secondary in the pulse transformer which is then used to trigger the sweep and other indicator circuits.

The repetition rate of the rotary spark gap is established by the number of times per second an arc is produced between stators and rotors. If the rotor rotates at a rate of V times per second, the number of rotors is R, and the number of stators is S, then the PRF of the system is:

$$PRF = VRS \text{ pulses per second}$$

The timing trigger is fed to a 'one shot' pulse generator such as a multivibrator, which produces a rectangular pulse output whose width is made equal to the microsecond equivalent of the maximum range of the system. Thus if the maximum range of 93 miles were desired, the width of the rectangular pulse would be 1000 microseconds. This rectangular pulse is then fed to the grid of the CRT, which is normally biased to cut-off, permitting the electron beam to flow only over the pulse duration. Similarly, this pulse can be used to turn on the receiver for this period—in which case the receiver would normally be cut off. Two modifications of the pulses used for this application would be to delay the pulse fed to the receiver by a period equal to the width of the transmitter pulse, thus reducing the possibility of injury to the receiver during this time; and provide a sawtooth waveform so that the gain of the receiver can be made to vary with time.

The rectangular pulse is also fed to the grid of a sawtooth generator. In the absence of the pulse the generator tube is conducting and its plate voltage is very low. The presence of the pulse, however, cuts off the tube — increasing the plate voltage to a high value. A condenser in the plate circuit then charges up to this value. At the termination of the pulse, the tube returns to its conducting status and the condenser discharges rapidly. Thus the output of this generator is a sawtooth voltage whose buildup time is exactly equal to the duration of the applied pulse. This sawtooth voltage is then applied across the horizontal deflection plates of the CRT causing the beam to travel across the screen.

Fig. 7. Block diagram indicating the basic principles of a Navar system.

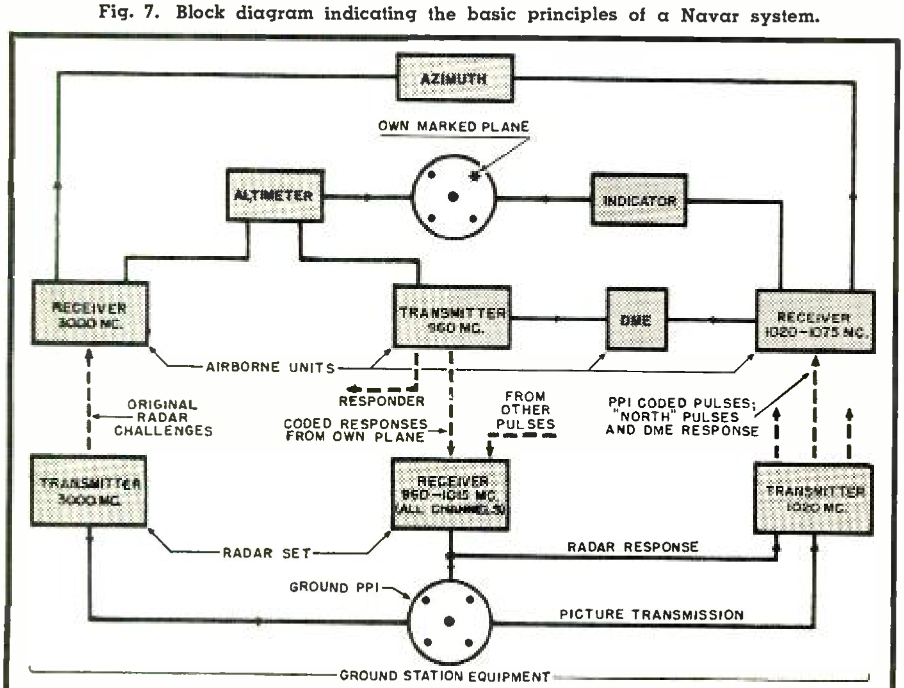


Fig. 3 is a block diagram of this system. It should be noted that the trigger pulse initiates the rectangular pulse, and the rectangular pulse initiates the sawtooth voltage — so that the electron beam commences its sweep across the screen at the time that a pulse is being emitted by the transmitter. Furthermore, it reaches the end of the screen after a period equal to the width of the rectangular pulse. The screen of the cathode ray tube can be calibrated directly in miles. If a 1000 microsecond pulse were used, the terminating point of the sweep would be equivalent to a range of 93 miles, the half-way point 46.5 miles and so on. This latter statement assumes that the sawtooth has a linear slope — which is generally designed so this is true. Of course the range of the unit can readily be varied by changing the pulse width. This usually means varying the RC constant of the generator and in many sets a number of ranges are provided which are obtained by switching to an appropriate value of resistance.

In the master oscillator system, passive pulse generation is employed with the basic sine wave being passed through shaping circuits such as those described in previous articles[1,2] to obtain appropriate waveforms. This system is more flexible and accurate than the self synchronous system mainly due to the fact that the oscillators utilized are much more stable than the rotary spark gap and hence provide a much more precise timing base.

Modulator

The modulator required in the transmitter differs from pulse generators that have been described[1] in that high power, of the order of kilowatts, is involved. Basically the modulator, which is also referred to as the pulser, consists of a storage element, which stores up energy during the 'off' period and releases it during the 'on' period, a switch to effect the 'on' and 'off' positions, and a timing element which established the pulse duration. This is shown in block diagram form in Fig. 5.

There are two general types of modulators (employing electrostatic energy storage — in contrast to electromagnetic storage which is rarely employed

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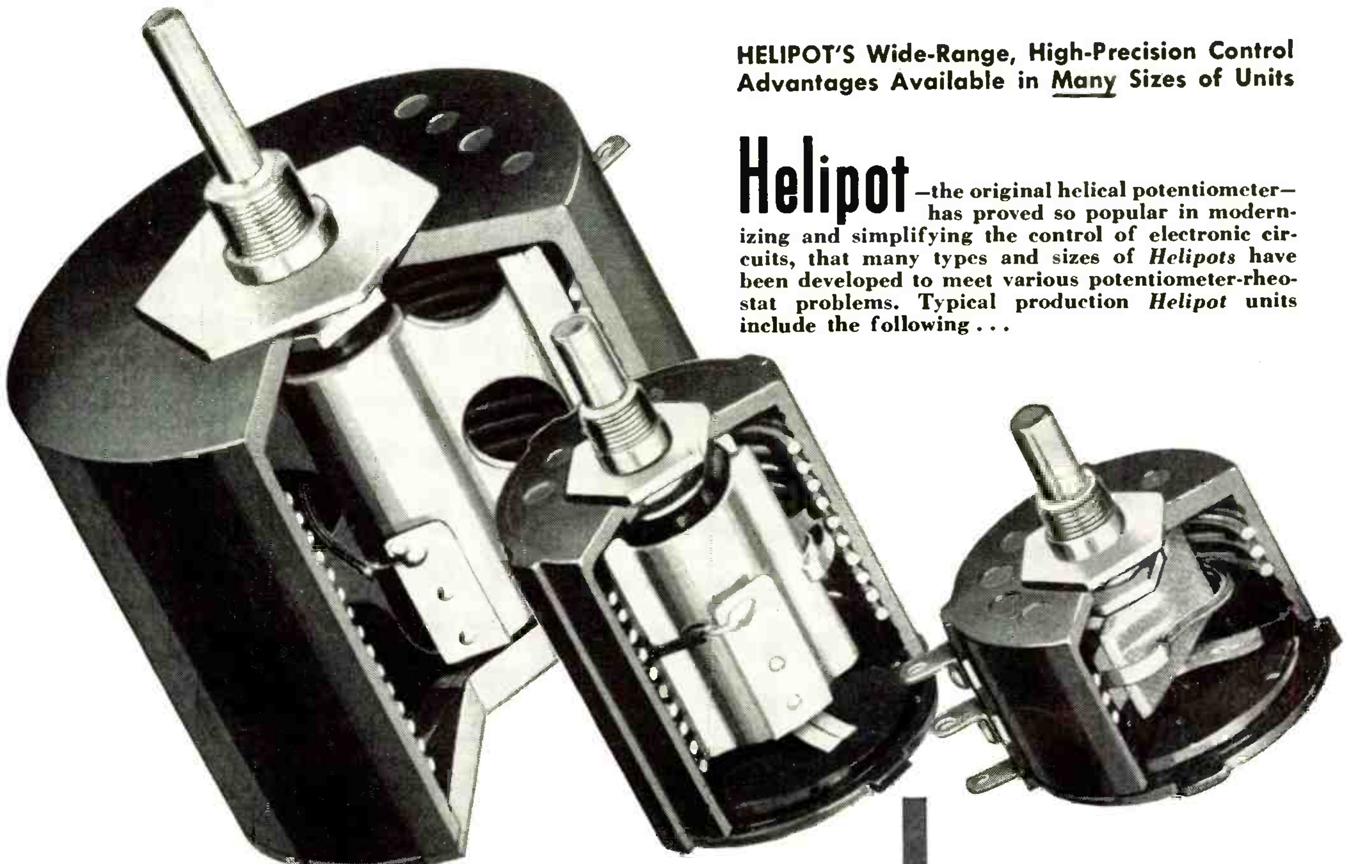

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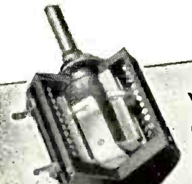

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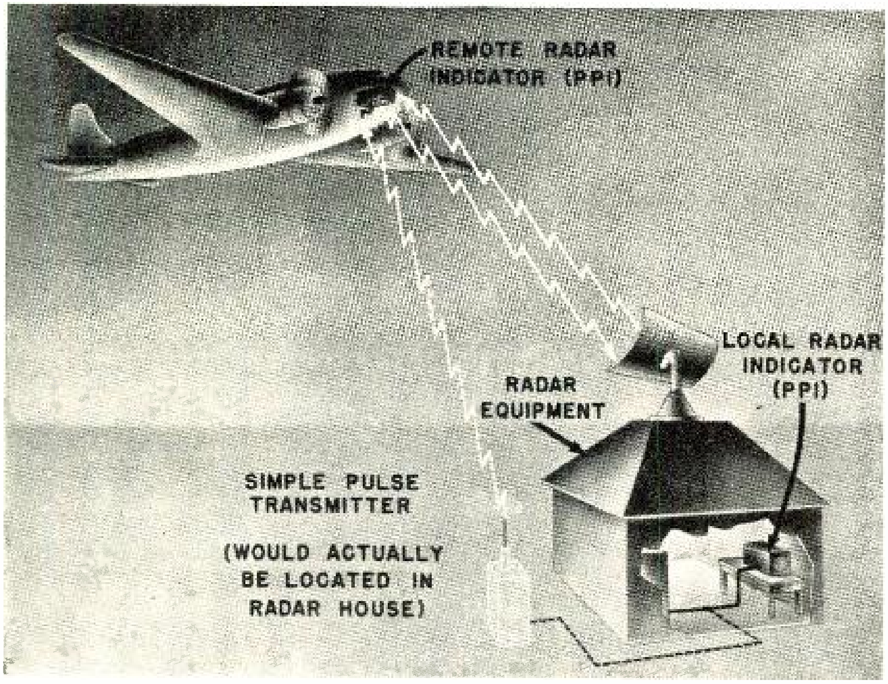


Equipment required in a remote radar indicating system using Navar.

and hence will not be considered in this article). In one, known as the hard tube pulser, the storage element is a condenser, the switch a vacuum tube, and the timing is obtained from a pulse generated in a previous stage. The second, known as a line pulser, employs a delay line which acts as both the storage and timing elements, and a rotary spark gap or equivalent for switching. The latter type is simpler, the former more accurate.

A simplified schematic diagram of a typical hard tube pulser is given in Fig. 8. The storage element, C_o, is charged through the isolation inductance L_1. In the quiescent state, the point A is at ground potential while the high voltage side of C_o is at the full d.c. supply voltage. The control grid of T is biased to cut-off. A rectangular pulse is applied to the grid, whose peak voltage is sufficiently large to enable the tube to conduct and whose duration is equal to the desired width of the transmitted pulse. When the tube conducts, the d.c. voltage drops to a very low value and, since the voltage across C_o cannot change instantaneously, the point A will assume a high negative potential, which is applied to the load, shown in the schematic diagram as a magnetron. A magnetron acts as a diode and hence does not generate r.f. energy until this negative potential is attained. Current will continue to flow out of C_o and around the load circuit until the driving pulse on the grid of T returns to zero value and the tube is cut off again.

During the presence of the driving pulse, the potential of C_o and hence that across the load slowly declines unless C_o is made very large. In any practical design it is usually desirable to make C_o no larger than absolutely necessary, the criterion being the permissible voltage drop while carrying a current pulse of definite magnitude for the duration of one pulse. Expressed more quantitatively, $C_o = I\, t_d / V_d$ where I is the current flowing through the load, t_d the duration of the pulse, and V_d the maximum permissible voltage drop. The sizes of L_1, L_2 and R_2 depend upon how quickly it is desired to bring the tail of the pulse down to zero, once the driving pulse has been removed, and also how much energy can be wasted in the elements during the pulse.

Occasionally, the most efficient operating voltage of the magnetron does not correspond to the optimum plate voltage for T so that there must be some impedance matching device between the pulser and the load, usually in the form of a pulse transformer. The introduction of the transformer in the circuit, however, tends to drive the pulse negatively, and a diode damping circuit[2] is frequently necessary.

A typical line pulser type of modulator is shown in Fig. 1. In this case, the storage element is a delay line of characteristic impedance Z_o. When such a delay line is charged up to a potential V_c and then suddenly connected across a resistance R, there will be a pulse of current flowing through the circuit for a time equal to 2δ, where δ is the delay time of the line. The voltage appearing across the load, V_L, during this time is given by:

$$V_L = V_C \frac{R}{Z_o + R}$$

It is obvious that if R is equal to Z_o, V_L will be equal to one half V_c. If R is not equal to Z_o reflections will occur, the amplitude of the nth reflection being equal to:

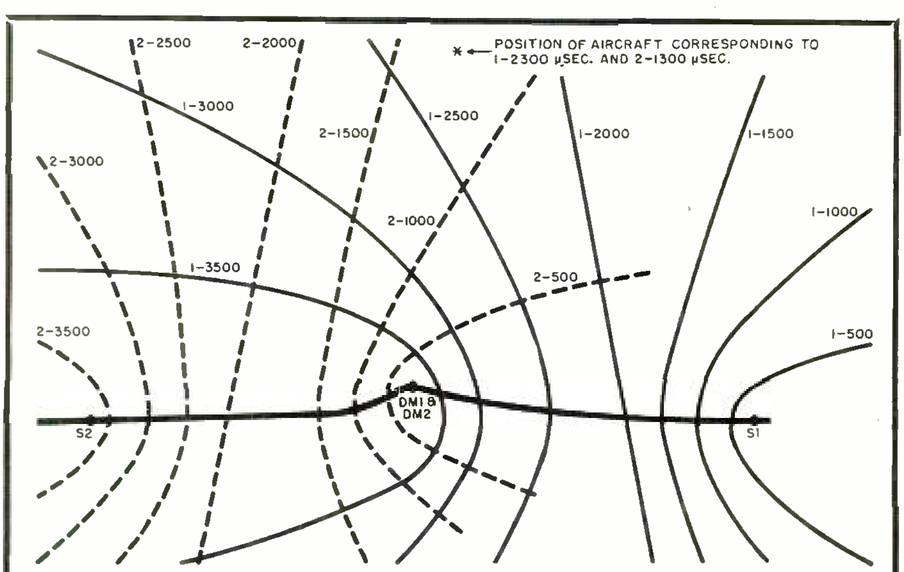
$$V_{Ln} = V_c \frac{R}{Z_o + R} \left(\frac{R - Z_o}{R + Z_o}\right)$$

Thus it is readily seen that if the delay line is terminated in an impedance equal, or closely equal, to its characteristic impedance, a rectangular pulse whose width is equal to twice the delay of the line will be applied to the r.f. oscillator each time the rotary gaps spark.

Receiver

The function of the receiver is to detect and amplify the echo signals, applying the amplified output across the vertical plates or control electrode

Fig. 8. Two families of Loran hyperbolic functions corresponding to given microsecond readings at the receiver.



of the cathode ray tube so that the signal appears on the indicator as a 'pip' or a dot depending upon the type of indication that is employed. The receiver must be capable of providing high gain, usually 120 db., to detect weak echoes (1-10 microvolts) and provide an adequate output (10 to 100 volts), maintain internal noise to a minimum and have a wide bandwidth characteristic—in some cases as high as 12.5 mc.

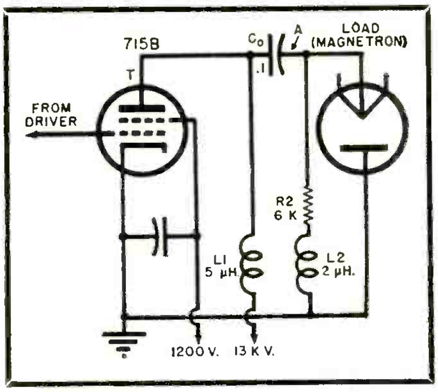


Fig. 9. Simplified schematic diagram of a hard tube modulator.

Fig. 4 shows the block diagram of a typical superheterodyne receiver. An r.f. amplifier is used to raise the signal level above the noise level of the succeeding mixer and i.f. stages. The main portion of the amplification is carried out at the intermediate frequencies, raising the signal level to the order of 1 to 10 volts so that high level linear detection may be utilized. This is followed by sufficient video amplification to raise the peak level to that demanded by the control electrode or deflection plates of the indicator tube.

At this point it should be noted that there are two basic types of indication that can be supplied. One, known as type *A* indication, shows only the range of the echo. In this case, a linear sawtooth voltage is applied to the horizontal deflection plates, and the receiver output to the vertical plates—thus the echo appears in the form of a 'pip' at the proper range.

The other type of indication, known as plan position indication or PPI, shows both the range and azimuth of the echo. This is accomplished by applying a linear sawtooth voltage to a deflection coil — providing electromagnetic deflection — with this coil rotating around the cathode ray tube in synchronism with the antenna. In this case, the receiver output is applied to the control grid or electrode of the CRT, producing a bright spot on the screen when a signal is received. By superimposing a map, whose center point is equivalent to the position of the radar set, on the PPI, the exact geographic location of echoes is automatically provided.

The receiver must also be designed so that it is capable of recovering rapidly from the effects of strong signals. Consequently, throughout the receiver, particularly in the i.f. and v.f. (video frequency) coupling circuits, care must be taken to avoid accumulation of charge on capacitors that may block the receiver.

In certain radar systems, continuous control of the i.f. amplifier gain is provided through the use of a gating pulse which, as previously described, also actuates and silences the receiver at appropriate intervals. By increasing the gain as a function of time the amplitude of all echo signals tends to equalize, irrespective of distance. Such a gain control may be accomplished by applying a sawtooth voltage across the grid of the final i.f. amplifier, with this tube normally cut-off in the absence of the gating pulse.

The radar equipment described thus far was developed during the war, mainly for the purpose of detecting enemy targets. However, with some modification these same principles were also employed to aid aerial navigation within the aircraft through the development of altimeters, whereby the height of the plane was determined by timing the ground echo, and identification of friendly aircraft. In this latter system all friendly aircraft contained a unit

(*Continued on page* 29)

NEW PRODUCTS

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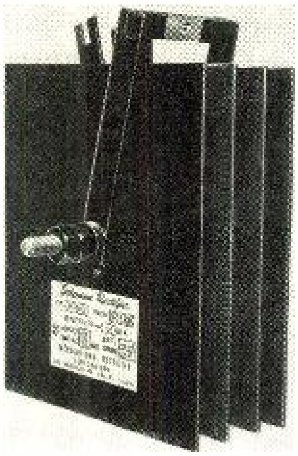
The *International Rectifier Corp.* has announced a new heavy duty selenium rectifier. It features interlocking as-

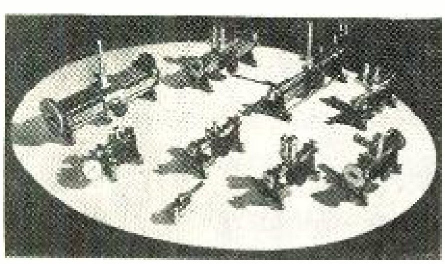


semblies of rectifier components, conservatively rated terminals and special moisture-proofing. Leakage current is less than 1 ma./ cm.^{2} at 25 volts r.m.s. in the reverse direction. The individual selenium elements measure 6¼" x 7¼" and are rated at 12 amperes. Inquiries may be addressed to 6809 S. Victoria Ave., Los Angeles 43, Calif.

PRECISION IMPEDANCE METERS

Precision impedance meters which have a 2 per-cent accuracy for 650 to 40,000 mc. are now being produced by the Industrial Department of *Sperry Gyroscope Company*, Great Neck, N.Y. These instruments determine impedance by measuring standing wave ratios and anode positions in microwave transmission lines. They can also measure relative power, attenuation and wavelength in the line.

The complete series of nine instruments covers all standard sizes of wave-

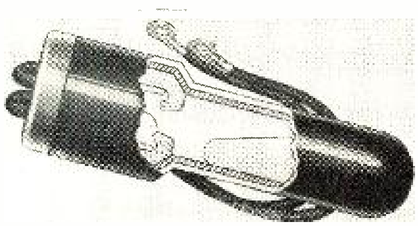


guide from 3" x 1½" to 0.360" x 0.220" and rigid coaxial lines of ⅝" and ⅞". Probe position can be measured to 0.1 mm. on vernier scale instruments and to 0.01 mm. on dial and micrometer instruments.

MERCURY SWITCHES IMPROVED

New technical developments in the manufacture of *Durakool* mercury switches have made differences in performance. An electrical weld now seals hydrogen gas under pressure in the metal case of the switch. The closure keeps that pressure intact whether the switch is in use or inactive on a machine or in stock. There is no noticeable deterioration over periods of many months.

The purpose of the hydrogen gas under pressure is to kill the usual arc between the mercury and the contact points of the switch. Thus corrosion of the electrode is all but eliminated. The metal case acts as one electrode. Models rang from 1 to 65 amperes in capacity and are made with or without plastic case. Rubber insulations may be had



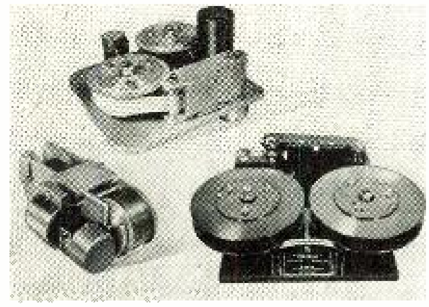
on order. Address *Durakool, Inc.*, Elkhart, Ind., for further information and a catalogue.

LEVEL AND ANGLE INDICATOR

A combination level and angle indicator usable from all four surfaces is now available from the *R-D Company*, P.O. Box 912, Flint, Michigan. Dial indicators are of clear, unbreakable plastic, calibrated in degrees and graduated to make the tool practical for use in exacting jobs. The frame is heat-treated aluminum, 16" x 3" x ¾". Total weight is approximately 1½ pounds.

DATA RECORDER MECHANISMS

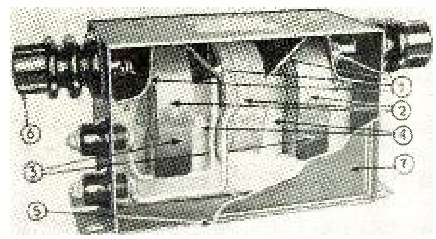
Newest in the line of data recorders produced by the *Cook Research Laboratories*, 1457 Diversey Parkway, Chicago 14, are types MR-3 and MR-6. These units are designed for building into vehicles, aircraft, guided missiles or other mobile equipment. The devices use magnetic tape to store variable or transient data under conditions of severe shock acceleration for later rerunning and analysis. All designs have



multi-information channels and in addition, include a time base channel for speed and error compensation purposes.

LUMINOUS TUBE TRANSFORMERS

Flickerless performance, quiet, low operating temperature and long service



life are featured by *Felco* luminous tube transformers, made by *The Forest Electric Company*, 7216 Circle Avenue, Forest Park, Ill. Coil design and placement minimize electrical stresses and direct short leads prevent destructive corona action.

There is midpoint grounding with larger wire in primary and secondary coils. Balanced design greatly reduces radio disturbance and effectively protects secondary coils from burn-outs due to ground or defective tubing.

TAPE RECORDER FOR FM

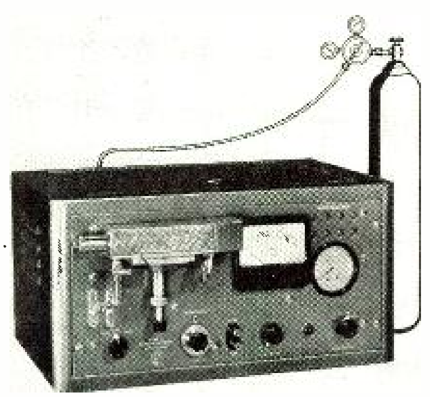
Expressly designed for the requirements of FM broadcast application, the *Ampex* tape recorder offers a 35-minute transcribing capacity at 30 inches of tape per second. The unit is self

contained, in a studio-styled housing. Included are precision tape drive, completely shielded plug-in head housing with separate heads for erase, record, and play-back, separate record and playback amplifiers, flexible controls and adequate power supplies.

Frequency response of the unit is within ± 1 db. between 30 and 15,000 c.p.s. The manufacturer is *Ampex Electric Corporation*, 139 Howard Avenue, San Carlos, Calif.

ALPHA COUNTER

An alpha proportional counter system has been designed for counting alpha particles in the presence of a



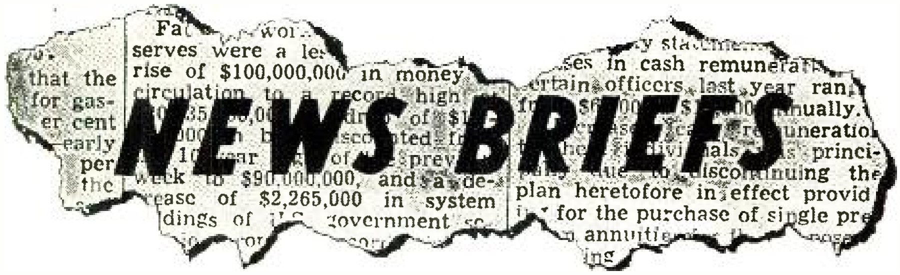
strong beta activity. The unit consists of a methane flow proportional counter with sample holder, a built-in variable high gain linear amplifier, scale of 256 to 1, a built-in high speed impulse recorder, and variable high voltage supply. The complete unit is constructed on a single chassis.

This type of counting system is now available from the *Instrument Development Laboratories, Inc.*, 223-233 West Erie Street, Chicago 10.

HIGH VOLTAGE MULTIPLIER

Reiner H.V.M. leads have special high voltage type of resistors built into the prod handles so that practically the entire voltage drop takes place before the wire lead of the cord is

reached and the instrument end or tip is relatively "cold." This is a scientific and safe way to measure high voltage. Special voltage ranges and sensitivities for vacuum tube voltmeters can be supplied upon request and detailed information is given in a bulletin. The manufacturer is *Reiner Electronics Co., Inc.*, 152 W. 25 St., N.Y. 1, N.Y.



MAN-MADE QUARTZ CRYSTALS

Clear, sparkling crystals of real quartz, identical in every way to those produced by the processes of nature are now being grown at *Bell Telephone Laboratories*, 463 W. St., New York 14, N. Y. A finely powdered form of silica is placed in the bottom of a steel bomb "test tube" and an aqueous alkaline solution is added. A seed plate, a thin wafer of quartz, is suspended at the top of the bomb which is then sealed and placed in a furnace. Under pressures exceeding 15,000 pounds per square inch and at temperatures of about 750° F., the silica dissolves, rises to the cooler part of the bomb and is deposited on the seed plate, molecule upon molecule, in perfectly regular order until it is in the form of a single clear crystal.

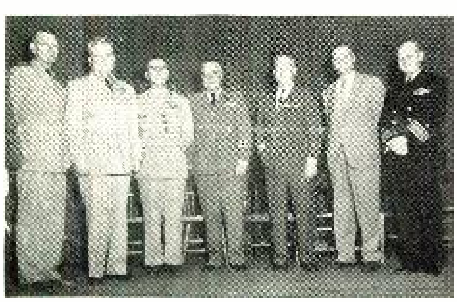
Due to controlled uniformity of such production, the synthetically produced crystals are superior to natural ones. Standard growth rate is an inch a month, and commercial manufacture is predicted for the near future.

I.I.T. APPOINTMENTS

Four new members of the teaching staff of the electrical engineering department of the Illinois Institute of Technology were recently announced by Dr. E. R. Whitehead, director of that department. Carl D. Pierson, Jr., has been appointed instructor, Leander W. Matsch, professor, Benjamn A. Fisher, associate professor and Elton W. Jones, assistant professor. These positions are all effective as of September 1.

NAVY AND ELECTRONIC INDUSTRY CONFER

The Chicago chapter of "The Representatives" recently held a meeting in the Civic Opera Building attended by



over two hundred key men in the electronics industry and officers in charge of various electronics divisions of the Navy Department in Washington. They discussed the particular problems of electronic companies in their relations with the Navy, what the Navy is doing and planning, electronically, and industry's place in that program.

Points emphasized were that bidders must check Public Law #413 before entering into contracts with the Armed Forces and that manufacturers interested in supplying the services should read the booklet titled "Mobilization Guide Book for U.S. Industry," obtainable at the Government Printing Office, Washington 25, D.C., for $.25.

Pictured here are the principal speakers at the Navy Electronics Program.

NEC CONFERENCE IN NOVEMBER

The annual National Electronics Conference will be held November 4, 5 and 6 at the Edgewater Beach Hotel in Chicago. Scheduled as the outstanding features of this year's program are the banquet in the Marine Dining Room on Thursday evening and a large screen television demonstration by the *Radio Corporation of America* in the Crystal Ballroom on Friday at 8:00 p.m.

Exhibits of manufacturers' new equipment will be on display throughout the sessions, and a comprehensive technical program has been arranged with all major fields of interest being covered. These include new materials, sound measurement and recording, servomechanisms, communications, electronic instrumentation, new tube developments, microwaves, computers, industrial applications, television, management of research, electronic circuits, magnetic amplifiers, and antennas.

SYNTHETIC MICA

A synthetic mica with the desirable characteristics of natural mica is now being produced on a pilot-plant scale under a coordinated research program sponsored by the Office of Naval Research, Army Signal Corps and the Navy Bureau of Ships. Known as fluorine-phlogopite mica, the synthesis has the properties of perfect cleavage into thin sheets, good electrical and mechanical characteristics and chemical stability. There is also the possibility that further research may reveal ways of directly fabricating mica components, which would eliminate the time consuming and laborious tasks of sorting, grading, splitting and trimming natural mica. Production of synthetic mica will make the United States independent of foreign sources for this strategic mineral that is widely used in communications and electrical equipment.

CLIENT RESEARCH DEPARTMENT

The Mayflower Electronic Devices, Inc., manufacturers of electronic heat sealing equipment and electronic sewing machines recently announced the formation of a client research department. This department will do research on dielectric heating and electronic sealing for clients on a contract or project basis. The company, located at 6014 Hudson Boulevard, West New York, New Jersey, has had wide experience in these fields and is manufacturing equipment under *RCA* licenses.

JARVIS HEADS CHICAGO I.R.E.

Ken Jarvis, well-known consulting engineer and president of *Jarvis Electronics Corporation*, has been elected

chairman of the Chicago Section of I.R.E. for the 1948-1949 year. Other officers include Don Haines, vice chairman, and Kipling Adams, secretary-treasurer.

The Chicago Section is the second largest of this non-profit professional organization devoted to the advancement of the theory and practice of radio and electronics, including allied branches of engineering.

WEST COAST AUDIO SOCIETY

The newly formed San Francisco Section of Audio Engineering Society elected a full complement of interim officers to operate until regular fall elections are held. Ratification of the constitution was scheduled for a later meeting, which will also include a program of recent disc recording developments, particularly the new microgroove records.

NEW LITERATURE

Manufacture of Iron Cores

A short description of the practices of the three leading German firms which were responsible for most all of the production and important development work of the manufacture of

(Continued on page 27)

NEW TUBES

RCA TUBES

The Tube Department of the *Radio Corporation of America*, Harrison, New Jersey, has announced three new tubes, a power triode, an improved and superseding version of the 812, the 672-A, an

improved version of the mercury vapor thyratron 672, and a radiator-cooled tetrode, intended for v.h.f. operation as a power amplifier and oscillator.

Small in size, the tetrode features low-inductance leads, low grid-plate capacitance, effective shielding between grid and plate circuits and a grid ter-

minal located at the center of the filament end of the tube to facilitate its use in coaxial circuits.

Type 672-A differs from 672 in that the heater current is reduced from 6 to 5 amperes, maximum peak anode current is increased from 30 to 40 amperes, maximum average anode current is increased from 2.5 to 3.2 amperes, and maximum peak forward and inverse anode voltage ratings are increased from 1500 to 2500 volts. The over-all length is shortened by ¼ inch.

The triode can be operated at high efficiency and low driving power. Operation with maximum ratings is permissible up to 30 megacycles.

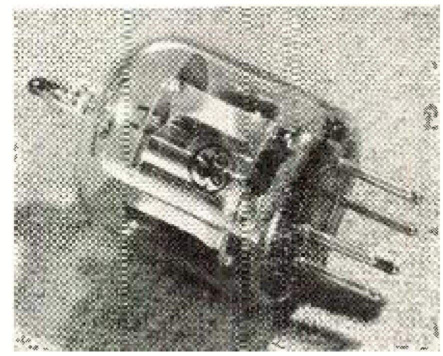
TRANSMITTING TUBE CHARACTERISTICS

More than a score of power and transmitting tube characteristics in a variety of common applications are tabulated for quick easy reference in a booklet available on request from *Sylvania Electric Products, Inc.*, Emporium, Pennsylvania. Rated plate dissipations range from 20 to 175 watts in a number of services. These services include a.f. power amplifier and modulator, class B and class AB_2, r.f. power amplifier, class B telephony, plate modulated r.f. power amplifier, class C telephony and others. In addition, the bulletin contains tube base diagrams and tabulation of tube types by base arrangement.

HIGH POWER MAGNETRON TUBE

A new high power magnetron tube, with a continuous wave output of 50,000 watts at the extremely high frequency of 1,000,000,000 cycles per second has been developed under a Signal Corps contract by *General Electric Research Laboratory*.

The magnetron's output represents



the greatest CW power ever produced at the billion-cycles frequency, according to the scientists concerned with the project. Frequency of the tube's output is estimated as roughly 1000 times as high as that of a standard broadcasting station.

The tube itself is water-cooled, but it obtains the necessary heat for operation of its cathode by secondary emission within the tube itself, created by the high velocity of the emitted electrons.

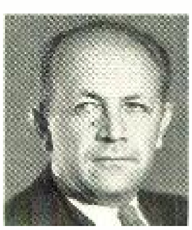
Personals

D. GORDON CLIFFORD is now field engineer at *Lenkurt Electric Company*, San Carlos, California. Mr. Clifford was formerly the chief engineer of *Industrial & Commercial Electronics*, one of the development engineers working on the klystron. He has been on the engineering staffs of *Sperry Gyroscope Company*, *Westinghouse Electric Corp.*, *Western Electric Co.* and *Sylvania Electric Products Corp.*, and received his degrees from Dartmouth and Harvard.

RAY DAVIS KELL, director of television research at the *RCA Laboratories* in Princeton, New Jersey, will be the 1948 recipient of the Stuart Ballantine Medal of The Franklin Institute. This award is made on the basis of his outstanding pioneer work in television, adaptation of it to military needs and for his inventive contributions and leadership in the development of color television. He was also instrumental in the development of the first iconoscope camera.

ROBERT A. KIRKMAN has been announced as a new member of the engineering staff of *Cook Research Laboratory*, 1457 Diversey Parkway, Chicago. His work will be principally in the design and development of high frequency communication equipment, including radar. Mr. Kirkman transferred to the *Cook Laboratories* from the *Signal Corps Engineering Laboratories* where he was chief section engineer for five years. He is an active member of IRE.

RALPH A. KRAUSE was recently appointed director of research at Stanford Research Institute. He was formerly assistant to the president of *Raytheon Manufacturing Company*, and has helped to organize the Laboratory of Nuclear Science and Engineering at Massachusetts Institute of Technology, serving as the assistant director. During the war he took charge of electronics research of the Office of Naval Research and later headed a scientific division.



DR. LADISLAUS MARTON, Chief of the Electron Physics Section of the National Bureau of Standards, spent the summer in Europe surveying current work in the field of electron microscopy. Dr. Marton will also assist in initiating and organizing electron-optics research in Belgium, where he did fundamental work in that subject prior to 1938. He is internationally known for his accomplishments in electron optics and research on the electron microscope.

A. C. MONTEITH is the newly elected vice president in charge of engineering and research of *Westinghouse Electric Corporation*. Mr. Monteith began his career with *Westinghouse* in 1923 as a graduate student engineer in the training course and was assigned to the central station engineering department in 1924. He became manager of that department in 1938 and in 1941 was named manager of the industry engineering department.

Electronic Digital Computers

(Continued from page 13)

Ten different kinds of pulses, six of which are in Fig. 9, are produced by the cycling unit and transmitted to all other units of the computer. The pulses are generated in a 100 kilocycle master oscillator, then applied to a twenty-stage ring counter and passed through a delay-line. The pulses are then gated by gate tubes operated by the twenty-stage counter, giving as a final result the pulses shown in Fig. 9. (The pulses shown are not all the pulses produced by the cycling unit, but include all those necessary for the processes of addition and subtraction.)

The number and selection of these pulses which are applied to the single counter decade are determined by the set-up of the various other counters and program control circuits of the computer for the specific problem which is to be solved. At the start of the operation (addition or subtraction) the counter registers some number from 0 to 9. The number to be added to that registered by the counter is received as a number of pulses at the digit input. Actually, two counters are always required for addition: one counter (the transmitter) represents the number to be added, and therefore controls the number of pulses which are added; the second (the receiver) represents the sum of some number plus the number represented by the transmitter. Thus, the nine-pulses are applied to one input of tube 2, Fig. 6, but the second input is controlled by the transmitting counter so that only the correct number of pulses is applied to the receiving counter.

As a specific example, suppose the counter originally registers the number 8, and the number 5 is to be added. Then five pulses pass through gate tube 2 while it is open, and advance the counter from 8 around through 9 and 0 up to 3. Since 8 plus 5 equals 13 (i.e., 3 with 1 to carry), a pulse representing 10 must be applied to the decade representing the next digit to the left. Since other decades may also be counting at the time the carry-over takes place, it must be remembered and sent on at a time when no other counts are taking place. This operation is performed by the carry circuit (tubes 9, 10, 11 and 12). At the count of 9, gate tube 7 is opened by the static output, so the following pulse which gives the count of 10 is also applied to tubes 9 and 24. This pulse opens gate tube 8, and does not pass through tube 24 because the carry-clear input is not open. After the count has taken place the carry-clear signal opens gate tubes 23 and 24, so that when the first reset pulse is applied to tube 8 it goes through tube 23 into the next decade, giving the carry-over. If, instead of holding the digit 3 at the end of the count, the decade held at 9, the carry-over pulse from the previous decade would go through the tubes 7 and 24, advancing the count by 1 and passing into the next decade as another carry-over.

The same circuit of Fig. 6 can also be used as a transmitting counter for the process of addition or subtraction. In this case, the number statically registered by the counter is converted into pulse form, so that the number of pulses emitted is a measure of the digit registered in the counter. During the process of addition, the number of pulses emitted is equal to the number registered in the counter. However, for greater circuit economy and efficiency the process of subtraction is performed by using the complement of the digit with respect to 10. (Thus, if 3 is to be substracted from 5, the result is 2 which may be achieved either by subtracting 3 from 5 or by advancing the counter around 7 places, which also gives the digit 2 when no carry-over is allowed to occur.) Thus, subtraction of a number is accomplished by adding the complement of that number with respect to ten (with no carry-over to the next decade).

How a counter decade transmits the correct number of pulses for addition and subtraction can be understood by reference to Fig. 6. The transmission process makes use of the ten-pulses from the cycling unit, which are introduced through tube 1. These ten pulses cycle the counter completely through a complete cycle, leaving it to register the same number it originally held. For example, if the counter originally held the number 5, the addition of ten pulses would cause it to cycle through 9 and 0, and up to 5 again. It can be seen that the counter circuit has two outputs, one for addition and the other for subtraction, which are controlled by the carry circuit. During the time the counter is cycling from the number which it registered initially until it goes through the count of 9, gate tube 13 is open to permit the complement number of pulses to be passed through the subtract output. (It should be noted that the number of output pulses will be the complement with respect to 9, and the missing digit is supplied by the complement-pulse from the cycling unit.) After the count of 0 the carry circuit is set, opening gate tube 14 and closing 13, so that the number of pulses which advance the decade from 0 to the digit which it originally registered are permitted to pass through the add output. In this method the number of pulses which the counter registered at the start of the process is permitted to pass through the add output to be added to any number stored in any other counter, while the complement number of pulses is permitted to pass through the subtract counter to give subtraction from any number stored in any other counter by the method of complements.

The various counting circuits are controlled and directed in their operations by means of program control circuits of the type in Fig. 11. Such a circuit can be set up for a large variety of operations, such as: (a) add and clear, (b) receive a number, (c) subtract without clearing, etc. When the program control circuit receives a program pulse, it directs its unit to the required operation, and when this is completed sends out an output program pulse which in turn initiates the next operation in the computation sequence to be performed. Thus a complete problem is set up by proper interconnection of the necessary amount of counter circuits and program controls in the proper sequence, and setting the program control circuits for the required function by means of the switches associated with them.

(*To be continued*)

News Briefs

(*Continued from page* 24)

high frequency iron cores is on sale for $.50 by the Office of Technical Services, Department of Commerce, Washington 25, D. C.

The mixing methods used by the *AEG* firm in Berlin and an extrusion process developed by *Siemens and Halske* at Wernerwerk are of special interest. Tabular data on common mixing processes for iron core manufacture, grades of iron ores, magnetic materials, hysteresis and other pertinent matter is included. To obtain this report, write for bulletin #PB-45067.

Recording and Reproduction of Test Data

Aimed at problems in recording and reproduction of test data, a free bulletin has been released by the *Cook Research Laboratories*, 1457 Diversey Parkway, Chicago 14. It describes their standard 6-information channel recorder and playback equipment together with three newly developed data recorders and a data interpretation unit.

The company has also established a new data analysis department and maintains a trained staff to render complete recording and analytical services on data received. With their help jobs are made easier and installations more efficient.

Silicone Mold Release Agents

General properties, major applications in the fields of lubricating tire molds, curing bags, and lubrication of mechanical rubber goods, floor tile, and plastics, of silicone mold release agents are discussed in a pamphlet of *Dow Corning Corporation.*

These agents were introduced by the company about four years ago and have since proved their commercial usefulness by reducing operating costs and improving the quality of rubber and plastic molded products.

The pamphlet is available upon request by writing the firm at Midland, Michigan.

Industrial Review

TESTING, 1-2

The 44BX ribbon velocity microphone undergoes a final inspection at the *Radio Corporation of America's* Engineering Products plant in Camden, New Jersey. These mikes will later be shipped to radio stations all over the world.

The 44BX was the first high fidelity, bi-directional microphone available to the broadcasting industry. Today, thousands of these sensitive units are in use.

* * *

NEW FIRM

Brociner-Mass Instruments, Inc. has been organized for the development and manufacture of photoelectric colorimeters, photometers, and related equipment in the electronic instrument and clinical fields. The first product to be announced is the clinical analyzer, a photoelectric colorimeter calibrated for 60 clinical determinations.

Officers of the company are president, Morris Mass and vice president and treasurer, Victor Brociner. Offices, laboratory and factory are located at 1546 Second Avenue, New York 28, N. Y.

* * *

MASS-SPECTROMETER IN METAL ANALYSIS

Vaporizing metal samples in a small filament type furnace has enabled *Westinghouse Electric Corporation* scientists to trace metal impurities by means of a mass-spectrometer. Using two milligram samples, the new method will detect as little as one part of impurity per million. The equipment was devised for a special research project and is not commercially available.

The spectrometer consists essentially of an ionization chamber and a curved section with narrow slots at each end. Ions of the vapor being analyzed are separated electromagnetically so that only those having certain atomic weights pass around the curve and through the exit slot. These are deposited on a plate just beyond the slot, and their quantity is determined by measuring the charge on the plate.

Thus an analytical job that would take days by chemical means can be completed in a few minutes.

* * *

BLIND HOLE ROTARY BROACHES

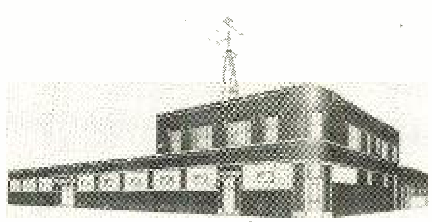
Designed to replace reamers and to eliminate a second broaching, rotary broaches, manufactured by *Shearcut Tool Company*, Box 746, Reseda, Calif., may be used in lathes, turret lathes, automatics, boring mills, milling machines and jig bores, etc. By a new technique, chips are removed to be fed out of the blind hole and this makes it possible to feed the rotary broach to the bottom of the blind hole. The result is a hole perfectly finished to the exact size.

The broaches are sharpened on the front end and also on the helical cutting flutes. Stock sizes start at 3/16" and run to 1½". Other sizes are available upon order.

* * *

COOK COMPANY EXPANDS

Cook Research Laboratories, a division of the *Cook Electric Company*, 1457 Diversey Parkway, Chicago, is in the process of expansion. A one-story structure is being added to the present quarters. The upper floor shown in the illustration will be devoted to engineering and drafting and most of the lower floor used as a model shop. A stockroom and a small room housing physical and high voltage testing equipment are at the rear of the model shop



and a third subdivision at the front of the model section will serve as an experimental test department for heavy equipment.

Cook Laboratories is engaged in physical, electronic, meteorological and nuclear research for the U. S. government and private industry.

Controlled Voltage Divider

(Continued from page 9)

still reduces the (b) effect. By properly choosing the values of the parts, this effect (b) may be completely removed under normal conditions during regular detection of audio frequencies, although still present to prevent oscillation when no signal at all is present. The circuit coupled to the output helps in reducing the (b) effect during normal functioning.

In order to receive AM, which otherwise is completely removed from the output of the controlled voltage divider, a changeover switch makes the proper changes in the circuit to obtain the circuit shown in Fig. 5. Here, the tuned circuits T_1 and T_2 shown by Fig. 4 have been substituted by the circuits T'_1 and T'_2 which are tuned on the same frequency equal to that of T_3 primary circuit. *CH* is an audio frequency choke and C_7 is a condenser large enough to insure a good filtering of the audio frequency. Now the output will depend only on the ratio between actual signal (given as percentage of modulation) and average carrier. It will not be affected by either changes in average amplitude proceeding from changes in field strength at the antenna, or from the effect of changes in frequency through the tuned circuits. The result during AM reception will also provide complete a.v.c. besides complete FM elimination.

The complete circuit for AM and FM with changeover switch is shown in Fig. 6. Here, the tuned circuit T'_2 is formed by switching in parallel the circuits T_1 and T_2 when the receiver is switched to the AM position. This gives to the resulting circuit a resonant frequency closely equal to the average between the resonant frequency of the two original circuits, i.e. the center frequency of the former discriminator. As shown in Fig. 6, the circuit is switched to FM with all the switches in the upper position and to AM with all the switches in the lower position. In practice, this is a single switching unit.

Circuit applications of the controlled voltage divider for purposes other than AM/FM detection and elimination in a radio receiver, may be derived from the basic circuit shown in Figs. 4 and 5 according to the particular purposes intended for. The following are some examples of the possibilities that the controlled voltage divider circuit affords.

T_1 and T_2 tuned to the same frequency and separately excited provide a means of comparing the amplitudes of two different signals by the circuit of Fig. 4. It permits comparison of the amplitude of one signal to the average value of another one if the circuit of Fig. 5 is used. If signals of different frequencies have to be compared, T_1 and T_2 must each be tuned to its proper frequency. The removal of the choke *CH* in the circuit of Fig. 5 provides a means of comparing only the average value of both signals. If the frequency is low enough, the circuits T_1 and T_2 may be properly substituted by transformers. If d.c. voltages, or voltages changing over a very wide range of frequencies have to be compared, they may be used to amplitude modulate a small local twin oscillator, with the output of this then fed to the controlled voltage divider with or without previous amplification.

Since a voltage signal as required by the functioning of the controlled voltage divider may be developed by the drop of a current through a resistance, or an impedance, currents may also be compared. This provides a means of comparing a current with a voltage and therefore obtaining the value of impedances at different frequencies. If the voltages or currents are generated by small crystal detectors placed in different positions along an energized r.f. transmission line, antenna, wave guide, etc. it can provide a means of determining the standing wave ratio. Other special modifications and applications may be derived case by case.

This development never would have materialized without the help of Giusto Fonda Bonardi, co-inventor.

Aerial Navigation

(*Continued from Page* 21)

known as IFF — Identification Friend or Foe — consisting of a transmitter and receiver which operated in the following manner. When a ground or aircraft radar noted the indication of a target, whose identity was in question, the IFF transmitter would be actuated. When the IFF pulse was received in the aircraft in question, it automatically triggered a coded pulse through its transmitter which was then received and identified at the questioning radar location, thus informing it that the target was a friendly aircraft.

In civil applications the same principles are adhered to but units are modified to provide a maximum of coordination and clarity for both pilot and control tower personnel. For example, the radar equipment previously discussed depends solely upon the reflection of the signal from the aircraft. Hence a high gain receiver is required which inherently causes the appearance of a great deal of noise on the CRT screen. This makes reading of indications difficult and uncertain, and weak signals are frequently overlooked.

Where cooperation of the aircraft can be secured, a unit can be installed in the plane which responds to the ground radar in a manner similar to the IFF equipment. As indicated in Fig. 6, beacon (or secondary, aided, or assisted) radar, as this system is called, requires a receiver in the plane which, when challenged by the ground radar pulses, instantly and automatically triggers an associated transmitter which returns an artificial echo on a different radio channel. This echo, of course, is much stronger than a naturally reflected one. The ground station receiver, tuned to the aircraft transmitter channel, rejects the unwanted natural reflections which would otherwise "clutter up" the indicator display and also, by means of a squelch circuit, eliminates much of the receiver noise from appearing on the scope. Hence a clear, accurate indication is obtained.

As indicated in Fig. 6, the use of a special multichannel receiver on the ground makes it possible to have either a "selective" beacon radar display, which shows only airplanes which respond to a given radio channel or a "comprehensive" display, which shows all airplanes regardless of their radio channel selections or both displays. The choice of display offers certain operational advantages for traffic control, and yet does not restrict the airborne transmitter in any way.

Navar is the name of an aerial navigation system which coordinates a number of radio aids to navigation and traffic control to provide the following services to control tower and aircraft: 1) The control tower is supplied with complete information regarding the position, height, and, if desired, identification of all aircraft in its radius of operation. 2) In the aircraft, information regarding its exact position relative to the airport and the position of other aircraft in the vicinity is supplied.

The ground station equipment in a Navar system consists primarily of a beacon radar system plus an alternative normal radar to detect those planes that do not contain responders. The beacon radar requires that the aircraft have at least one receiver tuned to 3000 mc. and a transmitter operating at 960 mc. When the receiver picks up the beacon radar pulse, it triggers the transmitter which returns an artificial echo to the ground radar.

This latter 960 mc. pulse can be coded to contain other information, usually the altimeter reading so that the ground station is provided with the height as well as position of the aircraft. Transmission of the altimeter reading can be accomplished by modulating the pulse in accordance with its reading. Any of the modulation systems described in the article "Pulse Communication Systems"[3] may be employed. For example, the duration of the transmitted pulse can be made proportional to the altimeter reading.

The 960 mc. transmitter used to respond to the beacon can also be utilized in conjunction with another receiver operating in the 1020 to 1075 mc. band, to provide distance and azimuth indication to the pilot. The DME, Distance Measuring Equipment, is obtained by causing the ground radar station, upon receiving the artificial echo, to transmit another artificial echo back to the aircraft in the 1020 to 1075 mc. band. The time interval between transmission and reception of the pulse is measured in the aircraft. This time interval is converted directly into the appropriate distance and indicated on a meter calibrated in miles.

For azimuth indication the ground equipment must provide another signal. Whenever the radar antenna points directly north, another signal is transmitted omnidirectionally by the ground station in the 1020 to 1075 mc. band. This signal is, therefore, picked up by the second aircraft receiver. When the beacon is pointed at the aircraft, the radar signal is picked up by the first receiver. The time interval between reception of the 'north' signal and of the beacon signal is measured and knowing the speed of rotation of the beacon antenna, the azimuth can be

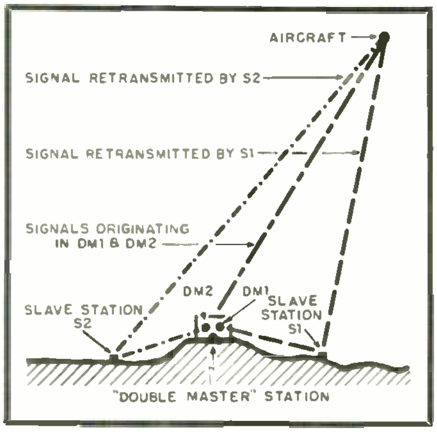


Fig. 10. Basic layout of Loran system.

determined. The azimuth indication is provided on a meter calibrated directly in degrees.

To review briefly, the chain of action is as follows. When the beacon radar antenna points north, an omnidirectional signal is sent out in the 1020 to 1075 mc. band which is picked up by the aircraft receiver tuned to that frequency. This signal is coded differently than that later transmitted by the ground responder so that it is recognized as the 'north' signal and it initiates the azimuth circuits. When the antenna is directed towards the aircraft, a 3000 mc. signal is picked up by the other aircraft receiver which then forwards a pulse to the azimuth circuit, initiates the DME, and triggers the 960 mc. transmitter. The transmitted pulse is modulated by the altimeter and received by the ground radar. The plane position and altimeter reading thus become available to the control tower. Upon reception of the 960 mc. pulse, the ground station also transmits a pulse in the 1020 to 1075 mc. band which is received by the 1020 to 1075 mc. receiver in the aircraft and establishes the distance of the plane from the airport. Fig. 7 shows a block diagram of this system plus the PPI indication to be described in the next paragraphs.

To prevent collisions, it would be very helpful if each aircraft had full knowledge of the other aircraft located in his surrounding area. To provide an airborne radar set with its inherent high wind resistant antenna, normally required to obtain sufficient directivity, plus the mechanical problems of rotating this antenna, adds up to an extremely difficult design and one which is impractical for most aircraft. To overcome this the Navar System proposes relaying the information contained on the beacon radar scope to the airborne unit by duplicating the ground picture on a similar cathode ray tube located in the airplane. This system employs television techniques to transmit this 'picture' and utilizes the 1020 to 1075 mc. receiver, already in the aircraft, for r.f., i.f., and video amplification. Thus by the addition of an indicator unit, complete information of the location of aircraft in the area is available to all pilots with the position of his own aircraft clearly indicated.

Identification of aircraft can be accomplished by supplying each one with a special response code which is actuated only when identification is desired by the control tower. In this case, as in all previous ones where coded pulses are used, the techniques developed for television and pulse communications are employed. The final result is that the ground transmitter sends out a continuous train of pulses with each pulse carrying certain intelligence. At the receiver the pulses are channelled to their proper circuits and the intelligence extracted.

There are other systems of aerial navigation, such as Teleran and GCA (Ground Control Approach), that have been developed. In virtually all such cases the basic elements outlined thus far in this article are used with different modification to meet individual requirements.

Loran

In the system described heretofore the maximum range of operation is limited to line of sight ranges which, under optimum conditions, may be several hundred miles. However, usually the maximum range is well below this value and hence for long range navigation of the order of 500 to 1500 miles other methods must be utilized. The Loran system (from LOng RAnge Navigation) permits precise over-water navigation for aircraft up to 1500 miles from shore-based stations at night and 750 miles during the day.

Loran, using the principles of hyperbolic navigation, consists of four pulse-transmitting stations located along a line adjacent to the area over which navigation is desired as shown in Fig. 10. Two of these stations, DM_1 and DM_2, are at one point known as the "double master" station. This station sends out pulses omnidirectionally at a highly precise repetition rate. Two sets of pulses operating in the 1700 to 2000 kc. range are transmitted. One set, initiated by station DM_1, operates at a given rate such as 25 pulses per second. The other set, generated by DM_2, operates at a slightly different rate, such as 25.075 pulses per second. The difference in repetition rate enables the aircraft receiver to distinguish between those pulses originating at DM_1 and those originating at DM_2.

Consider first a pulse transmitted omnidirectionally by station DM_1. The pulse travels to the associated "slave station" S_1, where it is received and retransmitted after a known time delay. Hence stations DM_1 and S_1 send out identical pulses at the same repetition rate, but those transmitted by station S_1 are emitted later than those of DM_1. The two sets are received at the aircraft with a time differential equal to the difference in their range plus the time delay of the receiver.

At the receiver the two pulses are displayed on a cathode ray oscilloscope and the difference in their times of arrival is measured with an accuracy of 1 microsecond. Since the location of DM_1 and S_1 are known, and the difference between the length of the other two sides of the triangle made between the two stations and the aircraft is also known, the navigator can describe a hyperbolic function upon which he must be located.

In a similar manner the difference in the time of arrival of the pulses originated by DM_2 and retransmitted by S_2 is measured on the scope and again a hyperbolic function determined. The intersection of the two hyperbolic functions is, of course, the location of the craft.

Actually the navigator does not have to make all of these calculations upon receipt of the Loran signal. Special Loran charts have been drawn which provide hyperbolic curves for a number of equally spaced microsecond readings. The navigator must therefore only interpolate his reading on the chart and his position is rapidly determined. A typical Loran chart is shown in Fig. 8.

The maximum range of this system is mainly a function of how far a 1700 to 2000 kc. signal can be transmitted with sufficient strength to overcome noise and sky wave reflection interference. The sky wave reflections are sometimes utilized to extend the range of the system. However, considerable operator experience and inaccuracy are inherent characteristics of such a system.

This paper concludes this series of articles on "Pulse Techniques." The authors hope that they have proved to be of value to the readers. Of course, many subjects were, of necessity, left

Errata: In the August issue, P. 17, Fig. 3, the ordinate should be milliroentgens per hour.

In the Sept. issue, P. 13, Col. 1, line 10 should start with V_{cx}. The bottom line of Eqt. 1 should read $v = v_{oo} = 0$. Col. 3, line 9 should be R_1/R_4.

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Page
10..........Radio Corporation of America
14, 15..........Nat. Bureau of Standards

out. Some of these subjects will be covered in a book now being prepared, entitled "Pulse Techniques," to be published by *Prentice-Hall.* It is based mainly upon this series of articles. The authors would welcome all suggestions from the readers as to what subjects they would like to see covered in this book.

BIBLIOGRAPHY

1. *Moskowitz and Racker. "Pulse Generation,"* RADIO-ELECTRONIC ENGINEERING, *July,* 1948.
2. *Moskowitz and Racker. "Pulse Shaping Circuits,"* RADIO-ELECTRONIC ENGINEERING, *April,* 1948.
3. *Moskowitz and Racker, "Pulse Communications Systems,"* RADIO-ELECTRONIC ENGINEERING, *Sept.,* 1948.
4. *Moskowitz and Racker, "Pulse Techniques,"* RADIO-ELECTRONIC ENGINEERING, *Jan.,* 1948.
5. *Moskowitz and Racker, "Delay Lines for Pulse Applications,"* RADIO-ELECTRONIC ENGINEERING, *April,* 1948.
6. *Moskowitz and Racker, "Pulse Amplifier Design,"* RADIO-ELECTRONIC ENGINEERING, *Feb.,* 1948.
7. *Moskowitz and Racker, "Pulse Measurements,"* RADIO-ELECTRONIC ENGINEERING, *August,* 1948.
8. *The Loran System, Electronics, Nov.,* 1945, *p.* 94.
9. *Ridenour, L. N., "Radar System Engineering," McGraw-Hill Book Company,* 1947, *pp.* 352-385.
10. *Fink. D. G., "Radar Engineering," McGraw-Hill Book Company,* 1947, *pp.* 11-19, 301.

H.F. Heating

(*Continued from page* 6)

between the plates of the test fixture and A is the area in square centimeters. The corresponding Q of the dielectric material was evaluated by using the formula:

$$Q = \frac{Q_1 Q_2}{Q_1 - Q_2} \cdot \frac{C_1 - C_2}{C_1} \quad . \; . \; . \; . \quad (9)$$

The numerical value of Q obtained from Eqt. (9) provides sufficient information to obtain the power factor of the dielectric material. From the formula for power factor:

$$p = \frac{R}{\sqrt{R^2 + X^2}} = \frac{1}{\sqrt{1 + Q^2}} \quad . \; . \; . \quad (10)$$

and for values of Q considerably greater than 1, the equation for p reduces to:

$$p = 1/Q \quad . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \quad (11)$$

The numerical values of the dielectric constant as well as the power factors are tabulated in Table 1 for aluminum oxide, silicon dioxide, magnesium oxide, cellulose acetate and acetobutyrate. This tabulation includes the effects of frequency from 1 to 50 mc.

Another concept relating to the h.f. properties of granular dielectric material is the effective conductivity σ and the effective resistance which are related by the equation:

$$R_e = \frac{d}{\sigma A} \quad . \; . \; . \; . \; . \; . \; . \; . \; . \; . \; . \quad (12)$$

since the capacitance of parallel plates is

$$C = 8.85 \cdot 10^{-14} \varepsilon \frac{A}{d} \quad . \; . \; . \; . \; . \; . \quad (13)$$

where A is the effective area of the parallel electrodes and d the distance between them in square centimeters and centimeters respectively. The susceptance or the reciprocal of the reactance may be expressed by multiplying Eqt. (13) by ω. With the definition of the Q of a capacitance branch of the circuit as R_c/X_c or ωCR_c, the combination of equations (12) and (13) provide a formula for the effective conductivity σ in terms of Q, the dielectric constant ε and the periodicity ω. This formula is:

$$\sigma = 8.85 \cdot 10^{-14} \varepsilon \omega / Q \quad . \; . \; . \; . \; . \; . \quad (14)$$

The materials tested with these design factors in mind for high-frequency drying were aluminum oxide, silicon oxide, and magnesium oxide while the plastics group were cellulose acetate, and acetobutyrate. An extremely interesting result, relating the power factor and dielectric constant to the grain size of the dielectric, was observed. This relationship may be visualized by considering the distribution of the electric field within a powdered dielectric. To do this, one must consider the small capacitances throughout the volume of the dielectric. Each particle of the dielectric is a small condenser and each air gap between the solid dielectric is also a condenser. The over-all picture provides a large number of condensers connected in a series-parallel combination. To simplify this analysis, all of the condensers representing the solid dielectric should be merged, providing a single condenser with a solid dielectric, and all the condensers representing the numerous air gaps combined and replaced by a single equivalent condenser with an air dielectric. These two final condensers are considered as being connected in series as in Fig. 8, thereby providing a simple equivalent circuit as a substitute for the more complex combination. It is evident that under similar conditions, that is, with the h.f. voltage across the electrodes maintained constant, the voltage across the equivalent air capacitor decreases with an increase in capacitance.

The equivalent capacitance of the air dielectric condenser is actually equal to the volumetric summation of the incremental capacitances of each air pocket. Since the ratio of the projected area to the effective thickness of each air pocket increases with the size of the pocket, the capacitance will increase with the size of the pocket. Due to the fact that there are fewer such condensers in series, the net capacitance is greater.

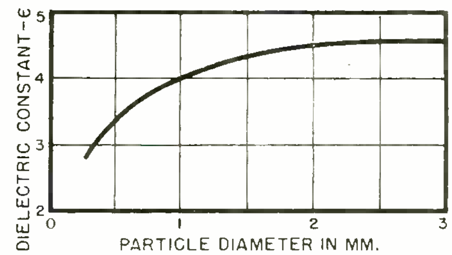

Fig. 10. Graph showing the effect of particle diameter of aluminum oxide on dielectric constant in the frequency range of 10 to 40 mc.

This means that the voltage across the equivalent condenser for the solid dielectric will increase and the power supplied to the dielectric will increase. This effect may be summarized graphically by observing that the slope of the curve of the power factor vs. particle size will be a positive quantity and is illustrated in Fig. 10.

The application of the foregoing theory was successfully achieved with a dielectric heating unit using a fixture of the type shown in Fig. 5. This unit was first used to preheat granular cellulose acetate and then the other granular materials with a fair degree of success. The capacitance of the load conveying fixture when fully loaded was 300 micromicrofarads, the frequency was 3 mc., the voltage 1400 r.m.s. and the power factor approximately 0.10. Substituting these values in Eqt. (6′), the calculated h.f. power delivered to the granular dielectric was approximately 1200 watts. This value checks very well with the heating capacity of the dielectric as it was possible to preheat about one pound of material per minute.

The author wishes to express his appreciation to Dr. E. Mittelmann for the excellent facilities of his h.f. laboratory and also to the *American Plasticraft Co.* for their cooperation in making the practical phases of this article possible.

Table I. Tabulation of power factor and dielectric constant for a variety of materials for frequencies from 1 to 50 megacycles.

f mc.	Aluminum Oxide		Magnesium Oxide		Cellulose Acetate		Acetobutyrate	
	p	ε	p	ε	p	ε	p	ε
1	.002	4.0	.0033	3.8	.020	3.8	.028	2.3
2	.0025	3.8	.0042	. .	.050	2.3	.035	. .
5	.005	3.7	.0075	2.3	.090	. .	.052	2.3
10	.0075	3.23	.0150	1.5	.100	. .	.076	1.5
30	.010	3.1	. . . .	1.5	.130	2.3	.090	. .
50	.015	2.9	.0150	1.5	.130	2.3	.090	1.2

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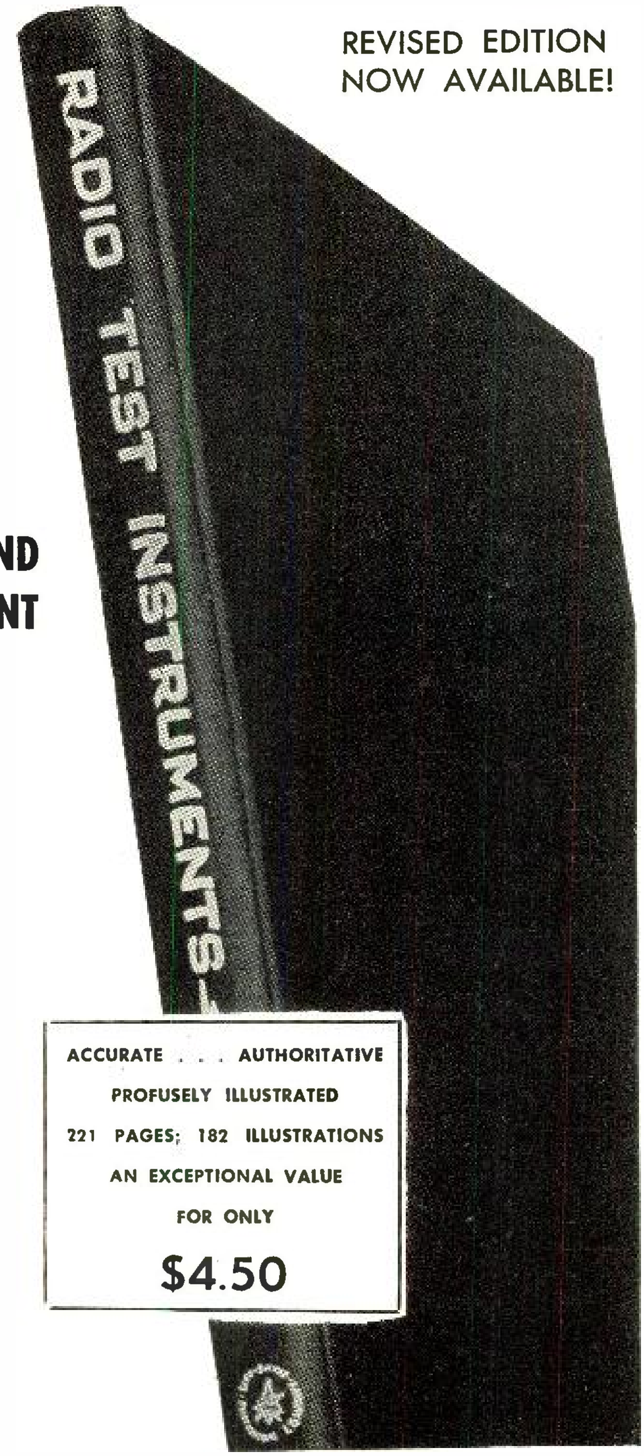

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D.C. Voltage Control

(Continued from page 67)

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* "Radiotron Designer's Handbook," Radio Corporation of America, Page 198.

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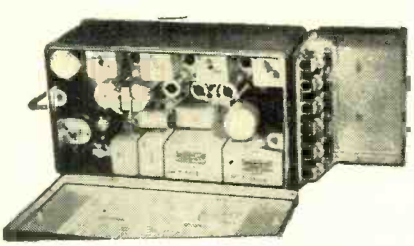

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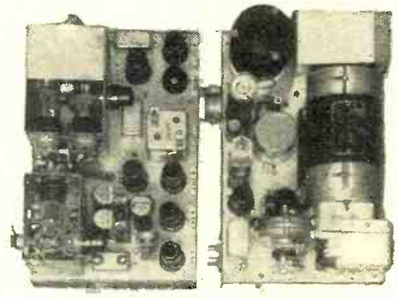

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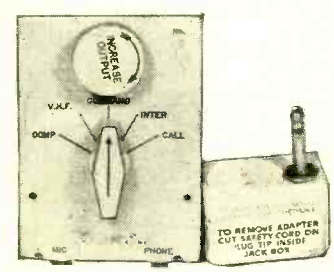

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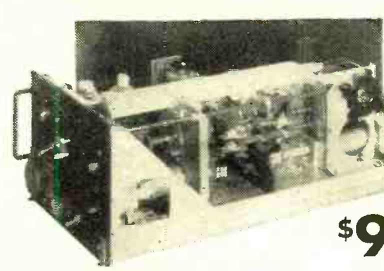

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MINE DETECTOR AN/PRS-1

The detector is designed to detect metals, non-uniformities (rocks, tree-roots) and may be used to detect metal buried in logs, to locate cables, pipes, sewer tile and etc. It is widely used by lumber camps, miners, prospectors, plumbers, treasure hunters and explorers.

A portable device used in the detection of both metallic and non-metallic by aural (ear) and visual (eye) means. These are brand new outfits, complete with instruction book and spare tubes. Shipped in original overseas moisture-proof container.

The set consists of the detector head with antenna and reflector meter, a meter housing and lower section of exploring rod, amplifier assembly, exploring rod extension, bag designated to carry equipment while operating; and wooden case for storing or transporting the complete unit when not in use. This detector is not nearly as sensitive as the SCR-625 Mine detector. However, because of its price and its simplicity, you cannot go wrong on buying one for $14.95. Shipping weight, 125 lbs. Weight in operation only 22 lbs.

Batteries are not included but we can supply them for $8.25 per set.

Our Price **$14.95**

Shipping Weight 125 lbs.
Weight in Operation Only 22 lbs.

SCR 274N COMMAND SET OR BC-348 POWER SUPPLY

To convert the BC-348 receiver for 110 V. AC operation. Constructed especially for the Esse Radio Company by a leading transformer company.

These power supplies have gained great popularity due to quality, price and simplicity in conversion. Filament supply 24V. Rectifier tube used: 6x5 (not included)

Price ....$8.95 ea.

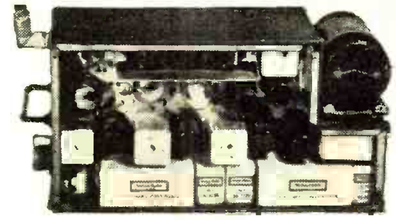
OXYGEN TANKS

Aviators' oxygen breathing bottles. Non-shatterable. Choice of two types.

Withstands 2000 lbs. pressure.

(A) Withstands 500 lbs. pressure.

CHOICE
$4.95 ea.



BC-733D LOCALIZER RECEIVER

A part of aircraft blind landing equipment. Operates on any one of its 6 pre-determined crystal controlled frequencies in the range of 108-120 Mc. Contains 10 tubes—3 of which are W.E. 717-A's—and crystals. Ideal receiver for conversion to 144 Mc. ham band or mobile telephone bands. For 24 V. DC operation. Size, 14½"x7"x4⅝".

Price With Dynamotor..$5.95
Price Without Dymtr....$4.95

MAGNESYN INDICATOR

To be used for beam antenna. Practically same as I-81-A Selsyn indicator. 15-25 V. 60 cycle AC. 3" size.

Excellent condition.$1.85 ea.
Plug for connection.... .50

FIELD TELEPHONE WIRE

3-conductor, stranded, insulated and weather-proofed. Ideal for intercommunication systems, telephones, Selsyn indicators. Use it inside or out of doors. 525 foot roll. Brand new.

Price...............$4.25 ea.

ARGON BULBS

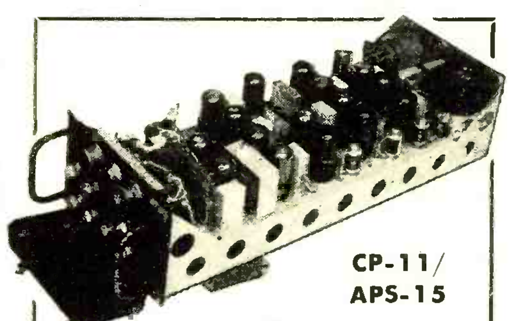
2-watt, 110 V., Edison base. Ideal for R.F. indication, night light. Brand new. Box of ten.

Price...............$1.75 ea.

WESTINGHOUSE RECTIGON BATTERY CHARGER BULB

Style 289416, 6 ampere rating. For replacement in most chargers or for building power supply to use on D.C. operated equipment. Brand new.

Price...............$1.90 ea.



CP-11/ APS-15

Contains following tubes: 13-6SN7-GT's, 3-6SA7-GT's, 1-5Y3-GT. 1: 24 V. motor and blower (blower will operate on 110 V. 60 cy.), 4-one megohm precision wire-wound resistors, 80-86 Kc. crystal, numerous other transformers, condensers, etc. Shipping weight approximately 25 lbs.

Price....................$9.95

TUBES
Minimum order $10.00

6SN7	$0.35 ea.
7Y4	.30 ea.
7C5	.30 ea.
7F7	.30 ea.
12A6	.35 ea.
1625	.30 ea.
1629	.35 ea.

PHONE—LINCOLN 8328
PRICES F.O.B. INDIANAPOLIS

TERMS· CASH WITH ORDER

AMERICAN SURPLUS PRODUCTS CO.
537 N. CAPITOL AVE.
INDIANAPOLIS, IND.

PILOT'S CONTROL BOX, TYPE CRV-23254

Used with CRV-46151 Receiver for remote control of volume, selection of any one of six frequency bands, has off/on switch or selection of C.W. and M.C.W. and M.V.C. or A.V.C. Black crackle finish. Size, 2"x2½"x 5" high. Brand new.

Price..............$1.50 ea.

RECEIVER TUNING HEAD CRV-23253

Used with CRV-46151 Receiver for vernier tuning. Has beveled dial with hairline cursor. Bands are 200-560, 560-1600, 1600-4450, 4450-9050 Kcs. Each band spread over about 280 degrees of dial edge. Has provision for flexible tuning shaft or can be adapted for direct drive on any tuning shaft. Black crackle finish. Size, 5"x3"x2" overall. Brand new.

Price..............$1.50 ea.

"S" Meters

(Continued from page 48)

tubes controlled by the a.v.c. may be directly grounded, which in some cases is desirable. It also is possible to use several tubes which are controlled by the a.v.c. and fed from point X along with a high current audio tube for V_2, or, if desired, instead of V_2 substitute a resistance which is connected directly to the ground as in Fig. 5. In this condition a meter of lower sensitivity can be used, such as a 10 mil type, depending on the number of a.v.c. controlled tubes available. R_1 is the zero adjust and R_3 the sensitivity control. R_3 can be a fixed resistor once the correct value for a given condition is determined. This value can be calculated mathematically or by the trial-and-error method—take your pick. It can be seen that the current flowing through R_3, the meter, and R_1 is opposite to and cancels the current through R_2, the meter, and V_1. Therefore, with no signal input the meter is adjusted to zero reading or balanced condition and as the signal strength increases the a.v.c. cuts off tube V_1 causing the balance to be destroyed and the meter to indicate the amount of unbalance. This circuit can operate on one tube with a sensitive meter or more tubes (all of which must be controlled by the a.v.c.) with a less sensitive meter, as desired.

Fig. 4 shows a different approach. This circuit utilizes the a.v.c. to control a tube used entirely for the "S" meter indication. It is perhaps the most desirable circuit for use in u.h.f. transceiver conversion inasmuch as a great many of the surplus units will have unused tube sockets, after conversion, which in many cases will be occupied by inoperative tubes simply to simplify the heater wiring. R_1 is the sensitivity control and again it can be either a variable control or a pair of fixed resistors once the proper value is found. R_2 is the zero adjust. The current flowing through R_2, the meter, and R_3 opposes the current through R_1, the meter, and V_1 and at zero signal these currents are equal. As the signal builds up, the current through V_1 falls causing an indication on the meter proportional to the signal strength. In choosing a tube for V_1 care must be taken to pick a tube with at least as high a grid cut-off voltage as the i.f. and/or r.f. tubes being controlled otherwise the meter tube may be cut-off at less than an S9 signal input.

All these systems depend on an a.v.c. voltage to secure the "S" meter operation but unfortunately some u.h.f. transceivers, or receiver/transmitter combinations have no a.v.c. This, in some cases, is difficult to supply due to the physical placement of the wiring and components. However, all of these units seem to have an empty socket or an unused tube, as mentioned before, so the circuit of Fig. 6 is applicable.

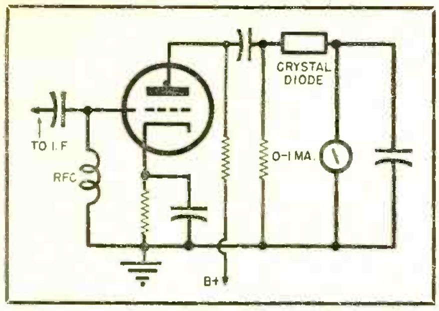


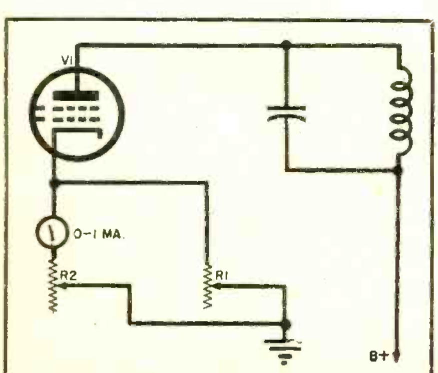
Fig. 7.

It will be noted that the circuit is identical to that of Fig. 4 except for the addition of a diode to develop the necessary a.v.c. voltage. In this case V_1 is to be coupled through C_1 to the last i.f. plate as loosely as possible and still obtain the necessary a.v.c. voltage to operate the meter tube grid —i.e., provide a sufficient voltage swing to give an S9 meter indication with an S9 signal input. If for some reason, no diode tube is available a crystal diode could be substituted. Don't forget to rebalance the last i.f. transformer or preferably install an output transformer in case the last i.f. transformer should prove not to be of the diode type. In some cases it might be advantageous to use the available tube as an i.f. amplifier and use the crystal diode current as the signal strength indication as in Fig. 7. In this case a sensitive meter must be used, probably one of those 200 microampere surplus jobs could be converted nicely. This circuit also has the advantage of loading the i.f. stage less. The r.f.c. *must* be effective at the i.f. frequency otherwise a serious loss will be incurred. A tuned circuit can be substituted for the r.f.c., if desired, with improved results.

The systems described all use a standard left-hand zero current meter for the signal strength indication such as an 0-1 mil d.c. meter. However, some surplus meters on the market have a right-hand zero (no current) position in which case one can use a different approach (both right- and left-hand zero meters may be used in the circuits described however).

Fig. 8 shows a very simple circuit incorporating a right-hand meter which can be used with any tube con-

Fig. 8.



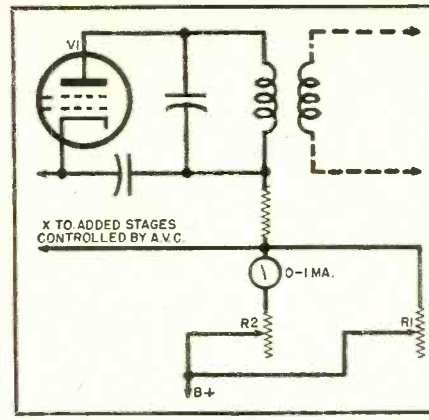


Fig. 9.

trolled by a.v.c. R_1 is the sensitivity control and can be set as mentioned while R_2 is the zero set. The operation is simplicity itself—R_2 is adjusted for the proper current through the meter, with no signal input to bring the pointer to the left-hand side of the case, or zero position on the scale. Then, at an S9 signal input, adjust R_1 to S9 on the meter scale.

Fig. 9 is identical to Fig. 8 except that the meter is in the plate lead and can be used with several tubes controlled by the a.v.c. instead of just one. Occasionally one tube might lack sufficient plate current for proper operation, depending on the sensitivity of the meter.

This series of circuits does not include all the methods for obtaining "S" meter indication by any means but they are, perhaps, the simplest and most readily applied methods of obtaining that "30 db. over S9" we all like to give that guy we can hardly hear. —30—

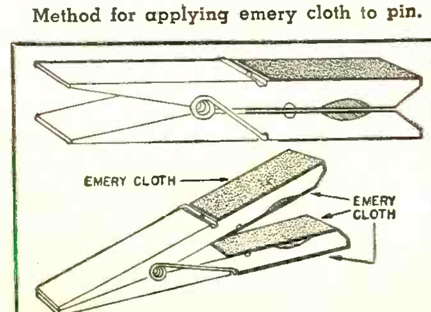
USEFUL SERVICE TOOL

By LEUNG CHO YUK
Hong Kong, China

BY gumming emery cloth to the jaws and cheeks of a spring-type clothespin, as shown in the diagram, a useful service tool can be fabricated at low cost.

This simple gadget will be useful for removing the enamel insulation from thin wire when the wire is pulled through the emery cloth. The cloth gummed on the cheeks of the clothespin can be used to clean connection joints or to remove the insulation from larger sized enamelled wires. —30—

Method for applying emery cloth to pin.



LAFAYETTE-CONCORD

ELECTRO NEWS

29 Years of Service—500,000 Satisfied Customers

HUGE MERGER PAYING OFF FOR RADIO MEN!

Here's aspirin for those high price headaches. Bargains are still around for smart shoppers. Take a look at a few samples we've taken from our stocks:

SPECIAL BUY!

VACUUM TUBE VOLTMETER KIT

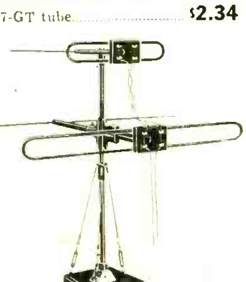
4½" square meter. 0-500 microamps dc. DC input resistance of circuit, 11 megohms. AC input resistance 6.5 megohms. Ranges: .1 to 1000 megohms in 5 ranges. AC and DC voltage on linear scales. 0-3; 30; 100; 300; 1,000 volts. Tubes: 1-6SN7, bridge type voltmeter circuit. 1-6H6 balanced linear diode as rectifier. Precision resistors, 1% accuracy. Output meter scale is calibrated for 600 ohm circuit and based on reference level of 1 mw. Rectifier power supply. 6"x9"x5". Kit complete with case, tubes, battery and instructions ready for assembly. 110 V., 50-60 cycles. AC.

No. 24540R **$29.95**

PLAY RECORDS BY REMOTE CONTROL THRU RADIO

Supplies sufficient power to play records through radio receiver at full volume in other rooms, without wired connections. Oscillator frequency variable between 1350 to 1700 KC by means of screw driver adjustment of trimming condenser. Small enough, 4" x 4" x 2" metal case, to go into any standard record player. No. 24531R, complete kit, less tube **$3.49**

No. 117N7-GT tube **$2.34**



13 CHANNEL TV-FM ANTENNA

Covers 44-216 mc. Arrays use hairpin type dipole and reflector elements. 5 ft. tempered aluminum mast. Low and high frequency sections individually rotable for maximum signal regardless of direction of stations. Each section may be oriented to eliminate ghosts, images and interference. Ceramic insulation. All angle adjustable base mount. Complete with instructions.

No. 21983R **$9.71**

MAGIC RADIO-MIKE

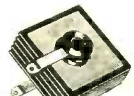
Without wires, lets you broadcast through your own radio. Simply turn on radio and tune to any clear channel between 1250 and 1700 KC, talk into the mike, and you'll hear through your own radio up to 75 feet away. For home, office, restaurants, nurseries. Uses 45 V. miniature "B" battery and flashlight cell. No. 22548R, complete with tube & battery **$5.98**

BEST BUY! 12" SPEAKER

Alnico V Permanent Magnet Dynamic Speaker. 1" voice coil with 6-8 ohm impedance. 14-18W. capacity. Dust proof construction. Ideal for fine FM reception, public address work, etc. An unbeatable value, limited quantity, so rush your order!

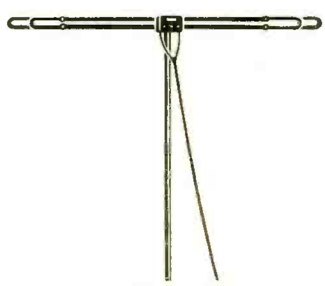
No. 5B7010R **$5.95**

RUGGED SELENIUM RECTIFIER



May be used to replace 117Z6, 117Z3, OY4, and other rectifier tubes and socket in AC-DC battery type portable radios, intercoms, etc. Peak inverse V. 380 V.; 100 milliamps max. 1¼" square x 11/16" high. Replaces both tube and socket. These miniature rectifiers are extremely rugged and long lasting. Order a half dozen.

No. 10560R .... **75¢**



STROMBERG-CARLSON DYNATENNA FM DIPOLE ANTENNA

Covers all FM bands. Heavy mounting bracket with swivel base permits antenna to be turned for best reception from any direction. Slide-in trombone type arms are calibrated and marked in megacycles. Arms and mast of light, seamless, heat-treated aluminum tubing. Easy to handle, yet tough enough to withstand winds, ice, snow. Complete with hardware, six feet of 300 ohm low-loss twin lead-in wire.

5B9578R – Each, singly **$4.95**

Each, in lots of 3 .... **$4.45**

Just 30 days ago we broke the news about the sensational Lafayette-Concord merger. And ever since, cheers have been pouring in from value-wise radio men all over the world!

New Versatile Hi-Fi Amplifier!

NEW YORK: Lafayette-Concord engineer, Frank W2AMJ Lester announces a new amazing versatile amplifier. It delivers 10 watts at less than 5% distortion over the entire range of 40 to 15,000 c. Variable bass and treble controls. Separate high gain channel for G. E. pickup or mike, and low gain channel for tuner. The amplifier is also designed for use with the Webster 79 wire recorder foundation unit. A complete package is being made up which includes the amplifier, Webster foundation unit and a high frequency roll-off control. The rolloff control with 6 positions for the G.E. variable reluctance or Pickering cartridge permits switching from mike to pickup. Write for info on how to adapt this equipment to your needs.

NEWS ON THE TV FRONT

At the start of 1948 there were 17 TV stations on the air. Today there are 31 and many new ones are scheduled to open fast, right across the country. A few of these are: Birmingham, Ala.; Phoenix, Ariz.; San Diego, Calif.; Ames, Iowa; Peoria, Ill.; New Orleans, La.; Lansing, Mich.; Syracuse, N. Y.; Nashville, Tenn.; Dallas, Tex.; Atlanta, Ga.; Jacksonville, Fla.; Indianapolis, Ind.; Portland, Ore.; Salt Lake City, Utah; Omaha, Neb.; and Louisville, Ky.

Here's the opportunity of a lifetime for servicemen. There's room to make a buck in TV. Manufacturers are turning out sets as fast as they can, and their service organizations are frantically trying to find men to install the sets. But don't be fooled. TV is a lot trickier than radio. If you figure on being a TV man in your community, now is the time to smarten up. As a starter you might look over the new Lafayette-Concord TV bulletin. It will give you a quick picture of equipment and accessories available and how much they cost. It's free. Just clip the coupon below.

These fellows like the deal because it means even better service, even lower prices — *and they know it!* Lafayette-Concord is now the *largest radio supply organization in the world,* bar none. Does that put any butter on your bread? Mister, just ask your wife why she likes to shop at the A & P, at Woolworth's, at R. H. Macy, and she'll tell you. It *pays* to do business with the top organization. You get what you want. You get it right away. You get it for less. And you're sure of a square deal! Check these 5 important points: 1. GREATER VALUE; 2. COMPLETE STOCKS; 3. FASTEST DELIVERY; 4. ENGINEERING HELP; and 5. OLD TIME RELIABILITY. You get more than a full measure of each when you head your orders to Lafayette-Concord.

HAVE YOU SENT FOR YOURS?

180 pages bulging with bargains — plus everything in famous brands. Complete coverage of TV, Hi-Fi, Ham, AM & FM Radios, P.A. Test Equipment, Parts, Tools, etc. Rush the coupon now for your free catalog.

RUSH THIS COUPON AT ONCE FOR YOUR FREE CATALOG

SHOP IN PERSON AT ANY ONE OF OUR OUTLETS:

NEW YORK
100 Sixth Avenue
542 E. Fordham Rd., Bronx

CHICAGO
901 W. Jackson Blvd.
229 W. Madison St.

ATLANTA
265 Peachtree St.

BOSTON
110 Federal St.

NEWARK
24 Central Ave.

Lafayette-Concord Dept. RJ-8
100 Sixth Avenue, New York 13
901 W. Jackson Blvd., Chicago 7
265 Peachtree St., Atlanta 3

MAIL NOW!

☐ Please rush Free catalog No. 89

☐ Please send Free television bulletin.

☐ I enclose $.......... Please fill attached order. Shipping charges extra.

NAME ....

ADDRESS ....

CITY .... ZONE .... STATE ....

LAFAYETTE-CONCORD

Within the Industry

(*Continued from page* 28)

oped courses of instruction on radar for Army, Navy, and civilian personnel attending the *Philco* Training School and had charge of the radar instructors. Later he did liaison work with the Radiation Laboratory at M.I.T. and in November, 1942 was made manager of the company's Dayton office.

He has made outstanding contributions to the development of new types of test equipment for AM and FM radios and television receivers, television and FM radio antennas, automobile radios and other electronic equipment and componets.

* * *

RAYTHEON MANUFACTURING COMPANY has recently moved its radio receiving tube warehouse into new streamlined quarters in Newton, Massachusetts.

Designed and arranged by Clifford H. Morse, head of *Raytheon's* Newton warehouse activities, the improved and more adequate quarters now provide *Raytheon* customers with a faster and better service through the more rapid handling of their tube orders.

All packing and shipping operations have been laid out in a continuous line on a single large floor. Within 24 hours of receipt, distributor orders can now be processed through the central office, scheduled into packing units, and made ready for shipment.

* * *

BERT M. DRUCKMAN has been appointed assistant advertising and sales promotion manager of *Tele-Tone Radio Corporation.*

Prior to joining the *Tele-Tone* organization Mr. Druckman was advertising manager of *Kelvens* publications in New York. In his new position he will assume much of the responsibility for trade and consumer advertising, direct mail, special promotions, and merchandising.

A graduate of the City College of New York, Mr. Druckman will also assist John S. Mills, vice-president of the company, in the firm's national sales activities.

* * *

R. W. FERRELL was recently appointed assistant manager of *General Electric Company's* Receiver Division at Syracuse.

Mr. Ferrell was formerly counsel for the Electronics Department at Syracuse and has been manager of Employee and Community Relations for *General Electric's* Affiliated Manufacturing Companies since 1947.

He is a graduate of Harvard Law School and was first employed by the company's law Department at Schenectady in 1937. In 1942 he was appointed attorney for the Electronics Department and in 1945 was made counsel.

* * *

MICHAEL KAPLAN is the newly elected president of *Sightmaster Corp.*, manufacturers of television receivers.

Serving with Mr. Kaplan is F. Wakefield Minor as vice-president and general manager of the corporation. Mr. Minor was formerly manager of the New York zone distribution of *General Motors* and *Delco* radios.

Arthur Aro, previously associated with *General Motors*, has been named sales manager for *Sightmaster*. He will maintain headquarters at 220 Fifth Avenue, New York.

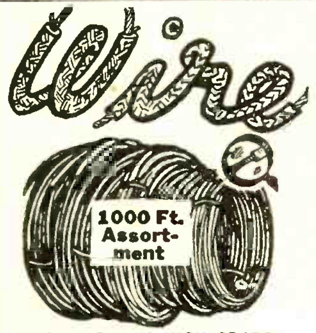
The company's new, enlarged factory and executive offices are located at 385 North Avenue, New Rochelle, New York.

* * *

BENDIX RADIO, Division of *Bendix Aviation Corporation* of Baltimore, has announced several new appointments in line with its recently announced direct-to-dealer merchandising plan.

George Bartlett, *Bartlett Radio Company*, of Portland, Maine, will cover that state as district merchan-

Bargains YOU MAY NEVER SEE AGAIN— Every item TOP quality • Brand NEW



ALL OF IT IS HIGH GRADE QUALITY WIRE

The Biggest Buy in Wire we have ever offered. Consist of size 22 to 16, both solid and stranded, with various types of insulation. Ideal for hook-ups, lead-in and all-purpose needs. Supplied in bundles of 10 100-foot coils.
No. 3A37.
Per Lot of 1000 Feet.... $4.95

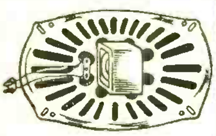
MIKE CABLE BARGAIN! FOR CRYSTAL, RIBBON, and CARBON MICROPHONES

WELL KNOWN QUALITY BRAND

Flexible stranding; cellulose yarn braid; waxed; rubber insulation; cellulose acetate yarn braid; tinned copper braid shield; plastic jacket. O.D. .210".
No. 2A190. Per 25-Foot Coil... 95c
In bulk lots 100 ft. and over, Per 100 Ft.... $3.29

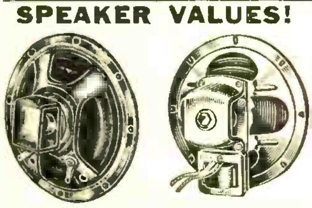
HEAVY DUTY OVAL P.M.

6⅜ x 9¼ x 4½" Deep Overall



Has heavy slug to handle high output. Voice Coil 3.2 ohms. **Just it for Auto Radio Speaker replacements** and other applications where space is limited and a heavy duty speaker is desirable.
14A651. Each... $2.95 Case of 4 $10.95

SPEAKER VALUES!

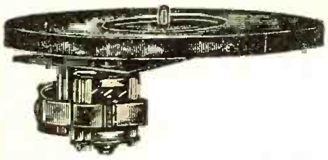


P.M. WITH ALNICO V. MAG.
5" P.M., a size you use most for AC-DC sets, record players, intercoms, etc. Quality make.
No. 14A649. Special, Each $1.45
Per Case of 24. ONLY.............. $29.95

6" P.M. with heavy enclosed slug.
No. 14A654. Special, Each........... $1.95

3½" P.M., Square mounting, heavy magnet. Ideal for small sets, intercoms, etc. Requires only 2" behind mounting panel
No. 14A653. Special, Each $1.45

Electro Dynamics 450 Ohm Field
4" With Output Transformer for 50L6 and similar tubes.
No. 14A645. Special, Each $1.85
5" With Output Transformer for 50L6 and similar tubes.
No. 14A652. Special, Each $1.99



HIGH QUALITY PHONO MOTOR

ONLY........................ $2.45
SIX FOR...................... $12.95

Has heavy 9" rim drive turn table, rubber tired idler, and an oversize induction motor with three point rubber cushion suspension. Very easy to mount. Extends only 2½" below motor board. Speed is standard 78 RPM and can be changed easily to 33⅓ RPM by removing drive bushing and reducing motor shaft diameter slightly. Furnished with spare rubber idler tire. Operates on 110-volt 60-cycle AC.

RECORD PLAYER KIT

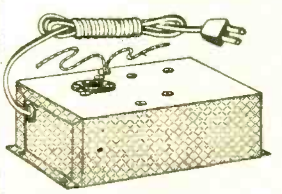
Kit With Amplifier — Contains motor listed above, a good crystal pick-up PLUS a completely wired phono amplifier. Uses 1 each 50L6, 12SJ7 and 35Z5 tubes (not included). Has volume and tone control.
No. 5B165. Special, Each (Less Tubes)..................... $7.95

Make Any Radio AN AUTOMATIC COMBINATION

FOR ONLY........................ $16.69

At this ridiculously low price you get a Model 650 Detrola Changer, a harmonizing metal base, brown crackle finish, an approved 6 ft. AC line cord and 6 ft. of shielded wire and plug for connecting to radio. Takes only a few minutes to assemble and connect to most any radio to make a combination that automatically plays twelve 10" or ten 12" records. For 105-125 volt 60-cycle AC only. Size when assembled 12x11x7".
No. 40A1002. Assembly as Listed........................ $16.69

WIRELESS PHONO-OSCILLATOR



Add it to your present single record player or record changer or build your own wireless player using this unit and any phono motor and pick-up.

Plays records through any radio without connecting wires. Tunes in like a radio station and is adjustable to any clear spot on your radio dial between 900 and 1600 KC.

Small enough to mount inside most portable players. Size 6" long, 3" wide, 1½" high. Tube extends 2¾" above unit. Operates on 110-volt AC-DC. **Complete with type 117L7 tube.**
Stock No. 17A345. SPECIAL, While They Last. ONLY......... $3.95

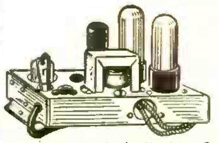
SEEBURG MODEL "M" A SUPER DE LUXE "INTERMIX" CHANGER

"INTERMIXES" 10" AND 12" RECORDS

VERY SELDOM IS THIS "KING" OF RECORD CHANGERS AVAILABLE TO OTHER THAN MANUFACTURERS OF HIGH GRADE COMBINATIONS (THE $500.00 AND UP KIND). A FORTUNATE B-A PURCHASE BRINGS THESE TO YOU AT A PRICE EVEN LOWER THAN ORDINARY INTERMIX CHANGERS.

Every One Brand New in Original Factory Cartons.
No. 35A1000. While They Last. BARGAIN PRICED AT.......... $39.50

3-TUBE PHONO AMPLIFIER



Works with any crystal pick-up. Small enough to install inside most record players to make your own amplified phonograph. Only 6" long, 3¼" wide. Mounts conveniently on bottom of motor board, extending only 4" below, with volume control and off-on switch shaft through motor board. Has two prong plug-in outlet for AC to phono motor, plug for phono input and 12" leads for connection directly to speaker voice coil. Output transformer is built in. Operates on 110-volt AC or DC. Requires one 12SJ7, one 35Z5GT and one 50L6GT tube.
No. 5B171. Less Tubes. **SPECIAL, EACH.................... $3.95**

SAVE ONE-HALF ON SYLVANIA TUBES!

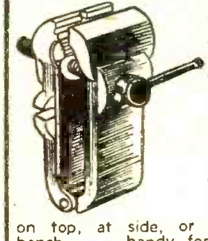
A special purchase from an overstocked set manufacturer makes these ridiculous Low Prices possible. Brand New guaranteed perfect — the identical Sylvania tube that would cost you up to Double our price—except they are bulk packed as set manufacturers buy them. Popular Locktal types.

Type	Stock No.	Each	25 Lots
14A7	21T3993	69c	62c
14Q7	21T3994	59c	53c
14B6	21T3995	59c	53c
35Y4	21T3996	59c	53c
50A5	21T3997	69c	62c

KIT OF FIVE
One of Each Type as Listed
No. 21T3998. Per Kit................ $2.95
10 Kits. Per Kit................ $2.75

IF YOU DO NOT HAVE THE COMPLETE B-A CATALOG, WRITE FOR IT TODAY.

PORTABLE KIT-VISE



Stronger than a Wrench. Just as handy. Advanced type jaws spring open instantly to 2¼" Pipe jaws will hold pipe or rod from ¼" to 1½". V-type jaws will hold wire upright or horizontal. **Fits anywhere . . .** on top, at side, or beneath work bench . . . handy for the tool kit, weight less than 3 lbs.—but its sturdiness will surprise you. **Regularly a $2.80 Value.**
No. 16A530.
Special Each............ $1.45

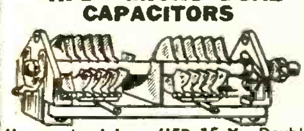
Saws in any direction, without turning frame. Cuts wood, plastic or light metal without binding or breaking. Blades are made of High Carbon Spring Steel with teeth cut spirally the full length, providing a sharp cutting surface completely around the blade. Sturdy steel frame has lever adjustment for proper tension.
No. 16A544—Frame and 15 Spiral Blades........... 95c
Extra Blades, also fit any standard coping saw frame. $1.00 value.
No. 16A545. 12 for.................... 50c

HANDY PLIERS

① KRAEUTER ROUND NOSE
A $1.50 Value. A handy plier for shaping wire, metal and all around radio work. Made of Forged steel with polished head and blued finished handles. **No tool kit should be without a pair.** Over all length 6"
No. 11A15.
Special Each............... 65c

② BERNARD PARALLEL ACTION PLIERS
Milled parallel jaws provide vise like grip, that won't slip. Has powerful side cutter on out-side of head. Made of nickel chrome alloy steel—blue-black finish.
No. 16A543.
SPECIAL, Per Pair....... $1.25

BIG BARGAINS in "HFD" MICRO DUAL CAPACITORS



Hammarlund type HFD-15-X. Double spaced 15 max.-6 min. Mmfd. per section 1500 volts. 11 plates per sect. .030" spacing. Screwdriver slot for tuning with shaft lock. Soldered brass plates cadmium plated. Aluminum end plates mounted on Isolantite base. Has isolating center shield. Silver plated rotor contacts can be shifted to 3 positions for shortest possible leads. Base mtg. Size 1 1/16x1½ x3". List value $3.50.
No. 14A680, SPECIAL EACH 99c

ORDER DIRECTLY from this ad. Terms are: Cash with order, F.O.B. Kansas City. Include postage PLEASE. C.O.D. orders require 25% deposit.

B-A BURSTEIN-APPLEBEE Company
1012 McGEE, KANSAS CITY 6, MO.

diser. The Vermont and New Hampshire territory will be served by Tom Farley of Haverhill, Massachusetts.

The Pittsburgh and Western Pennsylvania area will have the *J. E. Miller Company, Inc.* of Pittsburgh as its *Bendix* representative. C. J. Hassard of Philadelphia will serve all of eastern Pennsylvania including Harrisburg and southern New Jersey.

* * *

RAYMOND P. SPELLMAN has been named to the post of sales manager of the radio division for *Noblitt-Sparks Industries, Inc.*, manufacturers of *Arvin* receivers.

Prior to his new appointment Mr. Spellman served as assistant sales manager under Gordon T. Ritter, director of sales. He will make his headquarters at the company's executive offices.

Mr. Spellman has spent five years in *Arvin* field and office assignments and was, prior to his association with *Noblitt-Sparks Industries, Inc.*, connected with *Colonial Radio Co.* of Buffalo.

* * *

COLUMBIA TELEVISION, INC., of Stamford, Conn., manufacturers of a line of home television receivers, has changed the corporate name of the firm to *Videodyne, Inc.*, effective immediately.

* * *

SYLVANIA ELECTRIC PRODUCTS INC. has just completed an agreement with *Radio Corporation of America* whereby *RCA* becomes a licensee under some 200 radio and television tube patents of *Sylvania*.

The license runs for seven years at royalties of ¾ of one per-cent but not to exceed the sum of $200,000 in any one year.

* * *

JOHN R. MEAGHER has joined the Renewal Sales Section of the *RCA* Tube Department as a television specialist.

Well-known as a lecturer, teacher of radio, and author of numerous articles and publications on television, Mr. Meagher was formerly training coordinator on television for the *RCA Service Company.*

As the Renewal Sales Section's television specialist, Mr. Meagher will write a special series of articles on television servicing techniques and the use of television test equipment for the Tube Department's magazine "*RCA Radio Service News.*"

* * *

WELLER MANUFACTURING COMPANY of Easton, Pennsylvania, has been accepted for membership in the American Fair Trade Council according to the announcement made by John W. Anderson, Council president.

Weller is now fair-trading its line of soldering guns and price lists have been distributed reflecting the company's fair-trade prices.

—30—

Communications Receiver

(*Continued from page* 51)

coil to the rear deck of the bandswitch.

The cathode lead of the 6SA7 and the plate lead of the 6SG7 go across the bottom of the chassis to the bandswitch. The oscillator grid, mixer grid, and r.f. grid leads go through the chassis to the variable condenser. On the other side of the variable condenser these leads go through the chassis again and connect to the bandswitch. This places the long grid and plate leads on opposite sides of the chassis, thus providing a certain amount of shielding.

Here is an instance where common bypass grounding is impractical. The a.v.c. bypass condenser connects to a solder lug mounted under the mounting screw of T_1. The 6SG7 plate filter bypass condenser grounds to a solder lug mounted under the mounting screw of T_2.

The antenna lead from P_9 to the first deck of S_2 is shielded. The low impedance i.f. leads are also shielded.

The 6SA7 plate and screen bypass condensers ground to a solder lug mounted under the tube socket mounting screw. The 6SG7 cathode and screen bypass condensers ground to a solder lug mounted under the tube socket mounting screw.

The leads connecting P_8 to S_3 need not be shielded but may require bypassing if noise feeds into the tuner from these leads.

Coil modification information for T_3 was given in the second article of this series, September, 1948 issue of RADIO AND TELEVISION NEWS.

Tuning Procedure

The only test equipment necessary to align the tuner is a signal generator. If an output meter is available actual gain measurements can be made.

Connect the i.f. channel chassis to the power supply and audio amplifier and the r.f. tuner chassis to the i.f. channel chassis by means of the cables described in Part 2 of this series.

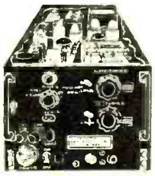
Establish the calibration error of the signal generator by using a frequency meter. Check the calibration at three points on each band to be used. Log this information so that corrections can be made easily for each frequency change of the signal generator. This will only take a few minutes and will result in a more accurate calibration of the r.f. tuner.

Due to manufacturing tolerances, the calibration of most signal generators is seldom accurate over the entire band. If the errors are known, corrections can be made.

It is impossible to design one set of coils that will maintain the same calibration irrespective of mechanical layout. The grid and plate leads are part of the inductance of any tuned circuit. Each mechanical layout will change the length of these leads which, in

STAHL SEZ! Compare Our Values

RADAR JAMMING TRANSMITTER



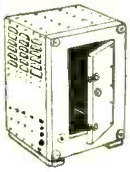
Ultra High Frequency
Band width 3½ meg. wide

1—931A
2—6AC7
1—6AG7
2—703A
1—807
2—5R4GY
1—2X2

Range 500-700 Meg.

Simple to convert to many uses. Has 10 tubes, contains blower and motor to cool tubes. Brand New and complete with all tubes. Weight approx. 50 lbs. Size 21" l, 10½" w, 7¾" h. in metal case.
Special—While they last.. **$19.95**

Standard Rack Cabinets



Heavy gauge steel, gray crackle finish; panel opening 19" wide, 27" high... **$12.95**

Blank Calibration Books

For BC 221 — Frequency from 125KC to 20000 KC printed in .10 divisions — 68 pages, aluminum cover, spiral bound.................. **$1.50**

Navy Standard Battery

Made by Gould Storage Battery Corp. 6 volt 15 amp hour. Excellent for motors, motorcycles, amateurs, experimenters, radio servicemen, etc. Shipped dry, with complete instructions for charging, 4⅝" wide, 4¾" deep, 6¾" high. Shipping weight 12 lbs.
While they last.......... **$4.95**

Battery Acid—1275 Sp. Grav.

Can be used in any storage battery—in hermetically sealed bottles.
36 oz. bottle.................................. **79c**
92 oz. bottle.................................. **$1.95**

JEFFERSON TRANSFORMER

Step down (or up) power circuit transformer double wound 230V input 50-60 cycle, to 115V output. .250KVA. Weight 17 lbs.................. **$7.95**

SOLAR TRANSFORMER

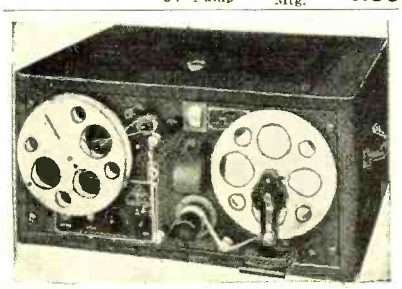
Step down (or up) transformer, 200V center tapped to 110V; 60 cycle; cap. V.A. 50; metal case, black wrinkle finish; 7 lbs. **$3.95**

AMERTRAN FILAMENT TRANSFORMER

5V-CT-6.5 amp. 115V-60 cycle AC........ **$1.95**

POWER TRANSFORMERS

Current Rating	Sec	Fil	Case	Price
40 Mil	350V CT	6.3V CT-5 amp 5V—3 amp.	Half Shell	**$1.95**
	Electrostatic Shield			
60 Mil	550V CT	6.3V-5 amp 5V-3 amp	Full Shell upright	**2.95**
	Electrostatic Shield			
100 Mil	700V CT	6.3V CT-4 amp 5V-3 amp	Full Shell Univ. Mtg.	**3.45**
200 Mil	800V CT	6.3V-6 amp 5V-4 amp	Univ. Mtg.	**4.95**



CODE KEYER TG—10

An automatic unit for code practice signals, from an inked type recording. It's a self contained unit, complete with 7 tubes and electric eye tube; operates on 110-120 volts AC. 60 cycles. Size 11x24x18½ inches. Weight approximately 63 lbs. Audio frequency output of 800 cycles per second. Power unit can be converted to P.A. system. Also a 78 RPM. 110 volt AC motor, can be used for turntable.
Like New. Complete, only........... **$19.50**

METERS

ALL BRAND NEW

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SPECIALS

Westinghouse Bakelite Case

2"	Round 0-10V-AC-DC..........	**$2.75**
2"	Round 0-30 Mil DC............	**2.25**
3"	Round 0-1 Mil DC with bad & good colored scale; can be used in tube checker....	Each **$3.45**
3"	Square 0-3 amp RF........	
3"	Square 7.5 V-AC..........	
3"	Round 0-15 Mil DC........	
3"	Round 0-35 Mil DC........	
3"	Round 0-50 Mil DC........	
3"	Round 0-100 Mil DC........	
3"	Round 0-150 Mil DC........	
3"	Round 0-200 Mil DC........	
3"	Round 0-150 V AC.........	
3"	Round 0-300 V AC.........	
4¼"	Round 0-150V DC...........	**4.95**
4¼"	Square 0-300 amp DC complete with shunt and leads..	**7.95**

WESTON Bakelite Case

2"	Round 0-75 amp antenna current Indicator with external couple	**$2.75**
2"	Round 0-10V output, portable; in small wooden case..	**4.95**
2"	Round 0-500V DC external multiplier	**4.75**
3"	Round 0-3 amp RF surface mount	**3.75**
3"	Round 0-5 amp external thermo couple	**8.50**
3"	Round 0-150V AC 400 cycle..	**3.45**
3"	Square 0-130V AC..........	**3.45**
4"	Square 0-20 Mil DC.........	**4.75**
4½"	Square 0-5 amp AC with a 0-200 amp scale............	**3.95**

G. E. Bakelite Case

2"	Round 0-15V AC-DC........	**$2.50**
3"	Round 0-100V DC...........	**2.75**
3"	Round 0-500 Mil DC........	**3.45**

WESTERN ELECTRIC Bakelite Case

3"	Round 0-1000 Mil DC.......	**$2.25**
3"	Round 100-0-100 Mil DC.....	**3.45**
3"	Round 20 amp DC charge & discharge	**3.45**

MISCELLANEOUS

3"	Round Beede 0-1000 Mil DC.	**$ 1.95**
3"	Round Triplett 0-150V AC...	**3.45**
3"	Round Burlington 0-75 amp AC	**3.45**
	Roller Smith portable lab 0-15V DC with handle; 5½x6x3½....	**19.50**
	Roller Smith portable lab 0-150 Mil DC with handle: 5½x6x3½.	**19.50**

RADIO COMPASS Selsyn Indicator

1-81-A, works on 16 to 25V AC; has 3-inch 0-360° dial **$2.45**
2 for **$4.45**

WESTINGHOUSE PHOTO CELL

Photox, ¼ mil. D. C. output. Brand New. Special **$1.95**

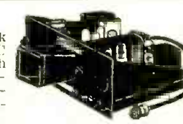
The Year's Biggest Bargain

IFF EQUIPMENT

1293B Signal Corp Scope Unit

consists of 5" Cathode Ray Tube and 24 tubes 1221A Indicator consists of high & low Voltage supply—8 tubes, electric eye & Selsyn indicator 110V-60 cycle AC—can be converted into an excellent scope. Shipping weight 500 lbs. Brand New in Original Case. Special................ **$49.50**

Oscilloscope



3"—BC991B—can be rack mounted; operates on 6VDC or 110VAC. Complete with 2—6H6; 4—6SF5; 1—6SJ7GT; 1—6SL7GT; 2—5Y3GTG; 1—3P1; in original export packed cases.
Brand New.... **$49.50**
COMPLETE SET of spare tubes same as above plus 1 extra 3P1 in export packed case **$12.50**

RCA-CRV-51019 Hand Sets self contained battery operated. Uses 4 pen light batteries excellent for Television Antenna installation. Sold in pairs only........................Pair **$15.00**

TS-10P Sound power handsets in original export packing. Each **$15.00** 2 for **$27.95**

CONDENSERS

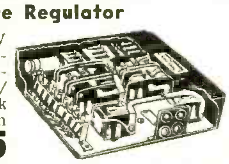
G.E.	0.35MFD	5000V	**$1.50**
G.E.	1MFD	2000V	**.75**
Sprague	1MFD	3600V	**.95**
Sprague	3MFD	4000V	**5.95**
Sprague	1MFD	1000V	**.39**
Sprague	0.5MFD	1500V	**.29**
Aerovox	.02MFD	8000V	**1.49**
Aerovox	2MFD	3000V	**2.95**
C. D.	.05MFD	200V	**.19**
Solar	.25MFD	2000V Bathtub	**.39**

WESTERN ELECTRIC CRYSTALS
1N23, **35c** each; 3 for................ **$1.00**
HIGH POWER quartz Crystal units, type CF5, 5000KC.
Complete with holder.................. **1.95**
ANTENNA for SCR522........................ **69c**

TRIODE 24G/3C24

100 W output. Fil. 6.3V-3A-Plate dis. 25W max plate volts 2,000. Max Ma 75. Here is a real bargain in surplus tubes. One of these tubes will give 100 watts output. Two of them will take ¼ kw. input. Stock No. 3C24—Each............ **39c**
10 for............. **$3.50**

Voltage Regulator



G.E. 110 to 220V AC, 400 cycle, single phase-.15 amp.-20 W; 0-7.2 ohms/2.75 amp; black wrinkle finish metal case...... **$4.95**

Transtat Voltage Regulator

Type RH 115V AC. 400 cycle .72-KVA-output 75 to 120 V @ 6 amp. black wrinkle finish metal case. Weight 11 lbs. **$2.45**

MICHAEL STAHL, INC.

39 VESEY ST.
Worth 4-2882 New York 7, N. Y

All Mdse. new unless otherwise specified

Prompt Delivery—25% deposit required on C.O.D. order. Shipped F.O.B. New York. Write Dept. RN10

turn, will alter the calibration. The amount of error will increase as the tunable frequency increases.

The minimum and maximum capacities of the variable condenser will cause the calibration to change. High minimum capacity will affect the high frequency end of the tunable range. Low maximum capacity will affect the low frequency end of the tunable range. This condition makes it advisable to use a variable condenser for which the coils were designed. Such design will allow the use of calibrated dials supplied by the manufacturer of the coils.

If the dial is to be hand calibrated, the minimum and maximum capacities of the variable condenser are not critical.

A certain amount of "cheating" can be done with the padding condensers. The padding condensers affect the low frequency end of the tunable range and the tracking. There is only one correct value of padding capacity for a given set of conditions.

The manufacturer of the coils recommends a certain value of the padding condenser to be used with his coils. If this value is used, the coils will cover approximately the frequency range of their design, and the tracking will result in satisfactory operation.

The tracking can undoubtedly be improved by changing the capacity of the padding condenser slightly to help correct for differences of mechanical design. The result will be higher gain at certain frequencies over the tunable range of the tuner.

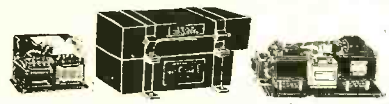
The padding condenser values indicated in the circuit diagram differ from those recommended by the *Miller Coil Company*. These changed padding condenser values offer optimum tracking conditions for the mechanical design described.

Connect the signal generator to the control grid of the 6SA7. Place switch S_2 in the "all-wave" position and S_3 in the "receive" position. Switch S_1 should be placed in the "Band 1" position.

Tune the signal generator to 455 kc. and increase the input until the "R" meter starts to indicate. Adjust the tuning of T_3 for maximum "R" meter indication, reducing the signal generator input to maintain an on-scale reading.

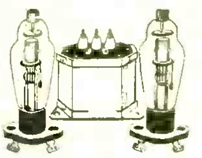
Rotate the variable condenser to minimum capacity and tune the signal generator to 1550 kc. Adjust the broadcast trimmers of T_1, T_2, and T_5 for maximum "R" meter indication, reducing the signal generator input to maintain an on-scale reading.

Next set the signal generator frequency to 600 kc. Tune the receiver to the frequency of the signal generator. Rock the variable condenser slowly back and forth and adjust padding condenser trimmer C_{19} for maximum "R" meter indication. Return the signal generator and receiver to the high frequency end and repeak. Repeat this procedure several times. Pay



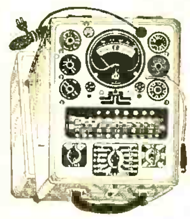
CONSTANT V'REGULATOR NEW RAYTHEON

in95-130V/60cy; Outpt115V/60Watt Csd.....$ 10.95
RAYTHEON in 198to242Vinpt/50-60cys; Outpt220V/500Watts/0.5%Rgltn Rack mtg.... 36.00
SOLA CONSTANT V'REGLTR USN Cased in 95 to 190V/50-60cys; Outpt 125to220V 2KW/17.4Amps/Constant Duty. LN*...... 130.00
SAME UNIT NEW. USN Cost $369. SPECIAL 162.00



KIT 866A TUBES TRANSFORMER inpt 115VAC/50-60cys Outpt 2.5VCT / 10Amps 10KV insltn, Sockets ceramic. SPECIAL $5.95
KIT 872A TUBES TRANSFORMER GE inpt 115VAC/50-60cys, Insltd 12.5KV wkg Sockets & Tubes. SPECIAL $12.95

POCKET VOM 1maMTR 1000ohm/pv OHMMETER ZERO SAME both RANGES MOLDED CASE 3⅛ x 5⅞ x 2¼" ETCHED PANEL WHITE LETTERS 6AC VOLTRANGES 0-15/30/150/300 & 1500 &3000 VOLTS 6DC VOLTRANGES 0-7.5/15/75/150 & 750 & 1500 VOLTS 4DC CURRENT R's 0-1.5 / 15 / 150ma & 0-1.5Amps 2 OHMMETER Rngs 500 ohm&1megohm COMPLETE BAT & Test leads $13.90



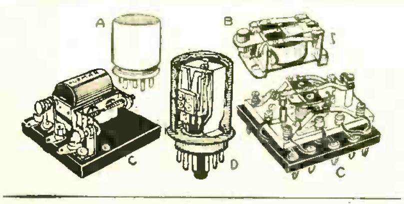
NEW TUBE TESTER CHECKS OCTAL, LOKTAL BANTAM, PEANUT, TELEVISION MIN. MAGIC I THYRATRONS & OTHERS CHECKS for SHORTS & leakage up to 5 megs. CHECKS INDIVIDUALLY Diode, Triode, Pentode sections of multi purpose TUBES. RMA Switching COMPLETE IN OAK CASE SLIP-ON HINGED COVER 10¾x8¾x5¾" & Obsolescence Safety factor with new element selector switching keeps tester up to date! SPEEDREAD CHART COMPLETE $29.90

HIPOWER VARIABLE ANTENNA MATCHING NETWORK 100IA/1KW RF NEW 1.5to7mc's convertible to Hifreqs. PiNetwork adjustable IN&Outpt. CASED 15x15x23" RACK MTG Ribbon Coil&250 mmf/7000V VarCondsr, RFmtr, Insltrs Tech Manual. Will match most ANTS. NEW requires recementing—coil turns "TAB" SPECIAL...$9.95

BENDIX TA12 / 100Watt XMTR LN* Separate ECO easily converted to 20, 40, 80mtrs. HAS Micrometer tuning for ea ECO/3000 divs 4 separate outpt tanks Selector channel switch simultaneously changes ECO, IPA & Outpt tanks with tubes used LN* "TAB" SPECIAL $36.00

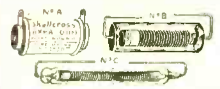
RELAYS SENSITIVE & POWER

(A) GE Plug type 2000ohm/8ma/SPDT/5Amps.$1.98
(B) LEACH DPDT/115VAC/10AmpContacts... 1.98
(C) KURMAN DPNO&NC/650ohm/4ma,adj/5 amp cts 2.25
(D) CLARE, VACUUM NITROGEN sealed SK5010 260ohms/18-28VDC/DPDT/lamp or 3amp int. SPECIAL, $1.49; with Rectifier for 115VAC.............. 1.98
(E) ADVANCE Ceramic HF ANT DPDT& SPNO 2500ohm/75VDC/15amp cts, $2.75; &Rect115VAC 3.25



"TAB" DEPT. 10RN, 6 CHURCH ST., NEW YORK 6, N. Y., U. S. A.

"TAB" THAT'S A BUY!



PRECISION RESISTORS FOR AMPLIFIERS RADAR, TELEVISION & TELEPHONE EQUIP STANDARD MFGRS SPECIALISTS IN PRECISION RSTRS. WRITE QTY Prices. "NO MFGRS CHOICE." We ship types in stock.

.116	179	680	2600	13500
.42	182	684	2635	14000
.425	182.4	689	2700	14400
.607	199	697	2850	14440
.7	200	700	2860	14460
1.01	209.4	733	2900	14500
1.3	216	750	3000	15000
1.75	220	800	3100	15500
3	220.4	806	3290	16500
3.83	225	854	3384	17000
4	230	900	3500	17500
4.35	235	910	3509	18000
5	240	917	3700	18380
5.025	245.4	946	3730	18500
6	250	978	3760	19000
6.25	260	1000	4000	19500
7	271	1030	4200	20000
7.5	275	1056	4280	20520
7.8	280	1060	4300	21000
7.9	286	1100	4314	21500
8	289	1110	4440	22000
10	299	1150	4444	22500
10.38	300	1155	4500	22990
10.48	310	1162	4720	23000
11.25	311.5	1175	4750	23150
12	320	1200	4850	23325
13.52	325	1225	4885	23400
14.2	340	1250	4900	24000
14.5	350	1260	5000	24600
15	366.6	1322	5100	25000
16	370	1350	5210	25200
16.37	375	1355	5235	25400
17	380	1400	5200	26600
20	390	1495	5500	27500
21	400	1500	5600	29000
25	410	1510	5730	29500
26	414.3	1518	5910	29900
30	418.8	1600	6000	30000
37	425	1640	6140	31000
48	427	1646	6200	33000
50	440	1650	6300	35000
51.78	450	1670	6495	37000
55	452	1680	6500	38140
56.7	470	1710	6840	38500
60	475	1740	6990	39500
63	480	1770	7000	40000
68	487	1800	7500	43000
71.4	500	1818	7700	47000
74	520	1830	7930	48000
75	525	1865	8000	48660
80	540	1900	8250	49000
81.4	550	1910	8500	50000
89.8	575	1960	8700	52000
90	580	2000	8992	54000
95	600	2045	9000	56000
100	607	2080	9445	60000
101	612	2095	9500	61430
105	625	2145	9710	62000
107	633	2160	10000	64000
113.1	640	2195	10430	65000
120	641	2200	10500	68000
121.2	649	2250	10600	70000
125	650	2300	11000	72000
147.5	657	2400	11400	75000
150	665	2450	11500	80000
160	669	2463	11690	84000
165	670	2485	12000	90000
170	673	2490	12600	91000
175	675	2500	13220	95000

ABOVE SIZES EACH, 30c.......TEN FOR $2.50

100000	155000	240000	353500	575000
110000	166750	245000	380000	600000
115000	169360	250000	400000	620000
120000	180600	265000	402000	621000
125000	185000	268000	422000	654000
130000	201000	275000	458000	750000
135000	220000	294000	478000	761300
140000	225000	307500	500000	800000
145000	229000	314000	520000	900000
147000	235500	330000	521000	930000
150000	238000	333500	570000	950000

ABOVE SIZES, EACH 40c......TEN FOR 3.50

1 Meg	2 Meg	3.5 Meg	4.23 Meg	10Meg
1.2	2.855	3.673	4.5	11.5
1.5	3	3.9	5	12.83
1.8	3.673	4	9.05	20

ABOVE SIZES EACH 75c.........TEN FOR $6.50

Vacuum Precision Hivolt Resistors (C)

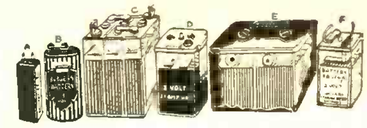
.12, .25, .6, .75, .83, .99megohms
1, 1.5, 2, 3, 3.75megohms

SPECIAL $1.00@ ....TEN FOR $ 7.50
SEALED, 10 or 12Meg/10KV/9W, $1.35@10 for 10.00
MVZ8/20Watt/30Megohms/25KV $1.98 @ 6 for 10.00
MFB105/1Meg/.5%accy/Jan, R-29 $1.98@ 6 for 10.00
WESTON 20meg/20KV/0.5% Precision....... 29.95
METER GE/0-2KV/1000ohms p/v&Resists.... 5.95
METER 0-10KV/1000ohms p/V& Resists...... 10.95
METER W.E. 0-200 or 0-500V...............ea. 4.95
WESTON SQ HTR 0-15VAC/476Type......... 4.50
WSTGHSE 0-150VAC/25to125cycles 3.95
WSTGHSE SQ MTR 0-7.5VAC/RA35 Type... 4.50
VARIAC 200B/175Watt/0-135V GR.......... 10.95
VARIAC 200C/860Watt/0-135V GR 16.50
VARIAC 100R/0-230or270/2KW 39.95

SPRAGUE ELECTROLYTIC CONDSR

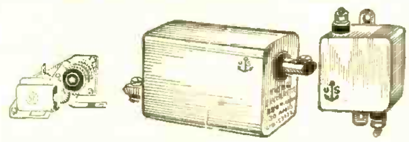
FP Type 30mfd/450V&2x20mfd/25V also 10 mfd/450V&2x20mfd/25V Both for.......... .59

"TAB" MONEY BACK GUARANTEE $3. MIN. ORDER F.O.B. N.Y.C. ADD SHIPPING CHARGES & 25% DEPOSIT, C'TABOGRAM. WO 2-7230.

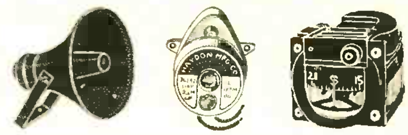


STORAGE & DRY BATTERIES

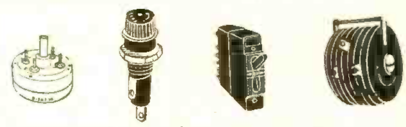
(A) BR18/BB52/5oz./36V minS'Baty $1.49 @..................................8 for $10.00
(B) BURGESS 3V/F2BP/dated 6/47. SPECIAL ....5 for 1.00
(C) GOULD 6V/15AH S'Baty USN NEW..... 3.98
(D) BB54/2V/27amp WILLARD S'Baty..... 1.98
(E) WILLARD 4V/40AH/TBY S'Baty........ 5.95
(F) BB2064U/2V/11AH WILLARD S'Baty... 1.89



NAVY LINE FILTERS 10amp/130VAC DC Cased filters 0.1 to 1000mc's/USN..........$1.29
TOBE 30amp/250 VAC DC filters 0.15 to 1000mc's USN Cased Cont duty $4.50 @ TWO for 8.00
GE 100amp filter & 2x5mfd/50V/pyranol Condsrs works 110 VAC DC SPECIAL...... 1.98



TRUMPET & DRIVER 35 to 55 Watts W.E. blast & moisture proof head 3½ L/15" dia. $28.75 @ ....2 for $ 55.00
TRUMPET & DRIVERS MULTICELLULAR 250 WATT, 9 Unit W.E. blast & Mstre proof 125.00
W.E. Diaphragms for above Trumpets 3.95
AIRCRAFT COMPASS MKVIII PIONEER BENDIX. Used good G'cost $75. SPECIAL 2.98
AIRCRAFT COMPASS MKIX KOLLSMANN Used good larger than VIII G'Cost $108 SPECIAL 3.98
HAYDON SYNCHRONOUS CLOCK MOTORS 110V/2.2W/60cy AC/1RPM 2.49
10V/60 cy AC/24RPM & SPST Cam&Sw.... .98
110V/2.2W/60 cy AC/3½ RPM 2.49
110V/2.2W/25cy AC/3½ RPM.............. 2.49



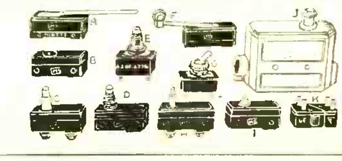
CONDENSER VARIABLE 360° SINE WAVE 4 taps 90° Quadrants for PUREWAVE freqs generator ....$ 2.39
BUSS HCM/4AG, HKM/3AG fuseposts, ea. 25c; 5 for 1.10
Littelfuse 1075S/3AG @ 18c, 1087F @ 25c; 5 for 1.10
WRITE FOR FUSE LISTING & HOLDERS
CIRCUIT BREAKERS—
HEINEMAN Magnetic BKRS 10ma, 220ma 3, 5, 7, 10, 15, 20, 30, 40, 80, 100 & 180 Amps. NEW, each, $1.95; Asstd, 10 for... 18.00
SQ'D, KLIXON & CH 5, 10, 20, 25, 33, 35 & 60, 70 Amps, 98c each; 10 for............... 8.00
THERMOSTAT 85 F/20A adjustable, each.... .49
XTAL DIODES 1N34/$1.08 @ 2 for $2.10; 10 for 9.85
1N21, 21A, 22, 23, 23A, 25, each $1; 12 for... 10.00
1N23B, 1N26 @ $2 each; 10 for.............. 17.50
THERMISTORS D170396 or 1C, 90c each; 3 for 2.50
D168391 COMPENSATOR @ $2 each; 3 for... 5.00

RECTIFIERS BRIDGE

In	Out	Amps	Price	In	Out	Amps	Price
18	14	1.35	$2.49	36	28	1.5	$3.95
18	14	3.5	3.49	36	28	3.5	6.75
18	14	5.	4.85	36	28	5.	7.50
36	28	.320	1.49	WRITE FOR LIST			

SWITCHES, MICRO, TOGGLE, Etc.

(A) MU/Leaf Switch 3½"/DPNO&NC/15A/ ½HP @ $0.98
(B) MICROSWITCH Pin Plunger SPDT/10A @ .54
(C) MICROSWITCH Plunger SPDT/10A @.. .59
(D) MICROSWITCH PLUNGER SPNO/10A @ .69
(E) ARROW H&H PLUNGER SPNO/6A @.. .39
(F) MICROSWITCH ROLLER SPNC/10A @. .89
(G) AH&H Toggle/6A/DPDT 30c @ 4 for.... 1.00
(H) MICROSWITCH PLUNGER SPNO&NC @ .59
(I) MICROSWITCH PLUNGER Button SPDT @ .... .69
(J) MICROSWITCH SPNO/30Amp/Cased @. 1.25
(K) SWITCHETTE DPNO&NC 30c @; SPNO @ .... .25



DEPT. 10RN, 6 CHURCH ST., NEW YORK 6, N. Y., U. S. A. **"TAB"** little attention to the frequency range and adjust for optimum tracking over the entire range.

Check the sensitivity over the entire range by slowly changing the frequency of the signal generator and receiver. When the receiver is tracking the sensitivity should vary less than three-to-one over the entire band. If the variation is more than three-to-one, repeat the tuning procedure picking a new high frequency starting point, such as 1600 kc., rather than 1550 kc.

If a calibrated dial is used, simply adjust the receiver frequency to agree with the calibration and maximum sensitivity at approximately 1300 kc.

Next rotate the bandswitch S_1 to "Band 2" position. Adjust the signal generator to 4500 kc. Rotate the variable condenser to minimum capacity. Adjust the Band 2 trimmer condensers of T_1, T_2, and T_5 for maximum "R" meter indication, reducing the signal generator input to maintain an on-scale reading at all times. Tune the signal generator to 1700 kc. and the receiver to the frequency of the signal generator. Adjust Band 2 trimmers of T_1 and T_2 for maximum "R" meter indication.

Return the signal generator and receiver frequency to 4500 kc. Rock the variable condenser slowly and adjust Band 2 trimmer of T_5 for maximum "R" meter indication. Now adjust the trimmers of T_1 and T_2 for maximum. Repeat this procedure several times and then check the sensitivity of the entire band by slowly tuning the receiver and signal generator at the same time. The sensitivity variation should not exceed four-to-one.

If a calibrated dial is used simply adjust the frequency of the receiver to agree with the calibration.

Next rotate the bandswitch S_1 to "Band 3" position. Repeat the same tuning procedure as used for tuning Band 2 using 15,000 kc. as a starting point. Keep the signal generator input level low to reduce the possibility of tuning up on an image.

When the receiver is correctly aligned the image will appear 910 kc. higher in frequency than the frequency indicated by the receiver calibration. If the image appears on the low frequency side, the alignment is incorrect and will result in unsatisfactory tracking. The sensitivity variation over this band should not exceed eight-to-one.

Due to the high sensitivity of the receiver this amount of sensitivity variation will not be noticed in actual operation.

Next short the antenna input terminals and open the gain wide open. There should be little if any noise. If noise does appear, it is an indication of regeneration.

The point of regeneration can be established by holding a screwdriver near component parts and wiring. If the noise changes when the screwdriver is held near a certain point, this is a fair indication that the difficulty is in that locality. Dressing wires will normally correct the situation. In some cases changing the location of a particular part, such as a condenser, will be required.

Dial Calibration

The *Croname* dial shown in the photograph is very adaptable to hand calibration. Irrespective of the dial used, the procedure outlined will apply.

An operator of a communications receiver spends no small part of his time looking at the dial. If the dial calibration is not neat, the calibration becomes more offensive each time he looks at it. Plan on making a neat dial at the start and not at a later date.

In manufactured receivers, the cost of engineering and parts actually used in a dial usually represent one-tenth of the total cost of the chassis. If you purchase a receiver for $200.00, the chances are that you bought yourself $20.00 worth of dial. If you are building this receiver, save a little of your energy for making a decent dial calibration.

There are a few fundamentals which should be remembered in making dials. If these fundamentals are understood dial problems will disappear.

1. Small numerals are more difficult to make than large ones.
2. The more calibration points placed on a dial the more complicated it becomes.
3. Straight lines are less difficult to make than curved ones.
4. Use as few numerals as possible.
5. Close the variable condenser and make a calibration point on the dial so that dial can be removed and replaced in exactly the same position each time. Do not make this calibration point with the variable condenser open since some condensers rotate past minimum capacity.
6. Make the original calibration in pencil. Do not ink the dial before you are completely satisfied with the actual layout.
7. Practice making numerals for five minutes.

The dial calibration shown in the photograph was made in approximately thirty minutes.

Actual calibration procedure is as follows:

Band One. Place the signal generator frequency at 1500 kc. and correct for frequency errors if such errors exist in the generator calibration. Tune the receiver to the frequency of the signal generator and tune for maximum "R" meter indication. Next turn on the b.f.o. and adjust for zero beat. Make a small dot in pencil on the dial. Write above this dot, also in pencil, "1500." Next move to 1450 kc. and repeat the same procedure, but in this case simply tune the receiver for zero beat.

Calibrate the dial every 50 kc. over the entire range. Write in pencil the frequency of several calibration points for identification later on.

Band Two. This band is calibrated in the same manner as Band One, only calibration points are made every 100 kc. Each 500 kc. point is identified by frequency (in megacycles).

The 75 meter phone band is calibrated on the bandspread dial. Calibration points appear every 5 kc. and are identified every 10 kc.

Band Three. This band is calibrated in the same manner with calibration points appearing every 500 kc. with identifying numerals every 1000 kc. (in megacycles). The bandspread dial can be calibrated for 40 and 20 meter ham bands or any other band of frequencies desired.

Each band can be calibrated in a manner of minutes since it is only necessary to set the signal generator on frequency and zero beat the receiver to it.

If more calibration points are desired, they can be included in the original calibration.

Receiver Operation

When the receiver is operated in the broadcast band the selectivity switch will normally operate in the wide-band position. The tone controls will be set to meet individual requirements.

For communication reception, narrow or sharp selectivity will be used. The bass control will be rotated for minimum bass response. The audio high frequency control is usually operated full on to compensate for the lack of highs due to the extreme i.f. selectivity.

The b.f.o., a.v.c. switch, and i.f. gain control are used for c.w. reception. The a.n.l. circuit is used to attenuate ignition noise or loud crashes of static. The a.n.l. circuit is strictly a "go," "no-go" system. There are no adjustments.

The receiver as a whole will stack right up with the average communications receiver. It will equal the performance of a commercial set in some instances and exceed the performance in such aspects as signal-to-noise ratio, selectivity, and tone quality.

With the addition of the individual tuners it will be right out in front. These tuners will offer gain, signal-to-noise ratio, image ratio, selectivity, and total bandspread over the entire dial. Equal performance with band-switching units will be difficult if not impossible.

The tuners are simple and straightforward from an engineering viewpoint. They are small and inexpensive to construct. Frequencies from 300 megacycles to 550 kc. can be easily covered. On top of this the average radio enthusiast can build this equipment at home.

(To be continued)

FRENCH REVEAL NEW DEVELOPMENTS IN TELEVISION FIELD

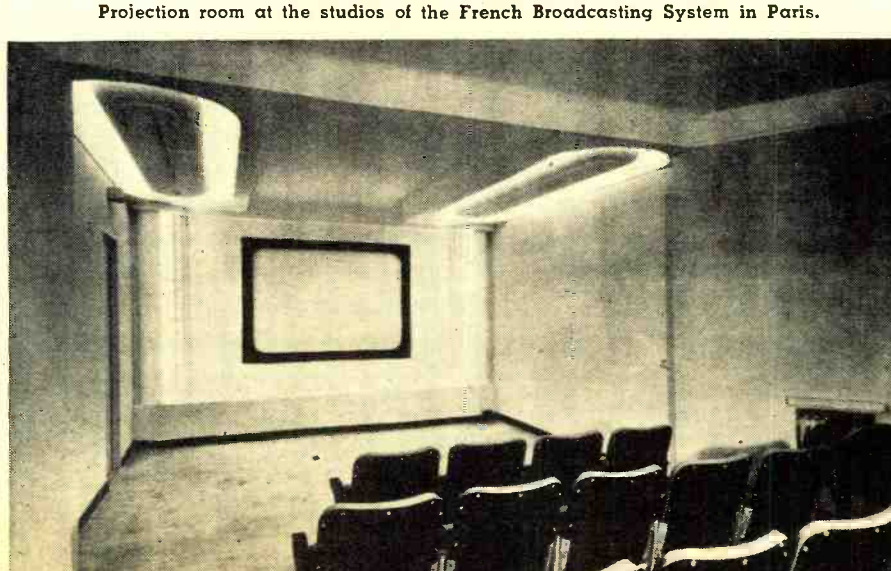
FRENCH TELEVISION experts are perfecting new transmitters and receivers capable of showing the clearest and sharpest images yet shown before television audiences, according to word from officials of the French Broadcasting System.

The new French video receiver will relay television at 840 lines as compared to the 525 lines now standard among American video broadcasters. The clarity of television screen images varies with the number of lines per square inch. Transmission under the new and improved system is expected to begin next January from the French transmitter located atop the Eiffel Tower.

French television engineers are also manufacturing a new video camera tube which, they claim, is even more sensitive than the image orthicon developed in the United States. The new French tube will mean the elimination of many of the hot, blazing lights which plague television actors.

—30—

Projection room at the studios of the French Broadcasting System in Paris.



BAND PASS FILTER

#70473. Sharp band pass peaked at 700 cps. High-to-high impedance. Can be plugged into 'phone output of receiver for good results. Cuts out QRM. New, with circuit diagram $2.25

COAX CABLE

RG 18/U, 52 ohm imp. armored ....$ .51/ft.
RG 24/U, twin coax, 125 ohm imp. armored ...... .50/ft.
RG 28/U, 50 ohm imp. pulse cable. Corona min. starting voltage 17 KV ....$ .50/ft.
RG 35/U, 70 ohm imp. armored .... .50/ft.

COAXL CONNECTORS

831R	$.35	UG 21/U	$.85
831SP	.35	UG 86/U	.95
831AP	.35	UG 254/U	.75
831HP	.15	UG 255/U	.85

Homedell male to type "N" male adapter $1.25

THERMISTORS (.95 ea.)	VARISTORS $.95 ea.
D-167332 (Bead)	D-167176
D-170396 (Bead)	D-170225
D-166382 (Tube)	D-168687
D-166228 (Button)	D-171121
D-167018 (Tube)	D-171631

EE-89A REPEATER

Extends range of field telephone apparatus, such as EE-8 up to 25 miles, when inserted in a line. New with spare tube and instruction manual, less standard type batteries $21.50

BC 686 LINE AMPLIFIER

With magneto ringer, 3-tube 25L6 amplifier. For local point-to-point telephone operation, remote operation of Phone Xmtr. remove reception of receiver output, monitoring facility. Requires only 24 vdc for tube "B" Supply for full operation.
New, less tubes, in wooden chest $18.50
Per pair for 2-way pt-to-pt operation $35.00

30 FT. MAST SETS

Heavy duty rugged plywood. Crated in 3 sections with coupling material. Two masts for ideal flat-top antenna. New ....$40.00 per set of 2

SCR 610 11-10 METER PORTABLE/MOBILE RIG

SCR 610 portable transmitter-receiver, 27 to 38.9 mc. crystal controlled, using FM for efficient operation. Unit consists of Xmtr-rcvr BC 659 and power supply PE 97 . . . operating from 6 or 12 vdc. Slightly used, excellent condition. Less xtals $21.00

ARC-5 ACCESSORIES CONVERSION COILS FOR ARC-5 TRANSMITTERS

M.O. Coils	P.A. Coils	Antenna Coils	Range
$1.00 ea.	$1.00 ea.	$.85 ea.	
#6029	#7247	#6033	3-4 Mc.
#6030	#9293	#6034	4-5.3 Mc.

ARC VFO KIT FOR 80 METERS

ARC-5, Xmtr M.O. parts and circuits for that new VFO-exciter. Kit consists of the following: 1-#6029 M.O. coil; 1-#5632 tuning condenser; 1-#4990 padding cap; 1-#ARC-5 Xmtr. schematic. (Specify freq. range when ordering). Complete kit $2.75
Single rcvr. mtg. racks......$1.00, ...dual $1.50
Modulation Trans. ARC #9466, push pull 807's to Plates and screens of 2 807's in parallel $1.65

A RACK FOR COMPLETE RIG

A professional cabinet for your receiver and transmitter. 46" high, 24" wide, 22" deep. Black crackle finish. 3 decks. Hundreds of useful parts. Below are just a few of the components:

- 11—1" Jewels
- 4—A.C. Outlets
- 2—0.3 Amp. RF Meters
- 1—40-0-40 Ammeter
- 2—Ceramic Switches
- 1—Ohmite Pot.
- 5—AC Relays
- 3—Fuse Blocks
- 2—115 VAC Contactors
- 1—6" Gong
- 7—Panel Controlled Circuit Breakers (4—15 amp. 2—35 amp. 1—50 amp)
- 3—Large Push Button Switches
- 3—Wall Type Switches
- 1—Reset Push Button Switch
- 1—Microphone Jack
- 3—Meters on 5-hole Meter Panel
- 5—Large Jones Strips
- 1—4" DPDT Heavy Duty Knife Switch
- 1—Control Amplifier

NEW, $45.00

MODULATOR UNIT BC 1203-B

Provides 300-4,000 PPS. Sweep time: 100 to 2,500 microsec. in 4 steps, fixed mod. pulse, suppression pulse, sliding modulating pulse, blanking voltage, marker pulse, sweep voltages, calibration voltages, fil. voltages. Operates 115 vac. 50-60 cy. Sliding pulse variable in phase up to 2,500 microsec. Amplitude of suppression pulse adjustable between 10 and 35 v. and width variable between the limits of 10 microsec. or less to 1,800 microsec. or more at a recurrence rate between 200 and 300 cps. Provides various types of voltage pulse outputs for the modulation of a signal generator such as General Radio #804B or #804C used in depot bench testing of SCR 695, SCR 595, and SCR 535. New $125.00

A complete line of Microwave Equipment in stock: 10 cm, 3 cm, 1.25 cm. Send for Microwave Flyer.

HEADSETS

Dynamic mike and headset combination. A high quality, efficient unit, used in B-19 tank Xmtrs. Mike and phones complete, new $2.75
R-15 headsets: 8000 ohms impedance, rubber cushions. Comes with 8" cord and plug PL 55. New $1.95
HEAD AND CHEST SET HS-19 for BD71 and BD72. New $2.75
HEADBANDS: HB-1, HB-4, HB-30. New ....$.25 ea.

MICROPHONE ELEMENTS

Carbon transmitter element for TS11-J, TS11-L, TS13-E, TS15-A ....$.75 ea.
Element for microphone T-24, 30 ohm resistance.$.95 ea.

INSTRUCTION MANUALS

BC312, BC 342	$1.25
SCR 281	1.25
ZA Eqp't	.75
MARK II	.75
SCR 508	1.00

QBG-1, ECHO RANGING DRIVER-RECEIVER

Complete underwater sound signal transmission and reception unit with range of 200 to 600 yds. and freq. range of 16 to 27 kc. New, complete with battery box in chest, less projector **$85.00**

SEL. RECTIFIER: Input: 115 vac. 60 cy. Out: 115 vdc. 1.66 amps. Full Wave Bridge, F. T. & R. #DE11 ....$9.95

SEL. RECTIFIER: Input: 30 vac. 60 cy. Out: 24 vdc. .5 amp. Full wave bridge, GE #SC10......$1.50

MAGNETRONS — KLYSTRONS KENOTRONS — PLIOTRONS

01-A	$ .45	WL417	$17.50
1A3	.70	530	90.00
1B24	4.85	531	45.00
1H5	.55	532	3.95
1N5	.69	559	4.00
1T4	.69	562	90.00
2C21	.69	615	.89
2C22	.69	703-A	7.00
2J21-A	25.00	704-A	.75
2J22	15.00	705-A	2.85
2J26	15.00	707-B	20.00†
2J27	15.00	714AY	15.00
2J31	25.00	715-B	12.00
2J32	15.00	720BY	50.00†
2J38	25.00	720CY	25.00
2J39	25.00	721-A	3.60
2J55	25.00	723-A/B	7.75
3J31	35.00	724B	1.75
2X2/879	.69	724-D	2.50
3A4	.65	725-A	25.00
3BP1	2.25	726-A	10.00
3C24	.60	800	2.25
3C30	.70	801-A	1.10
3D6	.79	804	9.95
3CP1/S1	3.50	811	1.95
3D21-A	1.50	814	4.95
3DP1	2.25	815	2.50
3EP1	2.95	836	1.15
3FP7	1.20	837	1.95
3GP1	3.50	843	.59
3Q5	.79	860	15.00
5BP1	1.20	861	40.00
5BP4	4.95	874	1.95
5CP1	3.75	876	4.95
5FP7	3.50	889R	78.50
5JP2	8.00	1005	.35
5J30	39.50	1613	.95
6AC7	1.00	1619	.21
6AK5	.69	1624	.85
6C4	.58	1629	.35
6G	2.00	1961	5.00
6J6	1.00	8012	3.95
6K7	.55	9002	.65
6L6GA	1.00	9004	.47
6SC7	.70	9006	.47
6SL7	1.00	CEQ 72	1.95
6V6	.79	EF 50	.79
7C4	1.00	E-1148	.75
7E5	1.00	F-127	20.00
7E6	.72	FC 258A	165.00
10Y	.60	FC 271	40.00
12A6	.35	GL 562	75.00
12GP7	14.95	GL 623	75.00
12K8Y	.65	GL 697	75.00
12SF7	.49	ML 100	60.00
12SR7	.72	OK 59	45.00
15R	1.40	QK 60	45.00
28D7	.75	QK 61	55.00
30 (Spec)	.70	QK 62	55.00
35L6	.69	RCA932*	.65
35Z5	.66	VR 91	1.00
45 (Spec)	.59	VR 130	1.25
50L6	.79	VR 135	1.25
39/44	.49	VR 137	1.25
35/51	.72	VR 150-30	.75
211	.75	VU 120	1.00
227A	3.85	VU 134	1.00
225	8.80	WL 532	4.75
250R	7.95	WN 150	3.00
268-A	20.00	WT 260	5.00
355-A	19.50		

* Photo Cell
† With Cavity

MAGNETRON MAGNETS

For 2J21, 725-A, 2J22, 2J26, 2J27, 2J31, 2J32, and 3J31 ....Each $8.00
4850 Gauss. 5/8" bet. pole faces, 3/4" pole diam. 8.00
1500 Gauss. 1 1/2" bet. pole faces, 1 5/8" pole diam. 8.00

XMTR TUNING UNITS

BC 375: TU-9 (7.7-10mc); TU-10 (10-12.5 mc); TU-22 (350-650 kc); TU-26 (200-500 kc). Each...$2.25
BC 223AX: TU-17 (2-3 mc); TU-18 (3-4.5 mc). Each $1.95

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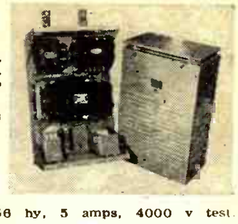
Dual 0-200 microamp. movement in 3" case. Each movement brought out to 6-term. receptacle at rear. Originally used in ILS equipment. New **$2.50**

VOLTAGE REGULATORS



Mfg. Raytheon; Navy CRP-301407: Pri: 92-138 v. 15 amps. 57 to 63 cy. 1 phase. Sec: 115 v. 7.15 amp. .82 KVA. .96 PF. Contains the following components:
REGULATOR TRANSFORMER: Raytheon UX-9545. Pri: 92-138 v. 60 cy. 1 PH. Sec: 200/580 v. 5.5/5.26 amps. 4000 v rms test.
FILTER REACTOR: .156 hy, 5 amps, 4000 v test. Raytheon UX 9547.
TRANSFORMER: Pri: 186 v. 5 amps: Sec: 115 v, 7.2 amps. Size: 12" x 20" x 29". Net Wt. approx. 250 Lbs.
Entire unit is enclosed in grey metal cabinet with mounting facilities. New, as shown $99.50

VOLTAGE REG. "Transtat." Amertran Type "RH" 2 Kva Load. Input: 90/130 v. 50/60 cy. Output 115 v..$40.00
TRANSTAT VOLTAGE REG. 11.5 KVA. 0-115 vac. 60 cy. 100 amps $75.00
ITE Circuit Breaker, 115 amps, 600 v 15.00
STEP DOWN TRANSFORMER: Pri: 440/220/110 volts a.c. 60 cycles, 3 KVA. Sec. 115 v. 2500 volt insulation. Size 12" x 12" x 7" $40.00
PLATE TRANSFORMER. Pri: 117 v. 60 cy. Sec. 17,000 v. @ 144 ma, with choke. Oil immersed. Size 26" x 29" x 13". Amertran $65.00
Fil. Transformer: Pri: 220 vac, 60 cy. .05 KVA. Sec. 5 vct., 34,000 v. test $24.50
Fil. Trans. UX-6899. Pri: 115 V. 60 cy. Sec: Two 5 V. 5.5 Amp Wdgs. 29 KV Test $24.50
Plate Transformer: Pri: 115/230 vac.. 50-60 cy. Sec: 21,000 v. 100 ma. $120.00

TRANSFORMERS

(All Primaries—115 V. 60 Cy.)

#5055: 525 vct 75 mc, 5 v 2 amp, 6.3 v 1.8 amp. 10 v 2 amp $3.15
#5084: 500 vct 250 ma, 6.3 v 1.5 amp 4.95
#5083: 6.3 v .6 amp ct, 5 v 2 amp 1.85
#5087: 6.3 vct 1 amp, 6.3 vct 7 amp 2.75
#5103: 6.3 v 1 amp, 6.3 v 1 amp, 6.3 v 1 amp 2.35
#5102: 1080 vct 55 ma, 6.3 v 1.2 amp, 6.3 v 1.2 amp. 3.45
#5104: 690 v 450 ma no ct 4.95
#5105: 800 vct 40 ma, 760 vct 500 ma 5.85
#5108: 50 or 46 v 200 ma, 5 v 2.4 amp, 5 v 1.2 amp. 2.50
#5110: 300 v 42 ma, 300 v 42 ma, 55 v 125 ma, 45 v 35 ma 3.75
#5123: 6.3 vct 5 amp, 6.3 vct 1 amp 2.55
#5127: 6.3 vct 3.2 amp, 6.3 vct 1 amp 2.25

400 CYCLE TRANSFORMERS

KS 9607: Pri: 115 v. 400-2400 cy. Sec: 734 VCT. 177 ma. 1710 vct. 177 ma $5.95
D-166333: Pri: 115 v, 400-2400 cy. Sec: 6.3 v, 0.9 amp, 7.7 v, 0.365 amp $2.79
GE #7471957: Pri: 100/110/120/130 v. 400-2400 cy. Sec: 2.5 v, 20 amp. HV ins $4.85
D-163254: Pri: 115 v. 400 cy. Sec. 6.3 v. 12 amp; 6.3 v. 2 amp; 6.3 v. 1 amp. P/O AN/APQ-5 ....$5.85
KS 9685: Pri: 115 v, 400-2400 cy. Sec: 6.4 vct. 7.5 amp; 6.4 v, 3.8 amp; 6.4 v, 2.5 amp $4.35
HV PLATE XFMR: Pri: 115 v. 400 cy. Sec: 13.5 KV. 3.5 ma. GE #52J652 ....$11.50
D-163253: Pri: 115 v, 400 cy. Sec: 2.5 v. 5 amp. 5200 v. 2 ma $7.95
PLATE XFMR: Pri: 115 v. 400 cy. Sec: 9800 v or 8600 v @ 32 ma dc $12.50
#12033, PLATE XFMR; Pri: 115 v. 800 cy. Sec: 4500 vct. 250 ma $4.50
KS 9445.PWR. XMFR. Pri: 115 v. 400-2400 cy. Sec: 592 vct. 120 ma. 6.3 v. 8 amp; 5 v. 2 amp $3.50
PLATE XFMR: Pri: 115 v. 400-2400 cy. Sec: 4500 v. 6 ma $6.50
#7143. Pri: 115 v, 400 cy Sec: 6.3 v, 7 amp. 8.3 v. 8.8 amp; 6.3 cv. 1.3 amp $2.50
KS 9584. Pri: 115 v. 400 cy. Sec: 5000 v. 290 ma. 5 v. 10 amp $15.00
PLATE XFMR: Pri: 115 v. 380-2800 cps. Sec: 2200 v. 350 va $3.95
PLATE XFMR: Pri: 115 v. 400 cy. Sec: 1150-0-1150 v. 40 ma $1.75

INVERTERS

PE 206-A. Input: 28 VDC @ 38 amp. Output: 80 volts @ 500 volt-amps. 800 cycles. Leland. New, complete with enclosed relay, filter, instruction book $12.50
PE 218: Input: 25-28 VDC @ 92 amps. Output: 115 volts @ 1500 volt-amps. 380-500 cycles. Poor physical but good running condition $15.00

POWER CHOKES

Swing. Choke: 4.5 to .8 hy; .2 to 1 amp $10.95

.03 hy. 2 amp	$1.45	.35 hy. .35 amp	$7.50
8.5 hy. 125 ma	1.50	Dual 2.5 hy. 130 ma.	1.25
25 hy. 65 ma	1.10	.1 hy. 12 amp, 46 ohms	16.00
6 hy. 150 ma	1.50	Dual .5 hy. 380 ma	.95
Dual 7 hy. 75 ma, 11 hy. 60 ma	1.65	5 hy. 40 ma 312 ohms	.65
Dual 2 hy. 100 ma	.75	2 hy. 200 ma	.75
.116 hy. 15 amp	4.50	Dual 120 hy. 17 ma	2.45
.01 hy. 2.5 amp	1.50		

DYNAMOTORS

Type	Input Volts	Input Amps	Output Volts	Output Amps	Radio Set	Price*
BD 77KM	14	40	1000	.350	BC 191	$20.00N 14.00LN
PE 73	28	19	1000	.350	BC 375	24.50N
DM 21	14	3.3	235	.090	BC 312	3.45LN
DM 21CX	28	1.6	235	.090	BC 312	3.45N
DM 25	12	2.3	250	.050	BC 367	2.49LN
DM 28R	28	1.25	275	.070	BC 348	5.75
DM 33	28	7	540	.250	BC 456	5.50N
DM 42	14	46	515 1030 2/8	.110 .050	SCR 506	6.50LN
PE 55	12	25	500	.400	SCR 245	5.25LN
PE 86	28	1.25	250	.060	BC 36	3.95N
PE 101 C	13/26	12.6/6.3 9	400 800 AC	.135 .020 1.12	SCR 515	5.25N
BD AR 93	28	3.25	375	.150		4.95N
23350	27	1.75	285	.075	APN-1	3.50N
35X045B	28	1.2	250	.060		3.50N
ZA .0515	12/24	4/2	500	.050		3.95N
B-19 pack	12	9.4	275 500	.110 .050	Mark II	9.95N

*N—New. LN—Like New.

HAND GENERATORS

GN 35: Output: 350 v. 60 ma. 8 v. 2.5 amp. less hand crank $3.50
GN 45: Output: 500 v. 100 ma. 6 v. 3 amp. less hand crank $4.15
Selsyns: 115v. AC 60 cy. Size 5, per pair 7.75

VIBRATORS

T R 1210, 12 vdc, 5 pin $1.20
OA K V-6675, 24-32 vdc, 7 pin 1.10
Mal. Type G534C, 12 vdc, 5 pin 1.25
Mal. Type G629-C, 12 vdc, 4 pin 1.15
Radiaart VR2, 6 v. DC. 6-pin special 1.40
Mfrs. quantities in all types available.

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Technical BOOKS

"BASIC MATHEMATICS FOR RADIO" by George F. Maedel. Published by *Prentice-Hall, Inc.*, New York. 334 pages. Price $4.75.

As its name implies, this text is truly a fundamental treatise on mathematics as encountered in radio work both by the serviceman and student.

The author has presupposed very little mathematical knowledge on the part of the reader and hence the discussion begins with a section devoted to arithmetic. Addition, subtraction, multiplication, and division are reviewed and the student is given several typical problems to solve in each classification. A chapter dealing with definitions and symbols is a valuable adjunct for, as the author points out, unless the student understands what is meant by the terms used in mathematical operations the discussion is of little value to him.

The second section of the text deals with algebra and covers among other subjects, positive and negative numbers, exponents and radicals in algebra, factoring, etc. Section 3 deals with arithmetic and algebra and covers decimals and powers of ten, the metric system, engineering problems and the slide rule, quadratic and radical equations, and simultaneous simple equations.

The section on plane and solid geometry leads up to the section dealing with radio mathematics. This section covers radio trigonometry, logarithms and decibels, and complex numbers. Although designating a section "radio mathematics" may lead the reader to conclude that the subject of radio is not covered until this chapter, this condition is not strictly true. The author has used radio and electrical problems throughout the text both as illustrative material and in the problems to be solved at the end of each chapter.

* * *

"RADIO AIDS TO NAVIGATION" by R. A. Smith. Published by *The Macmillan Company*, New York. 112 pages. Price $2.50.

This discussion of the development of radio systems for the navigation of aircraft covers both the prewar and war periods. The author, who was associated with *Telecommunications Research Establishment* in England, helped in the development of some of the systems outlined in the text.

The preliminary discussion deals with prewar systems and their limitations and then goes on to consider the various radar beacon systems, precision blind bombing, the hyperbolic lattice systems, and microwave radar maps of the terrain over which the plane is flying.

The book is thoroughly readable but Americans may experience a little difficulty with the terminology as used by Dr. Smith. A glossary of terms has been included in the text in order to facilitate understanding by the reader but many of the designations remain a little obscure to those not familiar with British terminology.

Since the material included was released by the British Ministry of Supply, this publication is quasi-official in nature and contains a great deal of valuable source material for those concerned with the development and operation of radio navigation systems for aircraft.

—30—

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Our 26th Year

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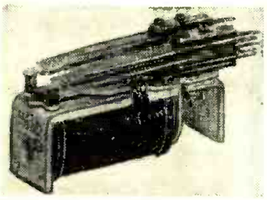
Dual coil with armature pivoted between coils. All contacts normally open. Operates 220-250 Volts. 8000 Ohms each coil. contacts S.P.D.T. Controls rated 2 amps. at 110 VAC. Ideally suited for balanced or bridge type circuits where limited current or power is available. Will withstand 12 G Vibration up to 60 cycles at 35,000 feet altitude. Special low price 88c



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18 Henries @ 100 Ma, 200 ohms D.C. Resistance Dimensions 4⅝ x 3¾ x 3⅛. Net Weight 6½ lbs. ....Each $1.25

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No. 10 Copper Enamel, 100 Ft. Lengths. Each $1.75
No. 12 Copper Enamel, 100 Ft. Lengths. Each 1.25
No. 14 Copper Enamel, 100 Ft. Lengths. Each .... .83
300 Ohm, Twin Lead Plastic covered, per 100 Ft. 1.95
RG-59U 72 Ohm Coaxial Cable, 7c per Ft., per 100 Ft. 6.75

A LEEDS LEADER

- 50 microamp Movement ± 2%
- 2500 ohms DC Resistance ± 2%
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- 4x4½" Black Bakelite Case
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This is the exact meter utilized in the G.E. YMW-1A Lab Type Unimeter. A Great Special. Each $9.75

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Low Loss Steatite Wafer Sockets for 829, 832, and 813 Tubes ....Each 73c

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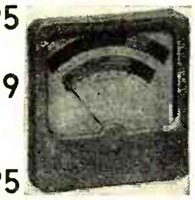
3C24 Triode 100 Watts output: 6.3 Volts 3 amp. Filaments 2000 Volts plate @ 75ma. Each 39c......................10 for $3.50
2x2/879 Rectifier 2.5 Volts 1.5 amp. .... .49

METERS



0-100 ma 2" Round McLintock $1.95
5-0-5 amp DC Charge and Discharge 2" Round .... .69
100 amp-6 volt DC 4½" square scale complete with 100 amp shunt as illustrated 2.95

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Type 20: 115 V. input, 0-135 V. output @ 3.0 amps. 0.4 KVA............ $12.50
Type 116: mounted; 115 V. input, 0-135 V. output @ 7.5 amps. 1.0 KVA.... 23.00
Type 116U: unmounted; 115 V. input, 0-135 V. output @ 7.5 amps. 1.0 KVA 19.00
Type 1126: 115 V. input, 0-135 V. output @ 15.0 amps. 2.0 KVA........ 46.00
Type 1226: 230 V. input, taped at 115 V. 0-270 V. output @ 9.0 amps. 2.4 KVA 46.00
Type 1156: 115 V. input. 0-135 V. output @ 45.0 amps. 6.1 KVA........ 118.00

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Manufactured by G. E., New. Input 24 V. @ 23 amps. 7500 RPM; output 515/1030/2/8 V. @ 215/260 milliamps; filtered. Special $2.95

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13 x 17 x 3 Black Crackle $2.22
13 x 17 x 4 Black Crackle 2.58
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Made of 1/16 inch steel

PLATE TRANSFORMER

Primary 115/230 Volt, 25-60 cycle. Secondary 820 Volts Center Tapped at 775 Ma. Hardly any voltage drop at 950 Ma. Completely shielded. Dimensions 6⅝ x 6⅝ x 7⅛. Net weight 36 lbs. Special $7.95

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6 Henries at 550 Ma. 28 Ohms DC Resistance. High voltage insulation. Completely shielded. Dimensions 5½ x 4½ x 5⅝. Net Weight 15 lbs. Special $4.95

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4 Mfd 600 Volt D.C. Sprague .... $ .49
8 Mfd 1,000 Volt D.C. Tobe 1.69
0.5 Mfd 600 Volt D.C. Bathtub ....Each .19
10 for 1.50
7.5 Mfd 330 Volt A.C. G. E. .... .98
2 Mfd 10,000 Volt D.C. C. D. 13.95

VARIABLE CONDENSER

6 Gang; 1 section of .00025 Mfd. 4 sections .000035 Mfd. 1 section of .00005 Mfd; with 5 air trimmers of 15 to 25 Mfd capacity. This condenser is all silver plated. Each, only 95c

PLATE TRANSFORMERS

For Small Transmitters. DC Voltage Ratings are Approx. Values Obtained at Output of a 2 Section Choke Input Filter. Using Mercury Vapor Rectifier Tubes Pri. is for 115 V. 60 cy.

Type No.	Sec. Rms. Volts	Sec. DC Volts	DC Sec. MA.	Dimensions H.	W.	D.	Price Each
P 57	660-660† 550-550	500 400	250	4⅝	3 13/16	4⅜	$5.55
P 58	1080-1080 500-500	1000* 400	125 150	4⅝	3 13/16	5	7.20
P 59	900-900 800-800	750 600	225	4⅝	3 13/16	5⅛	6.00
P 67	1450-1450 1175-1175	1200 1000	300	5¾	6⅛	4	17.85
P 68	2100-2100 1800-1800	1750 1500	300	5¾	6⅛	4¼	21.30

* For dual operation with simultaneous use of both sec. ratings
† Has 40-volt bias tap

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100,000 ohm, precision made. G.R type, 25 watt 6" diameter. Brand New. $1.95

FILAMENT TRANSFORMERS

2½ Volts C.T. @ 10 Amps. 7500 Volt RMS Type 40 .... $2.40
6.3 Volts C.T. @ 3 Amps. 2500 Volt RMS Type 46 .... 1.65
10 Volt C.T. @ 10 Amps. 3000V RMS Type 316 .. 4.50

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Primary 115/230 volt 60 cycle. Secondary 5 volts at 15 Amps., 5000 volt insulation. Swell for 35T, 75T, 100TH, 250TH, HK-54, etc. Completely shielded dimensions 4¼ x 5 x 5⅜. Net Weight 10 lbs. Special $3.95

CHOKES

SMOOTHING Type	Hy	SWINGING Type	Hy	EACH TYPE MA	Price
C-80	10	C-87	4-16	150	$2.70
C-81	10	C-88	4-16	200	3.45
C-82	10	C-89	4-16	250	5.35
C-83	8	C-90	3-14	300	5.85

All Above 3000 Volts Insulation

H&H Wire Wound Rheostat

150 watts, 5.0 Ohms @ 5.48 amps, in approxim'ly 67 steps. Resistance Wire Wound toroidally around refractory core and embedded in vitreous enamel. 4" diameter. Depth behind panel 1¾". Makes excellent control for Toy Trains. A Buy at $1.95

If not rated 25% with order, balance C.O.D. All prices F.O.B. our warehouse New York. No order under $2.00. We ship to any part of the globe.

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115 Volt AC 60 cycles. Transmitters only. Can be used to turn small beam antenna or as indicators only. 3½" Diameter x 5½" High. Shipping Weight 10 lbs. Special per Pair—

$5.95

TELEVISION I.Q.

By Ed. Bukstein
Northwestern Vocational Institute

(*Answers on page* 142)

1. The frequency of horizontal scanning in the standard 525 line television picture is *(a) 60 (b) 525 (c) 15,750 (d) 31,500 c.p.s.*
2. The control which varies the bias on the cathode-ray tube is *(a) contrast (b) brightness (c) focus (d) vertical hold.*
3. The purpose of interlacing is to *(a) reduce flicker (b) reduce ghost images (c) make blanking unnecessary (d) make scanning unnecessary.*
4. The linearity control is located in the *(a) deflection circuit (b) sound i.f. amplifier (c) sync clipper stage (d) picture i.f. amplifier.*
5. Under present-day standards, the bandwidth occupied by a television signal is *(a) 75 kc. (b) 10 mc. (c) 525 mc. (d) 6 mc.*
6. The width control varies the amplitude of the *(a) sync pulses (b) horizontal saw-tooth (c) vertical saw-tooth (d) blanking pulses.*
7. Ghost images are caused by *(a) power supply ripple (b) audio signals reaching the grid of the picture tube (c) reflected signals (d) line voltage variations.*
8. The purpose of the blanking pulses is to *(a) synchronize the vertical oscillator (b) eliminate retrace on picture tube (c) reduce ghost images (d) prevent arcing in high voltage power supply.*
9. The picture carrier is separated from the sound carrier by *(a) 72 mc. (b) 21.5 mc. (c) 75 kc. (d) 4.5 mc.*
10. The vertical oscillator frequency is *(a) 60 (b) 30 (c) 525 (d) 15,750 c.p.s.*
11. The circuit shown in Fig. 1 is a *(a) sync separator (b) ratio discriminator (c) blocking oscillator (d) FM limiter.*
12. The field frequency of standard television broadcasts is *(a) 110 (b) 60 (c) 21.5 (d) 30.*
13. The frequency of the horizontal oscillator is *(a) 30 (b) 60 (c) 525 (d) 15,750 c.p.s.*
14. Which of the voltage waveforms shown in Fig. 2 is required to pass a saw-tooth current through a deflection coil?
15. The circuit shown in Fig. 3 is an *(a) integration circuit (b) differentiation circuit.*
16. The frame frequency used in standard television broadcasts is *(a) 30 (b) 60 (c) 525 (d) 31,500 c.p.s.*
17. Aspect ratio is a measure of *(a) image width to image height (b) transmitting antenna height to receiving antenna height (c) deviation of an FM signal (d) skip distance.*
18. The mosaic is part of the *(a) iconoscope (b) kinescope (c) damping tube (d) sync clipper.*
19. The hold control is located in the *(a) r.f. amplifier (b) sound i.f. amplifier (c) deflection circuit (d) FM detector.*
20. The diode connected to the horizontal deflection coils is known as the *(a) sync clipper (b) damping tube (c) video amplifier (d) video detector.*

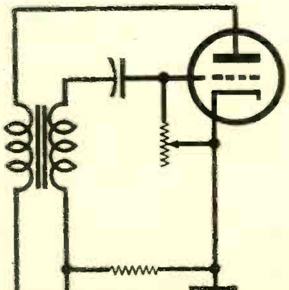

FIG. 1

FIG. 2

FIG. 3

RELAYS

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Over a Million in Stock!

Whether you require large quantities of relays for production runs or single units for laboratory or amateur work, Wells can make immediate delivery and save you a substantial part of the cost.

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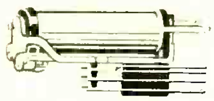
The following list represents only a tiny portion of our relay stock. Write or wire us for information on types not shown.

STANDARD DC TELEPHONE RELAYS

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-101	24V	1500.	DPST (NO)	Auto. Elec.	$1.35
R-102	24V	400.	SPDT	Auto. Elec.	1.10
R 103	24V	DUAL-1000	3PST (NO)	Auto Elec.	1.35
R-105	24V	600	3PST (NO)	Clare	1.20
R-106	24V	1300.	3PST (NC)	Clare	1.25
R-152	12V	50.	DPDT-SPST (NO)	Guardian	1.10
R-153	12V	200.	SPDT-SPST (NO)	Stromberg	1.25
R-154	12V	200.	SPST (NO)	Clare	1.20
R-155	12V	100.	SPST 4NO4NC)	Auto Elec.	1.15
R 158	6V	50	4PST (NO)	Stromberg	1.10
R-159	6V	50	DPST (NO)	Stromberg	1.10
R-160	6V	12	3PDT 3PST (NO)	Auto. Elec.	1.05
R-161	6V	10	3PST (2NC-1NO)	Auto Elec.	.90
R-121	150V	5000.	2PST (NO) SPDT	Clare	1.65
R-123	150V	6300	SPST (NO)	Clare	1.75
R-602	150V	6500	3PST (NO)	Clare	1.75
R-515	24V	750	SPST (NO)	Clare	1.25
R-517	12V	250	DPST (NO)	Clare	1.20
R-519	250V	14000.	SPDT	Auto. Elec.	1.95
R-520	250V	14000	DPDT	R.B.M.	2.10
R-521	32V	1000.	DPDT	Kellogg	1.20
R-166	24V	DUAL-200.	DPDT-SPST (NO)	Stromberg	1.59
R-168	24V	DUAL 200.	4PST (NO)	Auto. Elec	1.20
H-240	250 350V	40000	DPST (NO)	Auto. Elec.	2.95
H-241	48V	650	SPDT-SPST (NO)	Clare	1.25

TYPE 18 DC TELEPHONE RELAYS

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R 109	24-48V	4000	SPDT	Auto. Elec.	$1.50
R-110	24-32V	3500	SPDT	Auto. Elec.	1.50
R 112	90-120V	6500	SPST (NC)	Auto. Elec.	1.75
R-114	24V	500	4PST (NO)	Auto. Elec.	1.30
R-603	24V	400	DPST (NO)	Auto Elec.	1.25
H-238	24V	150	DPDT-SPST (NC)	R.B.M.	1.25
H-239	24V	180	DPST (NO)	Auto. Elec.	1.25



SEALED DC TELEPHONE RELAYS

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-125	24V	300.	DPDT	Clare	$2.75
R-126	90-120V	2000	OPDT	Clare	3.00
R-504	24-70V	2800	SPDT	GE-C103C25	3.00

V TYPE DC TELEPHONE RELAYS

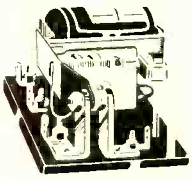
Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-164	24-32V	1000.	SPST (NO)	W. E.	$1.20
R-512	24-48V	3500	DPDT	W. E.	1.30
R-513	12-24V	300	DPBT-DPST (NC)	W. E.	1.20
R-514	4-6V	60	SPDT	W. E.	1.05
R-526	6V	35	DPDT-SPST (INC-1NO)	W. E.	1.05

AC-STANDARD TELEPHONE RELAYS

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-212	90-135V	—	NONE	Clare	$0.95
R-213	5-8V	—	DPST (NO)	Clare	1.50
R-605	24V	—	3PST (NO)	Auto. Elec.	.95
R-606	24V	—	OPST (1NO-1NC)	Auto. Elec.	.95
R-607	24V	—	SPST (NO)	Auto. Elec.	.95

DIRECT CURRENT MIDGET RELAYS

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-132	24V	300	DPDT	Clare	$1.20
R-133	24V	300	NONE	Clare	60
R-134	24V	250	4PDT	Clare	1.20
R-135	24V	300	SPST (NC)	Clare	1.15
R-137	24V	300	SPDT	Clare	1.15
R-138	24V	300	4PST (NO)	Clare	1.15
R-139	24V	200	4PDT	Clare	1.15
R-140	24V	280	SPDT	R.B.M.	1.15
R-141	24V	280	3PST (NO)	R.B.M.	1.15
R-142	24V	400	DPDT	Allied Cont.	1.20
R-143	24V	280	SPST (NO)	R.B.M.	1.15
R-144	24V	250	SPST (NO)	Allied Cont.	1.15
R-145	24V	300	DPST (ND)	Allied Cont.	1.15
R-146	12V	126	DPST (1NO) (1NC)	Clare	1.10
R-147	9-14V	75	SPDT	Guardian	1.05
R-148	12V	100	DPDT-SPST (NC)	Price Bros.	1.10
R-149	6-8V	45	SPST (NC)	Clare	1.00
R-150	6V	30	SPST (NO)	E Z Elec.	.95
R-522	2-6V	2.	SPST (NO)	R.B.M.	.65
R-523	90-125V	6500	DPDT	Clare	1.90
R-222	12V	100	DPST (NO)	P & B	.95
H-242	24-32V	300.	DPDT	R.B.M.	1.20
H-243	24-32V	300	4PDT	R.B.M.	1.20



SENSITIVE DC RELAYS

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-218	4-6V	1800.	SPDT	Kurman 220C	$1.95
R-220	75V	5000	SPDT	Allied Cont.	1.20
R-221	18-24V	5000	SPST (NO)	Allied Cont.	1.15
R-174	250V	5000	DPST (NO)	G.M.	1.85
R-175	350V	11000	OPDT-DPST (NO)	G.M.	2.95
R-176	24V	250	DPST (NO)	G.M.	1.50
R-177	24V	300	4PDT	G.M.	1.65
R-600	8-12V	5000	SPOT	S-Dunn-KS	2.10
R-507	24-48V	1000	SPDT-DPST (NC)	Guardian	1.15

TYPE BO DC RELAYS

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-169	24V	250	SPST (NO)	Allied Cont.	$1.95
R-171	24V	230	DPDT	Allied Cont.	2.15
R-172	5-8V	30	DPDT-SPST (NO)	Allied Cont.	1.70
R-173	2-6V	5	SPST (NO)	Allied Cont.	1.25
R-529	24-48V	1000	DPDT	Allied Cont.	2.50

TYPE BJ DC RELAYS

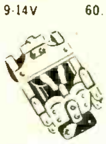
Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-204	12V	65	DPST (NO)	Allied Cont.	$1.15
R-205	24V	260	DPDT	Allied Cont.	1.25
R-224	12V	75	SPST (NO)	Allied Cont.	1.15
H-237	27V	230	DPDT	Allied Cont.	1.25

HEAVY DUTY KEYING RELAYS

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-248	28V DC	150.	SPST (NO) 10A.	Guard. 36471	$1.05
R-244	75V AC	265	SPST (NO) 20A.	Leach 1327	1.75
R 206	24V DC	150	5PDT-3 AMP.	P&B-KL	1.20
R-207	24V DC	210	4PDT-3 AMP	P&B-KL	1.10
R-219	50V DC	1500	DPST (NO) 15A.	P&B-SP	1.25
R-217	115 AC	600	SPDT-10 AMP	St. Dunn 1XAX	2.25
R-525	24V DC	200	DPDT-10 AMP	Guard. 34464	1.25
R-508	110 AC	600	SPDT-6 AMP.	Guard. 37189	1.95
R-506	24 V DC	300	DPST (NO) 6A.	—	.95
R-510	24 V DC	200	3PDT-10 AMP.	Guard. 516983	1.05
R-604	24 V DC	200	SPST (NO) 30A	St. Dunn-B2A	1.25
H-608	115 AC	—	SPST (NO) 20A	St. Dunn-1HXX	2.25
R-620	12V DC	35	3PST (NO) 10A.	Guard-BK2	1.05
R-223	28V DC	150	SPST (NO) 40A	Price Bros.	1.35
H-230	12-24V DC	80.	DPST (NO) 10A	—	1.20
H-231	24V	230.	DPST (NO) 5A	R.B.M.	1.15

DC-TYPE 76 ROTARY RELAYS

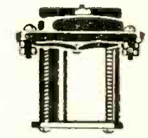
Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-197	9-16V	70	DPDT	Price Bros.	$1.65
R-198	9-16V	125	6PST (3NO) (3NC) SPDT	Price Bros.	1.65
R-199	24-32V	250	SPDT-DPST (NC)	Price Bros.	1.65
R-200	24-32V	275	3PDT-SPST (NC)	Price Bros	1.65
R-201	24-32V	250	DPST (NO) SPDT (NC) DPDT	Price Bros.	1.65
R-601	9-14V	60.	3PST (NO)	Price Bros.	1.65



DIRECT CURRENT KEYING RELAYS

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-190	12V	65	DPDT 10 AMP	Advance Elec. Type 2000-A	$1.15
R-191	28V	125	DPDT 10 AMP	Guardian	1.20
R-192	12V	44	3PDT 10 AMP	Allied Cont. Type NB5	1.35
R-193	5-8V	11	DPDT 10 AMP SPST (NO)	Leach Type 1027	1.05
R-194	24V	265	DPST (NO) 10 AMP	Leach Type 1054SNW	1.25
R-195	6V	32	DPDT 3 AMP	G.E.Co.	1.15
R-196	12V	50	DPDT 10 AMP SPST (NC)	Guardian	1.15
R-242	24V	170	SPDT 2 AMP	Leach Type 1253DEW	1.25
H-236	5-8V	18.5	SPDT 10 AMP	Leach-BFM	1.05

CUTLER HAMMER HEAVY DUTY CONTACTORS



Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-178	24V DC	100	SPST (NO) 100A.	6141H34A	$3.65
R-179	6V DC	6.5	SPST (NO) 50A.	6041H83A	3.00
R-180	12V DC	25.	SPST (NO) 50A.	604H308	3.25
R-181	24V DC	65	SPST (NO) 100A	6041H8B	3.35
H-232	24V	55	SPST (NO) 50A	Metal Cased	3.25
H-233	6V	15	SPST (NO) 50A	Metal Cased	3.15
H-235	24V	70.	SPST (ND) 100A.	Type B6	3.85

DIRECT CURRENT AIRCRAFT CONTACTORS

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R 182	28V	80	SPST (NO) 25 A.	Guardian	$1.85
R-183	24V	60	SPST (NO) 50 A.	Allen Bradley Type B6A	2.75
R-184	28V	50	SPST (NC) 100A.	General Elec.	2.95
R-185	24V	100	SPST (ND) 50 A.	Leach 5055ECR	2.75
R-186	24V	132	SPST (NO) 50 A.	Leach 7220-3-24	3.50
R-187	24V	100	SPST (NO) 50 A.	Allen Bradley	2.95
R-188	24V	200	SPST (NO) 75 A.	Allied Cont.	2.95
H-234	14V	45	SPST (NO) 30 A.	—	1.65

ANTENNA CHANGEOVER RELAYS

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-192	6-12V DC	44	2PDT 10 AMP	Allied-NB5	$1.35
R-231	12VDC	100	DPDT 6 AMP	G. E.	1.95
R-256	24-32V DC	—	SPDT-DPST (NC) 1KW	Guardian	1.45
R-501	110 AC	4.	DPDT (1KW)	G. E.	2.45
R-503	12-32V DC	100	SPDT-5PST	G. E.-500 W.	1.95

COMBINATION PUSH BUTTON AND REMOTE RELAY

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
H-244	12-24 V DC	Dual-60	SPDT	CR2791-R106C8	$1.65

ADJUSTABLE TIME DELAY RELAY

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-246	115 AC		SPST (NO) or (NC) 10 AMPS	R. W. Cramer 1-120 Sec.	$8.95

DC MECHANICAL ACTION RELAYS

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-245	12V	25.	4" Lever	G.M.	$0.95
R-527	6-12V	200.	2" Lever	—	.95

TYPE C.M.S. RELAY

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-511	24V DC	200	MICRO-SW. SPST (NO)	Clare	$2.45

DC CURRENT REGULATOR

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-509	6-12V DC	40	SPST (NC)	G. E.	$2.85

LATCH AND RESET RELAY

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-500	12V DC	10.	DPDT-10 AMP	St. Dunn-CX-3190B	$2.85

DC-ROTARY STEP RELAY

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-621	6-12V	30.	3 POLE 23 POSITION	W. E.	$10.95

DC-RACHET RELAY

Stock No.	Operating Voltage	Coil Resistance	Contacts	Manufacturer	Net Each
R-230	5-8V	2.	SPDT-DPST (NO)	Guardian	$2.15

Special Sample Engineering Offer

Any ten relays listed (one of each type) with the exception of Stock Nos. R-621 and R-246—only $10.00.

ORDER DIRECTLY FROM THIS AD OR THROUGH YOUR LOCAL PARTS JOBBER

Manufacturers: Write For Quantity Prices.
Distributors: Write For The New Wells Jobber Manual.

WELLS SALES, INC.

320 N. LA SALLE ST., DEPT. R-10, CHICAGO 10, ILL.

Spot Radio News
(Continued from page 20)

"If any reference is made to picture size or direct view television receivers, the diameter of the tube shall be stated. . . . It is recommended that the size of the picture also be indicated by approximate area by square inches or dimensional measurements.

"If the receiver is equipped with a built-in screen enlarger, that fact shall be conspicuously set forth. Any reference that is made to picture size of a receiver having a built-in enlarger shall also disclose the size of the picture tube."

Complaints on misrepresentative copy are said to have disappeared where the code has been applied, particularly in large centers.

Good work, NBBB!

THE RECENT EXPANDED USE OF FM receivers in streetcars and buses has routed FM out of its doldrums. When several months ago, the buses and streetcars of the *Cincinnati Street Railway Company* were equipped with FM receivers and tests conducted, many regarded the attempt as a stunt and certainly of no commercial significance. But the enthusiastic response of riders quickly altered the negative views. Advertisers began to show a lively interest. To date about 300 buses and cars are equipped with FM sets and about 500 more are scheduled to be equipped soon. Another line, the *Cincinnati, Newport and Covington Railway Company,* has also made arrangements to set up FM systems for their buses.

Surveys in many other cities indicate a decided interest in transit FM. According to reports, at least five cities in the east and south will also have bus and car FM before the year is out.

The supermarket has also come to the aid of FM, receivers in the large stores picking up programs during the key shopping hours of 10 a.m. to 1 p.m. and 2 p.m. to 6 p.m.

In both the transit and store projects, the programs are so prepared that they will be of interest to those at home as well as en route or shopping. This procedure is extremely important, since the law forbids the transmission of any program which is not in the public interest.

With over 300 communities now accommodating nearly 600 FM stations, the possibilities of these new services seem quite healthy.

Reporting on the progress FM has made since the war's end, J. N. Bailey, executive director of the FM Association, said that on January 1 of this year, the combined stations in operation, those authorized by FCC and applications then pending, totaled 1127. Today, he declared, the figure is 1160, with 565 commercial and 22 noncommercial educational stations on the air, 477 others holding FCC authorizations, and 96 applications pending.

Mr. Bailey stated that FM is radio's future, predicting that within a five-year period, FM will replace AM in virtually every community of the country.

MORE FM SET OWNERS will be able to hear high-fidelity programs next year, in view of the increase in 15-kc. terminals planned for installation by next January. Sixteen more relay points (there are now nine) will be set up by *A. T. & T.*, according to a report filed with the FCC.

SENATOR CHARLES W. TOBEY has succeeded Senator Wallace H. White as chairman of the Senate Commerce subcommittee which is conducting an inquiry into FCC operations. Senator White, who has been ill for over a year and is retiring from Congress, was also chairman of the Senate Interstate and Foreign Commerce Committee, which has over-all jurisdiction of communications legislative planning.

The subcommittee plans to do quite a bit of listening and learning during its probe, delving into such issues as FCC's scope of authority, allocations, State Department communications activities and even patent pools.

The House Select Committee is also setting up its query ears. The com-

bined Senate-House search for information will produce many striking headlines this fall!

THE NEXT SIXTY DAYS will undoubtedly see a general curb of the giveaway shows, recently criticized by FCC. According to FCC the programs violate Section 316 of the Communications Act of 1934, which prohibits the broadcast of ". . . any advertisement of or information concerning any lottery, gift enterprise or similar scheme, offering prizes dependent in whole or in part upon lot or chance."

In a new set of rules proposed by FCC, the 1934 clause is amplified to specifically include four conditions which will be considered violations of the law:

Where winner or winners are required to furnish any money or thing of value, or are required to have in their possession any product sold, manufactured, furnished or distributed by a sponsor of a program; or winner or winners are required to be listening to or viewing the program in question; or winner or winners are required to correctly answer a question, the answer to which is given on a program being broadcast or where aid to answering the question is given; or winner or winners are required to phone or write a letter if the phone conversation or contents of the letter are broadcast by the station.

If these rules are adopted, and there is every indication they will be, it will be mighty difficult to air an award program and not be in violation.

Although lottery programs have been on the air for years, it was one program broadcast recently from WARL, Arlington, Virginia, which set off the FCC blast. The station's program "Dollars for Answers" with phone calls to numbers listed in Washington, D.C., and suburban telephones, offering prizes for correct answers to questions, was declared to be a lottery by FCC and resulted in the announcement of the new rules, which would curb all giveaway programs.

PRESIDENT HARRY TRUMAN has signed the ratification by the United States of the International Telecommunication Convention, with Final Protocol and Radio Regulations, which were agreed to at Atlantic City, last October. The signing followed Senate approval of a resolution advising and consenting to the ratification. The new regulations replace those set up at Madrid in 1932 and at Cairo in 1938.

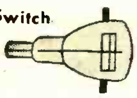
THE FAMOUS ARMSTRONG MEDAL, awarded posthumously to the late Stuart Ballantine at the 38th anniversary banquet of the Radio Club of America last December, was presented a few weeks ago to Mrs. Ballantine by Major E. H. Armstrong at her home in Boonton, N.J.

The medal was awarded to Mr. Ballantine for his outstanding contributions to the art, which included the

INDUSTRIALS! EXPERIMENTERS! Look at these EXCLUSIVE "G&G" BUYS!

JUST ARRIVED
TUBES
thousands of them!

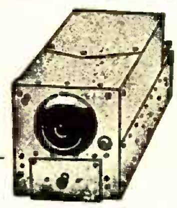
Famous Makes • Boxed and Bulk • Rock-Bottom Prices



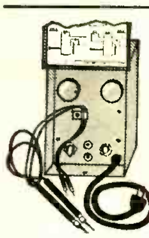
SPECIAL! SPERTI R-F Vacuum Switch Famed Collins Xmtr Antenna Switch. 9200 peak volts. 8 amperes. BRAND NEW! Only **$1.69**

12SH7	$0.40	6J5/GT	$0.40	14B6	$0.52
6AK5	.60	5T4	.72	7B6	.55
35L6	.45	6W7/G	.75	6H6/GT	.40
12SK7	.45	25Z6/G	.45	2X2/879	.50
12SJ7	.50	2051	.45	6SC7	.65
6C4	.40	VR-150	.65	7F7	.65
1LA6	.70	6AL5	.66	6SJ7	.55
1LC6	.68	6A3	.83	35W4	.45
1LN5	.65	6V6/GT	.55	50B5	.59
9002	.45	12SA7	.55	5U4/G	.55
807	1.10	6AG5	.62	6H6	.50
RK-60	.60	6AC7	.68	1R5	.65
1T4	.60	VR-105	.68	6K7	.50
3Q5	.65	6AG7	.85	6B8	.65
1LH4	.60	1N5	.60	45Z5	.50
954	.45	12H6	.40	14J7	.60
955	.50	5V4/G	.72	8011	.65
14A7	.50	12A6	.38	6L6/GA	.85
6SG7	.50	50L6	.55	7C5	.65
1LD5	.65	35Z5	.45	12K8	.55
1626	.35	7A7	.40	12K8/Y	.55
9006	.45	7Q7	.48	0Z4	.65
6SL7	.60	7Y4	.48	117L7	1.10
6SN7	.60	35Y4	.48	78	.50
83V	.85	14Q7	.52	77	.50
				6J6	.60

Smash Values in Radio Receivers!



	Brand New	Used
BC-453	$17.95	$10.95
BC-454	7.95	5.95
BC-455	8.95	7.95
BC-457	8.95	6.95
BC-458	7.95	6.95
BC-456	3.95	2.95



AC-DC TEST SET

BRAND NEW, in metal carrying case. Fine for testing condensers, resistors, chokes, short and open circuits, complete with instruction book. WONDERFUL BUY!

only **$4.25**

U. S. Army Field Phone Set EE-8

Leather case, with hand set, generator, ringer, etc. Requires 2 flashlight cells. Wonderful value!

Good Used ea...... **$8.50**

BC-645 XMTR RECEIVER 15 Tubes 435 To 500 MC

BRAND NEW! **$9.95**

2 FOR $19.50

The electronic equipment that saved many lives in the war. Set can be modified to use for 2-way communication, voice or code, on following bands: ham band 420-450 mc, citizens radio 460-470 mc, fixed and mobile 450-460 mc, television experimental 470-500 mc. 15 tubes (tubes alone worth more than sale price!): 4 — 7F7, 4—7H7, 2—7E6, 2—6F6, 2—955 and 1—WE316A. Now covers 460 to 490 mc. Brand new BC-645 with tubes, less power supply in factory carton. Shipping weight 25 lbs.

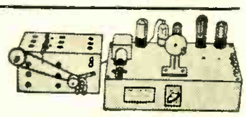
PE-101C DYNAMOTOR for above BC-645.............. **$2.95**

UHF ANTENNA ASSY. for above BC-645.............. **$2.45**

DC AMMETER 0-15 Amps

A terrific buy! 3½" easy reading scale. 75 divisions. Black plastic case 4½x5¼x2¼". Rubber covered test clip leads plus black metal carrying case with hinged cover. **Brand New.** Wonderful for automotive, battery charging, general test work. Value $25. All yours for only............... **$3.99**

McElroy Automatic KEYER



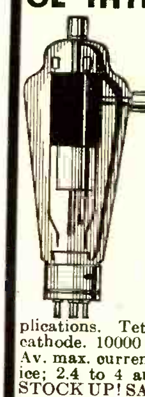
For Xmtr keying or code practice. Has photocell and sensitive relay. Variable speed motor, 110V AC or DC. Complete with 2-117Z6 and 1-117L7 tubes, your cost.................... **$14.95**

CATHODE RAY TUBE BUYS!

All Brand New, in Original Cartons

5BP1 Lots of 4, each	$1.79
5BP4 Lots of 4, each	3.95
3FP7 Lots of 4, each	1.49
304TL Eimac, each	1.95
GE-211 Each	1.22
826 Each	.69

BRAND NEW GE THYRATRON FG-105 MERCURY RECTIFIER



Sensational Value!

INDIVIDUALLY BOXED in factory sealed cartons. List Price $40.00

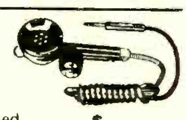
Your Cost **$11.95** each — While they last

Tube of a hundred uses! One of the best ever designed for continuous service and welder control service. Selling at far below the usual price, the FG-105 has a wide variety of industrial, commerical, and domestic applications. Tetrode type, indirectly heated cathode. 10000 V peak, 10000 V peak inverse. Av. max. current: 6.4 amps on continuous service; 2.4 to 4 amps on welder control service. STOCK UP! SAVE PLENTY! ORDER NOW!

HANDSET

Cradle-type handset with butterfly switch, unbreakable black plastic, 4-ft. 3 wire cable, BRAND NEW, individually packed, each... **$3.25**

HANDMIKE T-17



Shure model T-17 mike 200-ohm carbon single button, with press-to-talk switch, 5-ft. rubber cord and plug. BRAND NEW, individually packed, lots of 3, each.................. **$1.19**

HEADPHONES—*All Brand New!*

Individually packed, complete with phone plug.

HS-33 600 ohms, in lots of 3, each	$2.95
HS-23 2000 ohms, in lots of 3, each	2.25
HS-30, With earplugs	.99

BEEDE DC METER, new, black bakelite case, 3" round 0-1000 DC Ma. Special.... **$1.95**

QUANTITY PRICES

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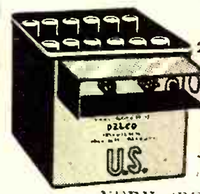
Please include 25% Deposit with order— Balance C.O.D. MINIMUM ORDER $3.00. All Shipments F.O.B. Our Warehouse N.Y.C.

G&G GENUINE MAJESTIC RADIO PARTS SERVICE
53 VESEY STREET • NEW YORK 7, N.Y.

TERRIFIC VALUE! 24-VOLT STORAGE BATTERY, BRAND NEW! 17 AMP. HRS.



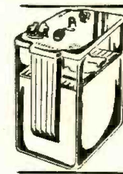
Made by Delco. 12 cells, heavy duty, very rugged. Shipped dry, uses standard sulphuric acid electrolyte. VERY SPECIAL........ **$16.95**

SPECIAL! 24 VOLT DELCO 12-CELL STORAGE BATTERY

11 ampere-hours. Only a few left at....................... **$14.95**

WILLARD 2-VOLT STORAGE BATTERY

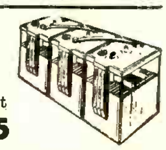
20 Ampere-Hours



Exact replacement for GE portables—**brand new.** Each....... **$1.95**

WILLARD 6-VOLT STORAGE BATTERY

27 Ampere-Hours



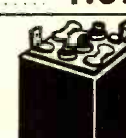
3-cell battery, transparent plastic case, very specially priced. **$5.75**

1-QUART BOTTLE BATTERY ELECTROLYTE

Made by Willard, for above storage batteries. 1 qt. sufficient for two 2-volt cells. Hermetically sealed. SPECIAL. per qt. bottle.................... **$1.25**

7-PRONG 2-VOLT RADIO VIBRATOR for Portable and Farm Sets Replacement for GE LB 530............. **$1.65**

GOULD 6-VOLT STORAGE BATTERY



Navy Standard, Black Rubber Case. BRAND NEW 15 Amp. Hour Rating......... **$3.99**

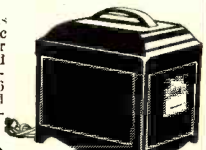
WILLARD 6-VOLT STORAGE BATTERY

Similar to above but in transparent plastic case. Real value at......... **$4.95**

Last Minute Specials!

G-E Tungar Battery Charger

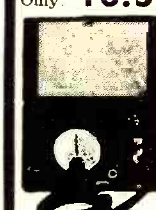
BRAND NEW!



5 Amperes—Famous General Electric Tungar Charger. For all automobile and radio storage batteries. Complete with 6 amp. tungar bulb and one extra spare tungar bulb.

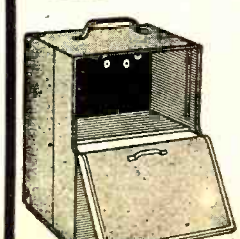
Only **$16.50**

BIAS METER BRAND NEW!



Excellent for measuring DC voltages, bias voltages, or checking polarity of DC voltages. Designed originally for telephone and teletype voltage measurements. With adaptor plug, schematic, metal carrying case. Batteries not needed for operation. Your cost, only **$5.95**

FREQUENCY METER CABINET



For BC-221 Series freq. meters. BRAND NEW! 3 compartments. Massively built. 14½x10½x10". Value $20.00. Complete with canvas cover for both ends. Yours for only **$3.95** development of the loop compass and radio direction finder during World War I, development of negative feedback and automatic volume control, invention of the throat microphone, development of new microphone techniques and high-fidelity reproduction methods.

RAY DAVIS KELL, director of television research at the *RCA Labs* in Princeton, New Jersey, has been named as the 1948 winner of the Stuart Ballantine Medal of The Franklin Institute, Philadelphia, Pa., "in consideration of his outstanding pioneer work in television, adaptation of this means of communication to military needs and for his inventive contributions and leadership in the development of color television."

The National Association of Manufacturers honored Mr. Kell in 1940 for his work in television with their Modern Pioneer Award, and in 1947 the IRE tendered a Fellowship Award to Mr. Kell for his advanced developments in television.

Congratulations, RDK, for honors well earned!

THIRTY-THOUSAND radio dealers will be asked to participate in a cooperative community advertising program during National Radio Week, November 14 to 20, to focus attention on radio broadcasting's 28th birthday.

Copy, which will stress the technical advancements in today's receivers, the variety and excellence of current programs and the availability of sets "for every room" and "for everyone," will be made available to all daily and weekly newspapers, with the suggestion that they solicit all dealers to sponsor the ads jointly. Spot announcements and program scripts will also be submitted to stations for dealer-station sponsorship.

A "Voice of Democracy" speaking contest will be another feature of the special week. The contest for high school students will be directed locally in each community by chapters of the U.S. Junior Chamber of Commerce, with the aid of local broadcasters and dealers. Four national winners will be selected following local and state elimination contests and be brought to Washington by RMA and NAB to receive college or university scholarships. Dealers will be asked to donate receivers to the high schools which produce the boy or girl chosen as the "Voice of Democracy" for each participating city or town.

THE STRIKING ADVANCEMENTS MADE IN RAILROAD radio were effectively demonstrated during a recent test run on the *Erie* road between Marion, Ohio and Meadville, Pa. Utilizing a four-way system, train crews were able to establish locomotive to caboose contact, locomotive or caboose communications with way stations, communication between trains within the radio range, and communication between way stations. One of the highlights of the test was a series of conversations held while the trains were speeding at 50 miles an hour.

At present, the radio link covers a 315-mile range between Marion and Salamanca, New York, with fourteen transmitters in operation. Extension to Jersey City is planned soon, and this will be followed by a terminal in Chicago. Another milestone in radio progress. . . . . L. W.

NOVEL AD IDEA PAYS OFF

BY MARK McMILLIN

A NOVEL advertising idea, originated by Ed Heil, manager of Ed Heil Electrical Appliance Company, boosted sales more than 150 per-cent over a period of six weeks and had the residents of San Bernardino, California, guessing.

One week Mr. Heil inserted this ad in a "box" in the local newspapers: "Mabel, why did you leave me? Please come home. I promise to be good to you—Harry."

After the first appearance of this unique ad the local newspapers were flooded with calls from subscribers who wanted the inside dope on who the parties in this little domestic tragedy were.

The following week, another ad, signed "Harry" begged "Mabel" to tell him what he could do to persuade her to return home. After five ads on the same theme, in the final one "Harry" promised to buy "Mabel" a new set of electrical appliances at Ed Heil's.

This new twist to the old advertising "come-on" paid off handsomely. Mr. Heil had first intended to keep the ads running indefinitely but, as he puts it, "The pressure was too much." However, after he builds up his depleted stock, Mr. Heil may again undertake more of the "stunt" type of advertising. In the meantime, he advertises consistently in the local papers to keep his company's name firmly entrenched in the customers' minds. —30—

Motorola, Inc.'s new "Handie-Talkie" unit, a frequency modulated portable two-way radio. During the ARRL Convention held in Milwaukee, Sales Manager Gene Goebel, W9ESG, flew over convention headquarters in his own Stinson and maintained "Handie-Talkie" contact from plane to headquarters.

NEW RECEIVERS for Fall Market

PHILCO'S "LP" COMBINATION

Five of the new *Philco* radios being introduced in the company's 1949 line incorporate the new balanced reproducer to play the new *Columbia* (long playing) Microgroove records, as well as regular type recordings.

The top of the line, the Model 1615, is a deluxe console combination housed in a mahogany cabinet. It is equipped to play both the new LP records and standard units, having a double tone arm, two speed motor, and improved automatic record changer. The company's "Scratch Eliminator" has been included in the design. The Model 1615 has 10 tubes and one rectifier and provides reception of standard broadcasts as well as the full FM band.

Full details on the 1949 line of receivers may be secured from *Philco Corporation,* Philadelphia, Pennsylvania.

ITI'S 20 INCH VIDEO

Industrial Television Inc. of New York has begun production on a new 20 inch "Teleceiver" which combines the exclusive features of the company's earlier models as well as offering several new advantages and improvements.

The new model, known as the Essex-20, will replace the company's model IT-1R, the earlier 20 inch receiver. The new receiver, in common with all units in the "Essex" line, features remote control and multiple screen operation. The set has an all-plastic mask which has been optically designed to reduce glare and prevent reflection.

Of interest to servicemen is the design of the metal cabinet which is assembled by the use of patented fasteners which greatly reduces the time required to disassemble the cabinet for servicing. All high-voltage circuits are contained in the picture unit so that no high voltage cables are required between the picture units and the remote control units. All controls on the picture unit are factory set and not exposed.

For full details on the Essex-20 and other receivers in the company's line of receivers for commercial and public installation write *Industrial Television Inc.,* 359 Lexington Avenue, Clifton, New Jersey.

BED LAMP-RADIO

For those who like to read in bed and listen to the radio at the same time *Mitchell Manufacturing Company* of Chicago has introduced a combination bed lamp and radio known as "The Lullaby."

Housed in a molded bakelite cabinet, the radio has five tubes and a built-in "Air Magnate" which eliminates the need for aerial or ground wires. The set operates on either a.c or d.c. The bed lamp consists of a tubular type lamp and frosted curve lens for maximum glareless light. The lamp and radio operate separately or together, as desired.

The unit, which has adjustable brackets to fit any type of bed, measures 9½ x 5¼ x 7 inches and weighs 9 pounds.

Mitchell Manufacturing Company, 2525 Clybourn Avenue, Chicago 14, Illinois, will supply prices and further details on request.

NEW WESTINGHOUSE SETS

Westinghouse Electric Corporation has added seven new radio models in ten cabinet variations to its current radio line of home receivers.

The new additions to the line include an AM table model, a table model equipped for AM-FM reception, a lightweight portable, and four AM-FM phonograph console combinations.

Additional information on the Models 187, 191, 190 and 186 consoles, the Model 185 portable, the Model 204 table model AM-FM receiver, and the

Model 188 AM receiver may be secured by writing the Home Radio Division, *Westinghouse Electric Corporation,* Sunbury, Pa.

MAGNAVOX TELEVISION

The *Magnavox Company* announced its entry into the television receiver field at a recent showing of new TV models in Chicago.

The line features twelve models in a wide variety of furniture styles. The

units incorporate the company's new picture system, the "Magnascope" which is said to result in better definition and contrast even under strong daylight conditions, suppress flicker and snow effect, and eliminate glare.

The new receivers have been designed to serve as companion pieces to the company's line of radio phonographs or as television units alone. One of the outstanding units in the line is the "Windsor Imperial" which has been designed as a breakfront bookcase receiver with a 12½ inch "Magnascope" designed especially for this unit. The new model has an auditorium-type speaker system, AM, FM, short-wave, and a wire recorder.

The *Magnavox Company,* Fort Wayne, Indiana, will supply full details on the new television line to those requesting this information from the company.

BLONDE TABLE RADIO

Radio Corporation of America has announced that the company's popular table model radio-phonograph combination, the Model 77U, is now available in blonde mahogany.

The new receiver, like the walnut and mahogany veneer models, contains the largest speaker ever employed in a comparable *RCA Victor* instrument and has fifty per-cent more power output than is usual in such a set.

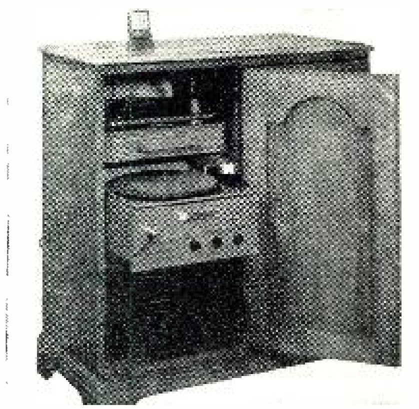
The cabinet is styled in streamlined modern design with the cabinet front and side panels of solid mahogany. The cut-back lid is of mahogany stripe veneer. All controls for both the receiver and the phonograph are incorporated in two knobs on the outside of the cabinet. The set measures 10½ x 17¾ x 18 ¾ inches and has six tubes and one rectifier.

Radio Corporation of America, RCA Victor Division, Camden, New Jersey, has full details available on request.

"DRAWERECORDER"

Hoffman Radio Corp. of Los Angeles, is currently marketing the new "DraweRECORDER" which is now available in the following models—Normandie, Concord, Kent, Bel Air, Malibu Moderne, and Malibu Traditional.

The "DraweRECORDER" is a separate home recording unit. Recordings may be made from radio programs, phonograph records, or direct from the microphone. The extra turntable is a portable drawer that may be removed from the cabinet and carried elsewhere for remote recording. Equipment includes one turntable and recording arm for making the record and another turntable and tone arm for reproducing purposes.



The unit features automatic tone control, volume level indicator, independent amplifier, professional-type magnetic cutting head, and a sensitive crystal microphone.

Further data on the new unit may be secured by writing *Hoffman Radio Corp.,* Los Angeles, California.

BENDIX TV COMBINATION

One of the new units being featured in the *Bendix* line is the Model 325M8, "The Pageant," a combination AM-FM, phonograph, and television receiver.

The new receiver covers all twelve television channels, receives the 88 to

108 mc. FM band, and provides AM coverage from 540 to 1620 kc. As many

as twelve 10" or ten 12" records can be played automatically.

The television circuit includes a 10" direct view tube, 21 tubes including the cathode-ray tube and two rectifiers, 12 push-buttons for instant tuning, simplified controls, and a new crystal picture detector.

A 12" Alnico V concert speaker has been incorporated in the receiver along with a three-point tone control, and eight watts push-pull output. The set also features built-in "Tele-wave" FM and AM antennas.

Housed in an 18th Century cabinet of mahogany veneers, the set measures 38" x 38⅞" x 21⅛".

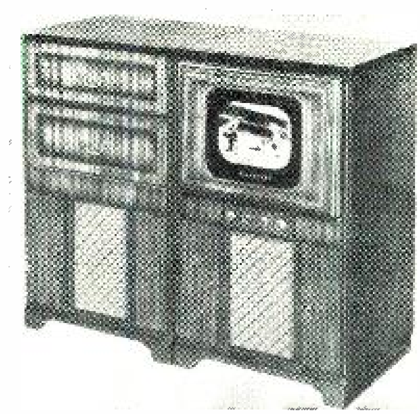
Further details on "The Pageant" may be secured from *Bendix Radio, Division of Bendix Aviation Corporation*, Baltimore 4, Maryland.

SENTINEL VIDEO

Sentinel Radio Corporation recently introduced two television model receivers to the trade.

The Model 405 is a table model receiver measuring 11½ x 15½ x 17½ inches and retails in the popular price class.

The Model 402-CB comprises two matching mahogany period style consoles, one with a 10" viewing screen,



and the other with complete FM-AM and record player.

Both sets provide full 12 channel coverage, simplified tuning, four controls, and transformer type of power supply. The table model provides a picture measuring 26 square inches while the console picture measures 52 square inches.

Details on either or both of these new television receivers may be secured by writing *Sentinel Radio Corporation*, Evanston, Illinois. —30—

"THE REPS" TO HOLD MEET

THE Missouri Valley Chapter of "The Representatives" is holding a radio and electronic manufacturer-jobber conference October 25, 26, and 27 at the President Hotel in Kansas City.

Manufacturers represented in the Missouri Valley area and jobbers in the six-state area are being invited to attend. This is the third annual conference and persons expecting to attend are asked to make reservations with "The Representatives" of Radio Parts Manufacturers, 402 Manufacturers Exchange Bldg., Kansas City 6, Missouri. —30—

Television Installation

(*Continued from page* 38)

tearing pictures, may be observed. These will be discussed now.

Fault "B," (ghosts) on our original list of four faults has, like fault "A," (tearing pictures) more than one cause. These are:

1. Multipath reception of the transmitted signal.
2. Transmission line standing waves caused by mismatch between receiver and transmission line, or between two portions of the transmission line.

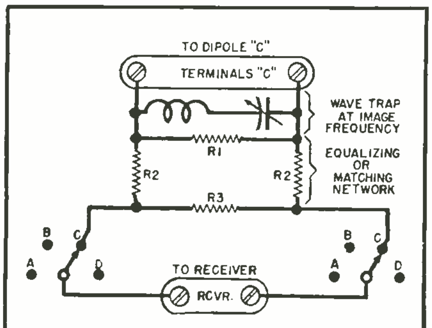
Cause number 1 for ghosts is due to signals being reflected from major obstructions such as mountains, bridges, or buildings. This case has been frequently described, and the use of highly directional dipole arrays, oriented to favor the desired signal path and reject the undesired, has already been well covered by other writers.

What has not been stressed, however, is the fact that a directional dipole oriented on one station will inevitably weaken reception or complicate the ghost problem on other stations. Only the use of a separate dipole for each station which presents a separate ghost problem, with the several transmission lines connected to the receiver through a low-loss constant-impedance switch box, can guarantee perfect pictures.

Cause number 2 for ghosts—transmission line mismatches—results in a series of closely-spaced ghosts which are sometimes quite indistinguishable from ghosts caused by multipath reflection, at least to the relatively untrained eye of the average radio-electronic technician. The cause is sometimes not at all obvious, and the appearance of these "false" ghosts vary. They are very often affected by movement of the dipole or of the transmission line, especially coaxials.

On the surface, impedance mismatches are not something to be expected from an individual installation

Fig. 15. A typical circuit within the switch box, combining dipole selector, wave trap, and pad for one channel. Similar or different arrangements for other channels are not shown, for sake of clarity. When only one dipole is used on all bands, it is connected to all dipole terminal strips, and absorption type traps are used instead of shunt types.



CAUSE OF TEARING	CURE
1. Overloading signal.	Permanent fixed attenuation pad.
2. Faulty horizontal hold or sync controls.	Reset hold control; troubleshoot sync clipper, separator, amplifier, oscillator, and tubes and components.
3. Interfering signals.	Install wave trap.
4. Interfering noise.	Raise dipole, relocate dipole and transmission line, or eliminate noise at source.

Table 1. Causes of "tearing" in television pictures and steps to be taken for cure.

of a new television receiver, and are, in fact, more often discovered on older installations when attempting to change types of transmission lines, or in connection with receivers which have had or which need r.f. realignment. On the other hand, it is a common problem in *multiple* receiver installations using one transmission line, such as in dealer store demonstration setups, hotel rooms, and fancy apartment houses or garden apartments.

At any event, the discovery of a persistent ghost which is not *readily* eliminated by orienting the probing dipole on the roof calls for the use once more of the variable pad box described in connection with tearing pictures. This time its use as a test device is to provide a reliable impedance matching connection between the receiver antenna input and the transmission line.

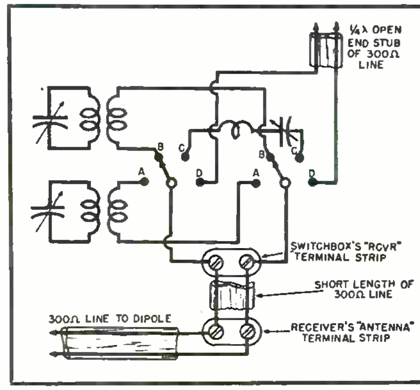


Fig. 16. Using switchbox as interference trap for four channels. Channels A and B shown using absorption-type trap; Channel C uses shunt-type trap and Channel D uses tuned stub-type trap. Choice of type is arbitrary with this type of arrangement.

Should the connection through the variable pad box eliminate the ghosts, it may be presumed that a mismatch is causing the trouble. Check the manufacturer's service or installation instructions to make sure the proper type of transmission line is being used, and then give the transmission line a careful once-over for shorted or broken wires, grounds or, in the case of coaxials, extremely sharp bends or kinks. As a final check, put the r.f. section of the receiver through a visual inspection, looking for obvious damage. If none of these steps reveal the fault, it will be wise to realize that even today mistakes in design or factory production control are being made, and that the fault may lie there.

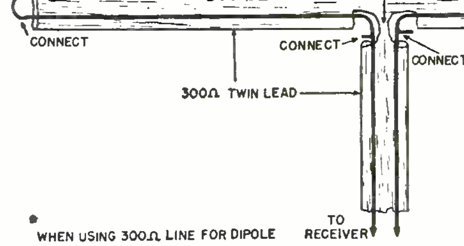
Very often moderate mismatches may be overcome by means of matching pads, or by means of series and loading resistors across the input of the receiver. This can be determined experimentally by bridging the variable pad box across the input receiver terminals, using one leg of the balanced ladder decade as a variable non-inductive resistor. These boxes are calibrated, and the accompanying instruction charts will indicate the single resistor value which will do the required job. See Fig. 8B.

Fault C, the third fault on our original list, is poor signal-to-noise ratio. Like the other faults, this too can have many causes. Examples are:

1. Excessive distance between station and receiver.
2. Low power or uneven radiation pattern of transmitter antenna.
3. Terrain obstructions in the signal path.
4. Excessive local noise-generating devices.
5. Standing wave patterns caused by local obstructions.
6. The use of an indoor antenna.

It is quite obvious that nothing can be done directly to affect the first three causes. For the fourth and fifth

Fig. 17. Construction of folded twin-lead dipole, with optimum length for greatest gain on each channel. Channel 1 has been removed from television service by the FCC.



CHANNEL	L IN INCHES	CHANNEL	L IN INCHES
2	102.1	8	30.5
3	92.0	9	29.5
4	83.6	10	28.5
5	72.6	11	27.6
6	67.1	12	26.8
7	31.5	13	26.0

THOUSANDS OF TUBES

SENCO LEADS THE TUBE PARADE IN SUPER VALUES!

R.M.A. GUARANTEE

INDIVIDUALLY CARTONED

Here's the final answer to your tube problem. Again we've gone the limit — cutting off every bit of overhead expense that unnecessarily adds to your cost. Result: lowest prices on the market today! So why not take advantage of these tremendous savings now.

IMMEDIATE DELIVERY

ALL BRAND NEW

ONLY SENCO CAN OFFER THESE TREMENDOUS SAVINGS!

Type	Each	Lots of 10 Each
OZ4	69c	59c
1A3	45	39
1A5GT/G	59	49
1A7GT/G	55	45
1C6	75	68
1E7	99	89
1H4	59	52
1H5GT/G	59	49
1H6	74	69
1J6	80	72
1L4	49	45
1LA4	49	39
1LH4	69	59
1LN5	69	59
1N5GT/G	59	49
1R5	55	49
1S5	59	55
1T4	69	55
1T5GT	59	49
1U5	36	30
1V	45	39
2A3	80	72
2A5	54	43
2A6	45	35
2A7	49	39
2X2/879	35	29
3A4	49	39
3Q5	55	49
3S4	55	45
3V4	79	69
5U4G	50	40
5W4GT	39	34
5X4G	39	35
5Y3G	42	37
5Y3GT/G	40	33
5Y4G	39	32
5Z3	49	39
5Z4	59	49
6A6	69	61
6A7	50	45
6A8GT	49	39
6AB7/1853	53	46
6AC5	69	59
6AC7/1852	65	60
6AG7/6AK7	89	79
6AH6	49	39
6AK5	74	69

Type	Each	Lots of 10 Each
6AL5	49	38
6AU6	49	39
6AV6	49	39
6B7	55	49
6BG6G	99	89
6BE6	49	38
6BJ6	59	49
6C4	29	25
6C5GT	40	35
6C5MG	89	79
6C6	45	32
6C8G	37	29
6D6	49	45
6F5	55	45
6F6GT	45	39
6F7	49	39
6F7/VT70	49	39
6H6GT/G	45	39
6J5GT/G	45	39
6J6	59	49
6J8	73	65
6P5GT	59	49
6J7GT	42	38
6K6GT/G	45	39
6K7G	50	41
6K7GT/G	49	39
6K8G	55	49
6L6G	79	69
6L7	84	78
6N4	49	38
6Q7GT	47	39
6R7	55	45
6R7GT	59	49
6SA7	49	39
6SA7GT/G	44	37
6SB7	55	45
6SD7GT	39	34
6SF5	49	39
6SG7	44	39
6SH7GT	40	32
6SJ7GT	44	37
6SK7GT/G	49	39
6SL7GT	49	47
6SN7GT	49	47
6SQ7GT/G	44	37
6SD7	49	39
6SS7	59	49

Type	Each	Lots of 10 Each
6U6	49	39
6U7G	35	25
6V5G	59	49
6V6GT/G	45	39
6X5GT/G	49	39
7A4	53	43
7A7	59	49
7B6	44	35
7F7	49	44
7J7	54	49
7N7	49	44
7X7 (XXFM)	44	35
7Y4	44	35
12A6	29	25
12A8GT	35	28
12AT6	50	45
12AT7	69	59
12BA6	50	45
12BE6	50	45
12F5GT	35	27
12H6	39	34
12J5GT	25	19
12J7GT	45	39
12K7GT	45	39
12K8Y	35	25
12Q7GT	45	39
12SA7GT/G	40	32
12SF7	35	32
12SC7/1634	49	39
12SG7	43	37
12SJ7GT	55	49
12SK7GT/G	45	35
12SL7	49	43
12SQ7GT/G	40	32
12SR7	35	32
14A7	65	55
14B6	59	49
24A	49	39
25A6	69	59
25L6GT/G	49	39
25Z5	49	45
25Z6GT/G	45	39
26	45	32
27	49	44
30	59	49
32	80	75

Type	Each	Lots of 10 Each
32L7GT	52	48
34	69	59
35/51	42	32
35L6GT/G	45	39
35W4	43	40
35Y4	43	40
35Z3	44	35
35Z5GT/G	43	39
36	35	29
37	45	39
38	45	39
39/44	25	19
41	49	45
42	47	41
43	54	47
45	49	39
45Z5GT	59	49
47	49	39
50A5	60	55
50B5	42	32
50L6GT	50	45
50Y6GT	50	45
56	55	45
57	45	39
58	45	39
59	65	59
71A	39	29
75	50	39
76	49	45
77	35	27
78	49	39
80	40	38
83	52	48
83V	79	69
84/6Z4	49	39
85	49	45
89	49	46
99V	35	25
99X	35	25
117Z6GT/G	89	76
182B	99	89
1231	39	29
1644	29	19

SENCO RADIO INC.

Dept. A, 71 West Broadway,
New York 7, N. Y.
TELEPHONE—BEEKMAN 3-6498

MINIMUM ORDER $1.00

WHEN ORDERING—Send 25% deposit for all C.O.D. Shipments. Include sufficient postage—excess will be refunded. Orders without postage will be shipped express collect. All prices F.O.B. New York City.

DIVIDEND OF THE MONTH

885

THYRATRON, TRIODE TYPE

SPECIAL

29¢ EACH

Fig. 18. Another example of FM interference with modulation pattern in evidence.

causes, moving or increasing the height of the dipole or transmission line several feet or yards may sometimes change the situation completely. Since the sixth cause will be described in detail later, it will be skipped for the present, except with the remark that basically it is handled in the same manner as the method using separately tuned dipoles about to be described.

Causes 1 to 3 may be tackled in either of two ways:

1. Use of a booster amplifier between the receiver and the incoming transmission line; or 2. use of separate tuned dipoles.

The first solution is adaptable to certain suburban or rural reception areas, where local noise interference is low. In general, the difficulty with this method is that unless the signal-to-noise pickup ratio is improved, about all that is gained is an increase in contrast rather than a decrease in noise interference. For this reason, tuned booster amplifiers are much to be preferred over untuned, with the provision that adequate bandwidth be designed into the stage by heavy loading of the tube. Also it is of great importance to use quiet tubes and components, lest the signal-to-noise ratio be made even poorer than it is.

One way of getting around this trouble in moderately noisy locations when dealing with a 300-ohm input receiver, is to exchange the 300-ohm transmission line for a 72-ohm coaxial cable. Being shielded, the coaxial picks up far less noise. However, the line must now be matched to the receiver. This is simply done, without rewiring the receiver, by means of a resistive matching network connected directly to the antenna input terminals, or by using one side of the grounded-midtap antenna input strip found in some television receivers.

In the former case, a good booster can be cut into the circuit. With a gain far more than sufficient to overcome all losses of the coaxial line and the matching network, it leaves the set with a higher signal-to-noise ratio, better contrast, and generally improved reception.

Again, it must be emphasized that this method depends upon the location. It must be tried out before the installer can be sure it will work. Block diagrams and schematics for

NO NEED FOR confusion

Correspondence from service technicians and distributors suggests that many may be confused by the question, "What instruments do I really need to service TV and FM receivers?"

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Fig. 19. FM interference lines are generally wavering and swaying, sometimes running in long sloping lines, and other times, as in this case, standing vertically.

this method are shown in Fig. 14A and 14B. Since the matching network is mounted outside the receiver it should be of good mechanical construction. They are available commercially for about 75 cents.

The second solution for weak signals is more direct, and eliminates the need for boosters, changeover to coaxial lines, and additional tuned circuits. It consists simply of tuning either a simple or directional dipole accurately to the exact frequency of the transmitting station's video carrier.

Most installers fail to realize the gain which can be secured in the antenna circuit itself, when only one channel frequency need be considered. By tuning the dipole and all parasitic element spacings and lengths for best gain, as seen in the television receiver picture tube, the signal-to-noise ratio may be greatly increased and the signal strength multiplied many times. Here, then, is another advantage of the individualized television installation.

Since each station will probably have to be treated similarly, the several transmission lines may be run to the receiver via the same route in one operation. At points distant from a city wherein are located several transmitters, all the dipoles can usually be mounted on the same mast, and oriented in the same direction. This simplifies the entire process, so that the cost is kept quite low. They should be spaced as far apart as possible.

At the receiver, as in the case of the problem of ghosts previously described, a low-loss dipole selector box is mounted, and the call letters of the stations hand-lettered in ink on its panel, as in Fig. 9. Thus, the switchbox is made to fill four functions; attenuation to prevent tearing and distortion, de-ghosting, better signal-to-noise ratio, and trapping out interfering signals.

The fourth function of the selector and equalizer box, to contain wave traps set for the elimination of signal interference which shows up on any channel, was covered in connection with tearing pictures. It must, therefore, be remarked here that signal interference can be very troublesome even when it is not of the proper strength or frequency to tear out the picture; it is therefore listed separately as *fault D* in our original list.

Different interference signals are responsible for troubles on different channels. Figs. 18 and 19 are typical. Since wave traps inevitably cause losses of the desired signal, they should be switched out when the channels for which they are set are not being used. This can be done along with the other functions of the switchbox as in Fig. 15 or it may be done separately, as in Fig. 16.

This entire discussion has covered the basic purpose and arguments for the "individualized" television installation, analyzed the most important troubles encountered in setting up receivers, and provided methods for eliminating or diminishing the troubles. All of these things have been discussed in relation to outside antennas, for the purpose of connecting one receiver. This, however, does not cover all the needs of the television technician.

In some cities, a major problem is the installation of television receivers in apartment houses or hotels where outside or roof dipoles are prohibited by the landlord. Folded dipoles made of 300-ohm twin-lead are popularly used for hidden indoor antennas in these cases. This is true for several reasons; they are thin, compact, and easily hidden and they have a broadband frequency characteristic. See Fig. 17.

On the other hand, these twin-lead folded dipoles are basically not very efficient. They are best used in areas of strong signal strength. Should the set-owner's apartment be on the side of the house facing away from the transmitting station, relatively weak signal fields will be found in the rooms, and consequently the twin-lead folded dipole will have to be very carefully placed in order to pick up enough signal. At the same time, ghosts are multiplied enormously within the brick-and-iron house, and for this reason also, positioning is extremely critical.

To attempt to find a location where one twin-lead folded dipole will pick up strong ghost-free signals for more than one station is patently as difficult as finding the proverbial needle in a haystack. A relatively quick and easy solution is to utilize the switchbox method already described together with a separate folded dipole cut to exact frequency, for each station.

The individualized technique has, finally, one other major advantage. *It cuts down on free service calls.* While it is a familiar fact to some television installers, a great many new ones have still to learn that possibly two of the national average of three first-year service calls, which usually come under the standard television installation warranty, are due not to receiver breakdowns but to the customer's inability to handle the receiver's controls.

Service calls like this remove the profit from this otherwise worthwhile business. To a great extent, however, such calls can be avoided by leaving the customer with an equalized installation. This means that all signals are boosted up or cut down to the same intensity before entering the receiver antenna input terminals, by means of attenuator or matching pads, called equalizers, or tuned dipoles or boosters.

As a result, when changing from one station to another, for example, the set-owner simply turns both the receiver's bandswitch and the switchbox's knob. Since the signals are approximately equal, only minor retouching is necessary on the contrast, brightness, focus, volume, or other controls on the front panel. There is no room for confusion, and the difficult first month is safely passed without the usual wasteful callbacks. The attractiveness of this feature in relation to tavern or bar installations is great indeed!

Furthermore, with the switchbox already installed, the launching of a new local high-band station on channels 7-13 can be accommodated immediately by the use of one of the switch positions. This event has already taken place in more than one television city.

The writer recalls hearing a speech by Mr. Richard Guilfoyle at the January Town Meeting of Radio Technicians, in Philadelphia. In his address entitled "I Spent $91,000 to Earn $90,000 in Television Service," Mr. Guilfoyle attempted to give his intensely interested audience the benefits of his short but bitter experience as owner of one of the largest television installation companies in the country.

"The television dealers' most important discovery," he said, "is when they find that selling a television set depends mainly on how well they can make it work in a given location." To which the writer recalls thinking "Amen!"

Unquestionably, the eye is more critical than the ear. No wonder, then, that television set-owners are so conscious of picture imperfections. Because television is new, many a customer can be induced, for a while, to accept imperfect reception on one or more stations. But sooner or later he becomes fed up with it! Will he then also be fed up with the dealer who sold the set . . . and the servicer who installed it?

The mark of an expert television servicer or a television dealer who values his top-rated customers is an individualized and an equalized installation. That is what we have attempted to describe in this article.

—30—

ANSWERS TO "TV QUIZ" PAGE 120

1. c	6. b	11. c	16. a
2. b	7. c	12. b	17. a
3. a	8. b	13. d	18. a
4. a	9. d	14. b	19. c
5. d	10. a	15. b	20. b

SCORING TABLE

19-20 correct	excellent
16-18 correct	very good
13-15 correct	good
10-12 correct	fair
9 or less	poor

Stagger Tuned I.F.'s

(Continued from page 55)

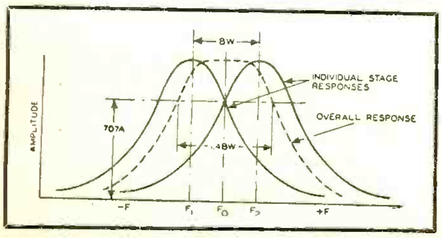
three frequencies had an amplitude of 1 volt at the input to this tuned stage, then at the output they would possess the following values. At 9 mc. = 1 x .707 = .707 volts; at 10 mc. = 1 x 1 = 1 volt; and at 11 mc. = 1 x .707 = .707 volts.

These same three frequencies are now passed through the second tuned circuit. Since this second circuit possesses the same characteristics as its predecessor, here is the result at its output: at 9 mc. = .707 x .707 = .49 volts; at 10 mc. = 1 x 1 = 1 volt; and at 11 mc. = .707 x .707 = .49 volts. After passage through the two amplifiers, 9 and 11 mc. are no longer within the .707 region about the resonant frequency, 10 mc. To find frequencies with voltages equal to at least .707 of 10 mc. voltage we must move *closer* to 10 mc. The result, of course, is a narrower bandpass; more accurately, 30 per-cent narrower. See Fig. 3B.

Now let us consider two single-tuned amplifiers, each with the same bandwidth, but with their peaks separated by an amount equal to their bandwidth. See Fig. 4. The result is a response in which the over-all bandwidth (to the .707 points) is 1.4 times the bandwidth of a single stage. The over-all gain, however, is now only one-half that of the two stages tuned to the same frequency. This is so because at the center frequency of the over-all response curve, the individual stage responses are only .7 of their peak response. The product of the stage gains is approximately one-half, (.7 x .7 = .49).

Now, to progress one step farther. We have seen that by stagger-tuning two tuned circuits, we achieve 1.4 times the bandwidth of a single stage but with only one-half of the gain. Suppose, however, we retain stagger-tuning, but we decrease the bandwidth of each individual tuned circuit. The over-all bandwidth of the stagger-tuned system will still be 1.4 times the bandwidth of the individual stages. However, because we have decreased the individual coil's bandwidth, 1.4 times, this new figure will be less than 1.4 times the previous figure when each individual bandwidth was greater. The advantage of this is that we still get a greater bandwidth than if we hadn't stagger-tuned the circuits, and the over-all gain remains high.

Fig. 4. By stagger-tuning two tuned circuits wide bandpass may be obtained. See text.



A simple illustration will perhaps make this clearer. Suppose that the bandwidth of each individual stage is decreased to .7 of its original value. To do this, we raise the individual circuit *"Q's"* to 1.4 times its previous value and this will provide an increase in gain by 1.4 times. Now, when the stages are staggered by an amount equal to this reduced bandwidth, the over-all gain is one-half the product of 1.4 times 1.4. The answer is 1. Thus, the over-all gain is now the same as with the previous amplifier with both circuits tuned to the same frequency.

There are other systems which can give high gain and bandwidth, but the prime advantage of the stagger-tuned amplifier is its ease of alignment.

An important relationship and one which should be remembered by all radiomen is the fact that bandwidth of any parallel resonant circuit (or an ordinary resistance-coupled amplifier) is inversely proportioned to the amplification of that system. Expressed a little differently, we can say that *bandwidth* x *gain* = *constant*. Thus, if we increase the bandwidth of a system by one and one-half times, we decrease its gain by the same amount. For any individual tuning coil, *bandwidth* $= F_0/Q$ where F_0 is its resonant frequency and Q is the figure of merit of the coil. This expression tells us that for any given resonant frequency, increasing the bandwidth can only be accomplished by decreasing the *"Q"* of the coil a proportional amount. However, if we raise the resonant frequency of the coil, maintaining the *"Q"* constant, then the bandwidth will increase in like measure. —30—

EASILY CONSTRUCTED LOCK FOR PICKUP ARMS

By LEE B. WILDE

Tampering with the pickup arms of automatic phonographs installed in public and semi-public places is usually a constant source of expense to the operators of such establishments.

A simple and low cost arm lock will prevent unauthorized persons from removing the tone arm from its rest with the resultant danger of dropping the tone arm or otherwise subjecting it to abuse.

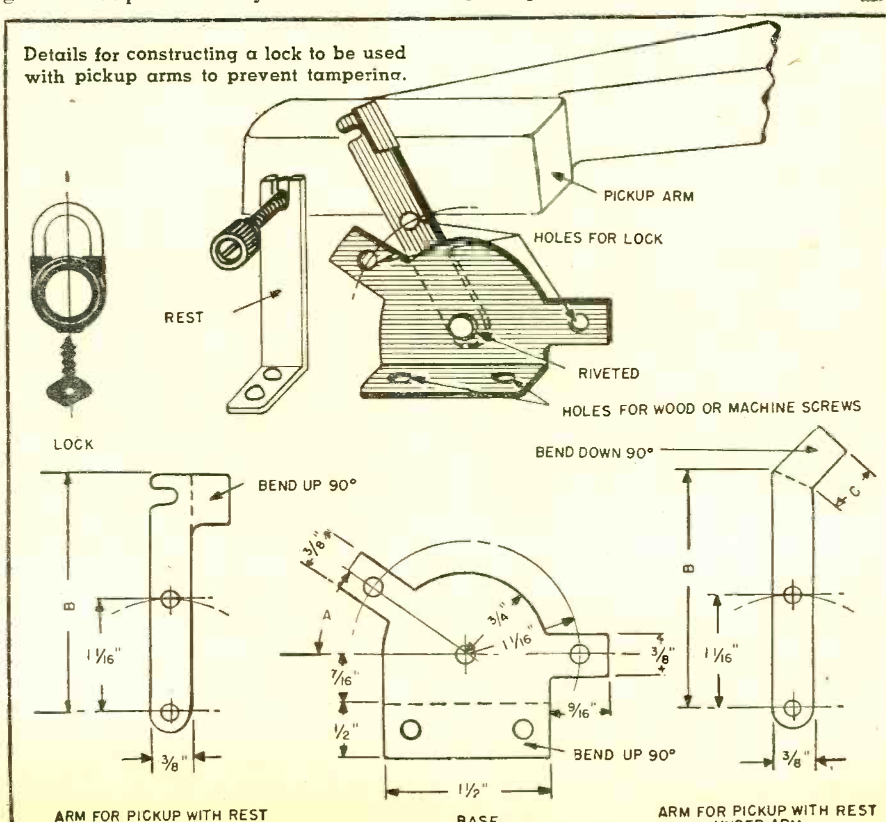
Many amplifiers are equipped with a switch lock to prevent tampering with the system when left unattended, however this does not protect the pickup from damage.

This pickup arm lock is easily constructed from 20 gauge steel or any steel sheet that is not too thick to cut and bend easily. The arm shown in the diagram is adaptable to any rest with a slotted top to hold the pickup screw and thumb nut as shown. It is also adaptable to any other type of rest merely by changing the shape of the part of the arm that holds the pickup down. Most other arms have a rest that sets under the pickup arm itself, but in this case the arm shown on the lower right side of the drawing is made to clamp the top of the pickup.

A small piece of rubber tubing is slipped over the arm where it clamps the pickup in order to prevent scratching. The lock is a small padlock such as is used for dog collars. To lock the pickup arm down, slip the lock through the two pieces, in the holes provided.

Dimension "B" on the drawing is not given as this value will vary to suit the height and distance away from the pickup the base piece is set. —30—

Details for constructing a lock to be used with pickup arms to prevent tampering.



Simple Simon SIGNAL TRACER

A signal generating tracer which features a multivibrator circuit with simultaneous output from 2500 c.p.s. to 20 mc.

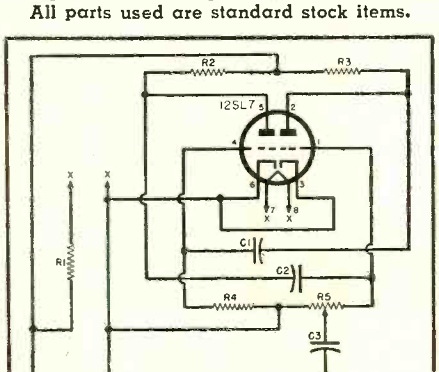
By H. J. GRUBER

Assoc. Eng., Clippard Instrument Laboratory, Inc.

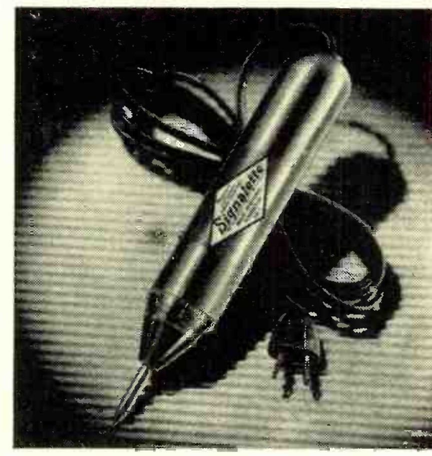
TOP-NOTCH radio servicemen and engineers are quite familiar with the signal generator method of signal tracing whereby an audio, intermediate, or radio frequency is set up on a conventional signal generator and the output introduced into an audio, intermediate, or radio frequency stage of the receiver under test. The output of the stage under test is then checked to determine whether the signal is passing in a normal manner. This method, although good, is time consuming; hence the common signal tracer, consisting of a detector probe and high gain amplifier, came into being. To use the ordinary "signal tracer" it is still necessary to introduce a signal into the receiver either from a strong broadcast station or signal generator and go through the receiver stage by stage from the antenna to the speaker to determine the faulty stage.

It occurred to the author that a simpler tracer could be developed which would generate its own signal, operate on a.c. or d.c. and be compact enough to fit into the serviceman's coat pocket or tool kit, making it usable in the shop or on home calls. The "Signalette," which incorporates a multivibrator circuit (Fig. 1) and

Fig. 1. Circuit diagram of signal tracer. All parts used are standard stock items.



R_1—760 ohm res. line cord ± 10%
R_2, R_3—22,000 ohm, ½ w. res. ± 10%
R_4—10,000 ohm, ½ w. res. ± 10%
R_5—10,000 ohm miniature pot.
C_1, C_2—.01 μfd., 200 v. cond. ± 10%
C_3—50 μμfd., 600 v. ceramic cond. ± 20%



Over-all view of the commercially-built signal tracer unit described in this article.

uses a single 12SL7GT tube, meets these requirements. It has a fundamental frequency in the neighborhood of 2500 cycles. The exact frequency of a multivibrator is rather hard to determine precisely and is of little consequence for the proposed application. The characteristic of this circuit is such that it has a very high harmonic output and therefore a useful output is obtained through 20 megacycles with a separation of 2.5 kc. between successive harmonics.*

To point out the simple method of signal tracing using this instrument let us consider the standard all-wave broadcast receiver. Disconnect the antenna and turn the volume control to the high position. Starting at the output stage of the receiver it is only necessary to touch the tip of the instrument to the grid of the output tube with the output attenuator (mounted in the nose piece of the instrument) adjusted to full (100 on dial) and listen for the tone of the "Signalette" in the speaker. Then proceed through the receiver, stage-by-stage, in the above manner, toward the antenna post of the set, decreasing the output of the

* This separation is desirably small so that when the multivibrator output is heard on the loudspeaker of a receiver under test the successive harmonics tend to blend together into a continuous harsh, raspy tone, easy to identify.

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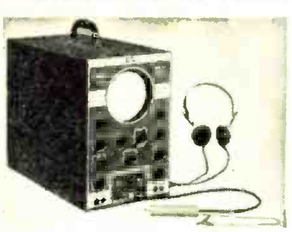

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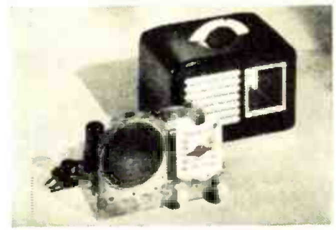

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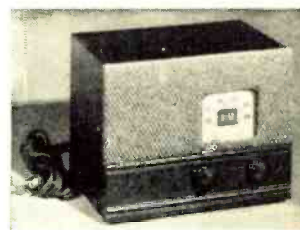

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unit as the instrument is advanced toward the antenna. Lack of signal output at any stage, of course, will indicate a faulty stage. Gain-per-stage can also be determined, for, if the attenuator does not have to be decreased as we proceed from stage to stage, we know that the stage does not have proper gain and conventional trouble-shooting technique should be employed to correct the trouble.

Signal tracing with the "Signalette" is by no means its only use, for it is ideal for checking receiver sensitivity due to its simultaneous output over such a wide range of frequencies. Therefore the sensitivity of an all-wave broadcast receiver can be checked merely by touching the tip of the instrument to the antenna terminal of the receiver and tuning the receiver successively over each band, noting any significant increase or decrease in audible output, thus determining if "hot" or "weak" spots are present.

This instrument will also do a good job of "touching up" i.f. stages of a receiver. Many radio servicemen think that the i.f. stages of a receiver should be aligned to a certain frequency, say 455 kc., but actually it is of no importance except in certain critical localities whether the i.f.'s are peaked at this frequency. In fact the important thing, for optimum receiver performance, is that all the i.f. stages be peaked at the same frequency and the oscillator correspondingly trimmed and padded.

To touch up the i.f. stages of a receiver touch the tip of the instrument to the converter grid and adjust the output attenuator for suitable speaker or output meter response, keeping the level as low as possible. Now adjust each i.f. trimmer for maximum output. The radio volume control should be on full. As usual, it is advisable to repeat the alignment for greatest accuracy.

After touching up the i.f. stages, the frequency to which the i.f. becomes peaked is the one to which most of the tuned circuits were set before realignment. In checking the operation of a number of receivers that were first realigned with the "Signalette," and then with a conventional signal generator, there was no difference found in over-all performance.

It is also possible to touch-up radio frequency stages, check poor shielding in auto radios, check audio amplifier gain, touch-up loop antennas in portable and home type radios and make many other tests which require the use of a signal in the 2500 cycle to 20 megacycle range.

The radio serviceman can save considerable time and money by employing this inexpensive multivibrator method of signal tracing. This instrument, while it is in no sense intended to take the place of existing types of test equipment, nevertheless is an invaluable tool for the simple and rapid location of receiver troubles and forms a vital adjunct to the serviceman's kit.

—30—

What's New in Radio
(*Continued from page 84*)

6 and 7 to 13. High gain dual-purpose miniature tubes are used in the circuit which contains its own power supply for 117 volt a.c.

Although primarily designed for television preamplification, the unit may also be used as a 2 and 6 meter preamplifier for ham receivers.

Sonar Radio Corp., 59 Myrtle Avenue, Brooklyn, New York, will supply additional details on request.

BATTERY TESTER

Chicago Industrial Instrument Co. has developed a battery merchandiser which is designed to increase the sale of dry "A" and "B" batteries by demonstrating to customers the condition of their batteries.

The new merchandiser may be used on the counter or hung on the wall because of its dual position design. A 5½ inch D'Arsonval movement meter

indicates whether the battery is fresh or should be replaced.

The unit will test any dry battery rated from 1½ to 150 volts. Two ranges provide for both low and high voltage batteries. The 1½ to 10 volt range accommodates flashlight cells and "A" batteries. "B" batteries are tested on the 10 to 150 volt range by merely flicking the toggle switch and setting the selector dial to the rated voltage of the battery. All tests are made under load according to the battery manufacturer's specifications.

For further information and prices on the battery tester write direct to *Chicago Industrial Instrument Co.*, 536 West Elm Street, Chicago 10, Illinois.

SOUND-POWERED HANDSET

The Wheeler Insulated Wire Company, Inc. of Waterbury, Conn., is currently in production on a self-powered telephone handset which is particularly adaptable for radio and television installation work.

No batteries or power supply are necessary for the operation of the equipment. The units may be operated over a two-conductor full metallic or a single wire, ground return circuit. The instruments are claimed to be spark- and explosion-proof as they generate an extremely small amount of energy in transmission.

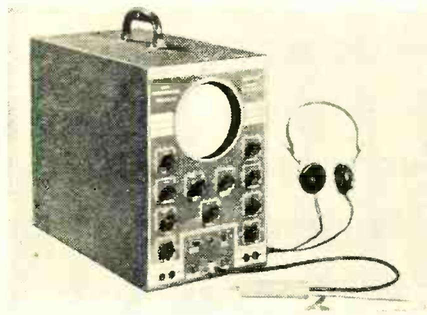
The unit is said to be weatherproof, all parts being made of nickel alloy metals which are specially treated for resistance to corrosive elements. The assembly is constructed to withstand the usual rough handling encountered in field applications. The handset cable, provided with strain relief, is of two-conductor stranded, neoprene outer jacket equipped with rubber insulated test clips. The handset itself is fabricated of high impact, compression molded black phenolic material of relatively high strength and drop test characteristics.

Full information on these self-powered handsets may be secured by writing *The Wheeler Insulated Wire Company, Inc.,* 150 East Aurora St., Waterbury 91, Conn.

CR "STETHOSCOPE"

Feiler Engineering Company of Chicago is now marketing a new cathode-ray "Stethoscope" which consists of a 5" cathode-ray oscilloscope combined with the company's "Stethoscope."

While primarily designed for FM and television servicing, the new in-



strument may also be used for AM and audio work. It can be used in conjunction with a "Stethoscope" probe and earphones (supplied at extra cost) enabling the operator to see and hear the signal simultaneously.

For full details write to *Feiler Engineering Company,* 947 George Street, Chicago, Illinois.

SOLDERING PENCIL

Ungar Electric Tool Company, Inc., of Los Angeles has announced a new and improved soldering pencil which features lightness and flexibility.

Weighing only 3.6 ounces, the new soldering pencil is said to make soldering in hard-to-reach places simpler and easier. Four interchangeable tips, the ⅛ inch chisel, ⅛ inch pencil, ⅝ inch chisel and the ⅜ inch pyramid, make this unit adaptable for a variety of soldering uses.

A 65-strand, extra flexible cord is an integral part of the molded plastic handle. The special plastic handle has both a cork insulator and cooling fins which are said to keep the handle cool under all working conditions.

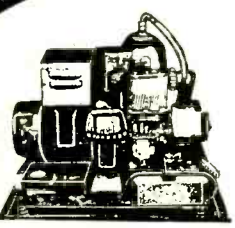
The new unit is 7 inches long and has a maximum diameter of 1 inch.

VALUES GALORE

MORE FOR YOUR MONEY

SEND FOR OUR BIG SPECIAL BULLETIN!

DC POWER SUPPLY (HRU)



(HRU)

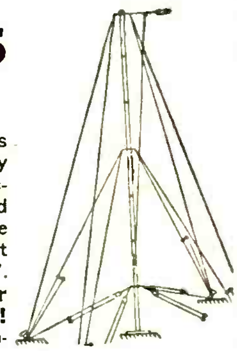
24-28 V. at 70 Amp. 2000 watts gasoline engine generator with electric starter. Power supply which can be used to operate 24-28 V. equipment, start airplane engines, charge batteries.

ONLY $69.50

VERTICAL ANTENNA MAST KITS

Complete $9.95

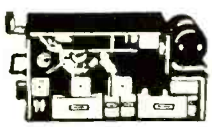
Fully Adjustable 5 to 35 Feet
Easy to Set Up
FOR FM, TELEVISION AND ROTARY BEAM



Doublet Antenna Kit used with the famous Hallicrafters BC-610, consisting of 7 steel-alloy mast sections in a handy canvas bag. Each section is 5′ 6″ long, 1½″ OD with the last 6″ rolled to a smaller OD to telescope into the end of the preceding section. No taper. Assemble into mast up to 35″ high or shorter by any multiple of 5′. Finished in weatherproof olive drab. **Ideal for erection of FM and Television Beams!** Drop your coaxial cable right through the center! Brand new, export packed.

SCOOP! 110 A.C. Rec. Bargain
BC-733 D Localizer Receiver

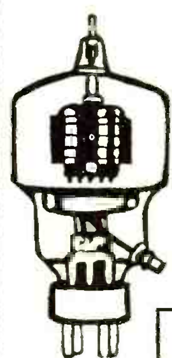
Freq. 108-110 Mc. Tube complement 10 tubes—1—12SQ7, 2—12SR7, 1—12A6, 1—12AH7GT, 2—12SG7, 3—717A. USED CONDITION. Companion to the glide path receiver. Also contains 90 and 150 cycle band-pass filters. Has the best



AVC system yet developed can use parts or use as a model for construction. 10 tubes, crystals, relays, etc. Schematic included, with dynamotor. Don't pass this up.
At only **$3.95**

2 for $7.50

POWER!! POWER!! EIMAC 304TL



BRAND NEW
JAN. INSPECTED
SUPER VALUE
BETTER ORDER 4 OR MORE TODAY

90c EA

While They Last
Any Quantity

SUPER SPECIAL
BRAND NEW EIMAC 304TL $3.95 ea.
JAN. INSPECTED

FOR your BEAM!

- Runs on 24 to 33 volts AC or DC (4 amp. transformer will do)
- Reversible — only three wires required.
- 7000 to 1 Gear Reduction stops free swing.
- Approx. ¾ RPM.
- Powerful ¼ H.P. motor, rugged precision gear train, and sturdy thrust bearing—will support and turn even a heavy dual beam.

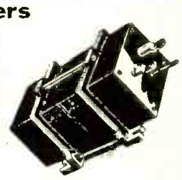
Used on aircraft to control pitch of propeller blades, these dependable power units are excellent beam rotators (see pages 22, 23, 29, Nov. QST). Used, but in perfect tested working conditions, with instruction sheet **$8.95**
Your Net Converted $10.95
(Mail orders add $1.25 for packing)

SAVE ON THESE VALUES

300 ohm Amphenol. Per C	$2.91
150 ohm Amphenol. Per C	2.62
75 ohm Amphenol (small). Per C	2.01
75 ohm Amphenol (heavy). Per C	7.20
Kilowatt 75 ohm Amphenol. Twin lead, Per C. ft.	7.20
3 Gang 410 mmfd. per Sect. Cond. Excellent Quality	2.95
4 Gang 150 mmfd. Variable	.95
Condensers—New:	
2 mfd. @ 2500 W.V. Each	2.95
4 mfd. @ 600 V. Oil—round can. Each	.69
Relay. Cramer type TD-2-120S—Max. 1 min. delay. Cont. 10 amp. 115V	4.95
Relay, Leach, 115V-AC DPST. New	1.50
Relay, Allen Bradley, heavy duty, 30 amp. 115V.-AC. Perfect for 1 KW rig—Near new cond.	3.95
Toggle Switch—SPST—plus spring return	.19
Toggle Switch—H.D.-DPST—12 amp. 125 V.	.39
Siren, Commercial type, hand operated, very loud noise. Govt. cost $21.00. Special	4.95
Phosphor Bronze dial cable 16 str.—250′ spool	.69

Cable—6 wire #16, glass insul. shielded, plastic covered—perfect for beam cont. Per ft.	.12
Cable—6 wire #18, unshielded. Per ft.	.08
Cable—4 wire #18 Plastic—shielded. Per ft.	.08
Cable—Single shielded grid wire #20-AN Specs. Special—Per hundred	1.50
Steel tape—50′ mfd. by Roe. NEW	4.95
Tubes—New—872-A .... 2 for	2.50
6L6G .... Each	.79
12SL7Gt .... Each	.39
1629 .... Each	.19
2051 Thyratron .... Each	.29
803 .... Each	3.95
807—Boxed .... Each	1.49
2C40 Lighthouse .... Each	.95
VR 150 .... Each	.75
Phone Plugs .... Each	.18
Jones Plugs 6 & 8 prong .... Each	.24
2″ PM speaker (Bakelite cased), used in Walkie-Talkie .... Each	1.95
SCR 522 Dynamotors PE94C—new .... Each	3.95
SCR 522 Receiver Conversion Kit with instr. (less dial)	3.50
ACN dial for above .... Each	3.30

304TL Transformers



Surplus Kenyon—Pri. 110 VAC. Secondary 5 V.C.T. @ 60 amps. Closed ends, open mtg feet. Weight 22½ lbs. Excellent condition **$7.95**

Overall Dimensions: 9½″ L 6″ W 4½″ H.
Also 5V. @ 115 amps.
Used .... $7.95 New $9.95
Add 75c for Packing

ATTENTION!!! All SCR-522 Owners

Remote Control Boxes for SCR 522's. Brand New in Original Packing. Consists of 5 push button switches, 5 W.E. Pilot Assemblies, with Pilot Bulbs, Dimmer, and Lever Switch all finished in Black Crackle. Order yours today.
Each **79c**

TERMS: F.O.B. Pasadena unless postpaid. No C.O.D.'s under $2.00. 25% deposit on ALL Orders. All C.O.D.'s shipped by Rail Express. Save freight and C.O.D. fees by sending full price with order and we will ship by fast truck, transportation collect. Minimum order $2.00. Californians include 2½% sales tax.

BE SURE TO ASK FOR OUR SPECIAL BULLETIN

SINCE 1930

DOW RADIO

1759 E. COLORADO BLVD.
PASADENA 4, CALIFORNIA

PHONE: in Pasadena, SYcamore 3-1196; in L. A., RYan 1-6683

The pencil is *Underwriters'* approved.

Further details on the new soldering pencil may be secured by writing to *Ungar Electric Tool Company, Inc.*, Los Angeles, California.

UTILITY TESTER

A new instrument which is said to be capable of testing all electrical circuits and appliances has been introduced by *General Electronic Distributing Co.* of New York.

The unit will measure actual current consumption of any appliance or utility whether a.c. or d.c. while the appliance is in operation. The reading is direct in amperes. The unit also incorporates an ultra-sensitive direct-reading resistance range which will measure all resistances commonly found in electrical appliances, motors, etc. This range will also permit continuity checks and tests for shorts and opens. It will read from a fraction of an ohm to 25,000 ohms.

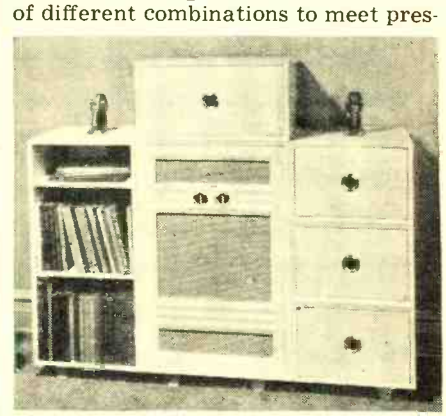
The Model 40 utility tester is housed in a crackle finished steel cabinet with portable cover. Test leads and operating instructions are included with the instrument. For prices and further details write to *General Electronic Distributing Co.*, 98 Park Place, New York 7, New York.

"CUSTOMODE" UNITS

Jensen Manufacturing Co. of Chicago is currently marketing a line of custom made, matching enclosures which have been designed to house various types of electronic equipment.

Four basic "Customode" units are now available; a medium utility cabinet for large equipment, small television sets, etc.; a small utility cabinet for tuner, amplifier, recorder, record changer, etc.; a reproducer cabinet of bass reflex design to house a 15 inch coaxial speaker; and a record cabinet capable of holding more than 200 records.

The units are made to a standard 18 inch depth with scientifically chosen length and height dimensions which permits stacking the units in hundreds of different combinations to meet pres-



ent and future audio-video requirements. The units are finished in finely textured blonde mahogany or cordovan mahogany. Flush satin-finish brass door pulls with dark green plexiglas windows add to the decorative appearance of the units.

For further details on the "Custo-mode" line write *Jensen Manufacturing Co.,* 6601 S. Laramie Avenue, Chicago 38, Illinois.

NEW V.T.V.M.

A moderately priced vacuum tube volt-ohm-capacity meter, known as the Model 300, has just been introduced to the trade by *Electronic Measurements Corporation* of New York.

The new instrument features a 4½ inch meter for quick and accurate reading, a sturdy oak case, clear easy-to-read panel, and precision construction.

Six ranges of "d.c. volts" are provided (0-3-10-30-100-300-1000) with an input resistance of 1 megohm per volt on the 0-3 and 0-10 volt ranges and 30 megohms input resistance on the other ranges.

A.c. voltage may be measured on five ranges covering 0-10-30-100-300-1000 volts at approximately 1000 ohms-per-volt. Full wave tube rectification is used. Six resistance ranges cover from 2 ohms to 1000 megohms. Capacity can be measured from 25 $\mu\mu$fd. to 20 μfd. A zero center position is available for lining up the discriminator of an FM receiver.

Electronic Measurements Corporation, 423 Broome Street, New York 13, New York, will supply additional details on request.

LONG-PLAYING RECORDER

Amplifier Corp. of America is featuring a new long-playing tape recorder, the Model 910-B "Twin-Trax."

Four hours of continuous recording and playback at the standard RMA tape speed of 7½ inches per second is offered with this new unit. Frequency response is 40 to 10.000 cycles ± 2 db. and instantaneous speed variation is ± .1%.

Through the newly developed principle of two-way dual-channel operation, whereby one sound track of the tape records in the forward direction and a completely isolated second track records during reverse travel, the 4900 foot reels of tape accommodated by the recorder provide four hours' playing time. An automatic switch and solenoid instantly reverses the direction of tape travel at the end of the reel, thereby eliminating the necessity for rewinding.

The unit is housed in a reinforced cabinet and weighs 55 pounds. The

cabinet measures 20½ x 17 x 15½ inches and houses specially designed recording and playback amplifiers with built-in floating preamplifier and supersonic oscillator on a single chassis which can be removed easily for servicing. An 8" *Jensen* speaker is housed in the cabinet.

The Magnephone Division of *Amplifier Corp. of America* will supply full details on the Model 910-B upon request. Address your inquiries to the company at 398-2 Broadway, New York 13, New York.

V.T.V.M. KIT

For servicemen, amateurs, and experimenters who enjoy building their own test equipment, *Electronic Instrument Co.* of Brooklyn has just introduced a new vacuum tube voltmeter kit.

The kit is, in reality, the company's "EICO" Model 221 vacuum tube voltmeter in disassembled form. In addition to proving instruction, building up the kit will save the user an estimated 30 per-cent of the cost of the commercial instrument.

The kit has been designated the Model 221-K and inquiries regarding the unit should be addressed to *Electronic Instrument Co.*, 377 Blake Avenue, Brooklyn 12, New York.

CHASSIS HOLDER

General Cement Manufacturing Company of Rockford, Illinois has acquired the manufacturing rights and are now making the "Field Chass-Ez" a patented chassis holder designed to facilitate radio servicing.

The new servicing tool will accomodate approximately 90 per-cent of all radios, either straight or flanged. The manufacturer states that the chassis holder will not fall over, can be tilted, takes no more room than the actual chassis, and takes only 5 seconds to install.

The tubes and other parts underneath the radio are easily accessible with this unit. Special reversible hooks on one end handle the flanged type chassis or permit the chassis to tilt back.

Further information and illustrated literature on the "Chass-Ez" may be secured by writing the Radio Division, *General Cement Manufacturing Company*, Rockford, Illinois.

MICROGROOVE NEEDLES

Duotone Company Inc. of New York has announced the availability of two of the company's line of needles in a size suitable for use with the new *Columbia* LP Microgroove records.

The "Star Sapphire" and "Shockproof Nylon" needles are now being made with a one mil radius.

In addition to one mil radius needles, the playing of the new records requires a turntable which operates at 33⅓ r.p.m.

Further information on the new needles may be secured from *Duotone Company Inc.*, 799 Broadway, New York 3, New York.

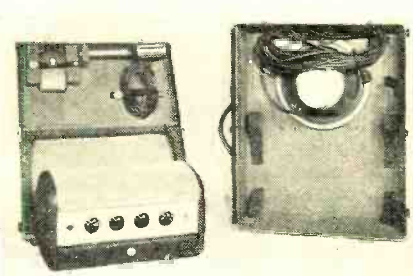
PORTABLE SOUND SYSTEM

The Engineering Products Department of *Radio Corporation of America* has announced production on a new deluxe portable sound system which employs a 15 watt amplifier and high efficiency components to provide acoustical output equivalent to that of a 30 watt portable sound system incorporating two average PM speakers.

Designated the *RCA* Type SP-15A, the new unit consists of an aerodynamic microphone, a low distortion, high output amplifier, a heavy duty Alnico PM type loudspeaker, and a two-tone luggage-sized carrying case.

The portable sound system is designed for use in such locations as moderate size auditoriums, bus terminals, night clubs, taverns, restaurants, auction rooms, and conference rooms. Two loudspeakers can be attached to the SP-15A amplifier to give the same high output for large auditoriums or locations requiring greater coverage than can be provided by one loudspeaker.

To place the system in operation it is only necessary to connect the power cable to any 117 volt, 50 or 60 cycle power supply and plug the microphone



and speaker cables into the amplifier. A phonograph jack permits the playing of transcriptions for musical programs or furnishing background for voice and announcements.

For further information write to Engineering Products Department, *Radio Corporation of America*, Camden, New Jersey. —30—

The Television Kit

(*Continued from page* 43)

"blue," and the transformer connections are such that a large positive voltage now appears on grid "4" to accelerate the process. Note, however, that this action charges the 500 μμfd. condenser in a manner that places its negative side on the grid.

Meanwhile, the positive voltage is coupled directly to the other grid so that this triode also conducts heavily and rapidly discharges the 1000 μμfd. condenser in series with the 100,000 ohm potentiometer. Presently a reverse action begins, for when the original triode saturates, its plate voltage can drop no further. Consequently, only the negative voltage applied by the 500 μμfd. condenser as it discharges through its grid leak is left to appear on the two grids, cutting off both tubes until the next positive pip ushers in a new cycle, and permitting the recharging of the 1000 μμfd. condenser previously mentioned.

In contrast to the saw-tooth voltages required for electrostatic deflection, modifications must now be introduced so that the currents flowing in the deflection coils will increase at a constant rate, the condition for linear deflection in electromagnetic systems.

If a coil did not contain resistance, the voltage across it would be L (its inductance) multiplied by the rate at which its current changed, and a constant change of current would therefore produce a constant voltage across the coil terminals. In other words, if the desired current is that of curve A in Fig. 3, the corresponding voltage is given by B.

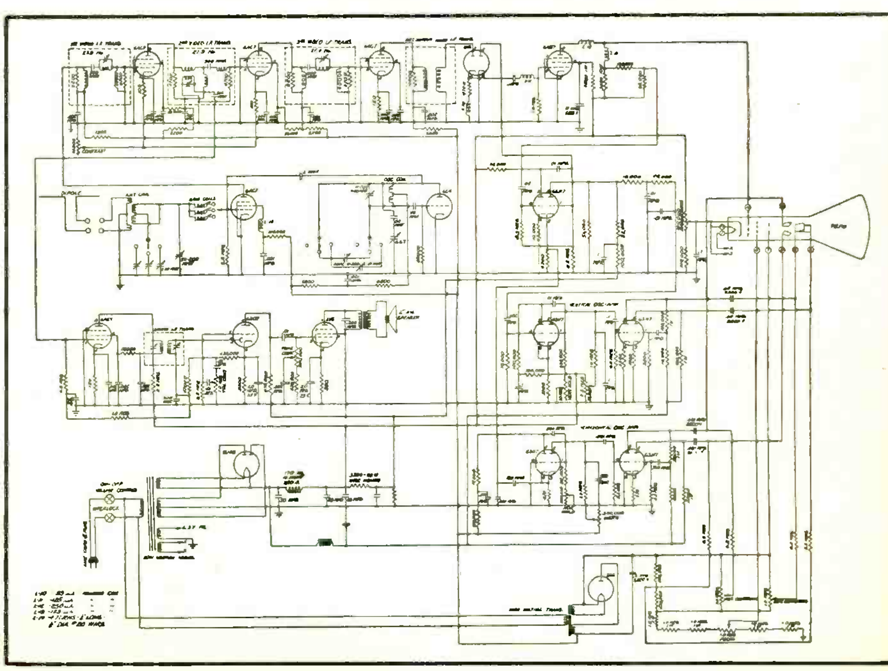
Unfortunately, real coils always possess finite resistance that leads to a further IR drop of the form denoted by C, and the terminal voltage accordingly becomes the sum of B and C as shown by curve D. Reflection should now disclose that, conversely, if a waveform of the form D is generated and impressed across a real coil, the resulting current through it must increase at a constant rate.

As a result we perceive that the linearity of the sweep depends upon how closely we succeed in matching D. Luckily, a reasonable approximation can be attained by holding the current flowing into a charging condenser and a series resistor substantially constant. A linear rise of voltage now develops across the condenser during the charging time, while the flood of current during discharge develops an appreciable voltage (V_r on D) across the resistor. In this manner, we achieve an acceptable duplication of the desired waveform.

The actual design task involved is tricky, however, leading to the additional components attached to the grid of X-4. Such compensation is generally found by trial, and in the kit field must also permit easy adjustment by the novice. This point illustrates one of the differences between kit and factory assembled receivers. The factory circuit can frequently use less components since trained personnel with access to suitable equipment make all adjustments before shipment. The kit, on the other hand, repeatedly must resort to expedients that offset the inexperience of the lay constructor but which do not sacrifice quality.

The remainder of the horizontal section needs little explanation. The 6BG6G is a straight current amplifier feeding an output transformer serving

Fig. 2. Circuit diagram of an early model kit using a 7 inch tube. Since electrostatic deflection was employed capacity charging circuits were used, controlled by simple multivibrators, to generate deflection voltages.



parts of the world, including an *English* beam to North America, probably during the evening hours in the United States.

Frequencies available to this Danish station include OZH, 15.165; OXY2, 6.042; OXY, 6.060; OXY3, 6.170; OZF, 9.520; OZG, 11.805; OZG2, 11.820; OZG3, 11.870; OZH3, 15.330; OZI. 17.750; OZ12, 17.810; OZ13, 17.835; OZX2, 21.625, and OZX, 21.710. (Kary, Pa.)

Finland—OIX4, 15.19, is often good signal at 2300-0000; begins with rooster crowing. (Balbi, Calif.)

French Equatorial Africa—Brazzaville's 7.000 outlet has been heard again recently around 1830-1915; news 1900; may not be complete schedule; when heard, the 7.000 outlet was in parallel with 11.970 and others, but was *not* announced. (Kary, Pa.)

French Indo-China—Radio Saigon, 6.163.3 (measured), has been heard recently in East around 0545-0630. (Kary, Pa.)

French West Africa—Radio Dakar appears to have left 11.713V for 11.898, scheduled 0200-0230, 0715-0830 (Sundays 0600-0900), 1330-1700. (Bluman, North Africa, via Radio Australia)

Germany—The short-wave transmitter at Munich on 6.080 carries *Radio Munchen* (German Home Station in Munich) and relays some programs from "The Voice of America," but some time ago began to also transmit RIAS (Radio In American Sector, Berlin), at 1700-1800; power appears 85 kw.; RIAS operates a medium-wave outlet on 629 kc. (Carlberg, Sweden)

Leipzig, 9.730, is scheduled Sundays 2300-1700, Mondays through Saturdays 2200-1700. Hamburg, 6.115, daily 2300-1730. Berlin's transmitter on 6.070 has not been heard lately. Baden-Baden, 6.321, is scheduled daily 2300-1705. (Miers, Germany)

Greece—Radio Athens, 15.345, continues to send a nice signal to North America, 1730-1830, news at start. (Worris, N. Y.)

Haiti—HH2S, 5.94, Port-au-Prince, operates 1830-2030; this may not be station's com- (*Continued on page* 187)

not found on 15.170, try alternate frequencies of 6.140 or 11.913 which may be used at times.) News in *English* is scheduled for 0600, 0800 (relayed from XGOA, Nanking), and 1000; other *English* programs include "The Baltimore Gospel Hour" on Sundays at 0430-0530; "Back to the Bible" on Saturdays at 0500-0530; "Showers of Blessing" on Mondays at 0545-0600; "Sermons In Song" on Wednesdays at 0635-0650; "Bringing Christ to the Nations" on Sundays at 0830-0900.

I am certain that readers of this Department join us in wishing all personnel of the Central Broadcasting Administration the best of wishes for the further development of radio—both international and domestic—in the Republic of China!

* * *

Club Notes

The newly-formed Nationwide Short Wave League is now accepting applications for membership. At present no fee is required. The local group in Gloucester, Mass., has formed a shortwave listening post where members meet each evening at 1830. Most members hope to eventually become amateurs; at present the members in Gloucester are sending out signal reports to amateurs whose signals are picked up at the listening post. Officers include co-managers, John A. Muise, Jr., and Hartman H. Brower, Jr.; president, Robert McCormack, and treasurer, Larry Provost. For further information, interested readers should contact Mr. Muise at P. O. Box 354, Gloucester, Mass.

A group of radio enthusiasts in Bergen county, New Jersey, have formed the Northern Valley DX Club. Members divide into two groups—one for SWBC and one for the ham bands. Two S-38's have been purchased for the club house. Secretary-treasurer is Thomas Campana, 240 Jefferson Avenue, Tenafly. New Jersey.

* * *

This Month's Schedules

(NOTE: Some stations may be changing from Summer Time to Winter Time shortly—in which case you may find them on the air *one hour later* than listed herein.—K. R. B.)

Albania—Stockholm Radio reports *Radio Scutari,* 8.220, at 2330-0100, 1300-1630.

Algeria—THA, 9.570, seems to close French program 1800, but is heard in Arabic to after 2010; badly QRM'd after 1950. (Ferguson, N.C.) Heard in New Zealand at 1500 with news in French. (Gray)

Angola—Stockholm Radio says the outlet on 8.090 has verified as CR6RF, Radio Club, Benguela; QRA is Caixa Postal nr 19, Benguela, Angola. Schedule is listed 1330-1600.

Argentina—LR3, 9.54, *Radio Belgrano,* has world news in Spanish 0500-0545, Argentine news 0545-0600; *no English.* This station announces it is in a network with LRI, LRI1, Buenos Aires; LUL, Mar de Plata, and LV2, Cordoba. (McPheeters, La.)

Brazil—Radio Jornal de Comercio, Recife (Pernambuco), 15.145, was first noted by Ferguson, N.C., on July 21 when tuned at 0650; has been heard at various times, including 1305, good level. Is heard evenings on approximately 9.565.

This station announces "Pernambuco falando para o mundo estas sao as emisoras do Radio Jornal de Comercio"; has been heard on 9.565 at 1730 and leaves the air at 2100. (McPheeters, La.) The 31-m. outlet is heard in Sweden at 1500. (Carlberg)

Frequencies and calls of *Radio Jornal de Comercio* are 780 kcs. (PRL6); 6.082 (no call given); 9.565 (ZYK3); 11.825 (no call given), and 15.145 (ZYK2). (Villela, Brazil)

PRE9, 15.165, Fortaleza, is heard in Sweden to 1600 sign-off. (Carlberg)

British New Guinea—The *new* station at Port Moresby, VLT5, 7.280, is heard signing off at 0745 with "God Save the King." Good signal in East. Widely reported throughout U.S. Uses 500 watts. The sister-station VLT7, 9.520, appears to be on the air most days around 0100-0300.

Chile—CE1180, 11.998, Santiago, announces "Radio Sociedad Nacional de Agricultura, Santiago;" heard from 0730 to 2200 weekdays and to 2230 on Sundays (with news and recordings of CBS Symphony); Spanish *only.* (McPheeters, La.)

China—XORA, 11.705V, Shanghai, not heard in months. (Balbi, Calif.) Not reported lately so may be off the air.

At the time this was written XGOY's 15.170 outlet had not been heard late mornings for some days; is possibly now using 6.140 or 11.913 for late morning beams.

Recently, one of the best signals from China has been on about 8.850, early mornings; may be a Communist-controlled outlet; signs off around 0900; call sounds XMAR or XMSR. (Dilg, Calif.)

Amoy, 6.105V, has not been heard for some months. (Dilg)

Colombia—HJFA, 6.054, Pereira, is in dual with HJFI; announces "La Voz de Pereira;" heard evenings to 2300 sign-off; *no English.* (McPheeters, La.)

Cuba—COBA, 9,965, noted first on July 30 from tune in at 2200 to leaving the air 2234, announcing CMBA and COBA and a call sounding like CM-31-M (?). (Ferguson, N.C.)

Czechoslovakia—Prague's 11.760 has news at 1245. (Jones, N.C.) At times may use 11.840 for this period.

Denmark—Stan Worris, N.Y., informs us that the new Danish 50 kw. transmitter (*not* 100 kw. as first reported) now comes on the air at 1100-1230 weekdays on (announced) 15.165; announces also is on 9.520, 1230-1400, with news in Danish 1235-1300. Announces in Danish and *English.* Stations officials say that reception reports from all over the world are welcomed and that when best frequencies have been determined, the station will begin regular daily transmissions to various reach 2257.5 kw., which is more than 200 times the prewar figure, and there will be no places where our broadcasts will not reach.

"For international service, two 50 kw. short-wave transmitters will be installed in each of these cities—Shanghai, Changchun, Canton, and Chungking. The Shanghai station will direct its transmissions to the West Coast of America; Changchun to the East Coast of America; Canton to Australia and the South Seas, and Chungking to Europe and Africa.

"Second, the function of broadcasting cannot be accomplished by powerful transmitters alone. A large number of receivers will be needed also. To increase the number of receivers is just as important as building great networks, and should not be overlooked, we feel. President Chiang Kai-shek, in his book, "China's Destiny," points out that 18,000,000 receiving sets should be installed throughout the country, and this will be our ultimate goal. In the first five years we shall distribute a minimum of 2,000,000 receivers, including five-tube, three-tube, and single-tube sets, either a.c.- or d.c.-operated, and crystal detectors, to listeners, all over this country. This number will then be increased gradually until the benefit of broadcasting will be enjoyed by every Chinese family.

"Third, except for the purpose of improving international friendships and consolidating internal beliefs, major importance will be laid on the introduction of culture in preparing the broadcasting programs. *Ultimate aim of broadcasting in China will be to embody education in entertainment, to increase mutual understandings, and to oust the pains of war from the world forever.*

"We also plan to increase wire-broadcasting, public-address systems, and recording equipment, which will be put into operation one after another. The training of technicians, announcers, and receiver servicemen to accommodate the requirements of large numbers of broadcasting experts, the promotion of scientific research, and the improvement of programs will be carried out also simultaneously by the Chinese Broadcasting System."

So says Fung Chien, director of XGOY, The Chinese International Broadcasting Station, long known as *"The Voice of China"* in Chungking.

We do not have space this month to give complete schedules for all Chinese s.w. outlets, but latest schedules for XGOY follow:

To Australia, New Zealand, and East Asia 0355-0550,* 15.170. To East Asia and South Seas 0535-0745, 15.170 and 7.153. To North America and Europe 0745-1000, 15.170 and 7.153. To Europe, America, China, and South Seas 1000-1050 (off with Chinese National Anthem), 15.170 and 7.153. (If

*(Note: Unless otherwise stated, time herein is expressed in American EST on a 24-hour clock basis: add 5 hours for GCT. "News" means in the English language.)

of freedom and glory for which they waited ever so patiently so long a time, should come at long last. Broadcasting played an important part during the war. It fully utilized its strength as the mouthpiece of the National Government.

"The spirit of the members in the field of broadcasting, who experienced intolerable sufferings, struggled with all their might and even sacrificed their lives, but still stood firmly at their posts, is comparable with those who actually fought on the front lines. Many martyrs lost their lives in broadcasting activities. The survivors worked with unshakable determination day and night under enemy bombardments without interruption. In the last few years of the war, commodity prices climbed sky-high, life in Free China became harder and harder, but Chinese broadcasters, although poorly equipped and badly fed, pursued their work diligently with redoubled efforts.

"China now has harvested her fruits of victory. *The achievements of broadcasting in China during her dark days will be remembered forever.*

"Needless to say, in the past two decades of Chinese broadcasting history, especially in the past ten years, there were many deficiencies. Although improvements were recorded in the past few years, they were either too slow or too late. When compared with other leading nations in broadcasting, we have lagged far behind—both in quantity and quality. Unavoidable defects were present in equipment or in techniques or in programs. We could use only what we already had at hand and no fundamental improvements could be expected.

"For future developments in Chinese broadcasting, the Central Broadcasting Administration has mapped out this plan:

"First, a great and complete national network should be established to promote international friendship on the one hand, and to consolidate internal beliefs and efforts on the other—so that the foundations of the Republic of China for many centuries to come will be thus planted. Domestically, this plan suggests the establishment of a central station in the National Capital of Nanking and 12 district stations in these cities—Shanghai, Foochow, Canton, Kunming, Lhasa, Tihua, Chungking, Changchun, Peiping, Hankow, Lanchow, and Kweisui. In addition, branch stations will be built in all important provincial capitals, cities, seaports, and other commercial centers. Close cooperation will be exercised between the central district and branch stations, just as the branches and leaves of a tree. These stations will assist one another and will proceed together on the road of prosperity and fertility. To put this plan into practice, 55 medium- and short-wave stations will be required. When completed, the total power of Chinese broadcasting stations will

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Model CIN-15B (Med.): 15-inch low frequency speaker (12 ounce magnet) with special 5-inch high frequency speaker. Handles 15-watt output, 8 ohm input. List price $47.50.

Model CIN-15C (Heavy Duty): 15-inch low frequency speaker (21.5 ounce magnet) with special 5-inch high frequency speaker. Handles 18-watt output, 8 ohm input. List price $62.50.

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with a total power of 274 kw. The Peiping station and the Taipei station were the largest among these, each having an output of more than 100 kw. Strength of the field of Chinese broadcasting was thus nearly tripled overnight. As for the northeast stations in Changschun, Mukden, Chingchow, Anshan, Yingkow, Antung, Kirin, Fushun, Pengki, and Chengteh, these were taken over successfully, while take-over personnel for other places have been assigned and are ready to proceed to their various destinations as soon as conditions permit.

"In the occupied areas, civil stations were not permitted to be established when under control of the Japanese and the puppets. After the surrender, numerous stations were built up like bamboo shoots after spring rains—especially in Shanghai, where at one time more than 100 stations were found operating. Naturally, such congestion caused much interference in frequency channels and deterioration in programs, resulting in a severe depreciation in the functions of broadcasting. With positive action taken by the Ministry of Communications to curtail and supervise these stations, only less than fifty civil stations remained, none of them having an output of more than 500 watts.

"The Central Broadcasting Administration has now under construction one 50 kw. medium-wave station in Shanghai; one 100 kw. medium-wave and two 20 kw. short-wave stations in Nanking (one or more of these s.w. outlets may now be completed—K.R.B.); one 10 kw. medium-wave outlet in Mukden, and one 50 kw. medium-wave and one 20 kw. short-wave station in Changchung. The Japanese left one 100 kw. long-wave transmitter and two 20 kw. short-wave transmitters in Changchung when they surrendered, but these were destroyed by war afterwards.

"Following is an estimate of the number of receivers now in various districts of China—Shanghai area, 112,600; Foochow area, 102,000; Canton area, 5000; Kunming area, 5000; Lhasa area, no estimate; Tihua area, no estimate; Chungking area, 3000; Changchun area, 143,500; Peiping area, 131,000; Hankow area, 4000; La-nchow area, 1600; and Kweisui area, 4000—or a total of 511.700 sets.

"China suffered greatly during the eight years of the war of resistance. To obtain national existance, independence, and freedom, we fought persistently in spite of numerous reverses and hardships, until the final victory was achieved. Chinese broadcasting was destined to serve its country even in its primitive day. During the war years it shared the heavy war burdens as well as its own difficulties and hardships. Eight years were not a short time. There had been many dangers and threats, shocks, and disturbances, but broadcasting offered effective support to the people's fighting spirit, revealed the enemy's evil plots, and positively crushed its rumor offensives. The *"Voice of China"* presented the actual accounts of the battle-fronts to the Allies, appealed to them for Free China's urgent needs, and sought understanding, sympathy, confidence, and assistance from abroad. To our fellow-countrymen in the occupied areas, broadcasting was like a hand of the National Government's concerns and consolation. Year in and year out it confirmed their belief that the day

Novel radio panel boards have been built into the backs of rear seats of the two Chrysler "Windsor" sedans which the Royal Danish State Radio Broadcasting Corporation uses throughout Denmark as mobile stations to feed local events to the Danish network. The car serves both as a control room and also as a small broadcast studio. Windows provide visibility for on-the-scene broadcasts. The unique mobile radio cars are inconspicuous and enable crews to cover events without difficulty.

lower than from average standard records, and consequently can be more completely removed with a given method of suppression. It is also true that since the average signal is lower, the signal-to-noise ratio with respect to turntable rumble, hum, etc., is appreciably poorer. This means that bandpass systems, such as the Dynamic Noise Suppressor originated by H. H. Scott, have a worthwhile advantage in connection with low frequency noise. With these records, as well as with other types, a thorough flushing of the grooves with soap and water periodically will aid in holding down the noise level.

The recording curve shown in Fig. 3 indicates a slope of approximately four db. per octave with a slight rise at both ends. This is sufficiently close to the NAB/Orthacoustic characteristic for satisfactory results with standard equalizers. —30—

International Short-Wave

(*Continued from page* 70)

after another and were re-established in the interior. Besides these, four more stations were built—one in Kangting, one in Sichang, one in Kansu, while the other was mobile. The Kiangsi Broadcasting Station was taken over. Until V-J Day, the Central Broadcasting Administration, on its vast battle-fronts in the great interior, had under its control eleven broadcasting stations with a total of 18 transmitters, thus organizing a fairly-strong broadcasting network. The 11 stations were—Central, International (both in Chungking), Kunming, Kweichow, Fukien, Shensi, Sian, Hunan, Kansu, Sikang, and the mobile unit. With the exception of the latter station (broadcasts from which were directed primarily to the Third War Area), the areas served by these stations ranged from the local province or neighboring provinces, up to the whole country and even to America, Europe, and the South Seas. The total radiated power reached 145 kw., while the daily operation periods were more than 90 hours. Even though under extremely difficult conditions, Chinese broadcasting during the war years made obvious improvements over prewar days.

"On August 15, 1945 (August 14 in America), the war concluded victoriously and the Japanese surrendered unconditionally. The Japanese and the puppet governments had many radio stations in their occupied areas, and these stations had been taken over successively by the Central Broadcasting Administration since August 27. They were located respectively in these 21 cities—Nanking, Shanghai, Hankow, Amoy, Peiping, Tietsin, Paoting, Taiyuan, Shihchiachung, Kweisui, Tangshan, Tsingtao, Kaifeng, Hauchow, Hangchow, Canton, Taipei, Taichung, Tainan, Hualienkang, and Chiayi. The transmitters totaled 41, and that even though sapphire is 9 and diamond is 10 the difference in hardness between them is very great. The hardness scale is an arbitrary scratch test source of information that does not truly indicate wear or penetration hardness. It is safe to say that no wear test will ever show diamond as being less than ten times the hardness of sapphire, and that 20 to 25 is probably a more realistic figure.

A given dimension for a flat surface worn on a .001 stylus is relatively larger, both with respect to the stylus and the groove, than a flat of the same size on a standard stylus. It is clear that a diamond stylus becomes even more desirable for playing Microgroove records than for standard types. It is worthy of note that many people have a misconception about the "brittle" qualities of diamond styli or are fearful of cleavage characteristics. High quality diamond styli are made from entire diamond crystals, and a chipped diamond stylus of this type is at least extremely rare. None has ever been observed in the experience of the writers.

It is, of course, a distinct advantage that the .001 stylus be used only on vinyl surfaces. Where both shellac and vinyl records are to be played, the shellac records will eventually wear a flat on the stylus that is not serious with respect to the abrasive shellac surfaces but is disastrously destructive for vinyl surfaces. With a properly ground *and polished* sapphire stylus used only on Microgroove vinyl surfaces at five grams tracking pressure in a well designed pickup cartridge and arm, it is reasonable to suppose that 500 to 1000 hours of playing time may be anticipated without difficulties.

It is obvious that the very light tracking pressures make the solution of mechanical problems considerably more critical. Vertical and lateral vibration of the turntable become relatively more important because low frequency disturbances are of greater magnitude with respect to the recorded signal than with conventional records. Hum and rumble must be at least six db. lower in order to have the same signal-to-noise ratio as with quiet standard records. The lower signal level also means, of course, that somewhat more voltage amplification is required for a given output from an amplifier and this, while not of serious consequence, inevitably requires lower inherent noise and microphonics for comparable results.

There has been some question as to whether noise suppression systems have real value in connection with the *LP* records. Earlier in this article it was mentioned that the surfaces of Microgroove recordings observed to date are exceptionally quiet. However, it is obvious that with any recording and reproducing system depending on a mechanically engraved signal, the accumulation of dirt and wear will introduce increasing percentages of noise. The surface noise from Microgroove records is initially appreciably

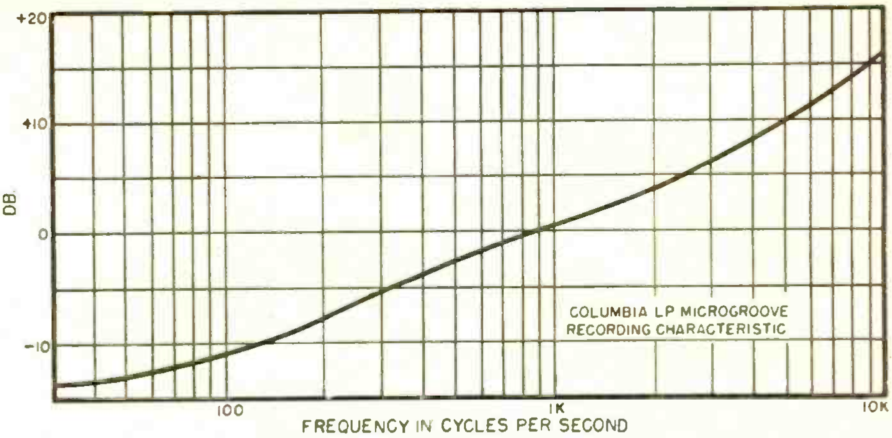


Fig. 3. Frequency characteristic of the Columbia long-playing (LP) Microgroove records.

Referring to the family of curves in Fig. 2, the total force is plotted against frequency. Curve 1 is an idealized condition for pickup characteristics intended for use on records with standard groove dimensions. In the region below turnover, the principal force is $\frac{1}{C}x$, at F_r the forces are resistive only, and at F_h the system is essentially mass controlled. Theoretically, with a record that includes unusually heavy bass passages. Curve 2 would be desirable with F_r moved downward and the stiffness reduced. With Microgroove recordings the maximum displacement at low frequencies is lowered, while it becomes possible to maintain the maximum high frequency excursion so that it is relatively larger with respect to the low frequency amplitude. This makes it practical to design the mechanical characteristics of the pickup in accordance with Curve 3, moving F_r in an upward direction and favoring the high frequency end of the spectrum. When large amounts of equalization (diameter plus high frequency pre-emphasis) are introduced, the curve is effectively modified to appear as shown by Curve 4. However, at low frequencies the magnitudes of the absolute values of this curve are lowered so that the low frequency end is actually lower than the curve indicated as ideal for standard records. Designing in accordance with these considerations makes it possible to produce a pickup for reproducing Microgroove records that has appreciable advantages over the mechanical design used for standard groove dimensions.

The unit load on the stylus and record material with Microgroove records with a .001 stylus at five grams tracking pressure has been shown to be comparable to the load with conventional reproducers at one ounce of tracking pressure. This means that conditions for wear of the stylus and the record may be assumed to be closely similar. Exhaustive investigations with conventional reproducers have shown that metal tips wear rapidly even on vinyl pressings, and that sapphire styli are only moderately superior in this respect. Surface dirt makes the vinyl record a lapping medium. The wear from a shellac disc is very much like grinding with a coarse stone whereas the wear from a vinyl disc is more like lapping with a fine stone. It is to be expected, and is demonstrated by test, that any stylus under given conditions will wear much longer on vinyl records than on shellac pressings. The softer materials such as osmium and sapphire do wear down, however, even on vinyl records. It must be borne in mind that the hardness scale is by no means linear,

Table 1. Specifications covering Columbia's LP Microgroove records. Tolerances indicate careful control of manufacturing processes to insure consistent results.

	10" Record	12" Record
Diameter	9⅞" ± 1/32"	11⅞" ± 1/32"
Thickness	.075" ± .010"	.075" ± .010"
Center hole	.286" + .001" − .002"	.286" + .001" − .002"
Concentricity	Run-out not to exceed .010"	Run-out not to exceed .010"
First record groove diameter	9½" ± .020"	11½" ± .020"
Minimum inside diameter	4¾"	4¾"
Eccentric groove diameter	4 7/16"	4 7/16"
Eccentric groove run-out	.250" ± .015" Shape same as music grooves	.250" ± .015" Shape same as music grooves
Speed	33⅓ r.p.m.	33⅓ r.p.m.
	Groove Shape	
Included angle	87° ± 3°	87° ± 3°
Tip Radius	Under .0002"	Under .0002"
Width at top	.0027" to .003"	.0027" to .003"

Microgroove Recordings
(*Continued from page* 41)

reproducer heads requires the use of very little damping, hence the damping force in well designed pickups will always be small. In the case of Microgroove recordings the force required to accelerate the mass of the stylus will be the largest involved because so large a percentage of the energy appears at high frequencies.

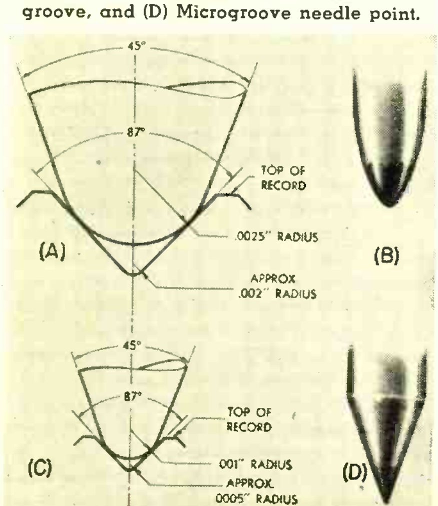
For a sine wave the instantaneous displacement is equal to $x \sin \omega t$, where $\omega = 2\pi f$ and t = time. It follows then that:

$$\frac{dx}{dt} = \omega \cos \omega t, \text{ and } \frac{d^2x}{dt^2} = -\omega^2 \sin \omega t$$

It is clear that any terms containing ω^2 become relatively very large at high frequencies. This is the principal force to consider in Microgroove recordings and states the reason that the reproducer should be designed to favor the high frequencies. In practice, the design procedure is to reduce the mass and increase the stiffness of the suspension.

In any pickup design the mechanical characteristics will be such that at some frequency the reactive forces will cancel out and the only remaining component will be resistive. It is important that this frequency be so selected that the absolute magnitude of the sum of the forces is equal for frequencies below turnover and for the highest frequency to be reproduced. This again refers to the fact that the total forces acting on the stylus tip must never exceed the tracking pressure, which in the Microgroove case is assumed to be five grams. The lateral force is applied to the stylus by means of an inclined plane (the groove wall) at an angle that may be assumed to be 45 degrees. Hence, if the total forces exceeded the tracking pressure, the needle would be thrown out of the groove.

(A) Diagrammatic view of conventional needle in record groove. (B) Conventional point. (C) Microgroove needle in record groove, and (D) Microgroove needle point.



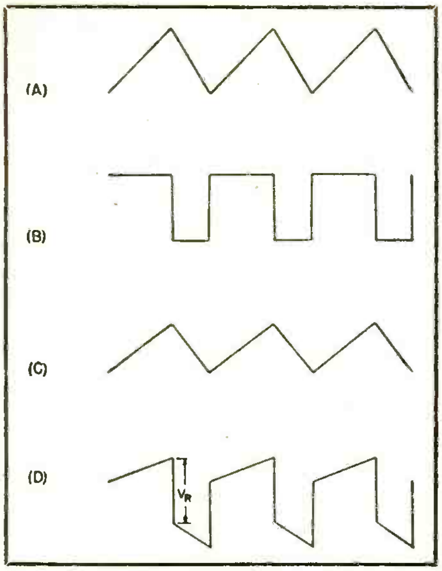


Fig. 3. (A) Current through and (B) voltage across perfect inductance. (C) Voltage across the finite resistance of an actual coil. (D) Combination of (B) and (C) gives required voltage across a real coil to provide a saw-tooth current waveform.

a dual role. One function performed is simply that of matching the amplifier to the low impedance of the yoke coils, while the other consists of tapping off a portion of the tremendous voltage induced during the retrace interval, with rectification accomplished by the 1B3GT and the 1200 $\mu\mu$fd. condenser in its filament circuit. Finally, the 6X5GT is inserted to damp out the transient oscillations created by discontinuities in the waveform. The tube is connected to conduct when current increases and consequently no lengthening of the retrace time is sustained. Although a factory-built receiver would probably use a heavier tube, careful investigation has vindicated the 6X5GT as completely satisfactory for this application, thus eliminating an extra filament winding.

Since the vertical section has to produce a deflection current and nothing more, its design is a simplification of the procedures just discussed and the reader may analyze the circuit at his leisure.

So far we have learned that the clamor for large picture size is currently making electromagnetic deflection almost standard for kinescopes, causing sweep circuits for both kit and factory-built receivers to be essentially alike. The i.f. section, however, gives us a totally different situation. For one thing, the i.f. channel in this particular kit has remained unchanged in form since its inception for the seven inch tube over a year ago. It also is completely different from i.f. systems appearing in many factory sets where staggered tuning or judiciously coupled stages are feasible. Notable success has been achieved with a double-tuned, trap-coupled innovation that allows the builder to perform i.f. alignment by visual and auditory observation. Examination of either Fig. 1 or 2 will reveal that an inductance resonates with interelectrode and stray capacities in both the plate and grid circuits, with severe damping present to attain wide bandpass. In the second video i.f. transformer (Fig. 2) a tunable resonant circuit traps frequencies immediately surrounding 21.9 mc. and conveys them to the audio stages, while another trap in the third video transformer is set for 27.4 mc. The two preceding sentences explain the term "double-tuned, trap-coupled," features that accept wanted frequencies and reject the undesired ones of adjacent channels. Although large damping resistors diminish gain, the three i.f. stages definitely provide all the amplification a receiver needs, and generally speaking, the factor limiting reception is geography rather than receiver sensitivity.

Detection and video amplification are effected in a conventional manner. Positive signals derived from the cathode of the diode excite a single stage of power amplification characterized by peaking coils in its input and output circuits.

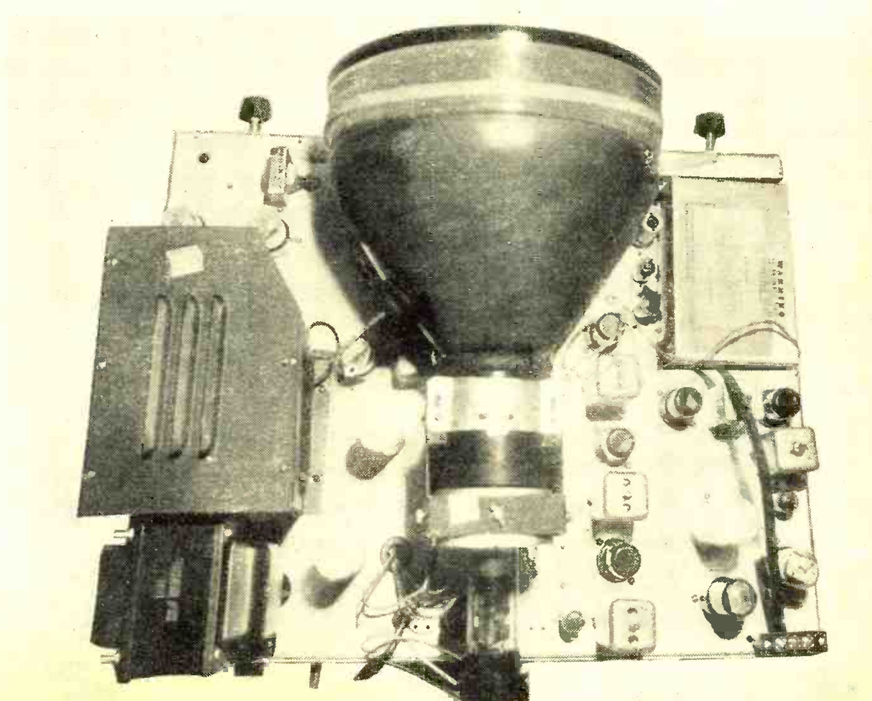
Considerable design latitude is available to the engineer when he tackles the sync limiter-separator. Probably this fact exists because the problem is still one of television's weak links, and until the appearance of a new technique that can really suppress interference effectively, we can expect to find extensive variety in these circuits. Nevertheless, they will all seek to perform the identical function of first responding exclusively to the synchronizing pulses, then transferring the narrow pips to the horizontal oscillator and the serrated pulses to the vertical oscillator.

Several interesting comments can be made about the audio channel. For one thing, a ratio detector is best suited for a kit because it is easy to adjust. Low output relative to other FM detectors is quite unimportant because amplification can be readily accomplished. But in this connection note the somewhat unusual procedure of using a high gain duo-triode ahead of the power tube. This gain could have been furnished just as adequately by the customary method of another i.f. stage. The 6SL7, however, dispenses with tuning an extra i.f. can, certainly a desirable simplification for a home-assembled receiver.

There remains only the r.f. unit to consider, and the situation here is of particular interest because of the crucial importance the tuner bears to the entire receiver. In short, a slipshod r.f. unit can nullify completely what might otherwise be a well-designed set. Clarity may be impaired, contrast may be reduced, frequency drift can necessitate periodic adjustment and image rejection, already inherently low, may be lowered still further. But most important of all, the picture may be badly marred by the incessant presence of "noise" and "snow."

For the uninitiated, "snow" is an advanced case of "noise," and both are marked by the impression of small dots swarming chaotically in all directions. Unfortunately, even the most expensive instruments are plagued somewhat by this defect. Since the occurrence is related to the signal-to-noise ratio in the output of the converter (the converter, to be sure, is the chief source of noise in any receiver), gain becomes secondary to the task of obtaining a high signal-to-noise ratio. Naturally, the problem is a formidable one justifying the full time of entire engineering staffs. And not to be overlooked is the vexing matter

Top chassis view of the completed television receiver.



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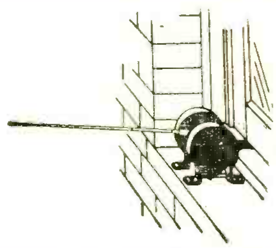

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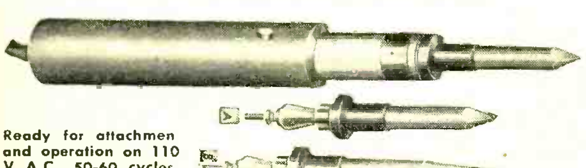

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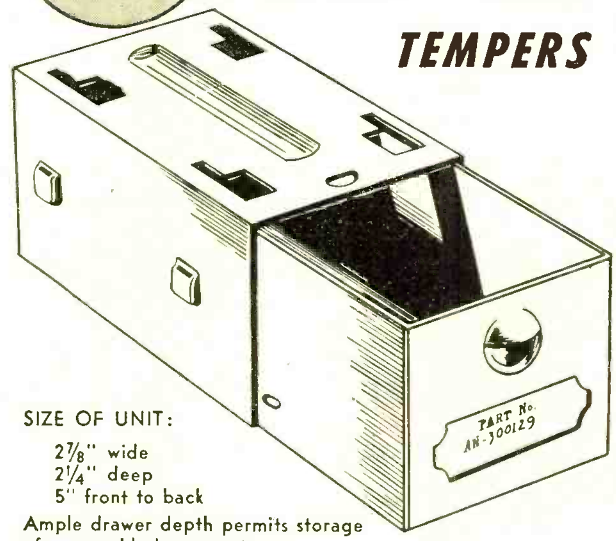
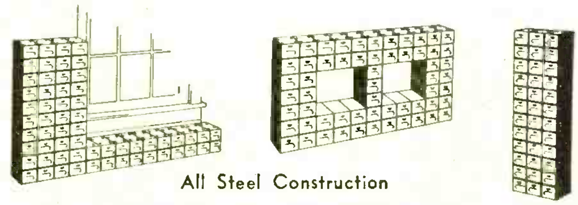


SIZE OF UNIT:
2⅞" wide
2¼" deep
5" front to back

Ample drawer depth permits storage of reasonably large parts.

Build Your Small Parts Cabinet To Fit Your Space . . . Add any number of units as needed!



All Steel Construction
Compact • Easy to Assemble
Unit Rigidly Interlocks with Others at Top, Bottom and Sides
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A NEW LOW PRICE IN PARTS CABINETS

Net Price — Single Unit - - - - - - - - 40¢
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Rated Jobbers, Manufacturers and Quantity Buyers Write for Quantity Discounts

JOBBERS . . . This is the hottest, fastest selling item to hit the market in years — some excellent territories still open — write immediately.

Available retail through radio shops; wholesale through jobbers — or write direct for nearest supplier.

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of mechanical layout, a problem that is aggravated by the high frequencies of television. Hence, by paying for rigorously designed r.f. units, and by alloting the manufacture of the unit to a sub-contractor, many kit manufacturers succeed in reducing noise to negligible proportions.

Certainly this discussion of design trends would be incomplete if we failed to mention the fundamentals of layout and similar considerations, like shielding the 6BG6G. We are also given an excellent example of how public opinion will make its power felt, as it was consumer reaction that relegated the "hold" controls to the rear of the chassis, leaving the front of the finished model as simple as possible.

The most imperative matter, of course, concerns space. Cramped corners and crowded regions are just out of the question if the beginner is to avoid confusion and if servicing problems are to be simplified. By providing generous space, incidentally, surprisingly neat wiring jobs are made possible.

One result of this consideration is the slightly increased chassis size of the kit compared to the factory product. Nevertheless, attractive cabinet design lends a distinctive and professional appearance to the kit that compares favorably with the factory-produced set.

All in all, the kit industry has unquestionably rendered three noteworthy services. First, it has brought the enjoyment of television to many people who otherwise would not have been able to afford it. Secondly, the use of kits has been a major factor in educating a pool of technically trained men for the industry. Thirdly, and in a humanitarian sense this is the most praiseworthy achievement of all, the kit has been a valuable source of recreational and emotional relief to patients in various hospitals.

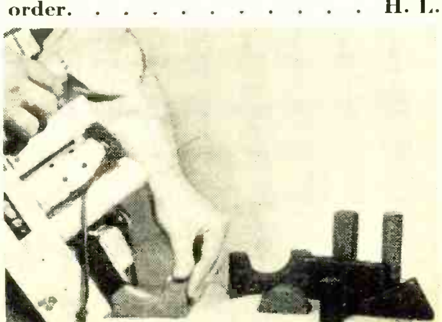
EDITOR'S NOTE: *Mr. Flomenhoft's article intrigued us to the extent that we too, assembled and studied a 10BL kit in our labs. Total time from unpacking to viewing WBKB's test pattern was 23 hrs. We weren't disappointed.*

—30—

PREVENT DAMAGE TO PARTS

A NUMBER of pieces of wood cut in shapes such as illustrated will hold the radio chassis in place safely for servicing.

Some friend with a power tool, if you don't have your own, can cut such pieces from soft pine wood in short order. . . . . H. L.



Television Receivers

(*Continued from page* 65)

worth, and *Stewart-Warner* receivers fall within the first category. In the *General Electric* (Models 801 and 802) and *Stewart-Warner* (Models T-711 and T-712) receivers, there are three amplifiers. See Fig. 4. Transformers T_1, T_2, T_3, and T_4 are overcoupled and heavily loaded with resistance to provide approximately a 4 mc. bandpass frequency characteristic. A third winding in each transformer functions as a trap to attenuate certain undesirable frequencies. (A complete discussion of trap circuits will be found in the September, 1948 issue of RADIO & TELEVISION NEWS, page 58. It is suggested that this be read before progressing farther.)

The over-all response of this video i.f. system is shown in Fig. 7. The curve is approximately 4.0 mc. wide, extending from 22.4 mc. to 26.4 mc. 26.4 mc. is the i.f. value of the video carrier and as such receives only 50 per-cent of the total amplification. The video frequencies containing the image information then extend from this point to 22.4 mc. In this system the response between 23.0 mc. and 22.4 mc. decreases to 50 per-cent, indicating reduced amplification for the higher video frequencies.

In working with the i.f. frequencies, it is interesting to note that in the incoming signal the video carrier frequency is below the highest video sideband frequency where as in the i.f. system, just the reverse is true. The reason for this is due to the placement of the mixing oscillator frequency above the incoming signal. As an illustration, assume that the receiver is tuned to channel 2. For this channel, the oscillator frequency is 81.65 mc. This combines with the 55.25 mc. voltage of the carrier to produce an i.f. value of 26.4 mc. In the same signal, the highest video frequency is 59.25 mc. and when this mixes with the oscillator voltage the i.f. produced is only 22.4 mc. Thus the reversal occurs in the mixing process because the oscillator frequency is above the signal frequency. If it had been below the signal frequency, no reversal would have taken place. However, it makes no difference as far as the operation of the receiver is concerned. It is important only to the serviceman when he has to align the i.f. system. If the i.f. response curve, Fig. 7, falls down around 22.4 mc., then the higher video frequencies will be adversely affected; if the curve falls down around 26.4 mc. the lower video frequencies will receive less amplification.

Many novice television servicemen make the mistake of attempting to judge receiver response by examination of a received picture during a program. Scenes change too rapidly for this method to have any useful value. What is needed is a specially designed test pattern and such patterns are transmitted by all stations 15 minutes to a half-hour before the start of each broadcasting period. If adjustments must be made with a picture on the screen, they should be made only when a test pattern is available.

In the video i.f. system of Fig. 4, two of the three i.f. stages, V_1 and V_2, receive a negative biasing voltage from a special bias rectifier V_4. 6.3 volts is applied to the cathode of this tube and rectified. Since practically no current is drawn by any of the controlled grids, the rectified voltage developed across C_1 is constant. The required amount of necessary negative biasing voltage for the two i.f. stages is tapped off by a contrast potentiometer. The final i.f. stage employs cathode bias and is not controlled by the contrast potentiometer.

The serviceman will recognize the contrast control as a simple gain control network. In sound receivers, a comparable control, volume, is usually located at the input to the audio amplifier system. In television receivers, a much more satisfactory arrangement is obtained when the contrast control varies the gain of the video i.f. amplifiers.

In later production runs of the same *G.E.* models, the negative voltage for the contrast control is obtained from other points in the circuit. It really makes little difference where this voltage is obtained as long as it is steady. The trap circuits in this system are simple absorption type units.

Transformer coupling is employed

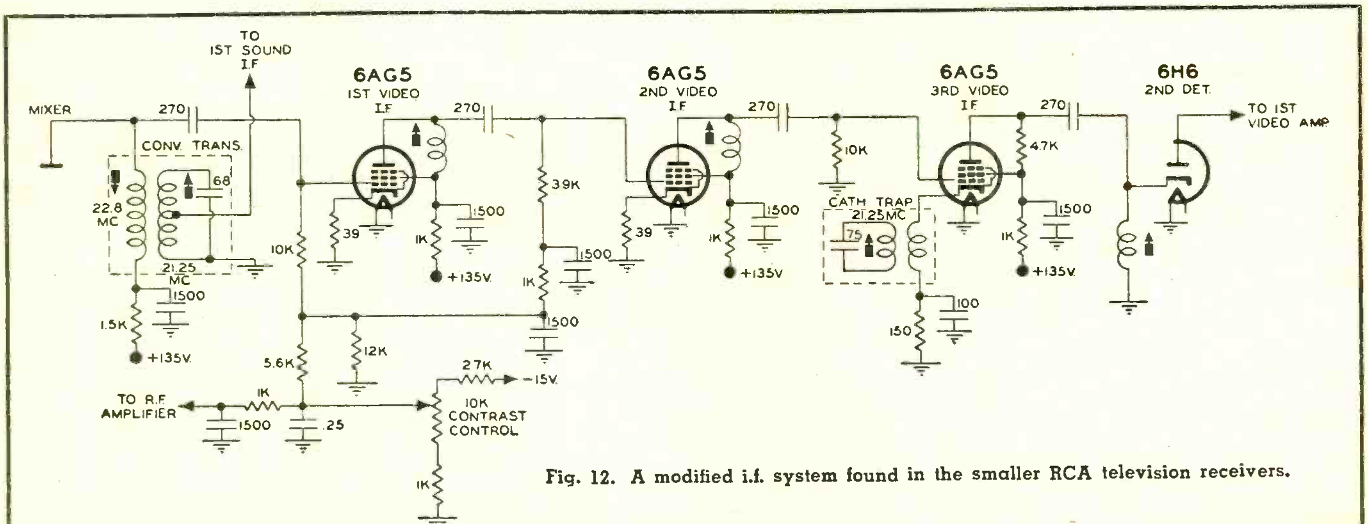


Fig. 12. A modified i.f. system found in the smaller RCA television receivers.

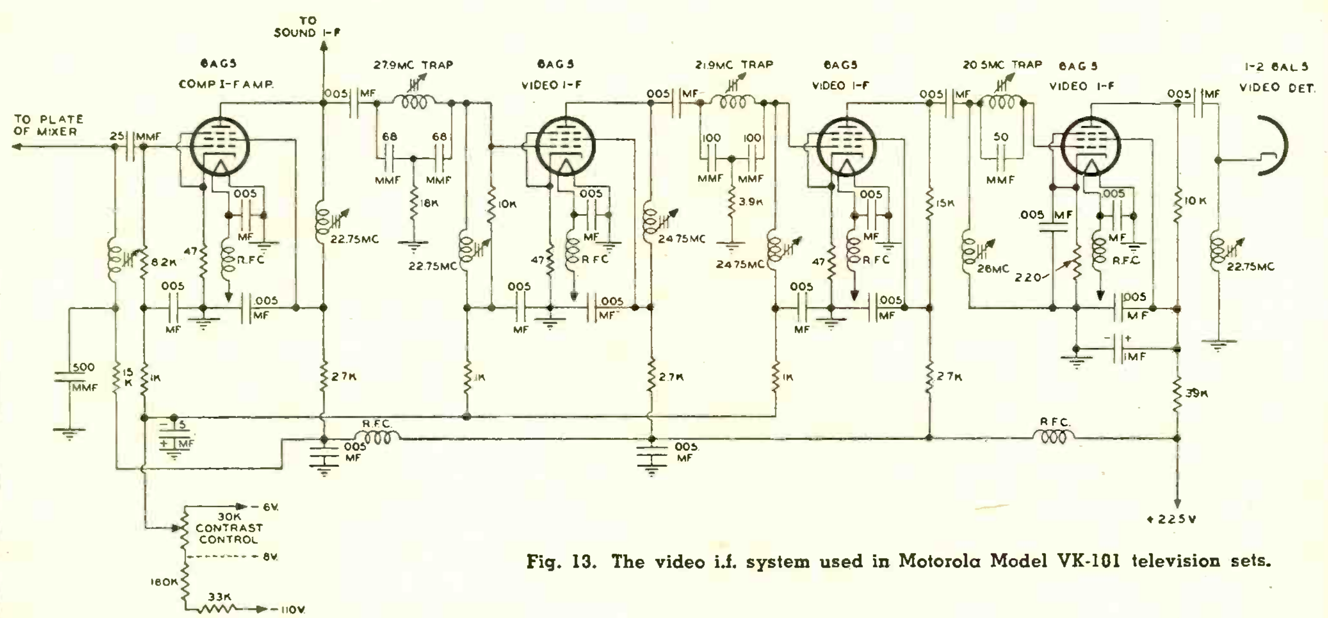


Fig. 13. The video i.f. system used in Motorola Model VK-101 television sets.

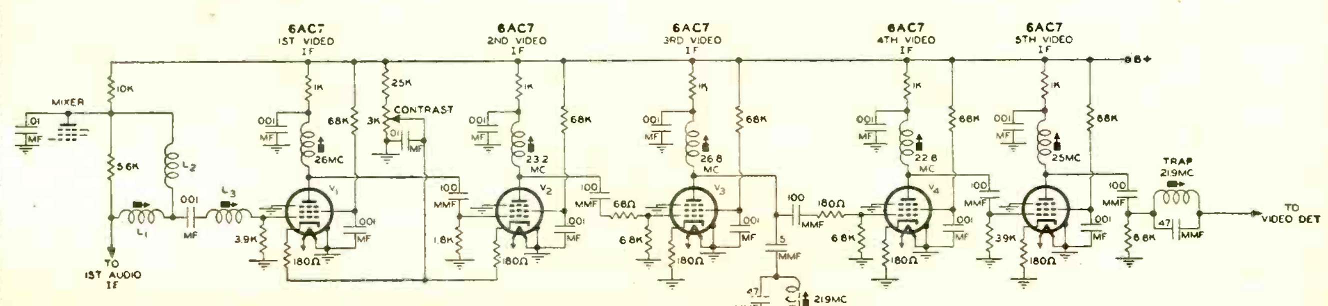


Fig. 14. An interesting combination of complex coupling and stagger-tuned coupling is shown. This circuit is employed in Industrial Television sets.

in the *Farnsworth* receiver, although with some modifications. The circuit, Fig. 5, contains three stages, each with a 6AC7 tube. Each transformer is resonated to the proper frequency by the individual distributed coil, tube, and wiring capacities. Variable adjustments are lacking on two of the four transformers and any significant change in these units cannot be compensated for by readjustment. Instead, the entire unit must be replaced. However, these two transformers are each heavily loaded, broadening the bandpass to about 4.0 mc. and reducing the effect of normal changes in component value. It must be realized, however, that the simplicity afforded by this system is accomplished at the expense of gain.

Each transformer has a tertiary winding which serves as a trap. At T_1, the trap frequency is 27.75 mc., the i.f. value of the adjacent channel sound carrier. The same is true of the trap coupled to T_2. The remaining two traps are tuned to 21.75 mc., the sound i.f. value for the channel being received. Each trap is tuned by a small trimmer condenser accessible either from the top or bottom of the chassis. The third trap circuit is the audio take-off point. The voltage appearing across here is applied directly to the audio i.f. system. The video carrier i.f. is 26.25 mc.

Automatic gain control voltage is developed at the detector and fed back to V_1 and V_2. Each of the stages, in addition, develops a small cathode bias voltage.

A fourth receiver (*Belmont*) employing transformer coupling is shown in Fig. 8. Two stages of i.f. amplification are utilized, with the first stage serving both video and audio signals. Separation of the signals occurs in the plate transformer of this stage, enabling the second i.f. amplifier to be designed solely for the video signal. The output of the second video i.f. stage feeds into a combined video detector and a.g.c. tube. Recipient of the a.g.c. control voltage is the first i.f. amplifier.

It is interesting to note that no adjacent channel traps are included in this receiver. Undoubtedly the rather limited bandpass of the system (approximately 3 mc.) was the deciding factor in the omission of these two circuits. Since the response is down markedly at those points where the adjacent signals would appear little interference from normal signals can be expected. Trouble will probably arise, however, if these adjacent channel signals should arrive in strength comparable to or stronger than the desired signal.

Stagger-Tuned I.F. Systems

The majority of sets today employ single coils which are stagger-tuned in frequency. That is, each coil is peaked to a different frequency within the passband of the system. Fig. 9 illustrates how five separate coils, each tuned to a different frequency, combine to give a 4.0 mc. bandpass in many *RCA* television receivers. Stagger-tuning combines the advantages of high gain and ease of alignment. (A more detailed discussion indicating how bandwidth and gain of stagger-tuned systems are linked together is given on page 55 of this issue.)

In the stagger-tuned i.f. system employed in the larger *RCA* receivers, Fig. 11, the amplifier strip contains four 6AG5 pentodes, each with a tuned plate circuit. The various peaking frequencies are as follows:

Converter transformer	21.8 mc.	(T_1 primary)
1st i.f. transformer	25.3 mc.	(T_2 primary)
2nd i.f. transformer	22.3 mc.	(T_3 primary)
3rd i.f. coil	25.2 mc.	(L_1)
4th i.f. coil	23.4 mc.	(L_2)

The effective "*Q*" of each coil is determined by the shunt plate load or grid resistor. Fig. 9 gives the relative gains and selectivities of each coil and the over-all shape of the combination (with the effect of the trap circuits included).

Four trap circuits are found in this system, of which the first three are absorption type traps. The first trap, coupled to T_1, is tuned to 21.25 mc., the audio i.f. of this system. The voltage developed across this trap is fed directly into the sound i.f. system. The second trap is coupled to T_2 and is set for 27.25 mc., the frequency of the lower adjacent channel sound carrier. The third trap, coupled to T_3, is peaked to 19.75 mc., the higher adjacent channel picture carrier frequency. The final trap is a degenerative one, located in the cathode leg of the fourth i.f. amplifier and tuned to 21.25 mc.

A contrast control network regulates the amount of negative voltage applied to the first three i.f. amplifiers and the r.f. stage. The manner in which this contrast control operates is not readily apparent from Fig. 11 and it is further complicated by the placement of a diode within the control circuit. To clarify the circuit, let us rearrange the components as shown in Fig. 10.

When the contrast control is in the maximum gain position (maximum clockwise), the movable arm *B* is at point C, and the i.f. bias is approximately −1 volt. The r.f. bias is obtained from a point connected to the plates of the diodes. Since the diode is conducting rather heavily (due to the presence of the +270 volt source) its plate resistance is quite low and for all *practical* purposes, point *D* is at cathode (or ground) potential. Consequently, the r.f. bias is zero.

As the control arm *B* of the contrast potentiometer is moved away from point *C*, the negative bias on the grids of the i.f. amplifiers increases. The contrast potentiometer is part of a series network (of the 2700 ohm and 680 ohm resistors) which connects from the negative 18 volt power supply terminal to ground. Point *A* is approximately −14 volts and point *C* is −0.9 volts. The potential of arm *B* becomes more negative as point *A* is approached. The current from the positive 270 volt supply travels through the 680,000 ohm resistor, a

10,000 ohm resistor, a portion or all of the contrast control and the 680 ohm resistor. Most of the 270 volts is dropped across the 680,000 ohm resistor leaving so little for the remaining resistors that, when point *B* is moved toward point *A*, the negative potential at *A* is actually able to overcome the positive voltage at point *D* and stop the diode conduction. Thereafter, the r.f. bias voltage changes rapidly and becomes even more negative than the i.f. grids. The objective of this fairly elaborate control system is to provide a good signal-to-noise ratio in the receiver. The gain of the r.f. stage is reduced when it becomes necessary to prevent distortion in the first i.f. amplifier. *Crosley, Admiral, Andrea,* and *DeWald* receivers contain video i.f. systems which closely parallel that of *RCA*. Variations between systems may include a simpler form of contrast control or fewer i.f. stages, but these are differences which will present no problems to the average serviceman.

In some *RCA* models, the contrast is incorporated into an a.g.c. network which provides an automatic variation above and below the bias point set by the contrast control. This is closely akin to the manual volume control and a.v.c. in sound receivers. A full discussion of a.g.c. systems in television receivers will appear in a future article.

In smaller (and less expensive) sets, *RCA* uses the modified video i.f. system shown in Fig. 12. The system contains three i.f. amplifiers, two sound traps, and a simple contrast control network. The position of the movable arm of the potentiometer determines the amount of negative voltage applied to the controlled tubes and their bias will vary accordingly. The video response of this network is 3 mc. wide.

In many respects, the video i.f. system of *Motorola* model VK-101 receivers (originally labeled VT-101) is similar to the *RCA* system. See Fig. 13. Thus we find impedance coupling, stagger-tuning, and a contrast control regulating the gain of the first three i.f. amplifiers. However, in the first and second i.f. stages, where the high and low adjacent channel traps are contained, each stage has two shunt tuning coils. In each instance both coils are effectively in parallel and determine the net tuning inductance. Two coils are used because it was felt by the manufacturer that they improved the performance of the traps. Two coils were found unnecessary for the 3rd stage containing the low-frequency rejector trap. Trap circuits are provided for the lower adjacent channel sound carrier, the sound carrier of the same channel, and for the video carrier of the higher adjacent channel. The first two traps are Bridged-T traps (see article, page 58 of the September issue) and reduce signals at these frequencies to 1/50th of their original value. The third trap is a simple parallel resonant circuit placed in the signal path.

The video i.f. carrier value in this system is 26.4 mc.

Garod sets employ a combination of stagger and transformer tuned video i.f. amplifiers. The first four stages are impedance coupled while the fifth and final stage is transformer coupled to the video detector. See Fig. 6. Each stage has a tuned trap, set either for the sound of the same channel (21.25 mc.) or the sound of the adjacent lower channel (27.25 mc.). The bias (and consequently the gain) of the second, third, and fourth video i.f. stages is indirectly controlled through a combination of automatic gain control and contrast potentiometer. The form of this arrangement and its mode of operation will be noted later.

The video i.f. system of *Industrial Television, Inc.* employs a stagger tuning in most of its stages and complex coupling between the mixer and the 1st video i.f. See Fig. 14. L_1, L_2, and L_3 utilize shunt inductive coupling (L_2) with a bandwidth of 4 mc. (i.e. 22.4 to 26.4 mc.) The sound i.f. is picked off prior to this tuned circuit and the video i.f. passes through to the grid of V_1, the first video i.f. amplifier. The remainder of the video i.f. system employs stagger tuned circuits to maintain the over-all bandpass of 4.0 mc. Two sound traps are provided, one at the output of the third i.f. amplifier and one in the lead between the fifth video amplifier and the detector. It is interesting to note that the first trap places a series resonant circuit from the plate of the tube to ground while the second sound trap is a parallel resonant circuit inserted in series with the signal path. Both traps are resonant to 21.9 mc., the sound i.f. of the channel being received.

The contrast potentiometer regulates the cathode bias of the first two video amplifiers. The control receives a positive voltage from the "B+" power supply and places this in series with the bias developed across each 180 ohm cathode resistor. Positive voltage applied to the cathode is equivalent in its action to an equal negative voltage applied to the control grid of the same tube.

(*To be continued*)

"That must be the Grid Leak!"

CQ Mobile

(*Continued from page 62*)

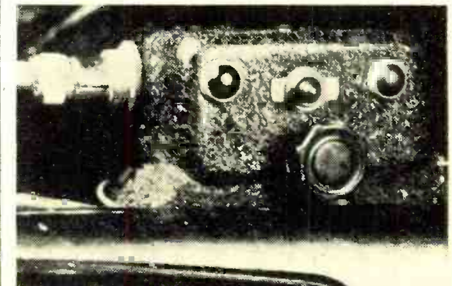
the other jacks, permitting the test meter to read in the proper direction. Next replace the plate cap on the 807 and plug the test meter into J_3. Tune the final tank condenser for minimum plate current. We may now place full plate voltage on the transmitter and repeat the tuning process with all tubes in their sockets and in operation. Actual r.f. output may be checked by placing a two-turn loop of hookup wire, which has been soldered across a 6 watt, 110 volt light bulb, near enough to the final tank coil to get a good glow. Before leaving the r.f. section let's check for any possible self-oscillation. With the r.f. indicating lamp near enough to the coil to glow, pull the crystal from its holder. The bulb should of course cease to glow immediately, indicating no self-oscillation in the r.f. section.

Testing the audio system is easily and quickly done. With all three audio tubes in place, the test meter is plugged into J_1, Fig. 3. About 12 to 15 mils of cathode current for the 6C4 is normal, when full plate voltage is applied. The current should not vary over 2 or 3 mils on voice peaks. Now plug the meter into J_2, where the modulator cathode current should be about 55 mils, swinging to about 65 or 70 mils on peaks. A system of both plate-and-screen modulation is used, permitting linear modulation, with exceptionally good quality for mobile transmitters.

Dynamotor Operation

In the transmitter described thus far the dynamotor and control circuit were designed to be operated with cars having the negative side of the battery connected to the car frame. It is not necessary to make any changes in the dynamotor when used with such cars. Note, however, when this circuit is to be used with cars having the positive side of the battery connected to the car frame the following simple alteration in the dynamotor is necessary. With the dynamotor removed from its base cover, clip the leads on pin No. 5 and pin No. 7 about one-half inch from the bottom of the base of the *Cannon* dynamotor power plug.

Fig. 7. The remote control head mounted below the dash. The center knob is the volume control for receiver.



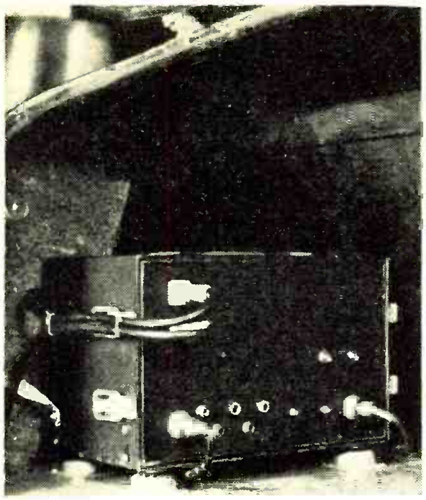
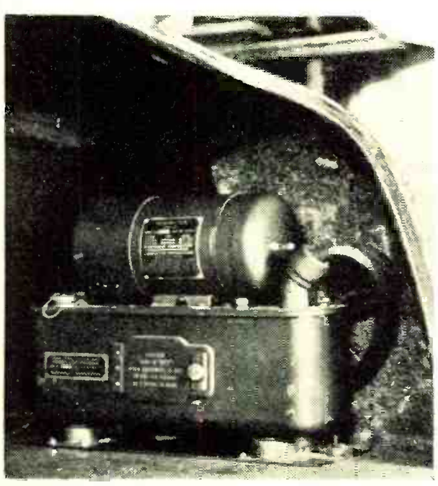


Fig. 8. Transmitter mounted in trunk.

Now take the lead which formerly went to No. 5 pin and splice it to the lead going to No. 7 pin. Take the lead that formerly went to No. 7 pin and splice it to the wire going to No. 5 pin. This is necessary in order to keep the "hot" lead going to the proper transmitter and control circuit points. Now disconnect the two wires that are soldered to what was formerly the negative side of the starting relay 3E6 actuating coil. Tape the ends of these wires as they will not be used. Solder about 4 inches of new wire to the starting relay coil where the two wires were removed and connect the other end of the 4 inch wire to pin No. 7. One further suggestion while the dynamotor is removed from its base cover. You will notice this word of caution written on the small door to the circuit-breakers: *Caution turn to "off" when equipment is not to be used for periods of 8 hours or more.* This warning may be ignored if you will disconnect a lead from either side of the actuating coil of relay 3E7 (as shown on diagram furnished with unit). Relay 3E7 is used as a safety device only and making it inoperative will not affect the normal operation of the dynamotor.

Fig. 9. The dynamotor installation.

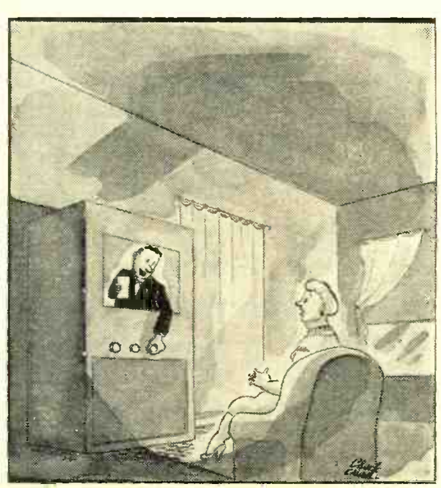


You will notice when using this setup, as described for a car having the negative grounded, that the filament protective circuit-breaker 3E5 is shorted out of the circuit and is inoperative. However, it was not considered of enough importance to warrant rewiring the relay. Also when the negative side of the battery is grounded the "B−" is still returned to the positive dynamotor pin No. 5. Thus the plate current of all the tubes must return to ground through the filaments. With a total plate current of 150 mils returning to ground through the filaments of the six tubes it will only tend to raise the filament current an average of 25 mils per tube during transmission periods. This condition, in our opinion, is good as the slight increase of filament current will tend to increase the emission of the tubes during transmission when it is most needed.

Conclusion

In conclusion, a few hints for the beginner or someone building a mobile transmitter for the first time. All leads should be kept as short as possible, none should be over about ¾" in length, otherwise the constant jar of the car will eventually break the lead. A liberal use of tie-points is highly recommended. The coils L_1, L_2 and L_3 were wound on polystyrene rods. The rods were drilled and tapped at the bottom ends with a 6-32 tap so they could be secured to the chassis. After the coils are wound on the rods, the turns may be secured by a liberal application of coil dope. All tuning condensers should be of the locking type or at least be made to drag quite heavily, to prevent detuning due to motion of the car. Any extra care taken to provide mechanical rigidity will be amply repaid by good operation and carefree service. The writer welcomes questions or suggestions from anyone building this compact little rig.

Address your correspondence direct to the author, F. L. McGraw, 2021 Allesandro Street, Los Angeles 26, California. —30—



"That will conclude our broadcast for tonight!"

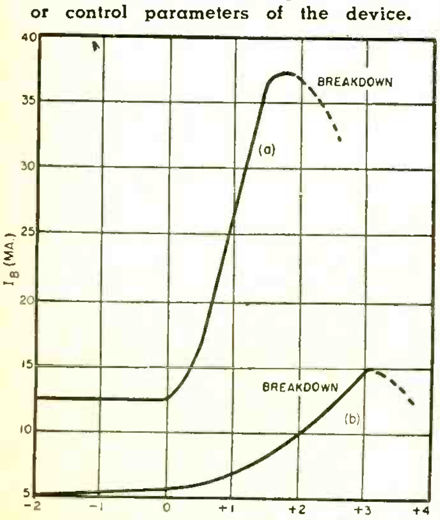
Crystal that Amplifies
(*Continued from page* 39)

sharp scissors and a short tip (say one-sixteenth or one-thirty-second of an inch) of bare wire can be exposed by gently and adroitly crushing the ceramic coating with a small pair of tweezers. It is advisable to prepare several of these cat-whiskers, inasmuch as they are quite fragile and several may be needed before a workable device is obtained.

As the photograph shows, the experimental assembly is mounted on a block of wood approximately 5½"x 3½"x¾". The lead from the germanium crystal mounting is saddled onto a brass nut in such a way that this assembly will turn concentrically about a 6-32 machine screw. The machine screw, in turn, is bolted to a soldering lug bent at right angles and soldered to a piece of No. 16 tinned bus wire. As can be seen from the photograph, the wire is held by a *Fahnestock* clip mounted on the wood block with a wood screw and spacer. This crude but effective arrangement facilitates adjustment of the crystal transducer.

Two cat-whiskers are brought to bear on the crystal surface. Clips, extracted from a wafer type miniature socket by cutting the bakelite away, are soldered to short lengths of No. 16 tinned bus wire. These wires slide into binding posts mounted on brackets by means of which electrical connections and a measure of adjustment are obtained. Since the cat-whiskers were prepared attached to the radio tube pins, they can be readily fitted into the socket clips. After suitable forming with tweezers or small pliers and the exercise of considerable cautious diligence, two cat-whiskers may be brought to bear upon the surface of the crystal. They should engage the crystal with a light pressure and should be as close together as feasible without contacting each other (the separation is only a few thousandths

Fig. 2. Two curves relating the transfer or control parameters of the device.

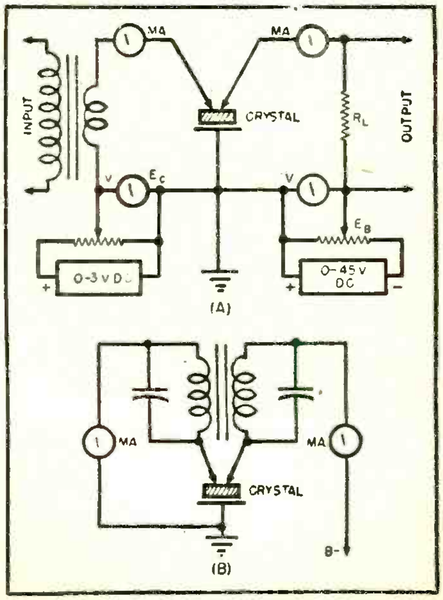


of an inch at most). A magnifying glass is essential and considerable juggling artistry must be exercised before good characteristics are obtained.

Fig. 1 shows a voltage current characteristic of a single cat-whisker (either one of them). It has the shape typical of a barrier type rectifier. The curves *a* and *b* are from data for different cat-whisker settings. Fig. 1B is a detail of Fig. 1A in the region of the elbow in order to show with greater clarity the high conductance characteristic in the forward direction. This data indicates that in the forward direction the impedance is approximately 100 ohms, while in the backward direction it is approximately 3000 ohms. These curves are typical of many taken. In the backward direction voltage breakdown is likely to occur at above 50v, while in the forward direction burnout takes place in the neighborhood of 60 or 70 ma.

Fig. 2 shows two curves relating the transfer or control parameters of the device. With a back voltage of approximately -50v. on one cat-whisker, the control effect on current to this cat-whisker of the application of small forward potentials to the other cat-whisker is shown. Curve *a*, indicating a transconductance of 15,000, was about the best the writer was able to do. Characteristics of the order shown by curve *b* are more readily obtainable. As Fig. 1 indicates, small forward potentials on the cat-whisker result in rather substantial forward current so that unlike typical vacuum tube operation the input electrode does require appreciable amounts of power for control purposes. However, since the output electrode potential is much higher than the control electrode potential, a favorable ratio of controlled power to controlling power may result even in cases where the input current is act-

Fig. 3. (A) Schematic diagram of test circuit used for measurements of amplification with the three-terminal crystal and for obtaining data of curves of Fig. 2. (B) Circuit diagram of an oscillator using double cat-whisker germanium crystal.



ually greater than the output current! The writer's nomenclature designates the output circuit as the "B" circuit, while that associated with the control cat-whisker is called "C" circuit. This is in rough accord with ancient usage.

Fig. 3A is a schematic diagram of a test circuit for measurements of amplication with the three terminal crystal and for obtaining the data of the foregoing characteristic curves. Since the control electrode impedance is only about 100 ohms, a stepdown transformer is needed to couple a signal into the device. The d.c. resistance of the transformer secondary is only a few ohms and its effect on input circuit current is negligible. The output load resistor R_L can be shorted out while data for the static characteristics is taken, although it is generally advisable to have a hundred ohms or so at this point in order to prevent runaway at high current levels. In fact, the writer's data set forth in Figs. 1 and 2 is in error to the extent of the *IR* drop in a protective resistor in series with the "B" circuit.

The best conditions the writer has so far managed resulted in a change of 15 ma. I_p at -50v. E_b with a control potential change of +1v. at 15 ma. This is a power ratio of 50 to 1. Unfortunately this condition was very unstable. More reliable and more readily obtainable adjustments gave power ratios of approximately 15 to 1.

As an amplifier, a load of 500 ohms seemed to give the best results even though the curves apparently call for 1500 ohms or more. A typical favorable adjustment of the cat-whiskers gave a maximum power output of 200 mw. at E_b -40v., I_b 22 ma. (*B* power .88 watts), a *C* bias of + 2.0v. and rectified I_c of 15 ma. ("C" circuit standby power 30 mw.) a likely a.c. input power of approximately 22 mw., giving a power gain of 10 to 1. The small positive bias on the input cat-whisker is necessary for relative linearity in output current. The waveform looked reasonably good on an oscilloscope and the response was constant from 20 cycles to 30,000 cycles. Substantial voltage amplification should be possible, if the resistor R_L is replaced by a properly designed step-up transformer.

Fig. 3B is a circuit diagram of an oscillator using the double cat-whisker germanium crystal. A 15v. r.m.s. signal was developed across either of the tank circuits at frequencies from 20 to 100 kc. depending upon the *L-C* ratio. E_b was −35v., I_b 4 ma., I_c 1.5 ma. and E_c probably around −1.5v. due to the d.c. resistance of the transformer winding. These figures are considerably different than the amplifier case. The oscillatory condition apparently has a marked influence on the behavior of the crystal.

The writer has not as yet succeeded in operating the double contact crystal at high frequencies but expects to do so at a later date.

Why does the device function as it does? An exact answer is doubtless couched in terms of mathematical physics. Any purely verbal description is likely to be a generalized approximation at best. Barrier rectifier characteristics stem from the fact that when dissimilar metals are extremely close together without actually touching (100 atomic diameters or so) electrons from the more electropositive metal, i.e., the one with the lowest work function, spill over into the other metal. That is to say, they actually jump the barrier. Enough of them will do this and equilibrium is established when a back-potential equal to the difference in work functions of the two metals is reached. If a positive external potential is applied to absorb the electrons across the barrier the process continues and a current can flow in the "forward" direction. A potential in the reverse direction, however, results in but little current since electrons merely pile up at the barrier unless, of course, the potential difference is great enough for breakdown. In the case of the germanium crystal and the tungsten contact a suitable barrier is supplied, as it were, by the atomic structure of the germanium crystal because it is a certain type of semi-conductor. As Fig. 1 indicates, electrons pass through the junction more readily in one direction than the other. If a back voltage is applied to such a germanium-tungsten junction and a second tungsten cat-whisker is positioned very close to the first one with a small forward potential applied to it the equilibrium conditions are upset and it is possible for electrons to flow from the first cat-whisker in spite of the backward potential.

What good is it? Prophesy is always hazardous, but it would seem that devices of this kind might certainly supplant vacuum tubes as oscillators, amplifiers, and frequency converters in many applications. While the writer's working model is admittedly crude—one could not sneeze in the same room without substantially altering its characteristics—one can readily see how the necessary mechanical and electrical refinements might be worked out as in all likelihood is already the case. New components and new circuit techniques must of course be developed to use them in radio, television, and industrial electronics.

—30—

When people in Mytilene, Greece, want their radios repaired they can call on five Kritikopoulos Brothers to fix things up in a hurry. Four of the brothers are shown in the service shop—while the fifth was busy snapping this picture for the record.

Mac's Service Shop

(*Continued from page* 54)

explained. "Now can you tell me at what frequency the oscillator is operating in this set with a 456 kc. i.f.?"

"Just 456 kc. higher, or 1756 kc.," Barney said promptly.

"That's right. Suppose we move the signal generator to a frequency 456 kc. higher than that, or to 2212 kc. The beat between this frequency and the oscillator—the difference beat, that is—will be 456 kc., exactly the same as when the signal from the generator was on the low side of the oscillator frequency. We will have to increase the output of the signal generator to get a signal through, for the tuned circuit in the grid circuit of the mixer tube is tuned to 1300 kc.; but if the signal is strong enough, it will force its way through."

To demonstrate this, Mac increased the output of the service generator, and the 400 cycle modulation came through just as strongly as it had when the generator was set to the receiver's 1300 kc. frequency.

"But I was not operating anywhere near 2212 kc.," Barney pointed out.

"You will remember that you said the oscillator was operating on 1756 kc. The second harmonic of that is 3512 kc. Now if your transmitter were operating on the phone frequency of 3968 kilocycles, the difference between the frequency of your transmitter and that of the second harmonic of the receiver's oscillator will be 456 kc., which will slip right through the i.f. channel along with any other signal being received and make it sound exactly as though you were operating in the broadcast band."

Once more Mac proved his point by setting the signal generator to 3968 kilocycles and producing a good strong signal in the receiver that had never been moved from its 1300 kc. setting.

"You can take a pencil and paper and figure out that various harmonics of the receiver's oscillator can combine with a signal in the 3500-4000 kc. band—falling either 456 kc. above or below that signal—and produce a difference beat that will be accepted by the i.f. channel. That is why you can hear your amateur signal at various spots in the broadcast band."

"How do I get rid of these images."

"If the set is well-shielded and employs an outside antenna, wave-traps of either the parallel-tuned or the series-tuned type inserted in the antenna lead right at the receiver will usually get rid of the images in good shape, as long as the transmitter is not moved in frequency very far from the frequency to which the traps are resonated; but if the set employs a loop antenna in which the loop is really the r.f. coil, as this one does, that is something else again. Anything you try to do to keep your seventy-five meter signal from reaching the grid of the mixer tube is nearly certain to upset the tracking of the tuned circuit.

"Sometimes the signal gets into the mixer tube by way of the light line rather than through the antenna circuit, and you can help these sets a lot by bypassing the filament leads to ground right at the mixer-tube socket. Quite often the best solution to the image type of interference—especially in a heavily populated neighborhood—is to select a frequency that will not allow the images to fall on any popular broadcast in that vicinity."

With this, Mac went back to work. Barney put in a 250 μμfd. condenser at the grid of the 12SQ7 tube as Mac had suggested, and he asked if he could get off a half hour early so that he could test out the broadcast-interference cure before Margie got home from work. He promised to report by telephone on the results.

Mac stayed around the shop a few minutes past his usual closing time, and just as he was going out the door the telephone rang.

"Mac," Barney said, "that condenser did the trick all right, but now I have to take it off."

"Why so?" Mac demanded.

Barney's voice came back over the wire with a mixture of pride and embarrassment: "Margie says that now she *wants* to hear my voice."

"Good night, Barney," Mac said softly as he gently replaced the receiver and went out of the shop grinning.

—30—

STACKED ARRAY

By EDWARD M. NOLL
Temple University

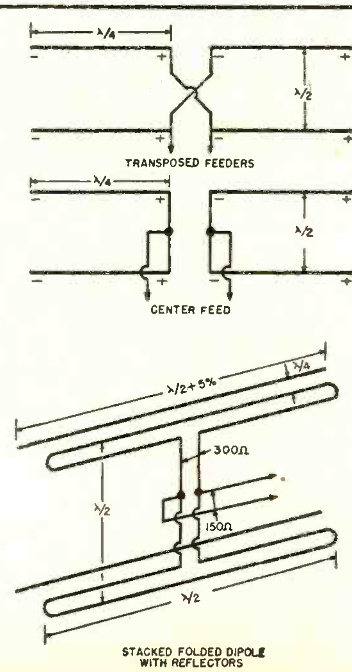
Horizontal antenna elements stacked vertically concentrate sensitivity at low vertical angles to correspond with the low angle of arrival of the television signals. At high frequency all high angle radiation is useless because it penetrates the ionosphere. Radiation at low vertical angles with respect to the horizon contributes the useful line-of-sight signal and extended line-of-sight signal. If the receiving antenna is designed with peak sensitivity at low angles we not only benefit from stronger signals but have a much improved signal-to-noise ratio because the antenna cancels noises arriving from above or beneath.

Stacked antennas are usually connected in phase, Fig. 1, to produce an additive signal at the transmission line. Noise components arriving above or beneath strike one element first and then, a half-wave later, a second, resulting in cancellation. The desired signal strikes broadside exciting both elements in-phase and by proper transmission line connection becomes additive. Two methods are shown. In the first drawing, feeders are transposed between elements putting both signals in-phase at the point the transmission line is attached. This system depends on half-wave spacing to give polarity shift. A second method is to feed at the center-point which will keep the transmission line point of connection the same distance from each element. This latter method is not as frequency-critical as the former.

Parasitic elements and various types of driven elements can be used. Fig. 1 shows stacked folded dipoles with reflectors. Whenever two in-phase elements are paralleled antenna resistance is halved.

For the stacked antenna shown 300-ohm line would run between elements and it would be opened at the center for attachment of the 150-ohm line for ideal match. Again it is important to stress that if the receiver has only a 300-ohm input match the receiver and let any mismatch which must occur be at the antenna. —30—

Fig. 1



Channels	λ/4 Element Inches	λ/2 Spacing and Element Inches	Reflector Inches
1	60	122.4	124
2	49	101	101
3	44	91.4	92.3
4	40	83.4	84.3
5	35	72.8	73.6
6	33	67.8	68.2
7	15 3/4	32.4	32.8
8	15 1/4	31.4	31.8
9	14 3/4	30.4	30.8
10	14 1/4	29.4	29.8
11	13 3/4	28.6	29
12	13 1/2	27.8	28.2
13	13 1/4	27	27.3
LO	42	87.2	88.1
HI	14 1/4	29.4	29.8

International Short-Wave
(*Continued from page 165*)

plete schedule; plays Cuban and semi-classical music, announces in French, interval signal is four chimes, gives call letters in French *and English;* has five-minute talk in *English* 2030-2035 (at least some days). (McPheeters, La.)

Honduras—HRN, 5.87, Tegucigalpa, *"Radio Mil Cien,"* this call refers to medium-wave outlet HRA; signs on at 0800 and is heard to 2300 closedown; Spanish *only.* (McPheeters, La.)

Iran—*Radio Teheran* lists calls and frequencies of EQA, 895 kc.; EQB, 6.150; EQD, 4.725; EQC, 9.680, and EPB, 15,100; QRA is The Director General, Wireless Dept., Ministry of Posts and Telegraphs, Teheran, Iran, Asia. (Kary, Pa.)

Israel—Tel Aviv, 6.835, is heard in East with good signal daily 2145-2230; *no English.* (Kary, Pa.) Usually is S9 or more here in West Virginia. Uses 7-pips interval and has setting-up exercises with piano accompaniment the first 15 minutes of this transmission, then news (presumably in Hebrew), and finally a period of classical or semi-classical music.

Java—*Radio Indonesia,* YDC, 15.145, Batavia, is a fair to good signal here in West Virginia early mornings; now has *English* period at 0600-0700; announces 15.150 but appears definitely lower.

"Voice of Free Indonesia," 10.841, has commentary at 0730. (Smith, Calif.)

Radio Australia reports *Radio Repoeblik Indonesia, Musantara,* on 11.-250 in the Indonesian language 2030-0030 daily *(except* Sundays when it continues to 0100); announcements are sometimes also in *English.*

Batavia's 19.345 outlet more recently was heard signing off 1235. (Fuller, R.I.)

Korea—HLKA, 7.933, Seoul, is being heard again on West Coast, around 0500 and later, according to Balbi, Calif. Also reported by Dilg, Calif., who also hears the dual outlet on 2.510.

JBBK, 4.400, is heard in New Zealand at 0600-0630. (Milne)

Malaya—*Radio Malaya,* 6.135, Singapore, operates Saturdays and Sundays 0230-0530. This transmitter also is used as a standby for operation when local power fails. On Saturdays and Sundays takes Blue Network programs. When power fails takes program normally carried by a medium-wave outlet with Red Network programs. Power fails often and this channel is thus heard erratically, (Desonza, Malaya, via Radio Australia.) Has been heard at times in California, but frequently seems closer 6.125. (Dilg)

Mauritius—V3USE, Forest Side, 7.143, 50 watts, is scheduled weekdays 2200-2315, 0315-0430, 0800-0900, 1000-1230; Sundays 0115-0245, 0800-0900, 1000-1230; news in *English* 2200, in

French 2230, 0345, 1000, 1228, in Hindustani 0800. Announcement in French is "Ici le Poste de l'Ile Maurice"; in *English*, "This is the Mauritius Broadcasting Service." Station signature tune, the march, "The Thin Red Line." QRA is Mauritius Broadcasting Service, Forest Side, Mauritius. (World Radio Handbook)

Mexico—XEBT, 9.625, Mexico City, seems to change time of *English* news frequently; latest schedule for the *English* news seems to be nightly at 1935 following Spanish news 1930. (Ferguson, N.C.)

Mozambique—CR7BJ, 9.650, Lourenco Marques, heard in Pa. signing off with "A Portuguesa" at 1518. (Kary)

Panama—HOLA, 9.050, Colon, has *English* program 1500-1800, Spanish 1800-2100, *English* again at 2100. (McPheeters, La.)

HERT, 6.060, Panama City, *"Radio Indoamerica,"* heard evenings to 2230 sign-off; signs on 0700 (Mc-Pheeters, La.)

HOFA, 6.060 (announced), signs off 2103 with Panamanian National Anthem; news in Spanish around 2038. (Kary, Pa.)

HP5K, 6.005, Panama City, is heard around 0630; Spanish *only*. (McPheeters, La.)

Paraguay—ZPA5, 11.948, Encarnacion, heard relaying *Radio Belgrano* with good signal as early as 1925; off at around 2100 to 2105; announces "Radio Belgrano y Encarnacion" and at times "LR3 and ZPA5."

Portugal—The Lisbon outlet on 15.100 has been heard opening 0600. (Ferguson, N.C.) Closes at 1430. Call may be CS2MQ. Reported testing 0930-1130 in parallel with CS2MT, 15.320. (Stockholm Radio)

CSX, 6.375, has been heard in parallel with CSW7, beamed to North America at 1930 to tuning out at 2016, good level in North Carolina. (Ferguson)

Portuguese Guinea—Bissau's CQM4, 7.948, heard weakly at 1740, much static and ham harmonics. (Kary, Pa.)

South Africa—ZRB, 9.110, Pretoria, is heard at 2350-0145 (may not be complete current schedule) when carries SABC programs. News at 0100 is probably relayed from BBC. This station fades slightly and has CWQRM. Cape Town's 5.878V outlet carries same programs from 0020, also has bad CWQRM, and is usually somewhat weaker than ZRB. (Hagen, Ala.)

Spain—*"La Voz de Falange,"* Madrid, is using 7.380. (Kary, Pa.) Schedule appears to be daily 1700-1830, using 400 watts. (Radio Australia)

Turkey—Current schedules of *Radio Ankara* appear to be—TAP, 9.465, daily, news in Ordu 1000; in Persian 1015; in Arabic 1030; in Turkish 1100; in *English* 1145; in French 1200; in Greek 1230; in Roumanian 1245; in Serbo-Croat 1300; in Bulgarian 1315; in German 1330; in Hungarian 1345. Special broadcasts for *English-speaking* listeners on Mondays and Thursdays 1530. TAQ, 15.195, has Postbag *(English)* on Sundays 1530; has special broadcast for U.S. fortnightly on Tuesdays 1700. The 1600-1615 program in Turkish (weekdays) appears to be a test as it is not officially listed by Radio Branch, Turkish Press Department, Ankara. (Kary, Pa.)

Vatican—HVJ, 11.685, has been heard with a broadcast in Spanish from tuning 1500 to closing down 1515, good signal. (Ferguson, N.C.)

Stockholm Radio reports HVJ is using 11.685 instead of 6.190 in parallel with 5.968 for the transmission 1345-1515.

Venezuela—YV5RM, 4.915, and YV5RN, 4.920, are in dual; heard to 2030; Spanish *only*. (McPheeters, La.)

* * *

Last Minute Tips

Paris, France, was recently heard testing as follows—0900-1200, 15.295; 1500-1600, 9.560; the following day tested 0900-1200, 15.100; 1500-1600, 11.-845. Asked for reception reports to Boothe, U.N. Services, Palais de Chaillet, Paris 16, France. Appeared beamed to U.S.

The *new* Nanking outlet XGRZ, listed 17.765, has been measured 17.-758.6; heard in Pa. as early as 0715 to 0925 sign-off; complete schedule unknown; carries commentary in Kuo-Yu from XGOY (Chungking) at 0715-0730; news in French 0742-0749; news in *English* 0800-0815; announced only XGOA which this new outlet relays. (Kary, Pa.)

Bucharest, Roumania, uses 6.200, 9.250, 11.900 in parallel at 1500-1530 for *English* program. (Radio Australia)

Teheran, Iran, now has its second transmission of the day at 0500-0700 on 15 100 and 9.680; programs include Russian 0600; *English* 0615; Arabic 0630; Turkish 0638; French 0645 to closedown. (Bluman, North Africa, via Radio Australia) The 15.100 outlet recently has been heard widely in America 1330-1430, *English* news 1410; fair to good signal here in West Virginia.

Herbert Bluman, North Africa, has notified *Radio Australia* that the station previously unidentified on 6.845 has been ascertained as Khoramabad, Iran; scheduled Wednesdays and Saturdays 1130-1230 (may not be complete schedule); identification is an Oriental melody played on a flute at 1125, followed by Persian Anthem at 1128, program begins 1130; translation of opening announcement is "Here Khoramabad, regional transmitter for the province of Luristan."

ZBW-3, 9.525, Hong Kong, is heard by Sanderson in Australia as early as 0430 when has Chinese and French news, then BBC relay, and music. Other late items from Miss Sanderson include—XHSR, 5.880, Communist-controlled Chinese outlet, has Chinese news and Western music 0645; XGOE, 9.820, Kweilin, China, with Chinese music and news 0615; Saigon, 6.165, 0530 with news in French and music; *Radio Cambodia*, also Fr. Indo-China, 6.035, with news in French and music 0630; KZPI, 9.505, Manila, with news 0600; KZRH, 9.64, Manila, news and music 0500; KZOK, 9.692, Manila, 0430 with good musical program, then news; KZRC, 6.140, Cebu City, Philippines, 0530; SUX, 7.865, Cairo, Egypt, 1630 with Arabic program of news and music; "La Voz de Falange," Madrid, 7.380, 1645 with news in Spanish and musical program; JKA, 7.285, Tokyo, 0430 with Western music, then news in Japanese; JVW3, 15.235, Tokyo, 0345 with Japanese news and Western music; Radio Musantara, Indonesia, on 11.250, at 0500 with announcements in Dutch, and music; PLU, 9.865, Java, at 0630 with musical program and news in Dutch; HLKA, 7.933, Seoul, Korea, 0615 with news in Korean and music.

The British Foreign Office has taken over the British Far Eastern Broadcasting Service in Singapore, Malaya, according to a BBC newscast. It was stated this is the first time that BBC has operated broadcasting facilities outside the United Kingdom. (Worris, N.Y.)

Latest schedules of *Radio Italiana* include beams to Latin America 1730-1840; to North America 1840-1955; news in Italian 1800, in Spanish 1820, in Portuguese 1830, in Italian (for station WHOM, New York) 1845, in *English* 1915. Frequencies are 15.12, 11.81. (Jeffrey, Indiana)

T. Y. Woo, director of XGOA, Nanking, airmails us that XGOA now is operating with regular programs on 660 kc., 5.985, 9.730, and (*new*) 17.765; call assigned new 17.765 outlet is XGRZ but only XGOA will likely be announced when this outlet is in parallel with the others in Overseas Service; at that time 17.765 is beamed to America and/or Europe. The two *new* transmitters completed in Nanking are 20 kw. each. On 17.765 one of the new transmitters operates regularly now 0300-0915 (to replace transmission previously carried on XGOA's 11.835, which has now been replaced by 5.985). XGSW (also *new*) is now transmitting tests on 21.45 daily except Sundays (in China) at 1930-2200; this being a test, is subject to change, says Woo. They would appreciate *detailed* reports on all outlets of XGOA and other Nanking channels. Normal current schedule of XGOA is to Philippines, Australia, New Zealand, South Pacific Islands, 0300-0500; to Mongolia, Tibet, Japan, South Sea Chinese, 0500-0730; to India, South Africa, Eastern Europe, 0730-0915; news commentary 0350; talk 0430; talk 0640; news (which now originates in Nanking studios instead of XGOY's, Chungking, as formerly), 0800. Readers should remember that the *new* 17.765 channel is used for this Overseas Service, beamed to America-Europe, at 0300-0915.

Of the Indonesian stations, Semarang on 11.034 should not be confused with Soerakarta on 11.125; Semarang is Dutch-controlled while Soerakarta is Indonesian-controlled. Indonesians have also been heard on 11.060, 11.080, 11.100, but are too weak to identify for certain. (Dilg, Calif.)

Kary, Pa., has received a verification from Cia. Internacional de Radio, S.A., Santiago, Chile, for CEC6B, 22.-325; transmitter is a 3 kw. *Western Electric* with rhombic antenna. QRA is Casilla 16-D.

Sweden's SBT, 15.155, is a good signal daily at 1240 when it has news; SDB-2, 10.780, is in dual. (Fargo, Georgia)

Balbi, Calif., says he hears the new VLT5, 7.280, Port Moresby, Br. New Guinea (Papua) from around 0315. He says the sister-outlet, VLT7, 9.520, appears on the air at least 0100-0300. VLT5 signs off 0745.

Radio Makassar, 9.55, Celebes, has improved signals, mornings. (Balbi, Calif.)

TFJ, located near Reykjavik, Iceland, has verified reception of its Sunday beam 1115-1145 on 12.175 for Anson Boice, Conn.; card is attractive, bears picture of transmitting panels on one side, and information on other. Says TFJ is operated by the Icelandic Post and Telegraph Administration and that programs are arranged by the Icelandic State Broadcast Service; glad to have reports.

ZJM5, 6.170, is back on the air carrying the Sharq-al-Adna broadcasts in parallel with ZJM6, 6.790, and ZJM7, 11.720. I believe location is more likely Cyprus than Amman, Trans-Jordan as reported by Swedish sources. This station is British-controlled, I understand.

The Department of Posts and Telegraphs of Ireland confirms to me that the new high-powered short-wave station under construction has been abandoned as an economy measure. The only s.w. outlets in Ireland are low-powered 17.840 which has news daily 1230, and 9.595 which has news daily 1610; transmissions last from 15 to 20 minutes. By this time the Irish may have reverted from Irish Summer Time, in which case you may find these periods *one hour later* than just listed.

ZIK-2, 10.598, Belize, Brit. Honduras, still has daily news broadcast beginning any time between 1330-1340; poor signal. (Eyles, Ga.)

Prague's 11.840 outlet has recently been weaker in its daily 1900-2000 beam to North America, news at start. (Worris, N.Y.)

Listeners who read c.w. will be interested in this item from John W. Young, Jr., Pa.—YAK, 9.975, Kabul, Afghanistan, has verified reception of February 29 at 2354 when the station was heard calling Tangiers; address is Radio Station YAK, Telecommunications Ministry, Technical Directorate General of Telegraph, Engineering Department, Kabul, Afghanistan; station also operates on 13.580. Among other c.w. stations listed by Young as heard during recent months are REL, 4.100, Kiev, USSR at 2129 (broadcasts weather); GFV3, 7.475, Habbaniyah, Iraq, 1930 (Royal Air Force); VSS2, 8.780, Aden, Arabia, 2035; YIU, 10.100, Baghdad, Iraq, 2025; AHO5, 11.948, Dhahran, Saudi Arabia, 2205 (U.S. Air Force); VV0149, 14.970, Singapore, Malaya, 2122 (Royal Navy); GZ0153, 15.370, Stonecutters' Island, Hong Kong, 1323 (Royal Navy).

Late tips from Peddle, Newfoundland, include CR6RN, 9.475, Luanda, Angola, improving, off 1600; CSX2, 4.845, Ponta Delgada, Azores, 1800-1900; CS9MB, 11.090, Ponta Delgada, 1415-1500; *Radio Andorra,* 5.985, 1600-1830; ZAA, 7.852, Tirana, Albania, news 1515-1530; KZCA, 7.221, Salzburg, Austria, 1500-1715; Brussels, 17.-845. Belgium, to Belgian Congo 1615-1630; LZB, 9.350, Sofia, Bulgaria, *English* 1515-1535; XMPA, 12.205, Nanking, China, 0530-0615; Prague's 6.010 outlet news 1545-1600, on 9.553 at 1445-1500, 1645-1700 with news; OIX1, 6.120, Finland, news 1915-1930; HVJ, 9.660, Vatican, news 1415-1430 now; YDC, 15.145, Batavia, Java, news 0500-0530; YUA, 6.107, Belgrade, Yugoslavia, news 1530-1545; Beirut, 8.020V, 0000-0100, 1345-1600; Monte Carlo, 6.035, 20 kw., in French 1445-1600; Douala, 9.160, Cameroons, to 1515 sign-off.

The Chinese station reported by "Down Under" readers on about 12.120 has been heard rather weakly in California on schedule of 0830-0945 with Chinese news at dictation speed 0900. (Dilg) May be Taiyuan?

HI1N, Ciudad Trujillo, Dominican Republic, now appears on 6.050 from 6.244; announces "Emisoras Unidas," and relays medium-wave HIN. (Kary, Pa.)

ZBW-3, 9.525, Hong Kong, has recently been audible again on West Coast, heard at 0615; at 0630 announces "You are listening to ZBW" (medium-wave outlet); woman then speaks in Chinese; some QRM from AFRS on 9.57. (Stein, Calif.)

T. Y. Woo, Director General of the Central Broadcasting Administration, Nanking, China, has asked me to inform readers of this *Department* "that we have been most grateful for the reports received from short-wave listeners all over the world. We have sent and will continue to send QSL cards to all reports if they correspond to our log. In the past we have received many requests for cards with a very brief statement that our station had been heard. We must have *detailed information* regarding our program contents, the frequency it was heard on, the time (preferably in GMT), reception conditions, and station calls before we can issue verification cards. In the past, we have received letters from listeners who claim to have heard our station with call letters and frequency that were not being used at the time. The most ludicrous example came from an ardent 'QSL card collector' who requested a card for a station that was never on the air. The call-letters were, however, registered at Berne, Switzerland. We had not given it any publicity, previously. How the person knew about it is a puzzle to us. On the other hand, we are very glad that we have so many fans, many with elaborate equipment, who monitor us, not for the sake of just a card, but for the pleasure that they derive from listening to our programs and being able to hear the *'Voice of China'* in Nanking."

Kary, Pa., reports a new Spanish outlet on approximately 8.250, announcing "Radio Nacional de España en la Coruña;" seems more powerful than Alicante; is heard 1630-1700 but this is *not* full schedule. Is believed to closedown around 1900; probably relays a medium-wave outlet.

In verifying for Kary, Pa., these schedules were listed by the new s.w. station at Port Moresby, Papua (British New Guinea); schedules are in Australian Eastern Standard Time (*subtract* 15 hours for EST)—VLT5, 7.28, weekdays, 0645-0845, 1815-2245; Sats. 0645-0830, 1815-2300; Suns. 0745-1100, 1815-2200. VLT7, 9.52, weekdays, 1200-1345, 1600-1800; Sats. 1200-1800; Suns. 1200-1400, 1600-1800. QRA is Radio Station 9PA, New Guinea Service, Australian Broadcasting Commission, Port Moresby, Papua. (Radio Station 9PA is the medium-wave outlet.)

Radio Dakar's new frequency in the 25-m. band has been measured by Kary, Pa., as 11.896.88.

Kary, Pa., reports HCJB, Quito, appears to have raised the frequency of its 50-m. outlet from 5.960 to 5.993, heard best after 0000 but suffers from teletype and multiplex QRM.

Latest schedules of Leopoldville, 9.-767, are 1300-1900, 1900-2300; *English* sessions begin 1430 (to Great Britain and British colonies in Africa), and at 2100 to U.S. and Canada.

* * *

Acknowledgments

Thanks for the FB reports coming in regularly. Keep up the good work! Additional reporters, from anywhere in the world, will be welcomed. Write Kenneth R. Boord, 948 Stewartstown Road, Morgantown, West Virginia, USA. Monitor's certificates for 1948-49 are now being sent out to all *active* monitors. . . . . .K. R. B.

Another lucky winner in the Hytron Servicemen's Contest is Gerard P. Diaz of Parkville, Missouri, who was named top man among the June entries. He is shown being congratulated by William T. McGary, Hytron representative while Merle Applebee of Burstein-Applebee Co. displays the double prize Mr. Diaz received.

"Super-Modulation"

(*Continued from page* 46)

from the positive modulator, for added sideband power output.

With the new lowered r.f. component reference level reduced from J to K, during this period of transmitter carrier compression, the high sideband power appears in the detector output on the upward sweep, as increased output corresponding to that of the increase in the transmitter from the compressed level of the carrier. With the transmitter output at G, the sideband power increase is observed, with the upward modulation far more than the usual two times carrier. We have also added extra sideband power, as shown below the non-modulated carrier level, during the carrier compression. Inasmuch as the instantaneous peak power output under modulation is the square of the increase which is conventionally 4 times or less, with the increase to P, our peak power can be considerably greater and reproduced as larger signal voltage out of the detector in the receiver as shown at H. The carrier interference level is reduced far below the intelligence transmitted and received, instead of the reverse as in conventional practice.

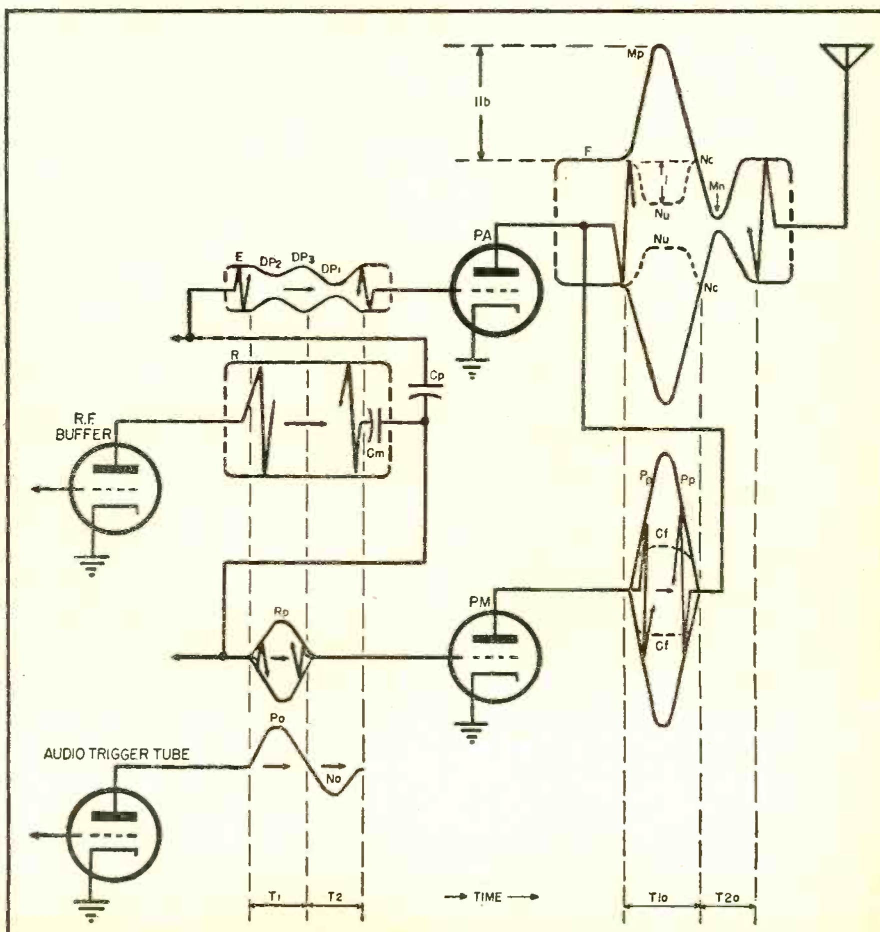
Therefore, if we listen to the "super-modulated" signal from the detector as at H at usual volume, the receiver gain could be reduced so that the carrier level would drop by that amount between R and K or about equal to that between N and M at the transmitter output. The resulting receiver gain reduction, would effect about the same reduction of the interference level in the receiver.

The re-introduced negative carrier cushion for the negative modulation half cycle as shown at A for the transmitter and the resulting detector action at B, functions only during that time required for the negative modulation, permitting the negative peak to be linear and efficiently reproduced at the receiver detector with low distortion.

A 900-A transmitter, arranged for increased sideband power production with increased degrees of carrier compression in the modulated envelope at Fig. 2, was adapted by rewiring the power amplifier and positive modulator output circuits with heavy copper bus to handle the terrific power peaks that would develop under expanded positive modulation and sideband power.

As shown in Fig. 3, we also arrange for the increased modulation amplitudes as M_p, greater carrier compression as at N_u, and negative carrier

Fig. 3. Expanded "super-modulation" showing waveforms at various circuit points.



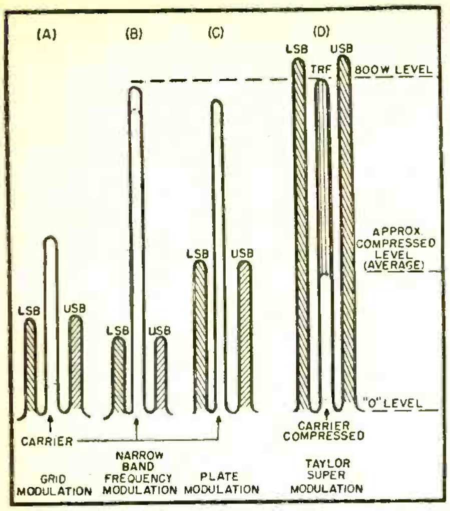


Fig. 4. Panadaptor test comparing "supermodulation" vs. other conventional systems.

cushion insertion at N_c, by the rearrangement of the voltage swings across the r.f. drive divider C_m and C_p, for the proper r.f. pulse drive power to tube *PM*. An increase in the r.f. power at reservoir *R* is necessary to maintain the new amplitude requirements of the larger r.f. trigger pulse at R_p. Tube *PM* will then provide an increase in the amplitude of the power output at P_p, which in turn is delivered to the output tank circuit as additional positive modulation energy resulting in M_p. This added modulation energy appears in the transmitter output as emphasized sidebands far greater than before. At the same time a larger degree of carrier compression appears at N_n, for a separate but coordinated function, which is effected by further reduction of the power input and output of tube *PA* during this period.

To take advantage of the power production facilities of tube *PM* as at P_p, we arrange for tube *PA* to rest, and dispense with most of its carrier at the same time. The accomplishment of this is very simple with this system with the operational functions previously used and extended to a greater degree. Where we reduced the r.f. drive power DP_2 to tube *PA* by a small amount during the time that tube *PM* was allowed to work, we find that the input drive to *PA* can be further reduced, as long as its power output does not go below the power output pick-up generating capacity of *PM*. We want the output of *PM* to work upward above the uncompressed carrier level at *F*. In addition it must replace the compressed carrier at *I* (Fig. 2).

With proper proportioning of the voltage across C_m and C_p so that *PA* is allowed to decrease in operation during positive modulation we must arrange to get it back into somewhat near full operation as at N_c. This must occur in time for the negative modulation half cycle M_n, to avoid distortion in the output by negative clipping. When tube *PM* has completed its positive half cycle it requires no r.f. drive at R_p. We take a portion of this drive and apply it to the tube *PA*, allowing

PA to produce normal carrier again as at N_c or *F*, during the negative modulation peak.

Functional timing in Fig. 3 will now be about as follows: before the one cycle modulation function starts as over time T_1, T_2 and T_{1a}, T_{2a}, the output of the audio trigger tube as well as the input and output of tube *PM* is almost zero. *PA* provides the carrier output at *F*, as the result of the r.f. drive at *E*.

Over time T_1, the positive audio pulse at P_a allows the r.f. pulse R_p to be applied to the input of *PM* from the source at *R*. The r.f. input to *PA* has been reduced at DP_2, at the same time as the output tube *PM* is providing power output P_p. Power output from *PA* is at the level of N_u which is filled in with C_f as part of P_p from *PM*. The balance of power at P_p provides the positive modulation shown at M_p. At the beginning of time T_{1a}, compression N_u starts to function downward toward its minimum level. At the same time C_f replaces the compression, simultaneous with positive power P_p effecting upward modulation M_p. At the mid-point of time T_{1a} this procedure is reversed so that at the beginning of time T_{2a}, P_p and C_f are back to about zero with N_c re-established to about the level of *F*. This also, over T_1 established DP_3 at about the same level as at *E* during the two time intervals.

Time T_2 now follows. The negative audio half cycle N_a allows the drive pulse DP_1 of the r.f. drive power to be applied to tube *PA* with the function following the pattern of N_a. Over time T_{2a}, *PA's* output shows as M_n from N_c downward to the mid-point of the time period, with the return to N_c level the same as *F* upon completion of this time period. Action during the T_{2a} period by *PM*, is about zero as indicated, or the same as before the beginning of time T_1 and T_{1a}.

During later tests, the expanded *TSM* system was pushed somewhat farther, to what seemed about the maximum capabilities of the tubes used in the 900-A transmitter at the time. The non-modulated carrier output was, in this case, about 800 watts represented by about 4 amps into approximately a 50 ohm load. The non-modulated plate power input to the power amplifier tube was about 3000v. x 320 ma., or 960 watts. Power input to the positive modulator was 3000v. x 10 ma., or a total plate power input to the two tubes of 990 watts, for the carrier power output of 800 watts. This represents a plate efficiency of somewhere around 80 per-cent with respect to total input over output.

With full heavy modulation at reduced bandwidth, power input to the power amplifier tube was reduced to about 150 watts or 3000v. at 50 ma. At a plate efficiency of about 75 percent this allowed a compressed carrier power output of about 100 watts. The positive modulator with plate voltage of 3000 volts was showing plate current peaks of 500 to 600 ma., so the maximum plate power input was computed to be about 1800 watts on the heavy modulation passages. Of the 1800 watts input to the positive modulator at the maximum modulation, an efficiency of about 90 per-cent allowed about 1600 watts of sideband power output with no spread or splatter. This was over and above the 100 watts of compressed carrier level. The r.m.s. measured output was found to be about 1700 watts with a load current increase of from 4 amps at no-modulation carrier level up to about 6 amps into the load at full modulation. This represented an increase of 50 per-cent of the un-compressed carrier output for full modulation instead of the usual 22½ per-cent.

Of the 1600 watts of sideband power output, about 800 watts was in each sideband or a talk power level of plus 51 db., with terrific peak power, while the compressed carrier of about 100 watts was around plus 42 db. This allowed an effective 20 db. spread of increased intelligence transmission efficiency over the normal method.

Fig. 4D shows the carrier and sidebands of the modulation tests when viewed on a *Panadaptor* during some of the first tests. The *Taylor* "super-modulated" transmitter output at no-modulation was around the 800 watt mark, while with modulation as in this test, each of the sidebands exceeded the 800 watt level before any distortion appeared in the picture.

Fig. 4A represents the carrier and sideband power of a 1 kw. input grid modulated transmitter. 4B represents that of a 1 kw. input NBFM transmitter where the modulation index and frequency swing is within the legal limits for amateur and communication service, and that of 4C a plate modulated 1 kw. transmitter with the carrier output a little less than for NBFM but with considerable more sideband power. 4D, as mentioned is the *Taylor* "super-modulated" transmitter at a kw. input according to the means of rating the other systems. —30—

RECORDING ERRATA

NO MAGAZINE is infallible but usually when errors are detected the correction is made in a subsequent issue to the one in which the mistake occurred. That in itself is fine and dandy —you read the correction and then, not being interested in building the equipment at the moment, you forget all about the error.

About a year later, when hunting a certain circuit, you come across one that had the error in it—but by that time you have forgotten that there was a correction to be made. You proceed to build the circuit and then discover that it doesn't work.

I eliminate the trouble by following a definite procedure with regards to the "Errata" which appear. I immediately turn to the initial writeup and make a notation to "see such-and-such issue and page for corrections." By writing myself this reminder, I am sure that I will not start to build a piece of equipment that has errors in the circuit without first noting the corrections to be made. . . . . M.K.

Manufacturers' Literature

Readers are asked to write directly to the manufacturer for the literature. By mentioning RADIO & TELEVISION NEWS, the issue and page, and enclosing the proper amount, when indicated, delay will be prevented.

SALES AID CATALOGUE

"Schematic for Bigger Profits and Better Servicing" is the title of a new sales aid catalogue prepared by the Tube Department of *Radio Corporation of America* for servicemen and dealers.

The new 12-page "Schematic" illustrates and describes many up-to-the-minute display, promotional, and business aid items. A five point business-getting formula is outlined in the booklet and the advantageous use of each item is fully explained.

Sales aids described range from a new "Fireball" fluorescent sign to a complete packaged direct-mail campaign.

RCA Tube Distributors have this catalogue available without charge to servicemen and dealers. Ask for your copy.

WALSCO CATALOGUE

Walter L. Schott Co. is currently offering a copy of its 1948 catalogue to radio servicemen.

This 16-page publication carries listings covering a complete line of hardware, chemicals, tools, finishing materials, and service items manufactured by the company for the electronic trade.

Included in the catalogue are such popular items as the company's "Unibelt," the standard test record, dial cable assortments, rivets, speaker cone patches, grille cloth, dial drive springs, radio knob springs, flux, dial oil, radio and fabric cements, etc.

A price list is included with each catalogue for easy ordering of parts. For a copy of the 1948 *Walsco* catalogue write *Walter L. Schott Co.*, 9306 Santa Monica Blvd., Beverly Hills, California.

CR TUBE PRIMER

A non-technical discussion of the cathode-ray tube and its functions is presented in the form of a handy, 63-page booklet entitled "The Cathode-ray Tube and Typical Applications" by the Instrument Division of *Allen B. DuMont Labs., Inc.* of Clifton, New Jersey.

This book has been especially designed for use in high schools, technical schools, and colleges, in conjunction with the company's Wall Chart on the cathode-ray tube.

A copy of both the wall chart and the book may be obtained by any instructor requesting them on school stationery. To others interested in the subject, the primer will be furnished at 50 cents a copy. Bulk quantities for school use will be furnished at $2.50 a dozen.

Address orders to the Instrument Division, *Allen B. DuMont Labs., Inc.*, 1000 Main Avenue, Clifton, New Jersey.

"TRIPLE PINDEX"

The Tube Department of *Radio Corporation of America* has just released a unique booklet known as the "Triple Pindex."

By means of the new publication radio servicemen can quickly identify, locate, and study any two or three tube base diagrams simultaneously. Over 475 types are listed in the new booklet.

The "Triple Pindex" provides three complete and separate base diagram booklets, joined in a single cover with a spiral wire binding. To locate the base diagram of a particular tube, the serviceman need only flip over the pages of one of the booklets. If a second base diagram is desired, it may be quickly located in the second booklet without disturbing the first. A third diagram may be independently located in the same way. All three diagrams are thus available on the same "three-in-one" page for quick and easy checking without the necessity of continual back-and-forth thumbing of pages.

Listings in the "Triple Pindex" are arranged in alphabetical-numerical order, according to tube types, completely eliminating the need for tables of contents or indexes. Uncommon tube types are listed on a back page of the book, together with a key to appropriate diagrams in the book.

The booklet is printed on heavy stock and measures 4 by 8 inches. Copies of the "Triple Pindex" are available from *RCA* Tube Distributors at 75 cents a copy.

"BRUSH USER'S GUIDE"

Stackpole Carbon Company of St. Marys, Pennsylvania has just issued a 44 page booklet, "Fractional Horsepower Equipment Brush User's Guide," which will be of interest to those responsible for selecting and applying brushes for long life and better performance on a wide variety of small motor equipment.

Particular attention has been paid to brush problems and their remedies for universal motors, automotive generators, automotive starters, aviation generators, single phase motors, and other types. Of special interest is the complete information given on the choice and method of calculating suitable brush springs on which proper brush performance depends to a great extent.

In addition to data on the regular *Stackpole* fractional horsepower motor brush grades, the guide describes the company's unique silver graphite types. Also included is data on shunts and shunt connections, caps, terminals, and hammer plates, along with a complete discussion of the company's brush grade characteristics.

Requests for a copy of this guide must be made on company letterhead. Make your requests direct to *Stackpole Carbon Company,* St. Marys, Pennsylvania.

ANDREW PRICE LIST

Andrew Corporation of Chicago, manufacturers of a complete line of antenna equipment and transmission lines, has just issued a new general price list which offers a comprehensive tabulation of over 600 items of the company's manufacture.

In addition to listing many new items, the new price list has been completely revised to facilitate the selection of the equipment desired. Major equipment items are listed together with related accessories in a compact family grouping. A cross index, enclosed with the price list, contains a numerical listing of all equipment with cross references to the general price list. The cross index also provides delivery information on all equipment.

For a copy of the general price list write to *Andrew Corporation,* 363 East 75th Street, Chicago 19, Illinois. —30—

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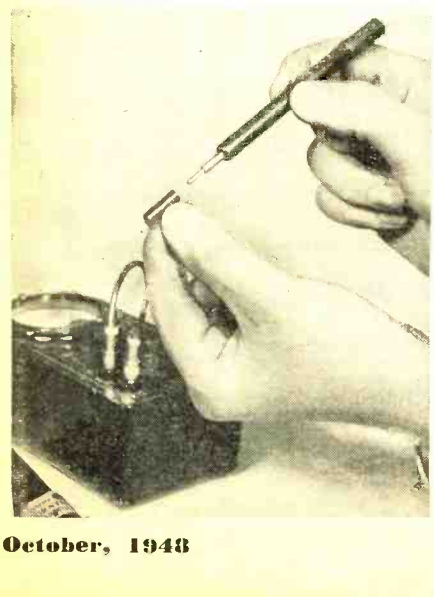
WHEN servicing a.c.-d.c. or three-way portable radios the clearances between socket pins and between various voltages is very slight.

When using a regular test prod a slight slip and tubes or other parts are burned out.

Sleeving of the proper size may be slipped over most of the test prod, permitting only the extreme tip to be exposed.

Such procedure will save many expensive short circuits. . . . H. L.



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SALE

FM CONVERTER Units, old band to new 88-108Mc band, with instructions, $5. Radio-Electronics, 436 Cornelia St., Boonston, N. J.

BRAND New GF11/RU-16, everything but cables, mike, phones, antenna, $45. New 453-B converted to AC. 190-500kc, just plug in, $20. Used 453-B converted for external power, $10. New 454-B, $10. Hollis Button, Valley City, N. D.

MEISSNER 5 band receiver with Pilot FM tuner. Diedricksen, 11 Vine, New Britain, Conn.

RAYTHEON 6V6GT, 90 day guaranteed. Cartoned, 59c, 10, $5.50; egg crated 25, $10.50; 50, $19.50; 100, $36. Auto Antennas, 2 post, chromed brass, unshielded lead, $1.25; 10, $11.95. Speakers moulded cone Alnico V, 5", light, $1.49, 10, $13.95; 6" Permoflux heavy (List $6.25) Special $2.49. Guaranteed "tops"! Code Practice and Xmitter Keys, J-38 69c, J-41A heavy contacts, 79c. Coil Forms, ribbed lo-loss 7 prong, large, 19c, 10 $1.75. All postpaid in U.S.A. R. Lyman Walker Co., 436 Wilson St., Napa, Calif.

EDISON Storage Batteries, Nickel-Iron-Alkaline type, 32 volt sets of 25 cells assembled in trays of 5 cells, capacity 19 ampere-hours, charge rate 4 ampere and discharge at normal 125 watts. Government surplus intended for communication equipment, will last 10 to 15 years, only $25.00 complete, factory price over $160.00. John L. Pulster, Battery Specialist, 510A Audubon Bldg., New Orleans 16, La.

EXPAND your FM and television business. Use the VHF alignment wand (60c) for fast, simple and systematic servicing. Free particulars. Hawkins Radio Co., 621 E. 31st St., Kansas City 3, Mo.

HEWLETT-Packard 205-AG Audio signal generator. Will swap for 10" Television kit. W1KUW, 7 Shangri-La Lane, Middletown, R. I.

THE Radiotician selling out equipment, parts, tubes. 5639 University, Chicago, Ill.

NEW and used Collins, Hallicrafters, National Hammarlund, RME, Meissner, other receivers, transmitters, speakers, television receivers, test equipment, etc. Lowest wholesale prices. Terms. Write. Henry Radio, Butler, Mo. and 11240 W. Olympic Blvd., Los Angeles, Calif.

WRITE Dept. RN18 for our free wholesale list of Radio parts & accessories. R. C. Radio Parts & Distributing Co., 731 Central Ave., Kansas City 6, Kans.

PANELS for experimenters, custom builders. Gilpin, Box 638R4, Mt. Clemens, Mich.

$4.95 IDEAL Charger for 2-volt batteries; Quantity close-out 98c; Sample $1.75; Attractive, well-constructed. Modelectric Products, Asbury Pk., N. J.

GRILL Cloth. Celanese, light and dark pieces. 1000 square inches for $1 bill. Write for list of lowest priced national brand parts in nation. Bursma Radio, Route 5, Grand Rapids, Mich.

SURPRISE "Electronics Parts" kit. $1.48. Royal Radio Supply, 1800 Frazier St., R4, Madison 5, Wisconsin.

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YOU can accurately align superheterodyne receivers without signal generator. Complete instructions. $1. Money-back guarantee! Chas. Gates, Pecos 1, Texas.

LOWEST Prices Radio Tubes parts. Bargain lists, 3c. Potter, 1314 McGee, Kansas City 6, Mo.

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RADIO tubes in exchange for things Chinese (curios, pictures, embroideries, silks, etc.). Mc-Chang, Postbox 341, Shanghai, China.

DYNAMOTORS DM-25, want 500 to 1000 quantity new. Box 466, % Radio & Television News, 185 N. Wabash, Chicago 1, Ill.

BC-1016 Code Tape Recorder. M. C. Stewart, Ashburnham, Mass.

WANTED, Aircraft Radios: BC-348, AN/ART-13, RTA-1B, AN/APN-9, R5A/ARN-7, AN/ARC-1, AN/ARC-3, SCR-718, BC-788-C, I-152, MN-26-C. Test sets with TS- or I- prefix. State quantity, condition and best price first letter. HI-MU Electronics, Box 105, New Haven, Conn.

HELP WANTED

RADIO Instructors, must have 5 years experience. Preference given men with degree. Adult School, 2536 Euclid Ave., Cleveland 15, Ohio.

INSTRUCTORS in Electronics and Radio. Prefer former Navy Radio Technician instructors willing to locate in the Detroit, Mich., area. Write to Box 452, % Radio & Television News, 185 N. Wabash, Chicago, Ill.

SITUATIONS WANTED

SELECTED group of men, graduates of well-known trade school, desire employment in Radio Field. Will travel anywhere. Qualified in radio servicing, installation, test instruments, circuit operation, etc. Contact Placement Dept., Eastern Technical School, 888 Purchase Street, New Bedford, Mass.

PATENT ATTORNEYS

LANCASTER, Allwine & Rommel, Registered Patent Attorneys. Patent practice before U.S. Patent office. Validity and Infringement investigations and opinions. Booklet and form "Evidence of Conception" forwarded upon request. Suite 414, 815 15th St., N.W., Washington 5, D. C.

CORRESPONDENCE COURSE

LEARN Railway Telegraphy at home. Instrument furnished. Operators needed. Jobs waiting. Bell Telegraph Ry. Institute, 10 Parker Ave., San Francisco 18, Calif.

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MISCELLANEOUS

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EMBED Radio parts and sub-assemblies in clear liquid plastic. Solidifies at room temperature. Insulates mechanically, electrically, and chemically. Easy to handle, just mix and pour. Use for resistors, condensers, chokes, plug-ins, etc., $2.65 per lb. Instructions included. Send money with order, no C.O.D.'s. We pay postage. Plastics Laboratories, 3324 Park Blvd., Oakland 10, Calif.

BRITAIN'S foremost radio monthly, "Practical Wireless," sent all over world to "Hams" interested European radio developments. Leading technicians describe new British ideas and much valuable advice published for both amateur and expert. Indispensable to the keen serviceman enthusiast who wants to "keep ahead" and for all DX "Hams" who listen out across Atlantic. For annual subscription mailed direct from London, send only $2.00 to George Newnes Ltd. (PW.22), 342 Madison Ave., New York 17, N. Y.

RADIO Diagrams. All AM-FM Models. State Manufacturer and Model Number. 25c per diagram or page consisting both sides. Kramer's Radio Service, 36 Columbus Ave., New York 23, N. Y.

26 YEARS' experience radio repairing at your fingertips. I've repaired 45,000 radios. Have perfected simple system you can follow step by step. No calculations or formulas. Total price, $2.00, postpaid or C.O.D. Money-back guarantee. Ross Radio, 14615-P Grandriver, Detroit 27, Mich.

RADIOMEN, Servicemen, Beginners. Make more money, easily, quickly. $250 weekly possible. We show you how. Information free. Merit Products, 216-32R 132 Ave., Springfield Gardens 13, N. Y.

CITIZENS RADIO SERVICE

ONE of the final steps looking toward the general use of individual radio transmitter-receivers for personal and private communication was taken by the Federal Communications Commission in announcing proposed rules governing the Citizens Radio Service. Existing rules concerning technical requirements were made effective by the Commission on December 1, 1947.

The proposed service would permit short-range radio equipment, including camera-sized sets now in development, to be put to a wide variety of uses, ranging from providing contact in isolated areas to operating radio-controlled devices. This equipment would also be available in periods of emergency when normal communication facilities are temporarily disrupted.

Two classes of citizens stations are proposed. Class A stations would be permitted to operate throughout the 460-470 mc. band, which was assigned to this service by the Commission's frequency allocations report in 1945. Class A stations would be required to meet more rigid technical requirements than Class B stations, which would operate on 465 mc. only. A maximum input power of 50 watts is provided for Class A stations while a maximum for Class B stations would be 10 watts.

Licenses would be limited to citizens 18 or more years of age. However, such a station (except one using radiotelegraphy) could be operated by any other persons authorized to do so by the licensee. The latter would be responsible for the operation of his station.

Citizens Radio stations could be used either at fixed locations, or as mobile units on vehicles, aircraft, or boats. The registered serial number appearing on the station license is proposed as the station call signal. The range of a citizens transceiver would, in effect, be a line-of-sight proposition, and therefore substantially limited in its range.

The FCC points out that, pending the adoption of final rules, no licenses are now being issued in the Citizens Radio Service except on an experimental basis. Attention is also directed to the fact that wartime "walkie-talkie" sets are not usually adaptable to this service without extensive modification.

—30—

ERRATA

Our attention has been called to an error appearing in the diagram of Fig. 2 in the article "Adding Single-Sideband Selectivity to the Communications Receiver" by McMurdo Silver, appearing in the June, 1948 issue of RADIO NEWS. The connection from the last i.f. transformer to the second detector should be to the diode rather than to the triode plate. The audio voltage is then taken from the triode plate.

* * *

In Part 5 of the series "Modern Television Receivers" by Milton S. Kiver appearing in the August, 1948 issue of RADIO NEWS, there is an error in the text as it appears on page 165. Under the subject "Balanced Ratio Detectors," the text should indicate that one lead of a v.t.v.m. should be placed at point C of Fig. 3C rather than at point B of Fig. 3C. Will you kindly make this correction in your copy.

* * *

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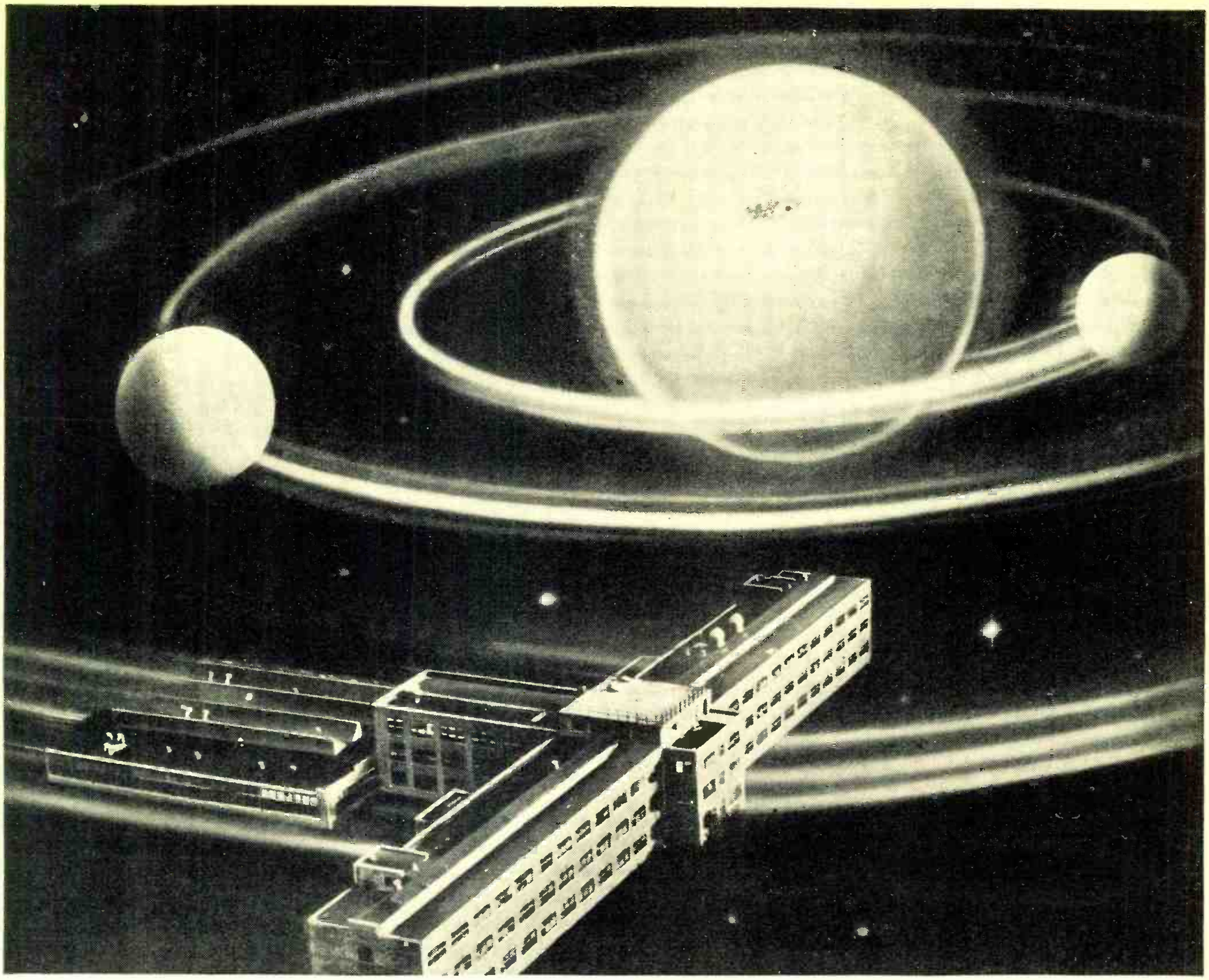

"Sunspot" research, by RCA engineers, helps radio communications to dodge interference from magnetic storms. RCA Laboratories is a center of radio and electronic research.

93,000,000 miles of laboratory space

A cyclonic spot erupts on the face of the sun, and—here on earth—we feel it. Sunspots cause "magnetic storms," which disrupt radio communications.

What can be done about it? Research, during which RCA scientists and engineers "worked" by instrument on the sun—93,000,000 miles away—offers an answer.

For many years, science related magnetic storms to sunspots. An accurate way of forecasting these disturbances was needed.

RCA scientists took a new tack. They noted that interference was most intense when sunspots were in a certain "critical area." Location and activity were observed to be more important than size.

Using this knowledge, RCA communications engineers accurately forecast the beginning and end of magnetic storms. They have established a daily magnetic storm forecasting service which is distributed like weather reports throughout the world. Transmission of messages can be arranged over circuits or paths that will dodge interference.

Such a pioneering spirit in research gives efficiency of service and leadership to all products and services bearing the names RCA, and RCA Victor.

• • •

When in Radio City, New York, you are cordially invited to see the radio, television and electronic wonders at RCA Exhibition Hall, 36 West 49th Street. Free admission. Radio Corporation of America, RCA Building, Radio City, N. Y. 20.

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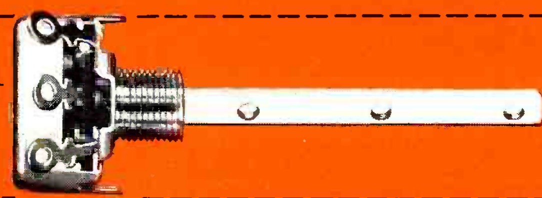
MALLORY Midgetrol

ALL NEW

ACTUAL SIZE $1\frac{5}{16}''$



ACTUAL SIZE $1\frac{5}{16}''$

The Little Volume Control with BIG Advantages

Bigger Market

The small size of the Mallory Midgetrol lets you service portables, auto radios and small AC-DC receivers which require $1\frac{5}{16}''$ controls.

Simpler Installation

The unique shaft design of the Mallory Midgetrol saves installation time with *all* types of knobs.

Simpler Stocking

Electrical characteristics let you use the Mallory Midgetrol to replace $1\frac{1}{8}''$ as well as $1\frac{5}{16}''$ controls. Stocks are further reduced because no special shafts are needed.

The Mallory Midgetrol is quietest by actual tests—and tests prove it stays quiet, too. In addition, it has nine big features that are *all new*.

- NEW SIZE
- NEW DESIGN
- NEW SHAFT
- NEW EXTENSION
- NEW SWITCH
- NEW ELEMENT
- NEW CONTACT
- NEW TERMINAL
- NEW TWO-POINT SUSPENSION

It's the NEW Standard in Carbon Controls. **See your Mallory Distributor.**

P. R. MALLORY & CO. Inc.

MALLORY

CAPACITORS . . . CONTROLS . . . VIBRATORS . . .
SWITCHES . . . RESISTORS . . . RECTIFIERS . . .
VIBRAPACK* POWER SUPPLIES . . . FILTERS

*Reg. U. S. Pat. Off.

APPROVED PRECISION PRODUCTS

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

Sitting before the sound-photo machine in the New York Daily Mirror radio car, John Reidy, the Mirror's chief photographer, advises the Mirror office (extreme left) that a photo is coming through.

The heart of the sound-photo receiving equipment at the office is Sylvania's Glow Modulator Tube, Type R1130B. A pin-point of light emitted by this tube is focused on a sheet of photographic paper attached to a revolving cylinder. As the cylinder revolves, the photograph is faithfully reproduced as it is being broadcast!

LINK FM SETS—SYLVANIA-tubed, too—transmit on-the-spot photos to paper's home office!

Pioneer in the radio car field, the New York Daily Mirror has made excellent use of its sound-photo apparatus. Equipped with Link Radio Communication units, the Mirror car has been in a position to scoop other newspapers by radioing pictures taken on the spot as soon as they are developed in the mobile photo-lab.

In these units, 36 highest quality Sylvania tubes, ranging from Lock-Ins to standard glass and GT tubes, help insure trouble-free operation of this ultra-modern method of photo-news reporting! For information on Sylvania tubes, see Sylvania Distributors, or write Radio Tube Division, Emporium, Pa.

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RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS