RADIO NEWS

MARCH 1947

35c


DRIVE
YOUR PRODUCTS
to market
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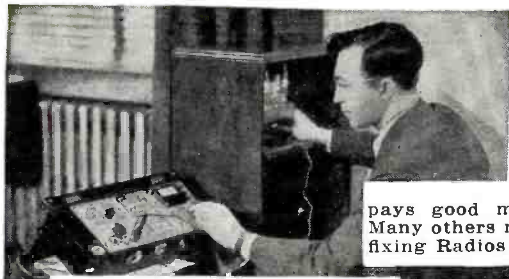
MOTORS
ALLIANCE PHONOMOTORS —POWR-PAKT MOTORS in shaded pole induction and split-phase reversible resistor types rated from less than 1/400th h. p. on up to 1/20th h. p. for powering valves, switches, controls, driving turntables, fans, record changers and automatic devices.
THE NEW MODEL A shaded pole, induction-type Alliance Fan Motor for speeds from 500 to 1050 R.P.M. operates on 50 or 60 cycles at voltages up to 220, 1/30th horse power, size 4⅝ x 2¾ inches. Porous bronze, oilless-type sleeve bearings. Open or fully enclosed construction. Approx. 8 to 40 oz. in. full load running torque, depending on stack length. Exceptionally quiet. For continuous or intermittent duty. Runs clockwise or counter clockwise—not reversible.
SLOWER SPEEDS • LOWER CURRENT COSTS
QUIETER OPERATION • SMALLER SIZE
Here are four big advantages built into the new Alliance Powr-Pakt fan motors. Results are longer life — less repair — smoother performance. This new Alliance shaded pole fan motor reflects advanced engineering! Mass-produced at low cost. Write!
WHEN YOU DESIGN—KEEP
alliance
MOTORS IN MIND
ALLIANCE MANUFACTURING COMPANY • ALLIANCE, OHIO



VETERANS
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Building this
A. M. SIGNAL GENERATOR
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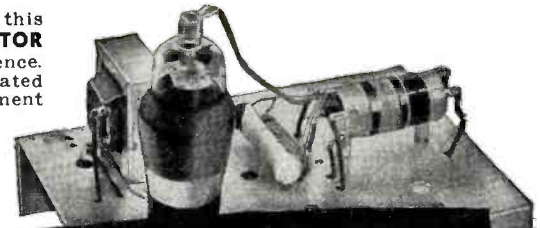

RADIO SERVICING
pays good money for full time work. Many others make $5, $10 a week EXTRA fixing Radios in spare time.

Learn RADIO by PRACTICING in Spare Time

with Big Kits of Radio Parts I Send You

You build this **SUPERHETERODYNE CIRCUIT** that brings in local and distant stations. You get practical experience putting this set through fascinating tests.

You build this **MEASURING INSTRUMENT** yourself early in the course—use it for practical Radio work on neighborhood Radios to pick up EXTRA spare time money!

Do you want a good-pay job in Radio—or your own money-making Radio Shop? Mail Coupon for a FREE Sample Lesson and my FREE 64-page book, "How to Be a Success in RADIO—Television, Electronics." See how N.R.I. gives you practical Radio experience at home—building, testing, repairing Radios with BIG KITS OF PARTS I send!

Many Beginners Soon Make Good Extra Money in Spare Time While Learning

The day you enroll I start sending EXTRA MONEY JOB SHEETS. You LEARN Radio principles from my easy-to-grasp, illustrated lessons—PRACTICE what you learn with parts I send—USE your knowledge to make EXTRA money fixing neighbors' Radios in spare time while still learning! From here it's a short step to your own *full-time* Radio Shop or a good Radio Job!

Future for Trained Men Is Bright in Radio, Television, Electronics

It's probably easier to get started in Radio now than ever before because the Radio Repair business is booming. Trained Radio Technicians also find profitable opportunities in Police, Aviation, Marine Radio, Broadcasting, Radio Manufacturing, Public Address work. Think of even *greater* opportunities as Television and Electronics become available to the public! Send for free books now!

Find Out What N.R.I. Can Do for You

Mail Coupon for Sample Lesson and my 64-page book. Read the details about my Course. Read letters from men I trained, telling what they are doing, earning. See how quickly, easily you can get started. No obligation! Just MAIL COUPON NOW in an envelope or paste it on a penny postal.
J. E. Smith, President, Dept. 7CR, National Radio Institute, *Pioneer Home Study Radio School*, Washington 9, D. C.

My Course Includes Training in
TELEVISION ★ ELECTRONICS
Frequency Modulation

BE A SUCCESS in RADIO
I Will Train You at Home
Sample Lesson FREE

Gives hints on Receiver Servicing, Locating Defects, Repair of Loudspeaker, I.F. Transformer, Gang Tuner, Condenser, etc., 31 illustrations. Study it—keep it—use it—without obligation! Mail Coupon NOW for your copy!

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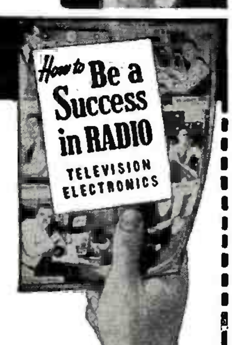
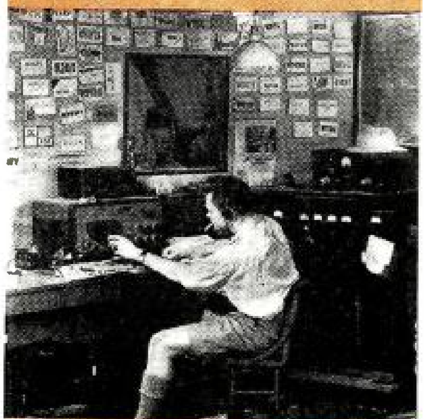


APPROVED FOR TRAINING UNDER GI BILL



THE COVER: Part of the extensive array of communications equipment that will accompany the Gatti-Hallicrafters Expedition for use at the main base in South Africa.

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RADIO NEWS

Reg. U. S. Pat. Off.

MARCH, 1947

FOR THE SERVICEMAN-DEALER

FOR THE AMATEUR

OF GENERAL INTEREST

DEPARTMENTS

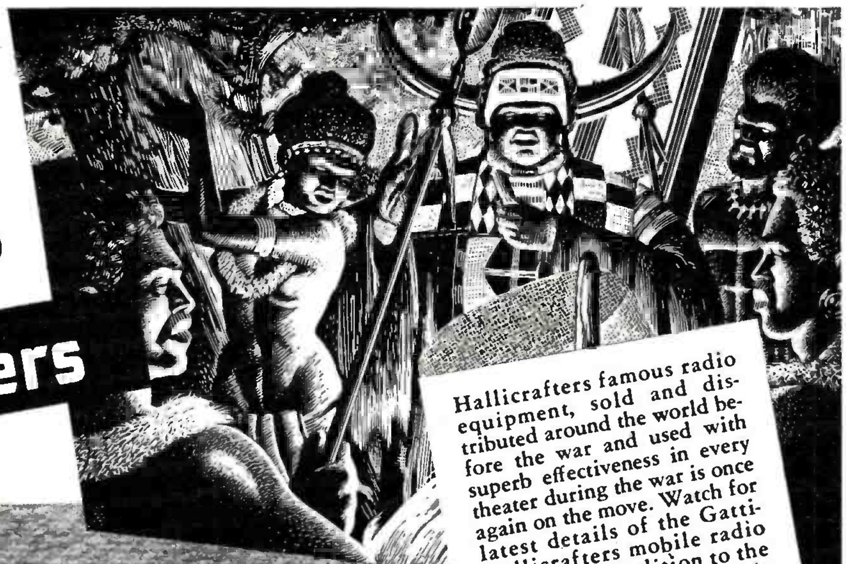
185 North Wabash Ave., Chicago 1, Ill.
VOLUME 37 • NUMBER 3

Member Audit Bureau of Circulations

RADIO NEWS is published monthly by the Ziff-Davis Publishing Company, 185 N. Wabash Ave., Chicago 1, Ill. Subscription Rates: in U.S. and Canada $4.00 (12 issues), single copies 35 cents; in Mexico, South and Central America, and U. S. Possessions, $4.00 (12 issues); in British Empire, $5.00 (12 issues)—all other foreign countries $5.00 (12 issues). Subscribers should allow at least 2 weeks for change of address. All communications about subscriptions should be addressed to: Director of Circulation, 185 N. Wabash Ave., Chicago 1, Ill. Entered as second class matter March 9, 1938, at the Post Office, Chicago, Illinois, under the Act of March 3, 1879. Entered as second class matter at the Post Office Dept., Ottawa, Canada. Contributors should retain a copy of contributions and include return postage. Contributions will be handled with reasonable care but this magazine assumes no responsibility for their safety. Accepted material is subject to whatever revisions and by-line changes that are necessary. Payment made at our current rates, covers all authors', contributors', or contestants' rights, title, and interest in and to accepted material, including photos and drawings.

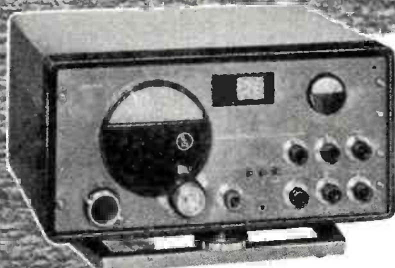
Going places (AGAIN)

hallicrafters



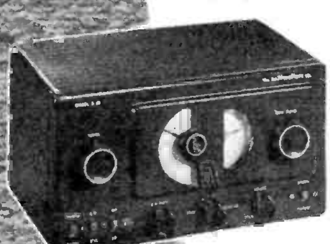
Hallicrafters famous radio equipment, sold and distributed around the world before the war and used with superb effectiveness in every theater during the war is once again on the move. Watch for latest details of the Gatti-Hallicrafters mobile radio equipped expedition to the Mountains of the Moon in deepest Africa—a new and exciting test for the ingenuity of hams and the performance of Hallicrafters equipment.

3 GREAT RECEIVERS designed and priced for hams who are going places, too



***Model* SX-42** Described by hams who have operated it as "the first real postwar receiver." One of the finest CW receivers yet developed. Greatest continuous frequency coverage of any communications receiver—from 540 kc to 110 Mc, in six bands. FM-AM-CW. 15 tubes. Matching speakers available. **$275.00**

***Model* S-40A** Function, beauty, unusual radio performance and reasonable price are all combined in this fine receiver. Overall frequency range from 540 kc to 43 Mc, in four bands. Nine tubes. Built-in dynamic speaker. Many circuit refinements never before available in medium price class. **$89.50**



***Model* S-38** Overall frequency range from 540 kc to 32 Mc, in four bands. Self contained speaker. Compact and rugged, high performance at a low price. Makes an ideal standby receiver for hams. CW pitch control is adjustable from front panel. Automatic noise limiter...................... **$47.50**

BUILDERS OF *Skyfone* AVIATION RADIOTELEPHONE

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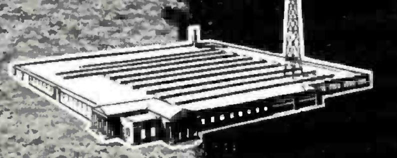

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New!

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MODEL P82

Tri-power portable Superheterodyne with Hi-Gain tuned RF stage in rich two-tone simulated leather covered wood cabinet. 5 tubes plus rectifier tube.

MODEL 1000

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MODEL 602

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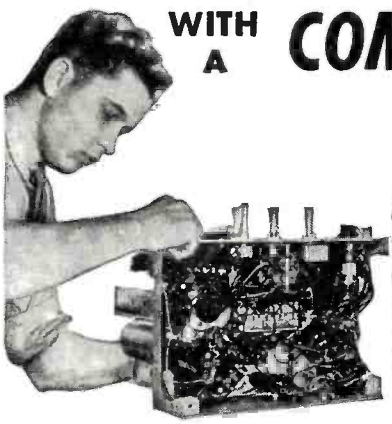

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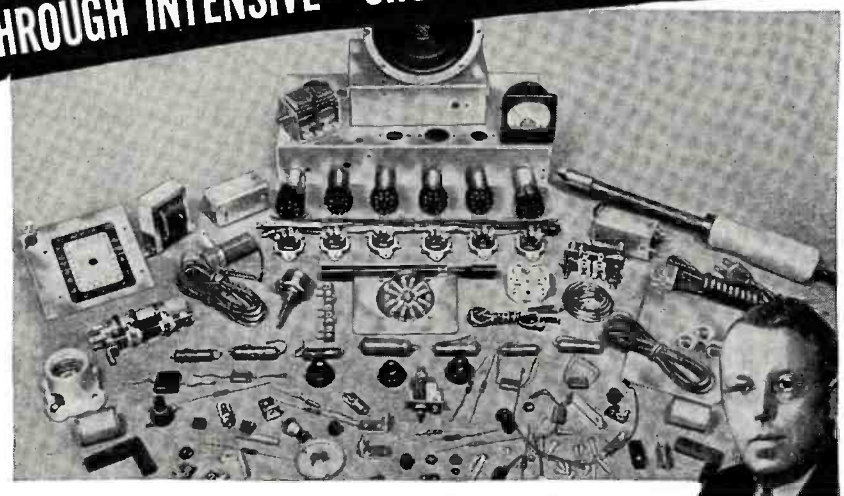

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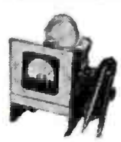
I'll show you how to perform over 175 instructive Experiments—how to build countless Radio Circuits. You'll learn a new, fast way to test Radio Sets without mfg. Equipment.



I give you a fine, moving-coil type Meter Instrument on Jewel Bearings—with parts for a complete Analyzer Circuit Continuity Tester. You learn how to check and correct Receiver defects with professional accuracy and speed.

You'll get valuable experience and practice building this Signal Generator and multi-purpose Tester. Makes a breeze out of fixing Radios and you don't have to spend money on outside, ready-made equipment.

Soldering, wiring, connecting Radio parts . . . building circuits with your own hands—you can't beat this method of learning. When you construct this Rectifier and Filter, Resistor and Condenser Tester, etc., you get a really practical slant on Radio that leads to a money-making future.

HERE'S THE LATEST, SIMPLEST WAY TO

TRAIN at HOME for a GOOD LIVING in RADIO-ELECTRONICS & TELEVISION

I train your *mind* by putting you to work with your *hands* on a big 6-Tube Superheterodyne Receiver. And, believe me, when you get busy with real Radio Parts — 8 big Kits of them — you really LEARN Radio and learn it RIGHT! You get the practical stuff you need to be *useful* in Radio, and that's what it takes to make money. You don't have to worry about what to do with these 8 Kits of Parts. Step by step, I show you how to build circuits, test, experiment, trouble-shoot. And you don't need any previous experience. The Sprayberry Course starts right at the beginning of Radio! You can't get lost! Simplified lessons, coupled with real "Shop" practice, makes every subject plain and easy to understand and remember.

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For the RECORD

BY THE EDITOR

LEADERS responsible for the success of commercial television as it gathers momentum in 1947 must decide right now that "good taste" in programming might well be the only key to the door of average Mr. and Mrs. TV Prospect.

Commercial AM programming, in many cases, has failed to maintain its original prestige in the eyes of the public. Commercials have gone from bad to worse and as far as education is concerned, AM today has little to offer in educational prestige. If this germ is absorbed by television program writers and directors, we shudder to think of what future generations will glean from that plague. We don't mean that efforts are not being made to properly launch television to the public, but we do feel that the press in general is not fully cognizant of the danger of TV getting off to a bad start.

According to best estimates, there will be better than 75 television stations offering program service by the end of the present year. To date the FCC has granted more than 47 construction permits in 22 of the most populous states throughout the country. In addition, there are now 6 commercial television stations on the air. Add to this the 25 or 30 applications on file at the FCC and we find that television is growing by leaps and bounds.

There were many factors during the past year which hindered the expected progress of television. They included such familiar stumbling blocks as strikes, material shortages, etc. In spite of these difficulties, much progress was made. Some even claim that 1946 was a good year for television.

It is quite possible that a half million folks will own television sets by 1948. Television during the coming presidential campaign will make it possible for all candidates to be seen as well as heard. We'll bet that many a housewife will vote for her favorite politician if he has a bit more glamour than his opponent.

Many of you old timers remember back in 1924 when radio had the same opportunity during that presidential campaign as television will have in 1948.

Many companies are already producing television receivers. Most of them are table models but the big stuff will come later when wood for cabinets becomes more plentiful. These manufacturers have done a great job, even though they did not reach the goal of nearly 200,000 sets which they had set for 1946. If it were not for material shortages, chances are that they certainly would have hit the jack pot.

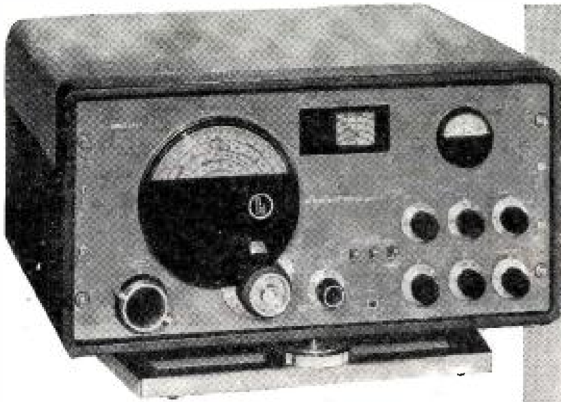
Another handicap still to be overcome at this writing is the restriction on the building of satisfactory quarters for television stations. This includes both transmitter houses as well as studios and offices. It is, however, quite likely that the controls will be dropped in the very near future.

In a recent talk Mr. Edgar Kobak, president of the Mutual Broadcasting Company, pointed out that, "We must not forget our responsibility as licensees, or we may wind up not running this television business. Television is going to have a great deal more to do than the movies or radio in bringing understanding among people . . . and with that responsibility we have got to be very careful that we do not misuse it." Mr. Kobak has really got something there!

It won't be very long until our youngsters will be sitting in the living room tearing their hair out as Dick Tracy approaches the gunfire of six desperados. It will be very easy for television to influence these children. Radio programming at present is surely bad enough but salt will be poured into the wound if TV sacrifices its prestige in exchange for revenue without due consideration for the type of material that will be televised.

On the other hand, television can and should set its sights very high as far as good taste is concerned. By so doing, it will expand at a healthy rate. There will be no time to experiment with public opinion unless telecasters can assure their televiewers that programs of high caliber are already programmed or are contemplated in the months to follow.

Television schools too, have a golden opportunity to campaign for decency and good taste in television programs. Yes, 1947 will be the "proving ground" for television. Many will butcher their opportunities while other organizations will band together to insist that good taste prevails. We'll bet (with our tongue in our cheek) on the latter. . . . . O.R.



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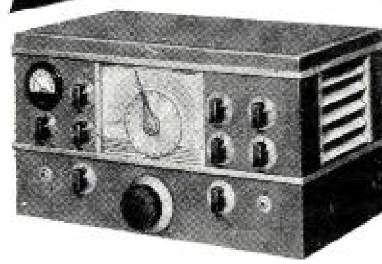
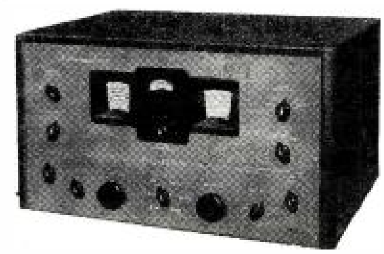
Net, less Speaker.................... **$275.00**



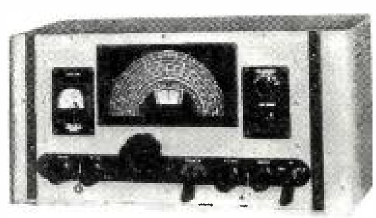
NATIONAL NC-2-40D

One of National's top receivers. Covers 490 KC. to 30 MC. range in 6 tuning bands. Has definite, accurate calibration for all bands. Features efficient single-dial control. Famous for its stable high frequency circuits. Frequency drift is reduced to a negligible value by temperature compensation. Has automatic band-in-use indicator. Wide-range adjustable series-valve-noise limiter. Flexible crystal filter. Special r.f. coupling circuits maintain full sensitivity.
Net, less Speaker.............. **$225.00**
Speaker in matching cabinet, *Net*..**$16.44**



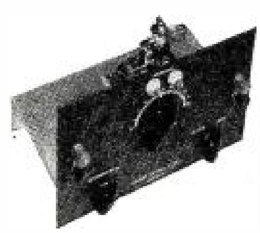
HAMMARLUND HQ-129-X

Designed to meet the most critical demand of professional operators. Full range, .54 to 31 MC. accurately calibrated. Has 4 calibrated Ham bands and one arbitrary scale. Variable selectivity crystal filter. Low-drift beat oscillator for code and locating stations. Antenna compensator. Voltage regulation. Automatic noise limiter. Compensated oscillator to reduce drift during warm-up. Earphone jack. Three i.f. amplifier stages. Two audio stages. Speaker supplied in matching metal cabinet.
Net, with Speaker.............. **$173.25**



THE RME 45

The famous RME 45 Receiver delivers peak reception on all frequencies—550 to 34,000 KC. Features full-vision calibrated dial using a single control for two-speed tuning. Includes five Amateur bands with ample band-spread. Has DB-calibrated signal level meter; 5-step variable crystal filter; Automatic Noise Suppression; stable, variable-pitch beat oscillator, and a host of other features. Housed in handsome streamlined metal cabinet with matching speaker.
Net, with Speaker.............. **$198.70**



SPECIAL! NEW 2-METER TRANSCEIVER KIT

For the new 2-meter band! Uses 6N4 as mod.-osc. in transmit position and as super-regen. det. in receive position; 7C5 as mod. in transmitting, and as power audio amp. in receiving. Supplies current for single button carbon mike; has output transformer for coupling to speaker or headphones. Requires 250 v. at 75 ma., 6.3 v. at .65 amp. for power. Kit when completed measures 6" x 5" x 9". Includes all necessary parts and tubes (less mike, speaker and power supply). No. 83-220. **NET**.................................... **$18.95**
Power Supply Kit. Includes all parts necessary to build power supply for transceiver. No 83-371. **NET** **$10.25**

Other Communications Receivers

Hallicrafters S-38	$47.50	RME-84	$98.70
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Hallicrafters S-41G	36.75	RME DB-20 Preselector	68.20
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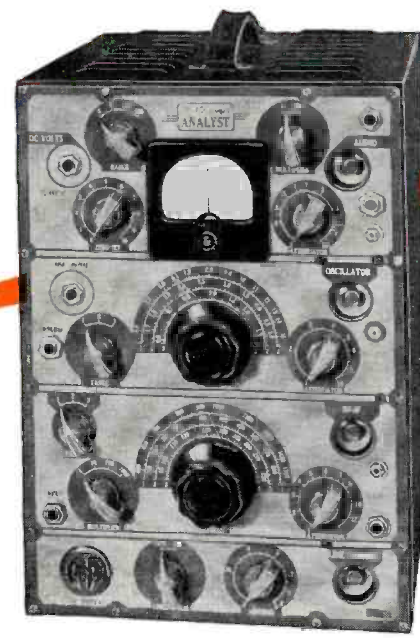

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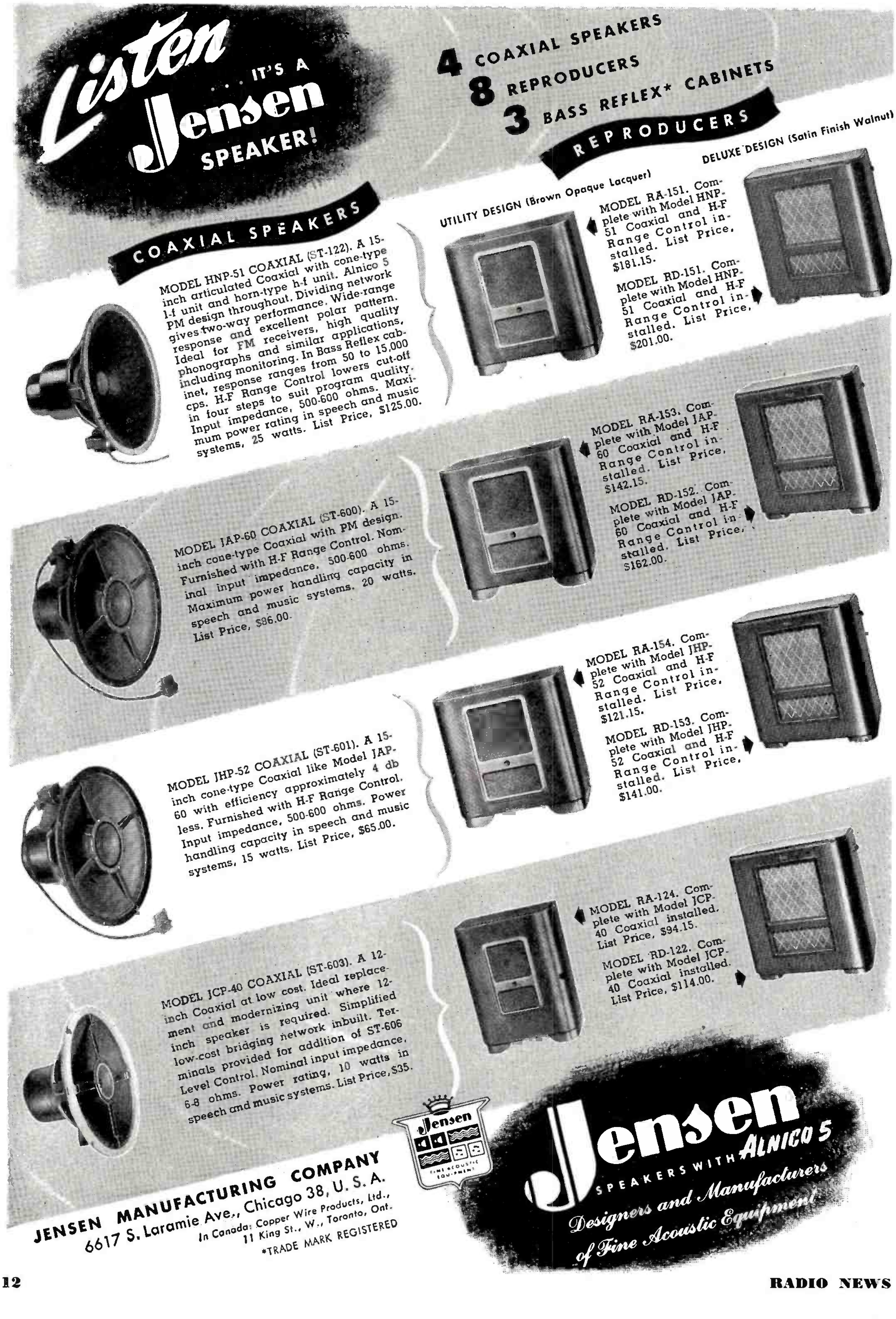

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8 REPRODUCERS
3 BASS REFLEX* CABINETS
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MODEL HNP-51 COAXIAL (ST-122). A 15-inch articulated Coaxial with cone-type l-f unit and horn-type h-f unit. Alnico 5 PM design throughout. Dividing network gives two-way performance. Wide-range response and excellent polar pattern. Ideal for FM receivers, high quality phonographs and similar applications, including monitoring. In Bass Reflex cabinet, response ranges from 50 to 15,000 cps. H-F Range Control lowers cut-off in four steps to suit program quality. Input impedance, 500-600 ohms. Maximum power rating in speech and music systems, 25 watts. List Price, $125.00.
MODEL RA-151. Complete with Model HNP-51 Coaxial and H-F Range Control installed. List Price, $181.15.
MODEL RD-151. Complete with Model HNP-51 Coaxial and H-F Range Control installed. List Price, $201.00.
MODEL JAP-60 COAXIAL (ST-600). A 15-inch cone-type Coaxial with PM design. Furnished with H-F Range Control. Nominal input impedance, 500-600 ohms. Maximum power handling capacity in speech and music systems, 20 watts. List Price, $86.00.
MODEL RA-153. Complete with Model JAP-60 Coaxial and H-F Range Control installed. List Price, $142.15.
MODEL RD-152. Complete with Model JAP-60 Coaxial and H-F Range Control installed. List Price, $162.00.
MODEL JHP-52 COAXIAL (ST-601). A 15-inch cone-type Coaxial like Model JAP-60 with efficiency approximately 4 db less. Furnished with H-F Range Control. Input impedance, 500-600 ohms. Power handling capacity in speech and music systems, 15 watts. List Price, $65.00.
MODEL RA-154. Complete with Model JHP-52 Coaxial and H-F Range Control installed. List Price, $121.15.
MODEL RD-153. Complete with Model JHP-52 Coaxial and H-F Range Control installed. List Price, $141.00.
MODEL JCP-40 COAXIAL (ST-603). A 12-inch Coaxial at low cost. Ideal replacement and modernizing unit where 12-inch speaker is required. Simplified low-cost bridging network inbuilt. Terminals provided for addition of ST-606 Level Control. Nominal input impedance, 6-8 ohms. Power rating, 10 watts in speech and music systems. List Price, $35.
MODEL RA-124. Complete with Model JCP-40 Coaxial installed. List Price, $94.15.
MODEL RD-122. Complete with Model JCP-40 Coaxial installed. List Price, $114.00.
Jensen
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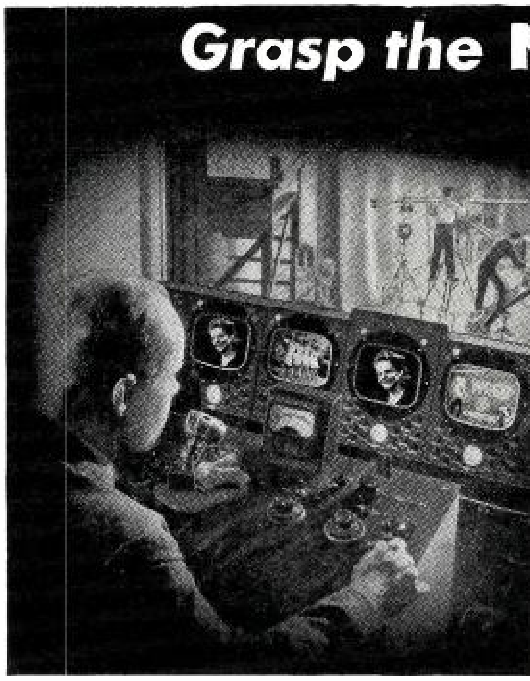

Modern Radio — FM Broadcast and Reception — Television — Industrial Electronics; Power, Control, Communications — new equipment and methods demand new technical ability and experience. Keep up to date with the latest.

MODERN RADIO EQUIPMENT FOR YOU TO USE AND KEEP

The very essence of National Shop Method Home Training is EXPERIENCE. You get actual experience by working with modern Radio and Electronic equipment—building many types of circuits. You may build a fine, long distance MODERN SUPERHETERODYNE, signal generator, miniature radio transmitter, audio oscillator, etc.—many other standard actual operating pieces of equipment—conduct cathode ray and other experiments. This practical work advances with your training—YOU LEARN BY DOING!

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By a Real Established Resident School with its own FM Studios, Shops and Laboratories.

TRAIN WITH ADVANCED TECHNIQUE

The good jobs in Radio Electronics now go to the men who are equipped to handle them. It takes training and experience. National Schools, one of the oldest and largest trade schools in the country, makes it possible for you to get this training right in your own home IN YOUR SPARE TIME.

National maintains modern resident training Studios, Shops and Laboratories where instructors and engineers are working constantly to improve training methods. SHOP METHOD HOME TRAINING is a logical extension of this practical system.

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Where do you stand today in modern industrial progress? What does the future hold for you? You owe it to yourself to investigate this opportunity. With National Training YOU GET AHEAD FAST—you may step into a good position or start a business of your own, with little capital, **even before you complete your National Course.**

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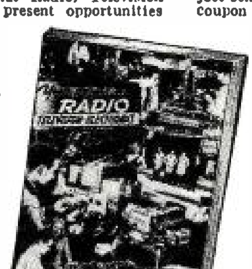

Get This Book FREE

This big book presents the facts about the field of Electronics and your opportunities in it together with full information about the advanced National Training. Read it and make up your own mind that National Training will equip you for a great future. No salesman will call on you from National. The book is FREE with your sample lesson. Clip and mail the coupon TODAY!

See What National Training Has Done For These Men

National Shop Method Home Training wins good jobs, independence and security. Take the word of National men who have established records in their favorite Radio, Television, or other branches of Electronics.

From O. K. Ivey, Washington, D. C., comes this endorsement: "I believe National offers the best course to be had . . . Keep up the good work."

Here's a statement from R. R. Wright, Blackfoot, Idaho: "Due to my training at National I was selected to instruct in the laboratory work of Navy and Marines."

Clifford Hannah, Portage La Prairie, Manitoba, Canada, writes: "My training has brought results as I'm in line for another raise thanks to National's encouragement and thorough training."

Joseph Michel, Jr., Granite City, Illinois, writes: "I am enthused with National training. I am now earning $225 a month as a radio operator and technician and $20 a week more in my shop at home.

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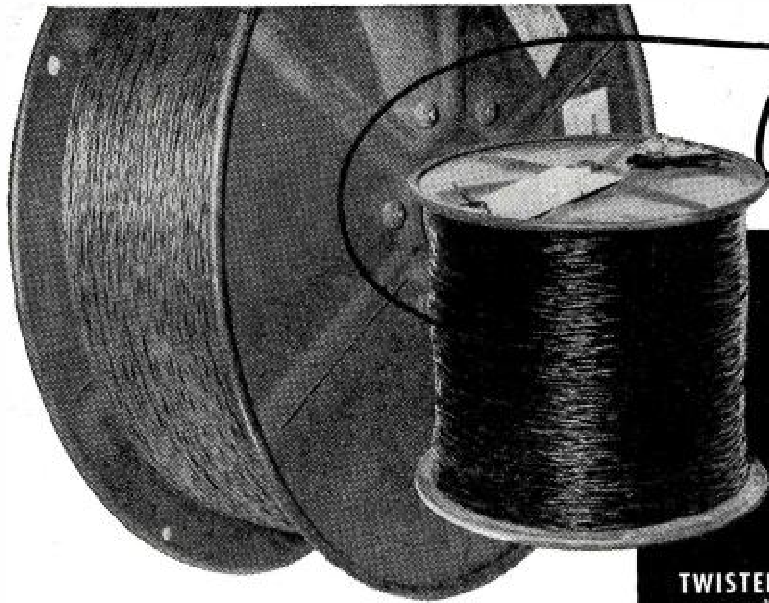
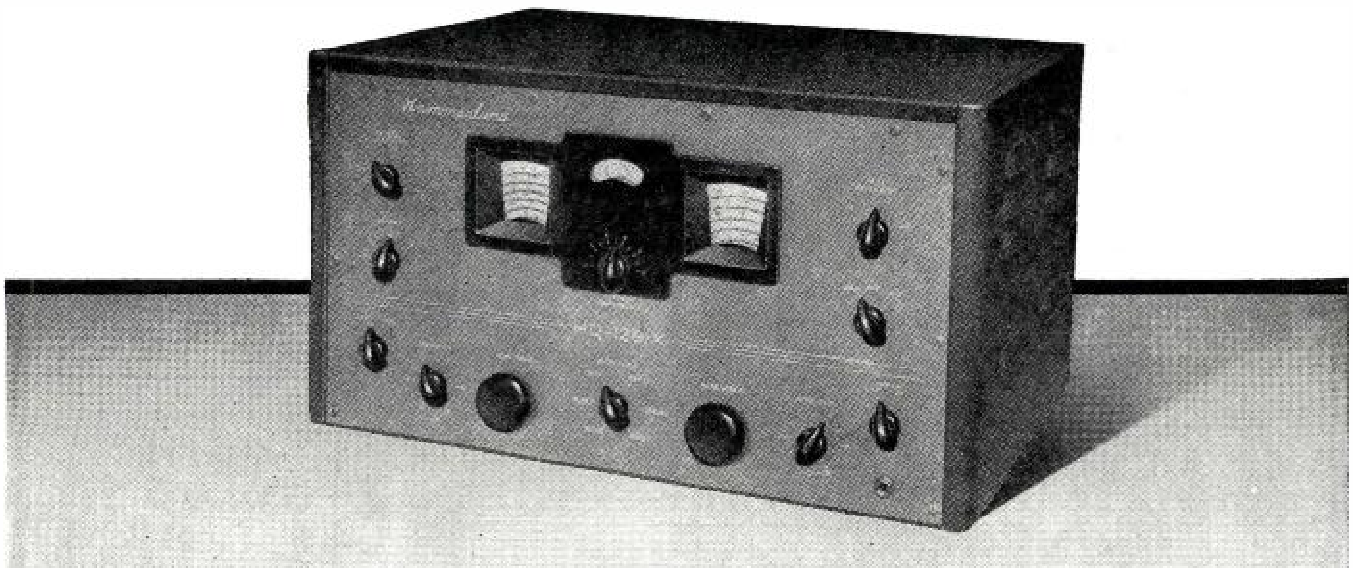


HQ-129-X

Choice of THOUSANDS



Hams are pretty shrewd individuals when it comes to selecting the gear they use. Many thousands knew what they wanted — they're using HQ-129-X receivers on the air every day. That, we believe, is one of the finest endorsements any product can achieve. Materials are still hard to get but hundreds of HQ-129-X's are being shipped every month.

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MANUFACTURERS OF PRECISION COMMUNICATIONS EQUIPMENT

Spot Radio News

★ *Presenting latest information on the Radio Industry*

By FRED HAMLIN
Washington Editor, RADIO NEWS

ITEMS TO ADD to your radio believe-it-or-nots; "radaranges," which can cook faster and more efficiently than any stove; radio hypnotism, which has the British Broadcasting Corporation and English television experts in a dither, and an electric baby sitter far more efficient than any you can engage in your neighborhood —as what wouldn't be?

RADARANGES recently became official when the Federal Communications Commission gave the remote-control stoves a frequency—2450 megacycles. On the heels of this announcement comes word from the Raytheon Manufacturing Company, that tests show you can cook a hot-dog in from eight to ten seconds, gingerbread and biscuits in 29 seconds, hamburgers and onions in 35 seconds, and frozen foods without thawing. Raytheon claims this timing to be 95 per-cent better than any existing stove. The trick is that the radar heater warms from the inside out, while with conventional units it's just the opposite. But tell the girl-friend not to get her hopes up—radaranges will be too costly for home use. Raytheon plans to make a hundred thousand of them in the next few years—for railroad diners, airliners, and vending machines.

BBC'S HYPNOTISM experiment via television was conducted privately, and officials were more shocked than pleased by its success. Peter Casson, a young ex-Royal Navy enlisted man, put some of the BBC brass so soundly asleep that he had to get off the air and talk to them personally before they woke up. One of them, more imaginative than the rest, began to think with horror of a whole nation being put to slumber by some future Hitler in the days when television will be as common (he said) as regular radio is now. The British immediately buried this possibility in England by barring hypnotists from television studios. Casson countered with the plea that telehypnotism could be used to help cure stammering and other neurotic disorders—he was successful with shell-shock cases during the war—but the BBC rule remains. U. S. televisors took an equally dim view. Said John F. Royal, National Broadcasting System vice-president in charge of television: "We feel hypnotism could be potentially a very dangerous and risky thing." No less ominous, perhaps, was his closing remark: "If people fall asleep watching our television," quoth he, "we trust it will be from natural causes."

THE BABY-SITTER DEVICE is the brain-child of a Washington, D. C., ex-electronics instructor, also a Navy man (U.S.). He is Keith C. Johnson, and has rigged equipment that broadcasts baby yells to and from his home and those of two neighbors, also with small children. The system amplifies baby sounds so that you can hear quiet breathing clearly in the receiver at the other end of the line. If the baby really tunes in with a howl, the loud-speaker nearly shakes the roof off. The trick is for the Johnsons to go to the movies, while one of the neighbors watches the kiddies by tuning in; another night, a neighbor goes to the movies, the Johnsons listen. Cost of the equipment, Mr. Johnson says, runs about $15 per family—$45 for his hook-up. In Washington, where baby-sitters are scarce, his device has created a sensation, but from where we sit (with an 18-month-old youngster upstairs) Johnson should be given dubious credit. Whoever heard of magnifying an infant yell—we can hear ours, when he gets going, for a mile upwind, without hook-up. We think that Mr. Johnson should be censured severely for aiding and abetting the situation.

THERE ARE a substantial number of good jobs in FM broadcasting, according to experts who recently attended the FM Association convention—first of its kind—in Washington. One of the delegates, Don Martin, of the School of Radio Arts in Hollywood, whose organization has been swamped with requests, estimates the grand total of openings to be more than 7000. This is on the basis that the average FM local station will have to have a manager, a sales manager, a production staff with a minimum of three announcers, a three-man technical staff, some kind of office manager, and a receptionist—ten persons in all. With (a conservative) 700 stations expected to be going by the end of 1947, he believes 7000 an equally conservative personnel figure. Speaking very generally—the talent of the individual, plus experience, and the city in which he works are important

The New DELCO RADIO Combination

For those who demand the *Best*

This handsomely styled, engineered-for-tomorrow radio-phonograph combination features the finest in AM and FM reception, with fourteen tubes plus rectifier, and a mammoth 15-inch speaker for full tone range. It provides push-button tuning—not only on the standard AM broadcast bands but on FM as well!

And the phonograph? Here again Delco offers the best of all that's new! A special lightweight tone arm, with sapphire permanent-point pick-up, gives amazing fidelity and tone quality . . . but that's not all! Its advanced design eliminates needle changing, makes records last years longer.

Add to these great features a smooth-action record changer with the extra capacity of fourteen 10-inch records or ten 12-inch records—an automatic shut-off that goes into action when the last record is played—and you realize that this instrument has *everything!*

To put this magnificent Delco combination in anything but the finest cabinet would be unthinkable. Expert craftsmen have produced cabinets of grace and distinction to give it the proper setting. Model R-1251 in walnut, and Model R-1252 in mahogany, are masterpieces of fine furniture.

Like other Delco portables and table models, this fine new Delco combination brings new honors to the trusted Delco name of General Motors. United Motors Service, General Motors Building, Detroit 2, Michigan.

Production is Improving

But there are still many shortages of materials and component parts which make it impossible to meet the large demand for Delco radios at this time. If your distributor is unable to fill your order for Delco radios promptly, keep trying. You can count on it that he's doing his best, and that we're doing ours to speed production.

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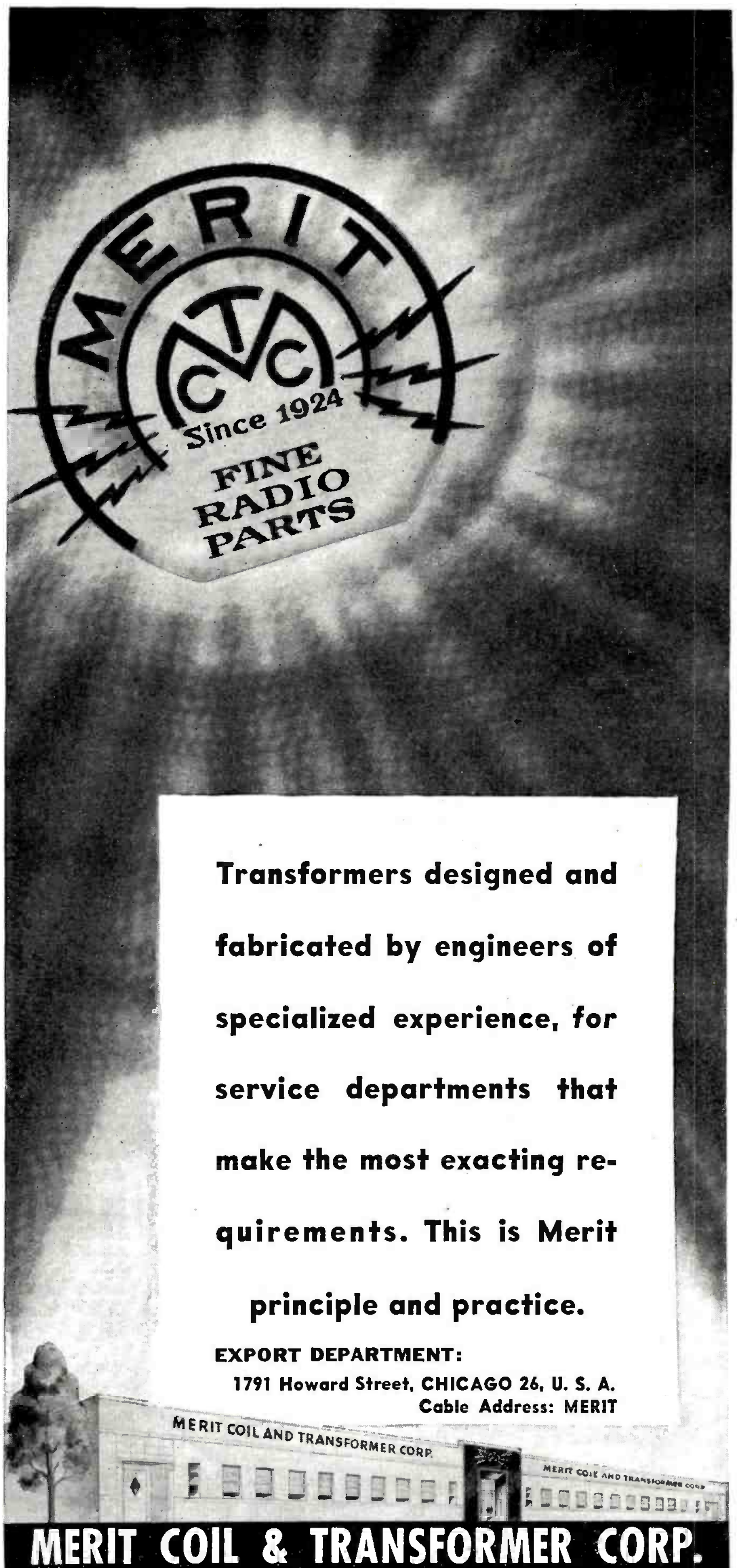
Delco radios are distributed nationally by United Motors Service. See your United Motors distributor about the Delco radio line.

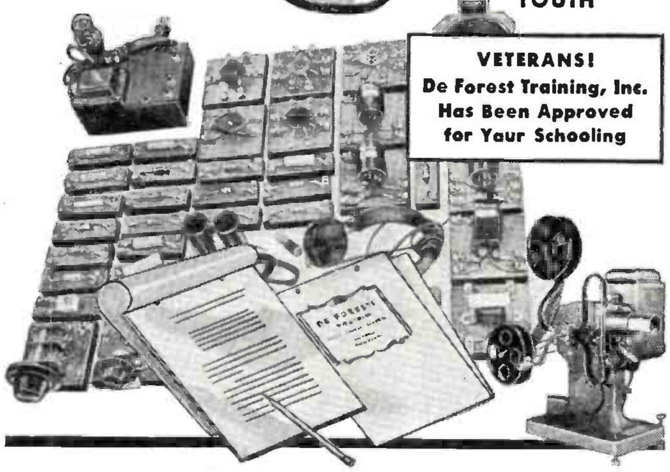


factors—price tags on the jobs begin at $60 per week for announcers, $75 for a chief engineer, $60 for operators. Combination men — Mr. Martin is training announcer-operators, for instance—get proportionately more. Supply of trained personnel, he reports, is far behind demand and "the need stands to be a real problem." To get such jobs, if you are qualified, best bet according to the leaders with whom we talked is to contact your nearest FM station, especially if it has not yet started operations.

FM-ERS, INCIDENTALLY, are the most optimistic businessmen in the nation today. With fewer than average transition problems after the war—they had nothing to "transition" from—with a brand-new gadget that has proved already that it fills a real need, and with RMA campaigning for "A Radio for Every Room—A Radio for Every Purpose"—FM manufacturers and broadcasters go into the spring proclaiming that 1947 is their year. Typical of the industry attitude is the recent statement by Prof. E. H. Armstrong, FM's inventor, that the new-style radio business has a potential of $100,000,000 a year on sets alone —and will go up from there. "The evidence indicates manufacturers can sell FM sets as fast as they can be turned out," he added. A production of 5,000,000 FM sets in 1947 is predicted by W. R. David of the General Electric Company. Less than 150,000 were produced in 1946. David also predicts that nearly a thousand stations will be in operation before 1948 rolls round. He hails their coming as "the biggest thing that has ever happened in radio broadcasting, the FM transmitter business, or the FM receiver business." . . . Roy Hofheinz, KTHT-KOPY, Houston, Tex., new FMA president, joined the others in predicting a banner year.

THE RADIO - IN - EVERY - ROOM campaign being conducted by RMA will—in case you don't already know —play up FM. Edward R. Taylor of the Zenith Radio Corporation, Chicago, is in charge of the drive. He says FM will open a huge new field for sales efforts and is a compelling reason for increasing the number of radios in the home. The increased number of radio stations which FM is bringing on the air, he adds, makes it more imperative to have additional receivers so that every member of the family may get his favorite program, if necessary, at the same time. . . . He brings out a number of other interesting facts: About 90 per-cent of American homes now have at least one radio. One out of every three families has at least two. Most radio sets today are in the living room. Bedrooms run second, the kitchen a poor third. The great majority of radio receivers in the living room are consoles and radio-phonograph combinations, while the bedroom has the greatest number of midgets and table

Let Us Show You How to Prepare
TO MAKE REAL MONEY QUICKLY!!



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"Dear Sir: Due to the fact that I am enrolled in your school, I am now employed by the Westinghouse Manufacturing Company instead of a steel mill. This is a great opportunity for me because this is a new branch opening in this territory and there is a great chance for advancement.

Elmer H. Havens
Lancaster, New York"

DeFOREST'S
TRAINING, INC.
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Whether you are an ex-G. I., a teen-age youth, or an older man eager to earn real money...There can be a place for you in The Billion Dollar Field of Electronics and Radio

You will probably find no greater variety of money-making opportunities than in the fields of Electronics and Radio. Hundreds of men, who today either successfully operate their own businesses or hold important jobs in these fascinating fields, are graduates of DeFOREST'S TRAINING, INC.

Our Home Study or Residence courses, thorough in every detail, offer a unique combination of training advantages. We furnish you with a 16 millimeter Motion Picture Projector and 12 reels of valuable movie film. You also use 8 big kits of Radio- Electronic parts as shown on this page, enabling you to work out 133 MODERN EXPERIMENTS for valuable practical experience.

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Send me your big book "VICTORY FOR YOU," showing how I may make my start in Radio-Electronics with your modern home training plan. No obligation.

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City.........................Zone......State....
☐ If under 16, check here for special information.
☐ If a discharged veteran of World War II, check here.

models. The kitchen runs second on midgets and third on table models. An estimated 20,000,000 pre-war radios are in need of replacement and Mr. Taylor expressed the opinion that many of them will be replaced by modern FM-AM receivers. . . . RMA is spending $50,000 on the drive, but thousands more will go into national advertising by industry members of the Association and cooperating sales groups.

LATEST DIRECT COMPARISON of FM-AM stations issued by FCC shows that this year began with 553 cities or metropolitan districts in the U. S. which had one or more licensed AM stations, but of these, no FM application has been received from 208, or 38 per-cent. Geography is the major factor in this—more than half of the non-applicants are located in the West Central, Mountain and Pacific regions. More specifically, the states in the West Central region in which proportionately few AM cities have provided FM applicants include North and South Dakota, Nebraska, Kansas, Arkansas and Oklahoma. These six states of the eleven in the region have a total of 57 AM stations, but FCC has received FM applications from only 19, or one out of three. Similarly, Montana, Wyoming, Colorado, New Mexico, Arizona, and Utah have 44 AM cities, but only 8 FM applicants—one out of five. Washington and Oregon, with 29 AM's and 9 FM applications, rate one out of three. . . . But the West is not alone in thin FM states—Maine, New Hampshire, Vermont, Alabama, and Mississippi show little enthusiasm for the new media, if applications are an indication. It follows that FM is most active in eastern metropolitan areas and in the middlewest.

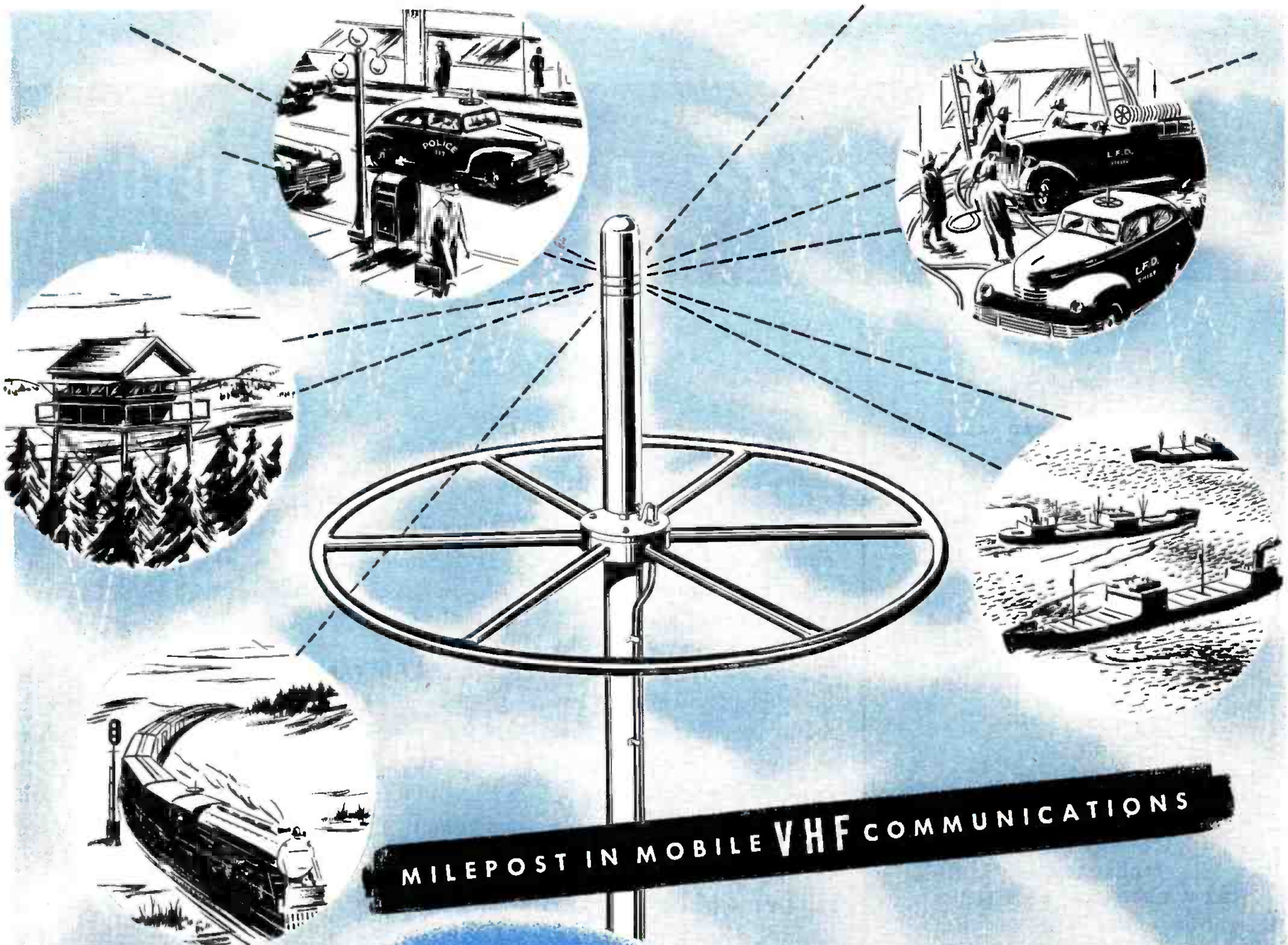
ALL OF WHICH is not to imply that AM broadcasting is not experiencing pretty good times itself, now that the war is over. Federal Communications Commission's most recent summary shows that a total of 365 permits for construction were granted for AM stations between VJ Day and last September 19. Of these, 187, or 51.2 percent, were issued in cities which had no existing radio station as of VJ Day. All such cities had populations of 50,000 or less. In addition, 82 construction permits, or 22.4 per-cent, were issued in cities with only one existing station and over half of these grants—57—went to cities of 50,000 or less. . . . The most common type of AM grant was for a 250 watt unlimited time station in a community of 50,000 or less. . . . More recent summaries are complete on FM activities. As of the first of this year, there were 136 stations on the air and construction permits granted since October 8, 1945, totalled 426. But AM still played an important role, even in the FM field. Of the permits issued, 74 per-cent were to persons already holding AM permits. An additional 12.6 per-cent were issued to non-AM newspaper interests. Over-all, 36.3 per-cent of the applicants had newspaper connections.

FCC, WHOSE PROFESSIONAL HAMS did dramatic work during the war detecting enemy radio activities, is having equally good luck catching up with domestic violators in the post-war world. The Commission's detection of illegal stations is so accurate, indeed, that those in charge of it keep wondering why anybody would want to try to beat the game. More than 200 illegal operators have been apprehended since the war ended. Many of them are kids up to mischief, and are dealt with accordingly on a first offense; but an increasing number of adults, who know exactly what they are doing and are under the illusion that they can get away with it, are showing up on FCC records. For these the going can be tough—maximum penalty may run to $10,000 or two years imprisonment—or both. . . . FCC does not take all the credit for its detection service, pointing out that 25,000 radio stations, 315,000 radio operators, and nearly 80,000 amateurs are always ready to report strange signals or an erratic "driver" in their bands. Hams "are especially quick to report," FCC says. Reports are relayed to FCC field offices and the Commission's 22 monitoring stations and from then on it's just a matter of time till the violator is run down. Why, in the face of this routine, illegal operators continue to crop up, is one of the minor mysteries at FCC headquarters in Washington these days.

ALTHOUGH, WHEN CONTRASTED with radio goings-on in this country, foreign activities seem small, they are nevertheless improving. In Japan, for instance, set production increased nine times its size between January and June of last year—from 8000 to 75,000. The Japs, like us, had tube trouble and total set production for the year was much less than we turn out in peak months. . . . Similarly, in England production for the year ending this spring was high for England—approximately 1,750,000 sets. Some 400,000 of these will be exported. The British Isles also report a new all-time high of radios in use—nearly 11,000,000. . . .

SUCH SAMPLINGS of the news from abroad indicate that U. S. manufacturers are far and away ahead of foreign competitors, and with this in mind the Radio Manufacturers Association has come out strongly through its export committee to urge the Federal government's support in protecting American interests. RMA's statement was made timely in light of the spring negotiations by the State Department on reciprocal trade agreements. RMA export committee chairman A. D. Keller has asked that trade barriers be withdrawn or reduced to "the point where our manufacturers

(*Continued on page* 153)



THE NEW AMPHENOL GROUND PLANE ANTENNA

Efficient VHF radio communications is a must in modern railroading. Used to expedite freight and express service, it is cutting hours from schedules, and eliminating waste time and money in switching operations.

Designed principally for use in the 152-162 mc band by railroads for "train-to-fixed-station" and "end-to-end" communications, the new Ground Plane Antenna illustrated is foremost among many new VHF radio components and accessories perfected by Amphenol engineers.

Providing maximum power radiation at low initial cost, this extremely rugged antenna consistently out-performs other antennas under normal and extreme conditions. It is easily and quickly installed, and has been thoroughly tested in main-line railroad installations.

Danger from lightning or contact with power lines is eliminated, as this antenna is at ground potential. The nature of its radiation pattern insures uninterrupted service during sharp "U" or "S" turns.

The Amphenol Ground Plane Antenna is also widely used by police and fire departments, by forestry, geophysical, power and petroleum field crews, for mobile marine installations, and many others. It is available with Ground Plane Skirt, as shown, for installations where a large metallic mounting surface is not available.

Write today for complete technical data on the Ground Plane Antenna, or for engineering aid in solving your VHF radio communications problems.

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WASHINGTON 25, D. C.

ADDRESS ALL
TO THE

IS READY TO SERVE THE NATION

November 27, 1946

Mr. John Curtis, Manager
Mobile Communications Division
Farnsworth Television & Radio Corp.
Fort Wayne 1, Indiana

Dear Mr. Curtis:

I wish to thank you for your letter outlining the excellent progress which the Farnsworth Television and Radio Corporation has made in developing and producing various types of equipment for railroad radio communication. I was especially pleased to read that section of your report which quotes various railroad presidents who recognize that radio will enhance safety and efficiency in railway operations.

As you know, the Commission has been convinced for some time that a properly engineered railroad radio system will contribute to safety of life and property, both in preventing accidents and in reducing the seriousness of injury and damage after accidents. While safety is of paramount importance we also recognize and encourage the use of radio as a means of improving the overall efficiency of the railroads.

Sincerely yours,

E. K. Jett,
Commissioner

Commissioner Ewell K. Jett has been a motivating factor in the development of radio communications since the pioneering days of the early 20th Century. From 1911-1929 he participated in the development of the Navy's use of what was then a new communications art. Since 1929, Mr. Jett has been associated with the Federal Communications Commission and its predecessor, the Federal Radio Commission, first as Assistant Chief Engineer; then, since February 1, 1938, as Chief Engineer. On February 15, 1944, Mr. Jett was appointed Commissioner.

Throughout his career with the Navy and the Commission, Mr. Jett has been alert to the ever-increasing usefulness of radio in mobile operations. More recently, with the development of radio equipment for railway and highway services and Mr. Jett's origination of the Citizens' Radio Communication Service, his activities wth the Commission have taken on even more significance to American economy and well-being.

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Television · Radio · Phonograph-Radio

Farnsworth Radio and Television Receivers and Transmitters • Aircraft Radio Equipment • Farnsworth Television Tubes • Mobile Communications and Traffic Control Systems for Rail and Highway • The Farnsworth Phonograph-Radio • The Capehart • The Panamuse by Capehart

Now! A 2-Band, Table Model with Console Features — Standard and Short Wave Reception with Interference Eliminator

Here's the kind of price-quality feature which brings extra business into a fine radio shop. Air King precision craftsmanship enables you to present to your most appreciative customers a 2-Band, high performance radio finished in rich American walnut. The set has superb good looks and exceptional tone. When you see how brilliantly it demonstrates and remember that it offers fine radio reception on both standard and short wave, anywhere in the country, you can see its great possibilities as a stepper-up of immediate sales income.

Note this combination of Air King Features—

Interference eliminator that blocks out code telegraph. Built-in Phonograph Jack to accommodate automatic record changer. Convenient panel control for phonograph connection. 6 Tubes (including rectifier) with Superheterodyne circuit. 7 inch Selectorloop. Alnico #5 "Tone King" speaker.

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The Royalty of Radio Since 1920

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Division of HYTRON RADIO & ELECTRONICS CORPORATION, *Brooklyn, N. Y.*

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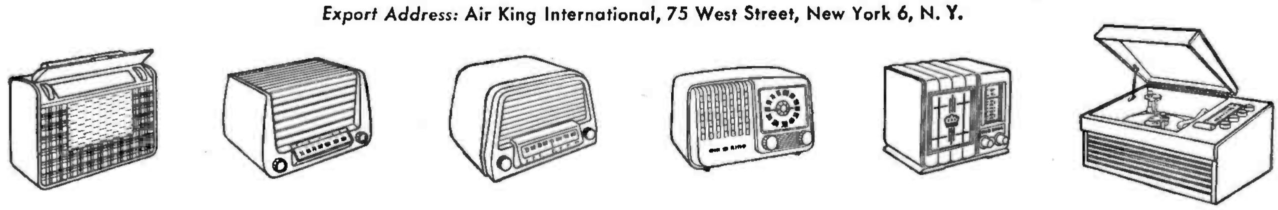

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Learn RADIO TELEVISION ELECTRONICS

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For a Good Pay Job or A BUSINESS OF YOUR OWN!

My Proven 2-Way Method Helps You Get into Radio *Quicker!*

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With over 250 students and graduates from many Radio schools, as well as experienced radio men, competing to find the best Radio Technicians in Cuba ... 7 out of the first 10 prizes were won by H.R.T.I. Graduates! These PROVEN RESULTS speak for themselves! You can't afford to gamble with your future. Choose the Radio School with the success record ... H.R.T.I.

WHAT WINNER OF FIRST PRIZE SAYS:

"Your training methods are so practical, and so clear, that no one should have difficulty in learning. I found everything so easy that it makes me feel that anyone who takes your course can be sure of success."

LUIS ILLADA, *Havana, Cuba*

WHAT SECOND PRIZE WINNER SAYS:

"I am very happy about my success, but it is to you and the H.R.T.I. staff that I owe my success. I am deeply grateful to H.R.T.I. for I have received all and MORE than you promised when I enrolled."

ALFREDO RODRIGUEZ, *Oriente, Cuba*

WHAT WINNER OF FOURTH PRIZE SAYS:

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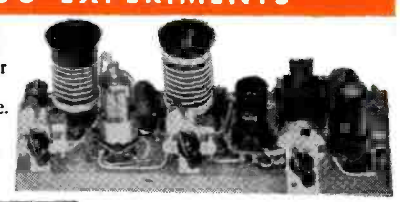
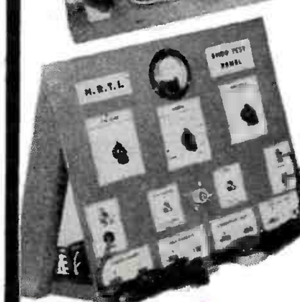


Above: You build this tuned radio stage, regenerative detector and audio amplifier. (Experiment No. 329)



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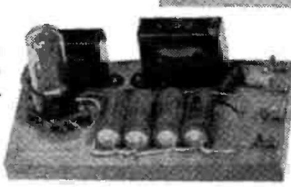

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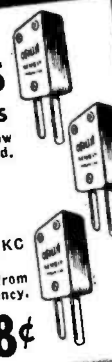

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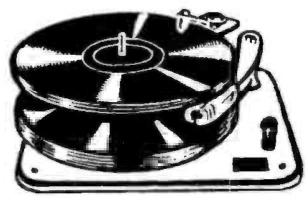

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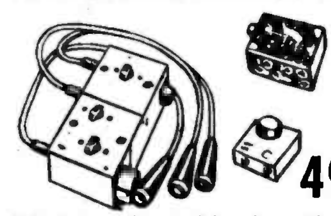

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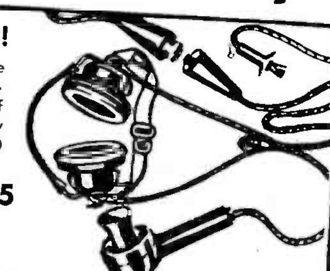

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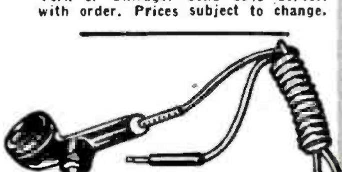

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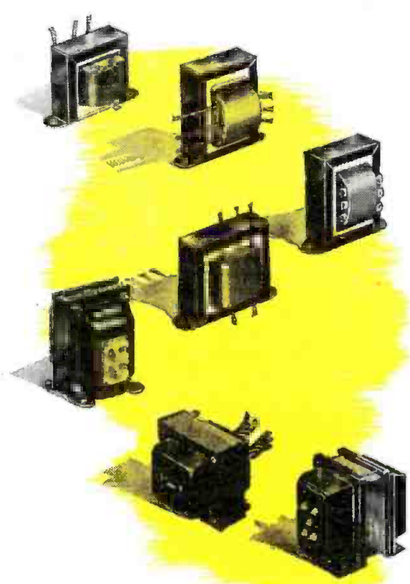

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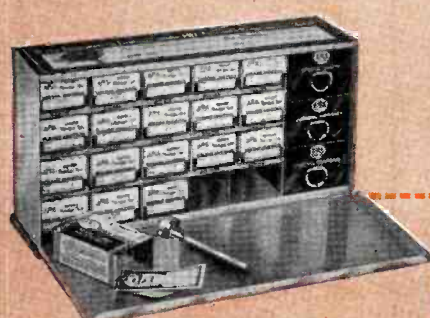

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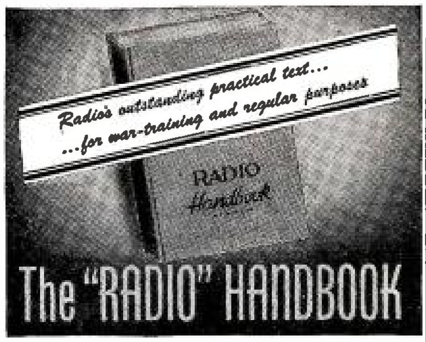

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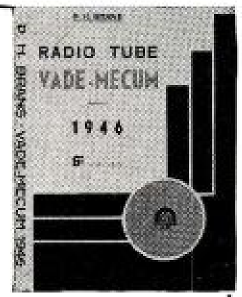

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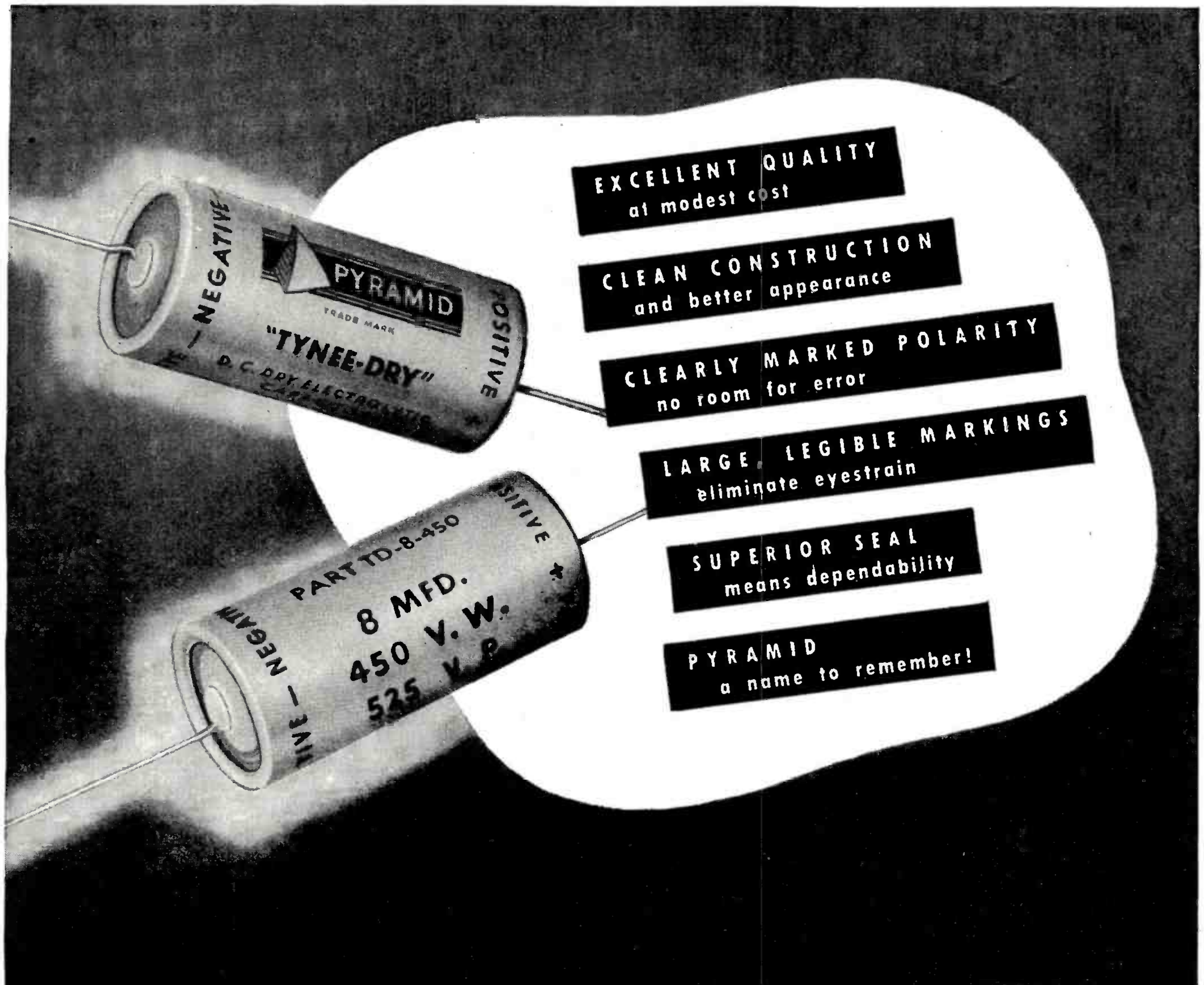

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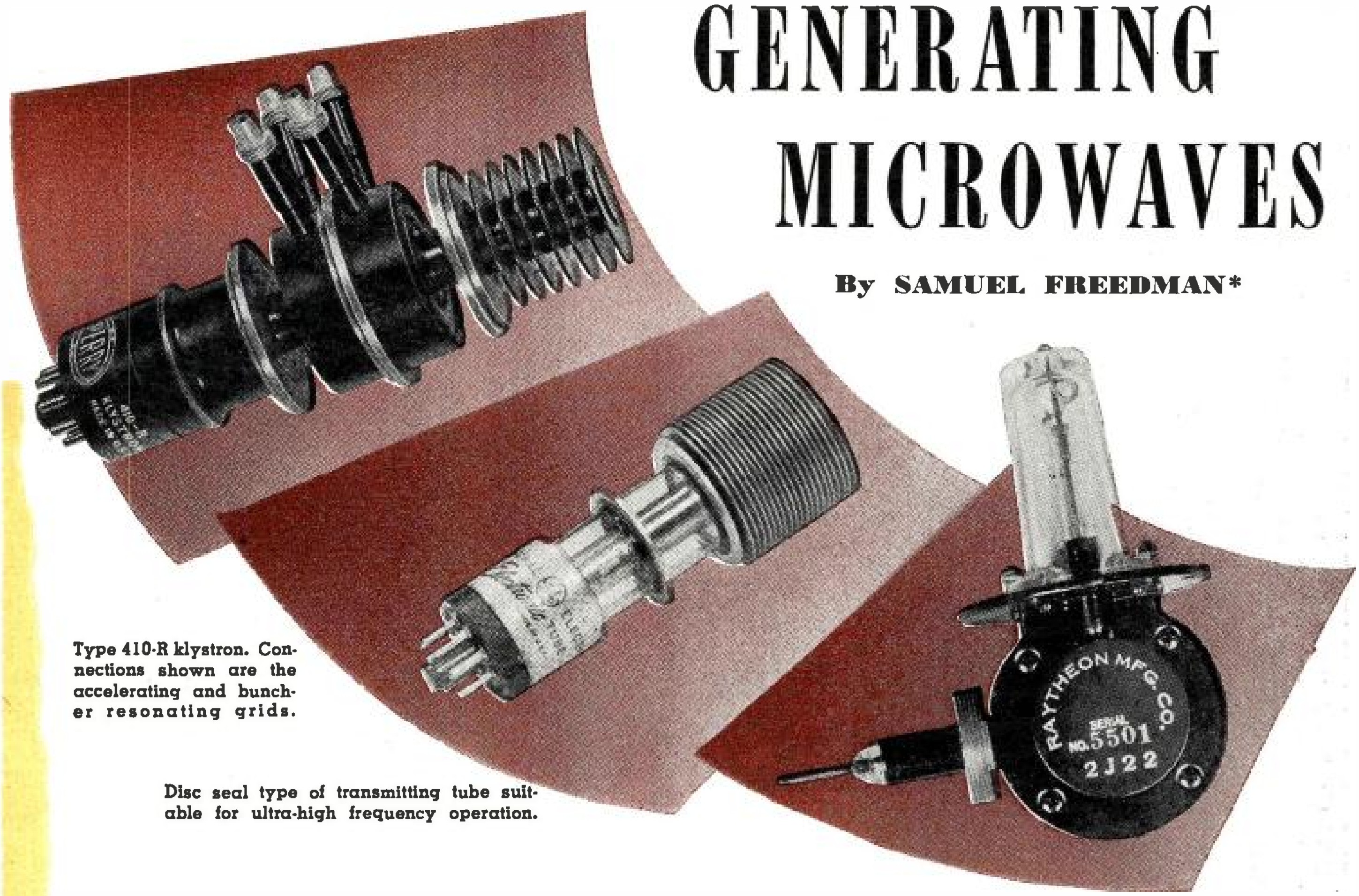
By SAMUEL FREEDMAN*



Type 410-R klystron. Connections shown are the accelerating and buncher resonating grids.

Disc seal type of transmitting tube suitable for ultra-high frequency operation.

Typical magnetron capable of developing about 300 kw. peak power for radar pulsed power transmission. It contains 8 cavities and is designed to operate fixed frequency in the 3000 mc. region. A magnet fits against the flat surfaces.

In generating microwaves various types of tubes may be used, ranging from conventional radio receiving tubes to the more expensive magnetrons; each and every one has its special advantage.

THE increasing utilization of radio principles for innumerable types of fixed, portable and mobile communication and navigation can only be achieved by the development of additional frequency spectrum.

Except in the most limited way, this must be accomplished by the development of tubes, circuits and techniques capable of functioning on wavelengths shorter than ever before put to common use. The utilization of shorter and shorter wavelengths have now brought us into the microwave regions known as the ultra-high and super-high frequency bands.

Ultra-high frequencies are those lying between 300,000 and 3,000,000 kilocycles. Super-high frequencies are those between 3,000,000 and 30,000,000 kilocycles. Together they represent those wavelengths shorter than 1 meter and longer than 1 centimeter. One centimeter today is by no means the stopping point. It is merely a convenient resting point on our road towards the infrared region which starts at about a hundredth of a centimeter. This will correspond to about three billion kilocycles.

Each time we halve the wavelength, such as from 2 centimeters down to 1 centimeter, we double the amount of frequency spectrum previously considered feasible to utilize. There is now no limit in sight as to the ultimate amount of frequency spectrum which may be developed in order to provide for existing or potential radio stations and services. The infrared light spectrum, and ultraviolet regions do not stop until a frequency of 25,000,000,000 megacycles has been reached.

Progress in the utilization of these frequencies becomes increasingly hampered as the wavelength is reduced. This is due to the wide differences of opinion between the conforming and non-conforming experts in their radio thinking. The conformists are much better educated and more formally trained as engineers and physicists. They also enjoy or dominate the best facilities and backing in their work. The non-conformists (which include the author) have, however, made many worthwhile contributions to the art. They do it in direct conflict with prior mathematical and theoretical conceptions of the limitations believed to be involved. Past experience indicates that many revolutionary developments originate with non-conformists. The ultimate development of such ideas, however, require the large scale participation by the conformists. The latter make their advanced mathematics and theories fit the new facts or discoveries by taking into account some new relevant factor which was not previously known or adequately evaluated.

As tubes are utilized for microwaves, problems arise which were of little concern at the lower frequencies of the past. These problems are as follows.

1. *Inter-electrode capacitance* as represented by the metallic tube elements and the spaces between them. This capacitance, small as it may be, makes it difficult, or impossible, to resonate the associated circuit high enough in frequency or low enough in wavelength as required when operating on microwaves.

* The author is co-inventor of the Fonda-Freedman series of inventions which make possible the utilization of conventional radio tubes to generate ultra- and super-high frequencies. He is the author of the book "Two-Way Radio" published by Ziff-Davis Publishing Company.

TABLE 1. FUNCTIONAL COMPARISONS OF MICROWAVE TUBES

FUNCTION	BARKHAUSEN-KURZ	KLYSTRON	MAGNETRON (NEGATIVE RESISTANCE)	MAGNETRON (TRANSIT TIME)	LIGHTHOUSE & SMALL CONVENTIONAL TYPES	FONDA-FREEDMAN CONVENTIONAL TUBES
The PERIOD	Electrons remain in the inter-electrode space different lengths of time. Some less, some more, than one period of oscillation, depending on the phase of the oscillation when they leave the cathode.	Electrons remain in the drift space a time approximately equal for all of them. They cross either the buncher or the catcher in a time much shorter than one period.	All electrons remain in the inter-electrode space less than one period of oscillation.	Electrons remain in the inter-electrode space more than one period of oscillation.	Electrons remain in the inter-electrode space less than one half of the period.	Electrons remain in the inter-electrode space more than, or as long as, one half the period of oscillation. It may also remain more than, or as long as one period for the alternative development.
INTERESTING BEGINNING OF ENERGY INTERCHANGE	When electrons leave the cathode.	When electrons cross the buncher.	When electrons leave the cathode.	When electrons leave the Critical.	When electrons leave the cathode.	When electrons leave the cathode.
INTERESTING END OF ENERGY INTERCHANGE	(a) When electrons with transit time longer than period strike the grid. (b) When electrons with transit time shorter than period strike the cathode.	When electrons cross catcher.	When electrons strike anode or are returned to cathode.	When electrons strike anode or are returned to cathode.	When electrons strike the anode.	When electrons strike the anode.
The OUTPUT	Energy is absorbed by the above electrons (b) and delivered by electrons (a). Useful output is the difference thereof.	Energy is absorbed by electrons in the buncher and delivered in the catcher. Useful output appears as the difference thereof.	More electrons strike negative section of the anode than the positive. Useful power output results from negative conductance.	Energy is absorbed from the d.c. field every positive half period and delivered to the a.c. field every negative half period. A smaller amount of power is absorbed from the a.c. field during the positive half periods. This is a loss.	Power output is effect of negative conductance. A loss appears as a result of grid conductance.	Power output is effect of negative (dynamic) conductance. There is no loss.
HOW OUTPUT IS OBTAINED	By making the grid positive and the plate negative. The electrons cross the grid several times before being collected on it.	By the special structure of the tube which results in velocity modulation in the buncher and electron bunches thereafter.	By deflecting the path of electrons by means of a magnetic field and use of proper relation between frequency and d.c. voltage.	Same as for other type magnetron.	By making the inter-electrode distance very small.	By making the inter-electrode distance large as in conventional tubes or otherwise, and adjusting the transit time to an integral multiple of (half) periods so that electrons flow in groups.
REQUIRED	That the anode be a grid which MUST be crossed by electrons, and that on the other side there be present a negative repelling plate.	That the catcher be crossed by electron bunches with the proper phase.	That the magnetic field be axial and have the proper intensity.	Same as for other type magnetron.	That the transit time be small when compared to the period of oscillation.	That the d.c. voltages be adjusted to produce the required phase relations between groups and a.c. voltages.
ENERGY LOSSES	Energy is wasted by the (b) electrons.	Energy is wasted in the buncher.	Energy is wasted by electrons striking back the cathode or absorbing power during positive half periods.	Energy is wasted by electrons arriving on the positive section of the anode.	Energy is wasted due to grid conductance.	None of these.
ADJUSTMENT ETC.	Not critical.	Not critical.	Critical.	Very critical. Requires high voltages. Frequency not very flexible.	Not critical. Limited power due to small electrodes.	Not critical nor limited in power.
APPROXIMATE MAXIMUM FREQUENCY	UHF	SHF	UHF	SHF	UHF	SHF
COST FOR TUBE	——	Up to $60 or more.	——	Up to $200 or more.	Up to $20.	Conventional tube prices 50c and up.
FREQUENCY FLEXIBILITY	——	Limited.	Limited.	Limited.	Unlimited.	Unlimited.

2. *Transit time* as represented by the amount of time which it takes an electron leaving the cathode to reach the plate or anode. Even though this time may be as short as a billionth of a second, it is equal to the time it takes 30 cycles to develop on a wavelength of 1 centimeter. When the transit time exceeds about an eighth of a cycle, the tube and circuit begin to seriously misbehave by conventional techniques.

3. *Phase shift or reversal* resulting from the fact that the electron leaving the cathode will arrive at the plate considerably different with respect to its relative position for the oscillating cycle.

4. *Miscellaneous factors* such as grid conductance, skin effect, dielectric losses, direct radiation by the tube elements and radiation of the connecting leads. These losses, while present and recognized, may be sufficiently controlled or compensated for by efficient techniques. They are not as serious as the first three problems enumerated above.

The principal consideration in microwave utilization is tubes to generate or detect such extremely high frequencies. This is achieved today by the following tubes or techniques:

1. The klystron or other forms of velocity modulated tubes.

2. The magnetron or tubes where a magnetic field serves in lieu of a grid.

3. The lighthouse or other forms of disc seal tubes.

4. Conventional tubes in special simple circuitry such as the Barkhausen-Kurz and the Fonda-Freedman techniques.

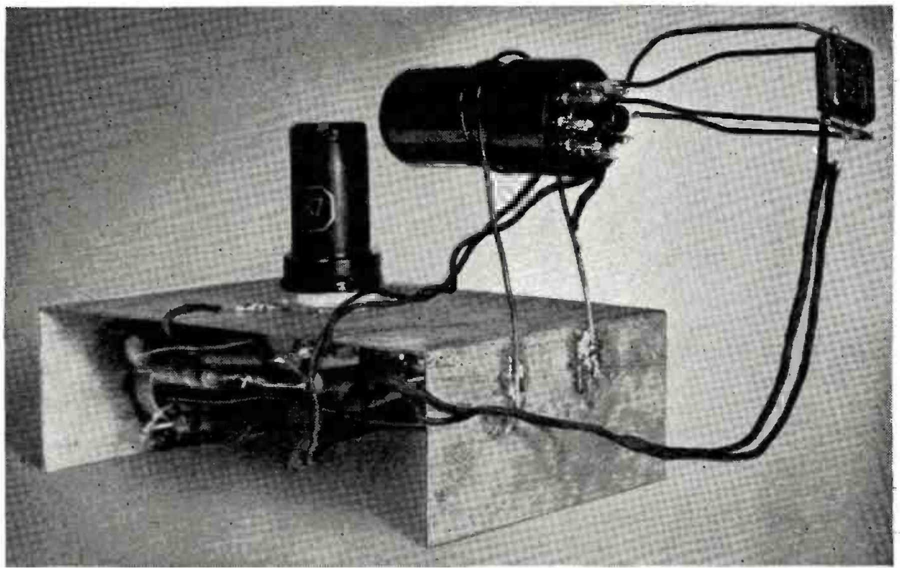
In any tube, three prime provisions must be recognized, namely: *a.* The production of electrons such as by heating of a cathode. *b.* The controlling of electrons produced by the cathode through the use of grids suitably biased or energized. The exception will be the magnetron where a magnetic field serves this purpose. *c.* The gathering up of the electrons and making them available as useful power in an external circuit. This is normally the function of the plate or anode. It ceases to be so in the case of the Barkhausen-Kurz technique or in certain types of velocity modulated tubes where the grid is kept more highly positive than the plate.

The klystron or velocity modulated tube is as different from a conventional tube as amplitude modulation differs from frequency modulation. A conventional tube depends primarily upon the numbers of electrons, whereas the velocity modulated tube depends on the changes in the velocity of electrons as they travel from the cathode to succeeding tube elements. Any impressed signal manifests itself by the speeding up or slowing down of the electrons. This includes the overtaking of slower moving electrons by faster moving ones with the result that they bunch up along the electron path.

This type of tube contains the following: *a.* A heater to heat the cathode. *b.* A cathode to emit electrons. *c.* An electron gun or path to beam the electrons which are accelerated in the space between the cathode and the first pair of accelerating grids. *d.* A pair of closely spaced accelerating grids which are kept highly positive to attract and accelerate the electrons through its perforations to the buncher grids except for those which strike the grids. *e.* A pair of "buncher" or "resonator" grids which are acted upon by the electrons that were both accelerated and able to get through the accelerating grids.

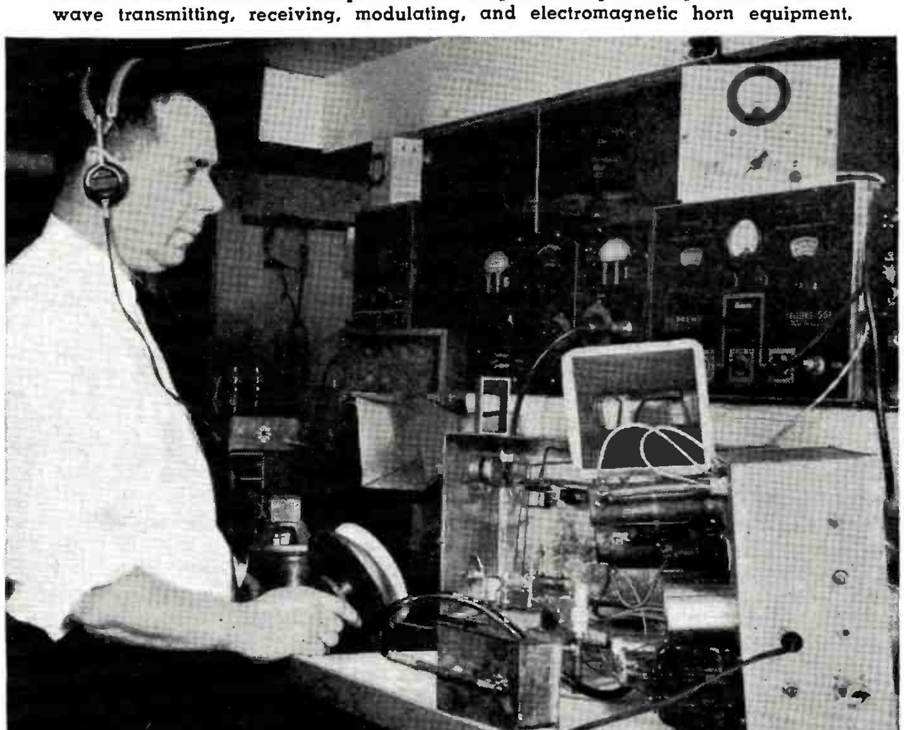
The acceleration of the electrons in passing the highly positive accelerating grids corresponds to a small fraction of a cycle of time even at microwave frequencies. A radio frequency field in the buncher resonator produces an alternating or oscillating electric field between the buncher grids. Electrons in transit will either be speeded up, slowed down or proceed in a normal manner depending on the state of the oscillating field as the electrons pass the buncher grids. This change in velocity gives the tube technique the name of "velocity modulation." Since some electrons approach the grid as it becomes less positive while others do so as it becomes more positive, a situation exists

(*Continued on page* 125)

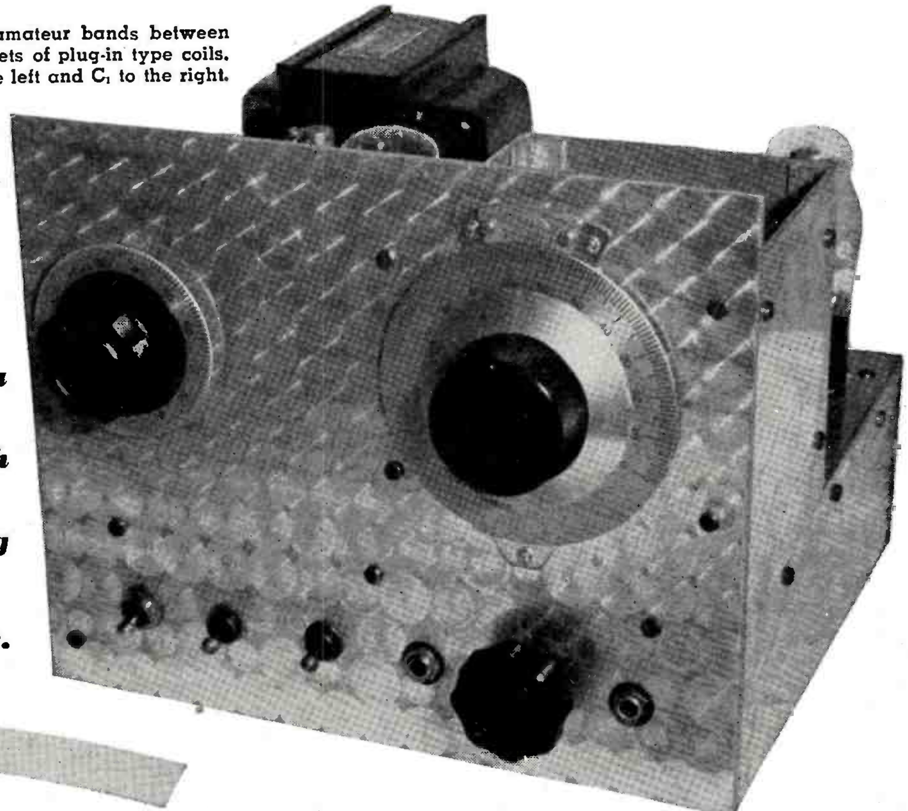


The first satisfactory working model of the Fonda-Freedman technique wherein a 6N7 tube developed frequencies in the 300-3000 mc. region. Author reports that later versions reached all frequencies between 100-50,000 mc. Photo shows complete transmitter exclusive of conventional power supply needed for either c.w. or tone transmission.

Author at work in his laboratory. Photo shows preliminary working models of microwave transmitting, receiving, modulating, and electromagnetic horn equipment.



Panel view of home-built unit. All amateur bands between 20-80 meters can be covered with 2 sets of plug-in type coils. Tuning condenser, C_{15}, is shown to the left and C_1 to the right.



By

JOHN F. CLEMENS,
W9ERN

Complete construction data for a 50-watt transmitter-exciter, with built-in power supply and using a variable frequency oscillator.

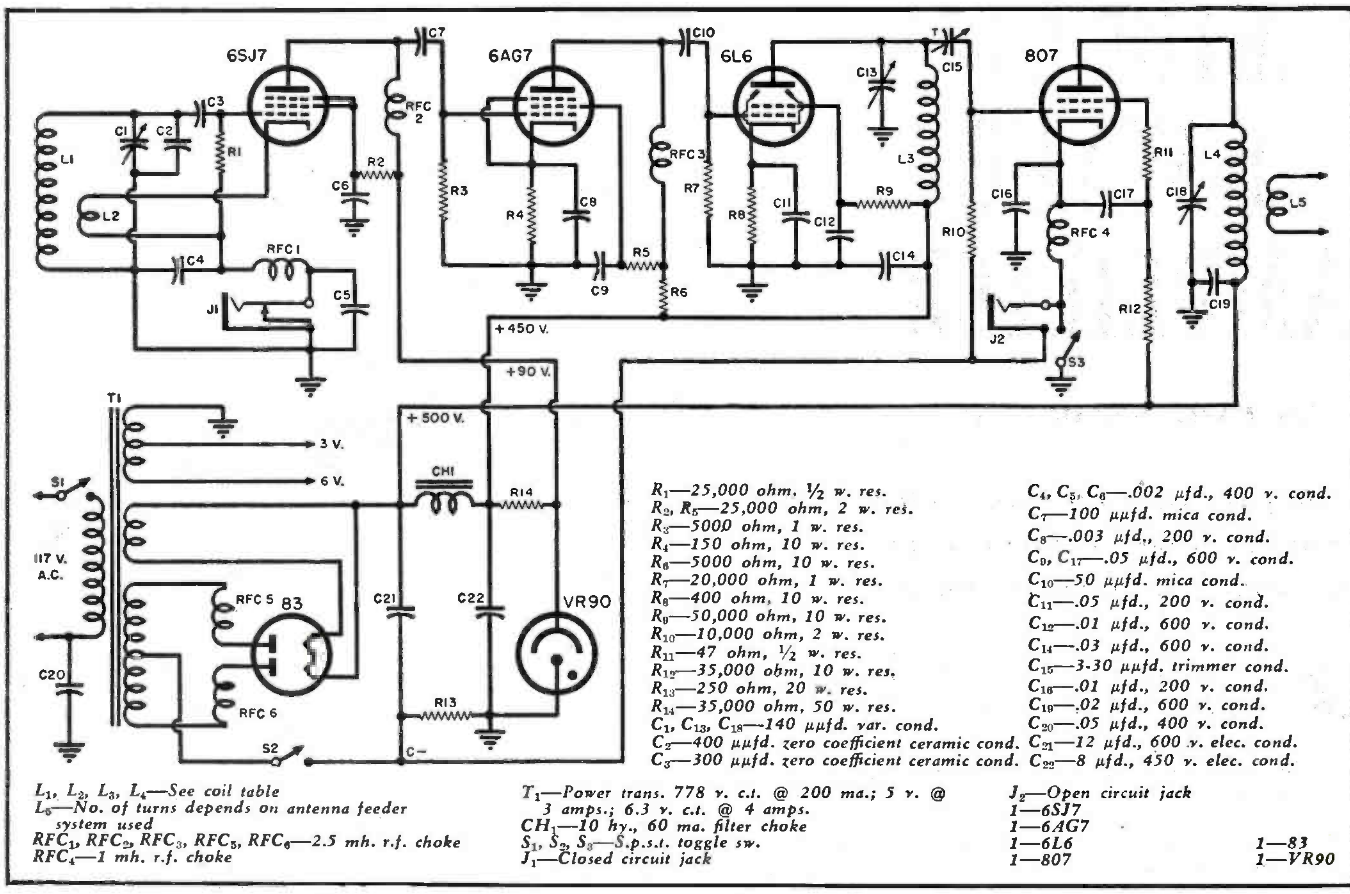
Variable Frequency TRANSMITTER-EXCITER

FOR those whose ham activities are restricted to a limited space, some ingenuity is necessary to build a transmitter which will permit a reasonable degree of operating success. The transmitter described here was designed primarily for compactness and makes a fine low-power transmitter or exciter for the operating table. For transmitters of under 100 watts an e.c.o. is almost a necessity these days as there is little chance of blasting a channel through the QRM. Considerable care has been expended on the e.c.o. in this transmitter to secure freedom from drift and roughness. Oscillator keying permits break-in operation and monitoring in the receiver. The keying is free from clicks and chirp and the signal quality will require no apology. Although this rig is operated on forty and eighty meters, a new set of coils will permit operation on twenty. Ten meter operation cannot be obtained without another doubler stage, unless the e.c.o. is operated on forty meters, and although several commercially built transmitters have adopted this expedient, it can hardly be considered good practice.

An investigation of numerous e.c.o.'s has revealed several facts which should be of interest to anyone planning a variable-frequency exciter.

First of all, mechanical stability is of prime importance. Although this fact is so well known as to be a truism, the method of achieving this mechanical stability does not always result in improved electrical stability. The only major item worthy of special mention is the method in which the e.c.o. tuning condenser is mounted, i.e., on a sub-panel attached, not to the chassis, but to the front panel. This method of mounting, in conjunction with the use of the *National* Type N dial which mounts on the front panel, prevents thrust forces from being transmitted to the variable condenser bearings. Those who have built e.c.o.'s have probably experienced instability from thrust force on the tuning condenser which is manifest as a frequency variation when the panel on the v.f.o. is touched or pushed. A double-bearing tuning condenser is used as an additional measure to insure stability. In tests with a number of different models, the double-bearing type of condenser showed a marked superiority over single-bearing types in eliminating backlash. The *National* Type N dial has proven satisfactory for v.f.o. use since it has high torque, no backlash, perfectly smooth action and a vernier scale which can be read accurately to one part in 1000. Other components of the oscillator, the tube, coil, and associated parts, are also rigidly mounted inside the e.c.o. compartment. The tube and coil sockets are raised one inch above the chassis by brass spacers so that the underside of these sockets is also inside the shield chamber.

The cut-and-try method of determining the tuning range of the oscillator can be eliminated by a few simple calculations. As an example, let us suppose it is desired to cover 1750 to 2000 kilocycles with the e.c.o. When doubled, this will, of course, tune the entire 80 meter band. From the formula, $f = 1/2\pi\sqrt{LC}$, it is evident that frequency varies inversely as the

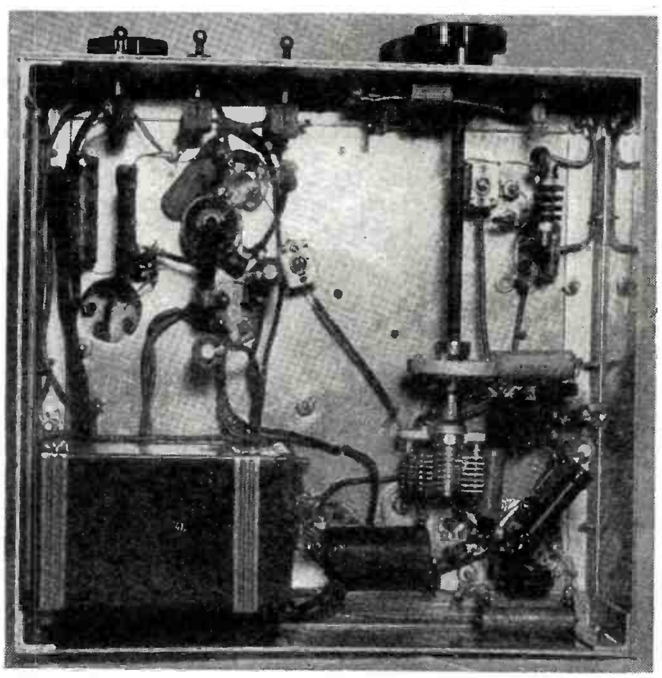


Schematic diagram of transmitter-exciter. In constructing this unit provision has been made for either oscillator or final amplifier keying.

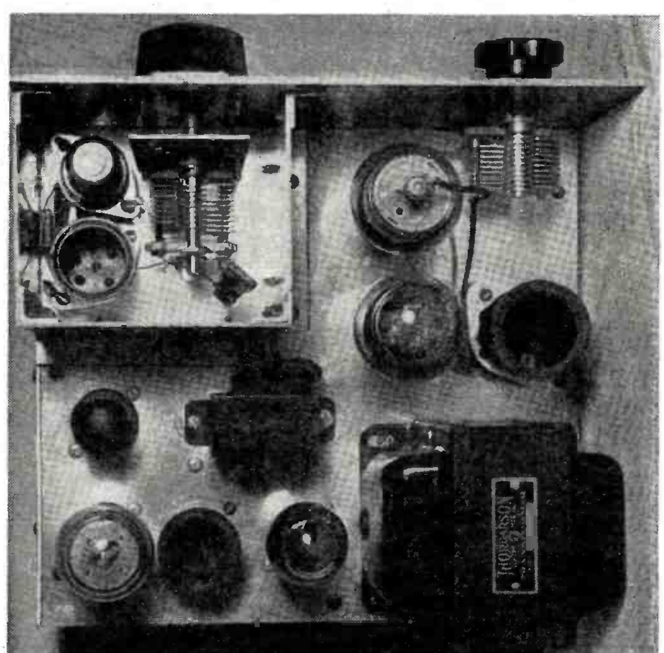
square root of the tuning capacity. Therefore, the capacity ratio (maximum capacity across the tuned circuit divided by minimum capacity across the tuned circuit) will be the square of the frequency ratio. The inverse relationship may be forgotten since it only means that the highest frequency will be obtained at minimum capacity and vice versa. The frequency ratio in this case is 2000/1750, or 1.142. The square of 1.142, or 1.306 is therefore the needed capacity ratio.

We must now decide what size tuning condenser to use, remembering that high-C circuits are a must for e.c.o. stability. The largest capacity generally available in the midget variety of condenser is the popular 140 μμfd. type and we will choose this value. We may estimate its minimum capacity at about 15 μμfd. We have, therefore, a *variable* capacity of 140 − 15 or 125 μμfd. We now know that $(125 + C)/C = 1.306$ from which $C = 408$ μμfd. C in the above equation is the

(*Continued on page 158*)



Rigid mounting of all parts is desirable for stable operation. Variable condenser shown is in the 6L6 plate circuit.



The oscillator stage (top view) is built in the shield box shown in upper left hand corner to provide circuit isolation.

MIDGET 4-WATT AMPLIFIER

By EARL SNADER, Jr.

A compact, easy-to-build audio amplifier that features both phono and microphone inputs.

Over-all view of home built amplifier. Note that input jacks are located on the side flanges of the unit.

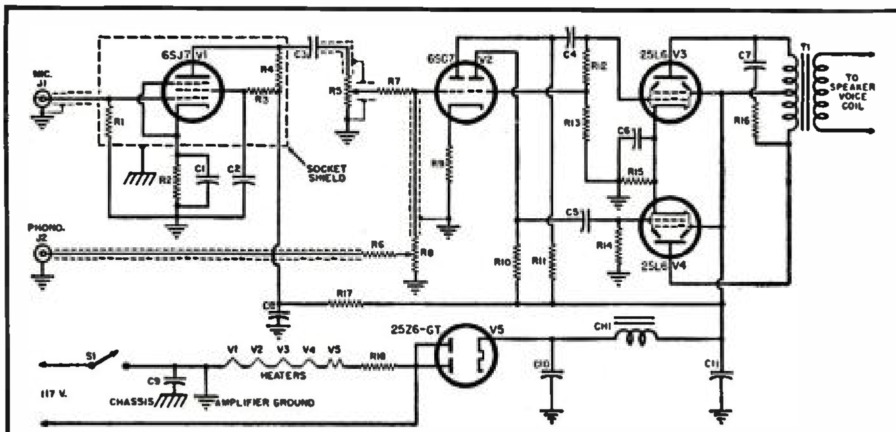
ONE of the chief difficulties encountered in the construction of high gain audio amplifiers is the presence of hum. This difficulty, involving the use of a certain minimum number of filter components and provisions for shielding, places severe limitations on the minimum size necessary for high gain amplifiers with any significant level of output. It is extremely difficult to conserve in space to a significant degree in the construction of amplifiers of this type.

Here is an amplifier which is unique on several counts. Most obvious is its small size. With the tubes inserted, the over-all measurements are four inches wide by three inches deep by only five inches high. Phonograph amplifiers with these approximate dimensions are relatively common. But this amplifier includes a microphone channel, designed to operate from the output of a low level crystal or dynamic microphone. It also has a separate phonograph channel, designed to operate from the output of a crystal phonograph cartridge of the low-voltage type. The power output stage of this amplifier consists of two 25L6 tubes operating in push-pull, driven by a 6SC7 which serves as amplifier and phase inverter. The microphone preamplifier tube is a 6SJ7. A 25Z6 is used as the rectifier. The two 25L6 tubes develop a power output of four watts, and this can be realized from either the microphone or phonograph channels separately or together. The mixing of the two channels is done through a resistance network permitting the output level of the one channel to be adjusted with no appreciable effect upon the other. With either or both the controls turned on full the hum level in the output of the amplifier is almost inaudible. The amplifier can be used for public address work in applications requiring four watts power or less, for playing phonograph records, or for making recordings. It is very efficient for the amount of space which it occupies. It will operate from 110 volts, either a.c. or d.c. All parts except the microphone and loudspeaker are built into the unit.

The amplifier is built on a standard 4" by 3" by 2" utility box. All five tubes and the filter condenser unit are mounted on the top cover of this box. The cover is taken off by removing the screws along each edge. The holes for the microphone and phonograph gain controls are drilled into the one 2" by 4" side of the utility box. This side serves as the front panel. These holes are bored midway from top to bottom, and 1⅛ inches from each end. The power switch is mounted in a hole midway between these two holes. The jacks for the microphone and phonograph inputs are of the standard microphone jack type, and are mounted at each end of the utility box, toward the front. The speaker jacks are mounted in the back, and an additional ⅜" hole is drilled in the back to accommodate the line cord. The output transformer and filter choke are mounted at both ends inside the box.

(*Continued on page* 102)

Schematic diagram of five-tube audio amplifier. The a.c.-d.c. operation not only simplifies operation of unit but reduces component cost.



R_1—2 megohm, ½ w. res.
R_2—1700 ohm, ½ w. res.
R_3—1 megohm, ½ w. res.
R_4, R_6, R_{10}, R_{11}—250,000 ohm, ½ w. res.
R_5, R_8—500,000 ohm pot.
R_7, R_{14}—500,000 ohm, ½ w. res.
R_9—4000 ohm, 1 w. res.
R_{12}—475,000 ohm, ½ w. res.
R_{13}—16,000 ohm, ½ w. res.
R_{15}—70 ohm, 2 w. res.
R_{16}—4000 ohm, 4 w. res.
R_{17}—25,000 ohm, ½ w. res.
R_{18}—110 ohm, 11 w. (minimum) line cord res.
C_1—20 μfd., 25 v. elec. cond.
C_2—.1 μfd., 200 v. cond.
C_3, C_4, C_5—.01 μfd., 200 v. cond.
C_6—20 μfd., 20 v. elec. cond. (Part of C_{10}, C_{11})
C_7—.03 μfd., 400 v. cond.
C_8—20 μfd., 150 v. elec. cond.
C_9—.05 μfd., 400 v. cond.
C_{10}, C_{11}—50/50 μfd., 150/150 v. elec. cond.
S_1—S.p.s.t. toggle sw.
J_1, J_2—Shielded jacks
T_1—Output trans. Push-pull 25L6 to v.c.
CH_1—15 hy. filter choke
1—25Z6 tube
1—6SJ7 tube
1—6SC7 tube
2—25L6 tubes

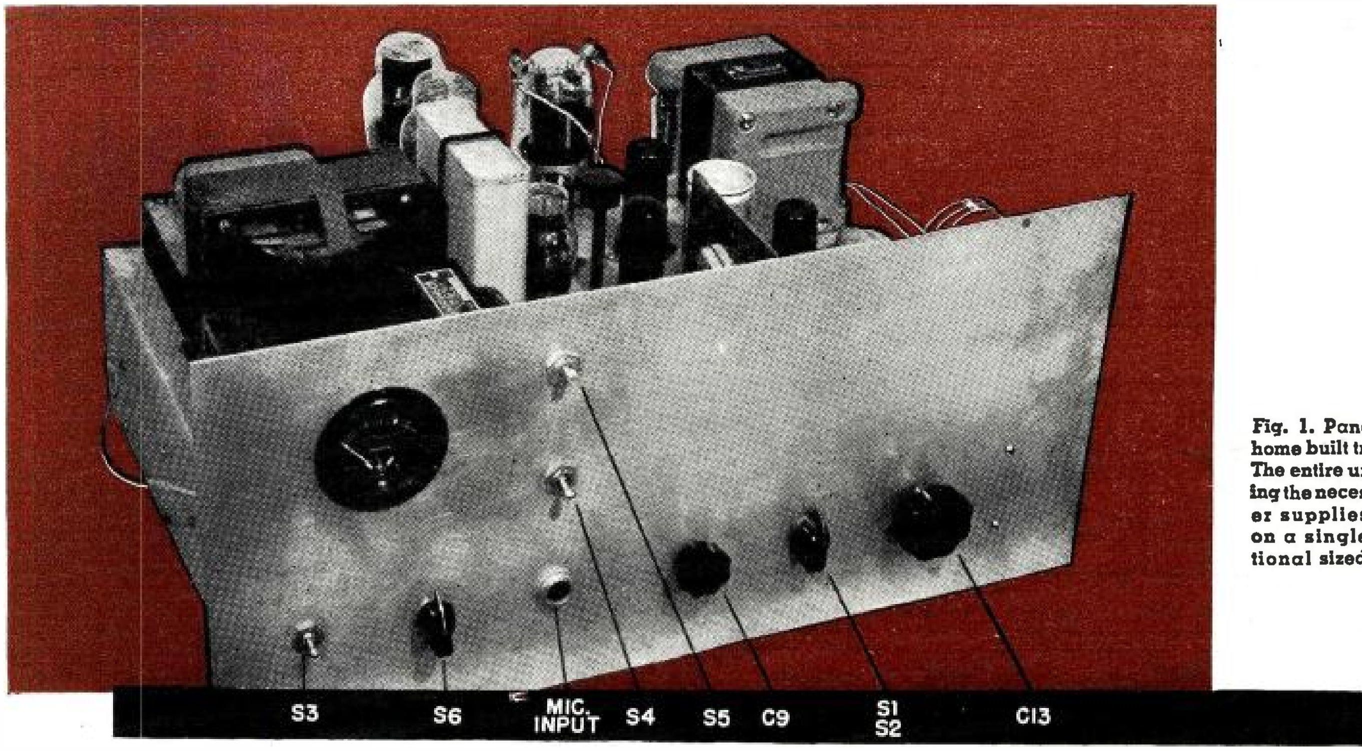


Fig. 1. Panel view of home built transmitter. The entire unit, including the necessary power supplies, is built on a single conventional sized chassis.

Compact 60-Watt Transmitter

By ROYDEN R. FREELAND, W5EMH

Complete construction details for a transmitter covering all amateur bands between 10-80 meters.

WITH the return of the amateur bands several months ago, a lot of hams were faced with the problem of getting a rig back on the air. Many amateur stations were broken up by the war when the operator was called into the Army, or moved to a new location; the old equipment being sold or too big for the new location.

The problem was to get a transmitter on the air that would be compact, versatile, and ready for operation on any of the bands when they became available. The transmitter shown in Fig. 1 is the author's solution to the problem.

The line-up of the transmitter is a 6J5 oscillator, 6AG7 buffer-multiplier, and an 815 final with an input power of 60 watts. Band-switching is used in the oscillator and buffer-multiplier stages while plug-in coils are used in the final to give coverage of all the amateur bands from 80 meters through 10 meters. A second 815 with its speech amplifier and driver stages supplies audio power for modulation. The entire transmitter, which is built on a single chassis, is powered from two power supplies.

Fig. 2 shows the schematic diagram of the transmitter. The oscillator is a modified Miller recommended for high-frequency crystals (harmonic crystals); however it works equally well on low frequency crystals. The oscillator operates with either an 80, 40, or 20 meter crystal according to the output frequency desired. For 10 meter operation either a 40 or 20 meter crystal may be used. The oscillator tank coil is tapped and switch S_1 shorts portions of the coil for coverage of the different bands. Only 150 volts is applied to the oscillator plate circuit which insures stable operation with low crystal current.

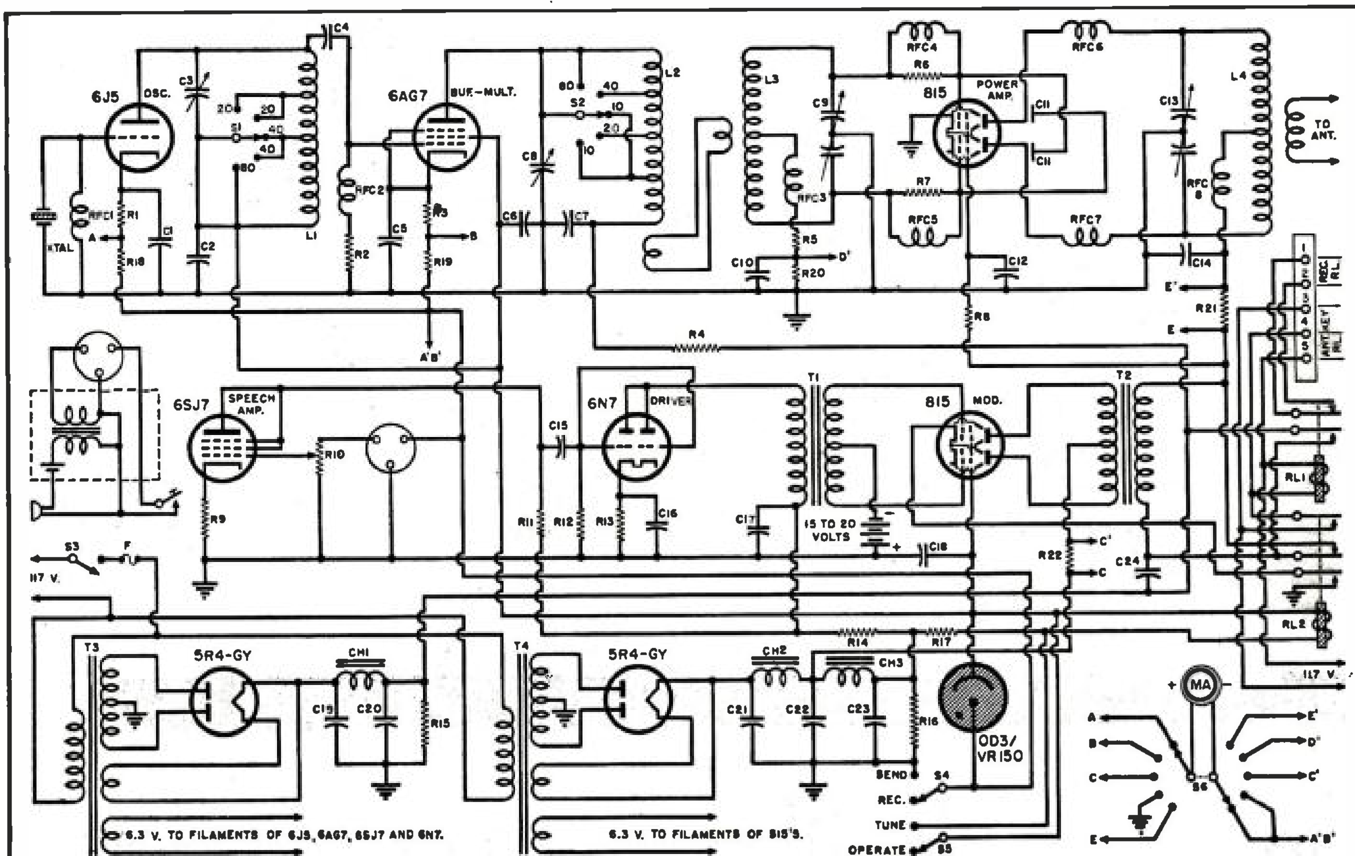
The output of the oscillator is capacitively coupled to the 6AG7 buffer-multiplier stage. This stage operates as a buffer, doubler, tripler, or quadrupler as required. The tank coil of the 6AG7 is tapped similarly to that of the oscillator and output frequencies are provided in the various switch positions as shown in Table 1.

In addition to the 10 meter band covered by positions 3 and 4, the 11 meter and 15 meter bands may also be covered in these positions when appropriate crystals are used. The 6AG7 has very low interelectrode capacitances and requires no neutralization when operating as a buffer amplifier. In addition, the 6AG7 requires very little driving power. Both cathode and grid-leak bias are used in this stage, the cathode bias limiting the plate current of the tube when no excitation is present. The screen grid voltage for the 6AG7 is regulated at 150 volts while 300 volts is applied to the plate. The output of the buffer-multiplier stage is link coupled to the balanced grid circuit of the final amplifier.

Table 1. Various output frequencies can be obtained by simply rotating switch S_1S_2.

Switch Position	Crystal Freq. in Meters	Output Freq. in Meters
1	80	80
2	40	40
3	40	10
4	20	20
5	20	10

The 815 push-pull final amplifier tube operates as a straight Class C amplifier on all bands. Plug-in coils are used in both the plate and grid circuits to cover the frequency range. As is the usual case with this tube, it is necessary to neutralize the stage. However, the neutralization is not critical. To eliminate the possibility of parasitic oscillations, the centers of the grid and plate tank coils are left floating and, in addition, parasitic chokes are inserted in the plate and grid leads. The 815 is plate and screen grid modulated for phone operation. The screen grid voltage is obtained through a dropping resistor from the 400 volt plate supply.



R_1—600 ohm, 1 w. res.
R_2—50,000 ohm, 1 w. res.
R_3—470 ohm, 1 w. res.
R_4—4000 ohm, 10 w. res.
R_5—15,000 ohm, 1 w. res.
R_6, R_7—10 ohm, ½ w. res.
R_8—15,000 ohm, 10 w. res.
R_9, R_{13}—900 ohm, 1 w. res.
R_{10}—500,000 ohm pot.
R_{11}—47,000 ohm, ½ w. res.
R_{12}—500,000 ohm, ½ w. res.
R_{14}—6500 ohm, 10 w. res.
R_{15}, R_{16}—40,000 ohm, 50 w. res.
R_{17}—5000 ohm, 10 w. res.
R_{18}, R_{19}, R_{20}, R_{21}, R_{22}—Meter shunts (see text)
C_1, C_2, C_5, C_6, C_{10}—.005 μfd., 400 v. cond.
C_3, C_8—75 μμfd. var. cond.
C_4—200 μμfd. mica cond.
C_7, C_{12}, C_{24}—.01 μfd., 600 v. cond.
C_9—100-100 μμfd. dual var. cond., .020" spacing
C_{11}—Neutralizing cond. (see text)
C_{13}—100-100 μμfd. dual var. cond., .030" spacing
C_{14}—.002 μfd., 1000 v. cond.
C_{15}—.05 μfd., 400 v. cond.
C_{16}—25 μfd., 50 v. elec. cond.
C_{17}, C_{18}, C_{23}—8 μfd., 450 v. elec. cond.
C_{19}—2 μfd., 600 v. elec. cond.
C_{20}, C_{21}, C_{22}—10 μfd., 600 v. elec. cond.
F—Line fuse
L_1, L_2—See text
L_3—Power amp. grid coil (B & W Type JCL)
L_4—Power amp. plate coil (B & W Type JVL)
RFC_1, RFC_2, RFC_3—2.5 mh., 125 ma. r.f. choke
RFC_4, RFC_5, RFC_6, RFC_7—Parasitic choke (See text)
RFC_8—2.5 mh., 250 ma. r.f. choke
S_1, S_2—Single-pole, 5 pos. ceramic sw. (ganged)
S_3, S_4, S_5—S.p.s.t. toggle sw.
S_6—Double-pole, 5 pos. ceramic sw.
T_1—Driver trans. Single plate to p.p. grids. 1.4 to 1 ratio. (Thordarson T-17DO3)
T_2—Modulation trans., 30 w. (Stancor 8001)
T_3—Power trans. 490-0-490 v. @ 200 ma.; 5 v. @ 2 amp.; 6.3 v. @ 3 amp. (UTC S-39)
T_4—Power trans. 400-0-400 v. @ 200 ma., 5 v. @ 2 amp.; 6.3 v. @ 3.5 amp. (Thordarson T13R16)
RL_1—110 v. a.c. relay with 1 normally closed and 1 normally open circuit
RL_2—Relay, 500 ohm coil with 2 normally open and 1 normally closed circuits
MA—Meter, full scale reading between 1 and 10 ma. (see text)
CH_1, CH_2—5 hy., 200 ma. filter choke (Thordarson 67C49)
CH_3—10 hy., 110 ma. filter choke (Thordarson 57C53)
1—Crystal (see text)
1—6J5 tube
1—6AG7 tube
2—815 tubes
1—6N7 tube
1—6SJ7 tube
2—5R4-GY tubes
1—OD3/VR150 tube

Fig. 2. Complete schematic of the transmitter. The microphone used is a single button carbon type with a push-to-talk switch. The microphone to grid transformer and the single flashlight cell for microphone current are built into a small steel case. Connections are made to the amplifier by means of a three contact plug and jack.

For 100 per-cent modulation of the final amplifier with 60-watts input, approximately 30 watts of audio is required. The 815 modulator is capable of supplying 40 watts of audio with a plate voltage of 400 volts and operating Class AB_2. Fixed battery bias is used, the bias being between 15 and 20 volts and adjusted so that the no-signal plate current is 20 ma. The screen grid voltage for the modulator is regulated at 150 volts. It is essential that the screen grid voltage remain constant with varying screen current if rated power output is to be received from the stage. The modulation transformer presents a load of 6000 ohms to the modulator tube, the secondary impedance of the transformer being 2500 ohms.

The 6N7 driver stage operates Class A_1 and is capable of supplying 400 mw. to the 815 modulator which is sufficient to drive the stage to rated output.

The 6SJ7 speech amplifier is connected as a triode and gives sufficient gain when using a carbon microphone. This tube can be connected as a pentode for use with a high-level crystal microphone.

All circuits of the transmitter are powered from two 400 volt power supplies. One power supply delivers plate and screen-grid voltage to the r.f. final amplifier and plate voltage to the buffer-multiplier stage. The second power supply delivers voltage to all of the other circuits. The oscillator plate, buffer-multiplier screen-grid, and modulator screen-grid circuits are connected to the second power supply through the regulator circuit made up of the regulator tube OD3/VR150 and resistor R_{17}.

One meter is used to measure the currents in the various circuits of the transmitter. Switch S_6 connects the meter to the circuit being measured. Five circuits are metered as follows: oscillator cathode, buffer-multiplier cathode, modulator plate, final grid, and final plate.

The control circuit of the transmitter is made up of three switches (S_3, S_4, and S_5) and two relays (RL_1 and RL_2). The control circuit functions in such a manner that the exciter stages can be tuned with no voltage being applied to the final; either phone or c.w. operation may be used; and push-to-talk action is available. In addition a circuit is brought out to terminals on the rear of the transmitter for operation of a receiver relay circuit. Also external connections are provided for operation of an antenna relay. For c.w. operation the key is placed in series with the coil of relay RL_1 which controls the high-voltage to the final amplifier. It was necessary to place RL_1 in series with the high-voltage lead instead of the cathode lead of the final stage because it was found that the cathode of the 815 had to be grounded directly at the socket to eliminate parasitic oscillations.

The control circuit works briefly as follows. Relay RL_2 has its 500 ohm coil connected in the regulator tube circuit, and thus closes when the various tubes connected to the regulator draw current. The three sets of contacts on RL_2 perform the following operations; one closes the coil circuit of relay RL_1; the second set closes the cathode circuit of the modulator; and the third set short-circuits the secondary of the modulation transformer during c.w. operation. Thus when relay RL_2 closes relay RL_1 will close. One set of contacts on RL_1 applies high-voltage to the final amplifier as previously mentioned. A second set of contacts on RL_1 operates the external receiver-relay circuit. Relay RL_2 is closed by switch S_4 which is the *"Send-Receive"* switch. In the *"Send"* position, S_4 grounds the cathode circuits of the oscillator, buffer-multiplier, and regulator tubes placing these tubes in operation and closing RL_2. Switch S_5 is the *"Tune-Operate"* switch and in the *"Tune"* position this switch short-circuits the coil of RL_2 thus preventing RL_1 from closing and applying high-voltage to the final. Switch S_4 is paralleled by the push-to-talk circuit of the microphone. Switch S_3 is the power switch.

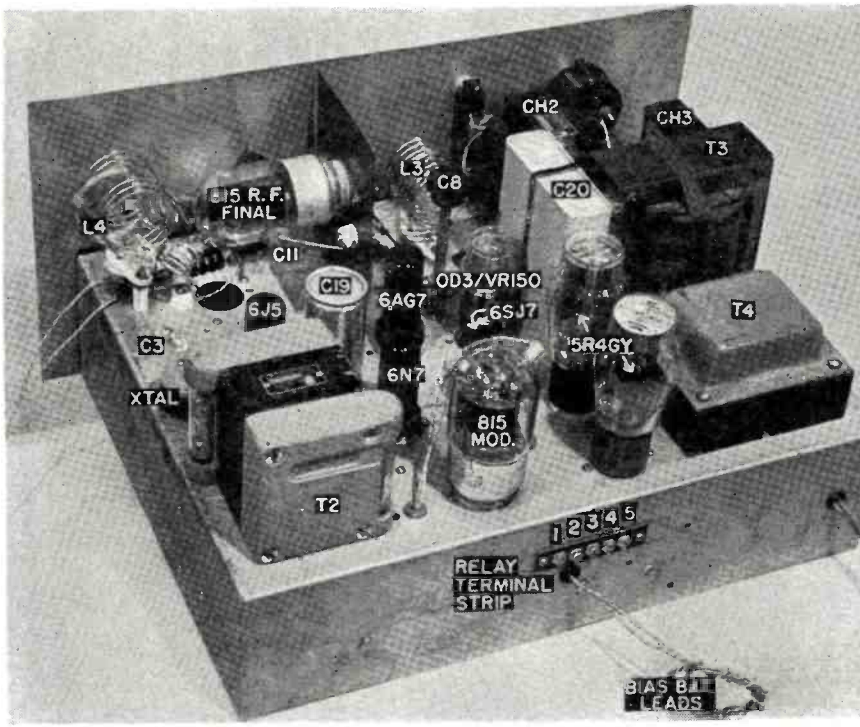


Fig. 3. Top-rear view of transmitter shows proper placement of component parts.

Construction

The transmitter is built on a chassis 13 inches by 17 inches by 4 inches. The panel measures 8¾ inches by 19 inches. The transmitter was built this particular size so as to fit into a small table relay-rack cabinet.

The layout of parts can be seen in Figs. 3 and 4. It will be noticed that power transformer T_3 is uncased. It was necessary to remove the case to get the transformer into the space available.

The tuning controls for the oscillator and buffer-multiplier stages are operated from behind the panel. If desired these controls can be brought out to the panel through flexible couplings. The coils for the oscillator and buffer-multiplier are constructed as shown in Fig. 5. Both coils are wound on 1-inch polystyrene rod and coated with *Duco* cement after winding. The coil taps may be connected to the bandswitch positions as shown in Fig. 2 or as desired by the builder depending upon the crystals available and the various frequency combinations wanted.

The 815 final amplifier tube is mounted horizontally with the socket key down. It is essential when mounting the tube horizontally that the key be on a vertical line either up or down. The tube mounting plate is an angle bracket made of 1/16-inch copper and acts as a shield between plate and grid circuits. The vertical portion of the bracket measures 4½ inches by 4½ inches.

The neutralizing capacitors for the final can be seen in Fig. 3. Each capacitor is made of a ½-inch square piece of copper soldered to the end of a short length of No. 14 wire which extends up along side the tube from a feed-through insulator. The plates of the tube act as the other plate of each capacitor.

The parasitic chokes for the plate circuit of the final amplifier (RFC_6 and RFC_7) are wound of hook-up wire and are self-supporting. Each choke consists of 9 turns ½-inch in diameter. The parasitic chokes (RFC_4 and RFC_5) in the grid circuit of the final are wound directly on parasitic resistors R_6 and R_7 respectively. Each choke coil consists of 11 turns of No. 22 wire close-wound.

The final tank capacitor C_{13} is mounted below the chassis as shown in Fig. 4. To prevent any stray capacitive coupling between capacitor C_{13} and other circuit elements, it is necessary to shield the capacitor. The shield extends the full depth of the chassis (4 inches). When the bottom cover plate is placed on the chassis the capacitor is shielded electrostat-

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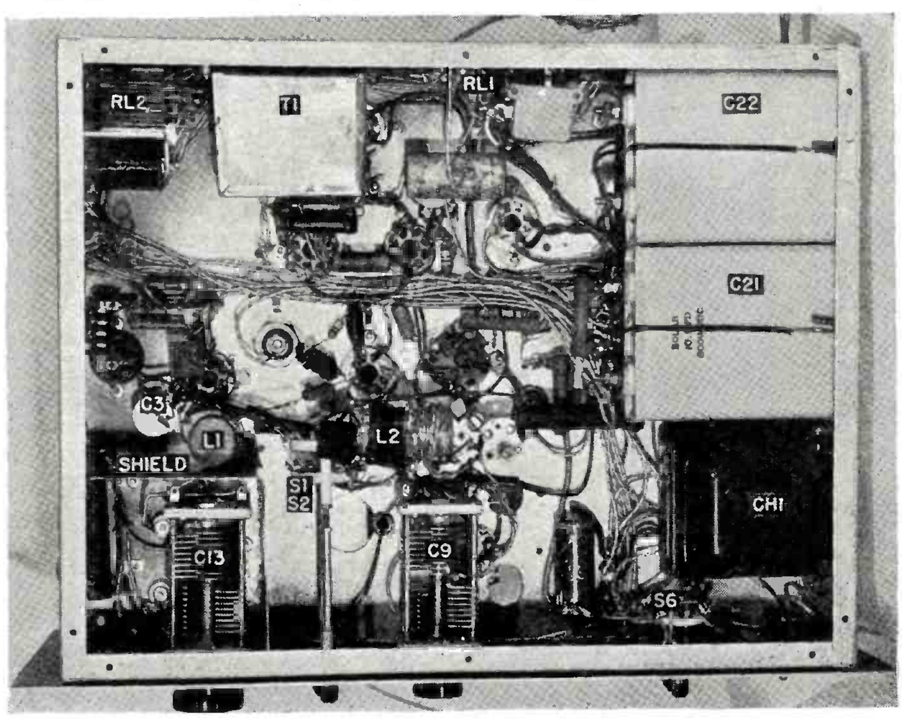
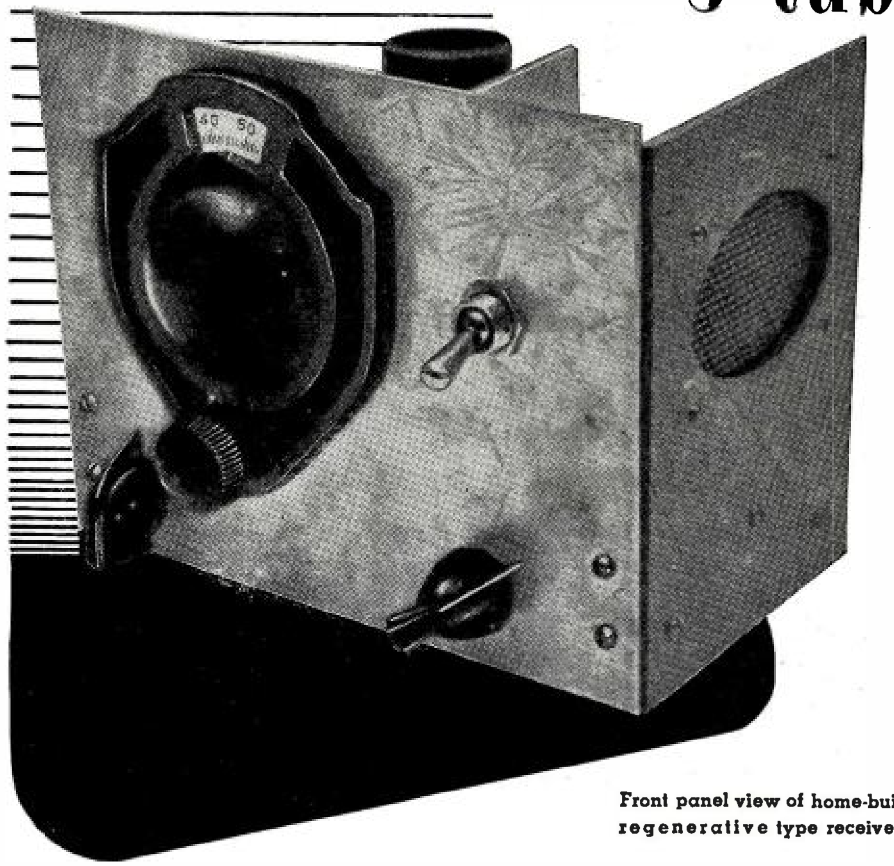
Fig. 4. Under chassis view. Note that all critical components are well shielded.



Miniature all-wave 3-tube RECEIVER

By

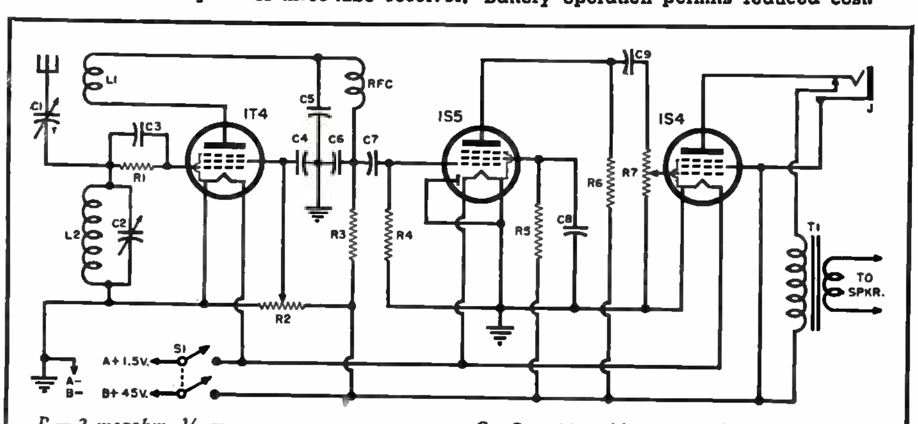
W. E. MILLER, W2HSV



Front panel view of home-built regenerative type receiver.

This all-wave receiver, using plug-in coils, can be built by the experimenter at a reasonable cost.

Schematic diagram of three-tube receiver. Battery operation permits reduced cost.



R_1—2 megohm, ½ w. res.
R_2—50,000 ohm w.w. pot.
R_3—.1 megohm, ½ w. res.
R_4—10 megohm, ½ w. res.
R_5—3 megohm, ½ w. res.
R_6—1 megohm, ½ w. res.
R_7—250,000 ohm pot.
C_1—35 μμfd., trimmer cond. (compression type)
C_2—140 μμfd. var. cond.
C_3—100 μμfd. mica cond.
C_4, C_7, C_9—.05 μfd., 100 v. cond.
C_5, C_6—.001 μfd. mica cond.
C_8—.5 μfd., 100 v. cond.
T_1—Output trans., 8000 ohms to v.c.
J—Closed circuit jack
RFC—2.5 mh. r.f. choke
L_1, L_2—See coil data
Speaker—Permanent magnet type
S_1—D.p.s.t. toggle sw.
1—1T4 tube
1—1S5 tube
1—1S4 tube

THE receiver described in this article is conventional in circuit but the use of miniature tubes permits more than average efficiency in design and also results in a set which is small enough to set on the palm of the hand. It is simple enough to be built by a newcomer to radio while its excellent performance and diminutive size make it attractive to the more advanced hobbyist, and to those who might want a portable receiver. This receiver will compare favorably with the smaller superheterodyne sets, particularly on short waves. With a thirty foot antenna strung across a room, the British Broadcasting Corporation in London was received on the receiver's two-inch loudspeaker with volume comparable to most local stations. Background noise in the set is negligible so that even weak signals stand out. In code reception this is especially advantageous.

Inspection of the circuit diagram indicates that a 1T4 is used as a regenerative detector, a 1S5 as a resistance coupled first audio stage, and a 1S4 as a resistance-coupled audio stage. A 1L4 may be used interchangeably with the 1T4 and will give equally good results. In place of the 1S4, a 3Q4 or a 3S4 may be used with proper filament connections. All these tubes will be recognized as those in use in many commercial miniature portable sets. The chassis of this set measures 6" x 3" x 1¾" high and a panel 6¼" x 5" is used. For the filaments of the tubes a 1½ volt dry cell is required while a single 45 volt B battery is sufficient for plate voltage.

Regeneration in the 1T4 detector stage is controlled by a 50,000 ohm potentiometer which varies the voltage applied to the screen grid of this tube. An r.f. bypass filter to ground, consisting of the r.f. choke and C_5 and C_6, is used in the plate circuit of the 1T4 to prevent any r.f. from entering the subsequent audio stages and thereby causing instability. The 1S5 is a standard resistance-coupled amplifier, as is the 1S4. Though use of resistance coupling instead of impedance coupling might possibly decrease the maximum possible output, elimination of a bulky coupling choke is an aid in keeping the set small. In any event, the use of two audio stages, rather than a single one, amply makes up for any slight loss of volume in the resistance coupling. The diode plate in the 1S5 is grounded and only the pentode section is used. A 250,000 ohm potentiometer, R_7, acts as a volume control and is necessary for strong stations, particularly when earphones are being used. The output of the 1S4 is fed into an output transformer, *T*, and a two-inch magnetic speaker. The .2 watt output of which the 1S4 is capable is ample to drive the small speaker. A 3Q4 or 3S4 would give somewhat higher output. A closed circuit jack, *J*, in the output circuit permits the use of earphones. The speaker is automatically silenced when the phones are plugged in. With the phone plug removed the speaker is in the circuit.

The set was built on a masonite baseboard supported by wooden sidepieces with a masonite strip screwed to the back, as shown in the photograph. Masonite was used because it is easier to work than metal, and from this standpoint is more suitable for a beginner, though a metal chassis could be used and would provide better shielding. However with the following scheme this was found unnecessary. Metal sheets of approximately 1/64" thickness and cut to the proper size, are inserted between the r.f. and audio stages both above and below the baseboard. Any tinsmith will cut some galvanized iron to size for a few cents. Both shields are vertically in the same plane and a single pair of screws passing through lips on the end of each shield binds them both to the baseboard. The panel is of metal; aluminum, steel or galvanized iron will do. The shields can be grounded very simply by bending a soldering lug into a right angle and soldering one end of it to the shield and the other end of the lug to the panel. This is easily visible in the photograph. If a metal chassis is used, the shields will be automatically grounded when they are screwed to the chassis which is already at ground potential and the soldering lug method can be dispensed with.

Placement of the various parts can be most easily seen from the photographs. The 140 $\mu\mu$fd tuning condenser, C_2, is mounted on the front panel with the tuning coil directly behind it. The 1T4 is beside this condenser near the front panel. On the other side of the shield are the 1S5 and 1S4 tubes, the 1S4 being nearer the front panel. A double-pole, double-throw switch, S_1, in the A+ and B+ leads, and the speaker which mounts on a piece of masonite, 4¾" x 3", screwed to the side of the chassis, comprise the remainder of the parts mounted above the baseboard. Below the baseboard, on the r.f. side are the 50,000 ohm potentiometer, R_2, and the resistors, condensers, and choke comprising the r.f. circuit. The lead from the r.f. choke to the .05 μfd. coupling condenser, C_7, passes around the metal shield to the audio section wherein are mounted the parts for the audio stages. The 250,000 ohm volume control is mounted on the front panel and the output transformer is bolted upside down to the baseboard. On the strip of masonite across the back are mounted the phone jack, the antenna trimmer condenser, C_1, and a four terminal strip for the A+, B+, ground (A— and B—), and antenna connections. This arrangement permits the use of very short leads, an essential for short waves. The chassis is so tiny, however, that almost any arrangement will be satisfactory so far as lengths of leads are concerned. All connections should be soldered and as short and direct as possible.

The coils used can be any standard two winding type, or they can be wound from the data given in the

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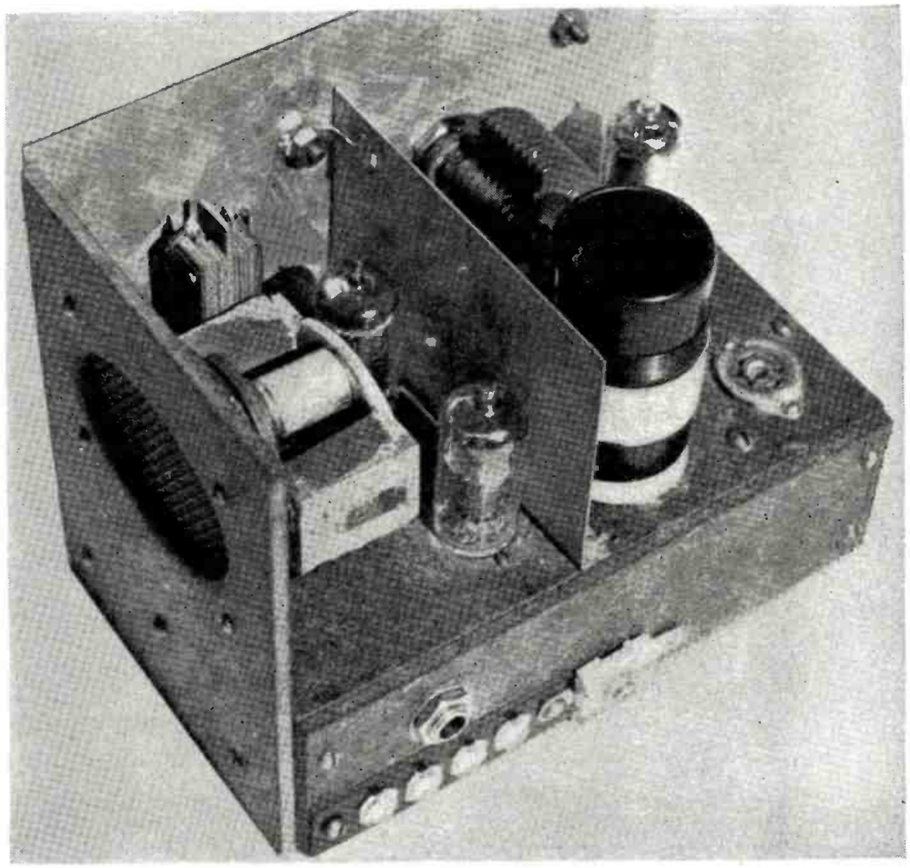
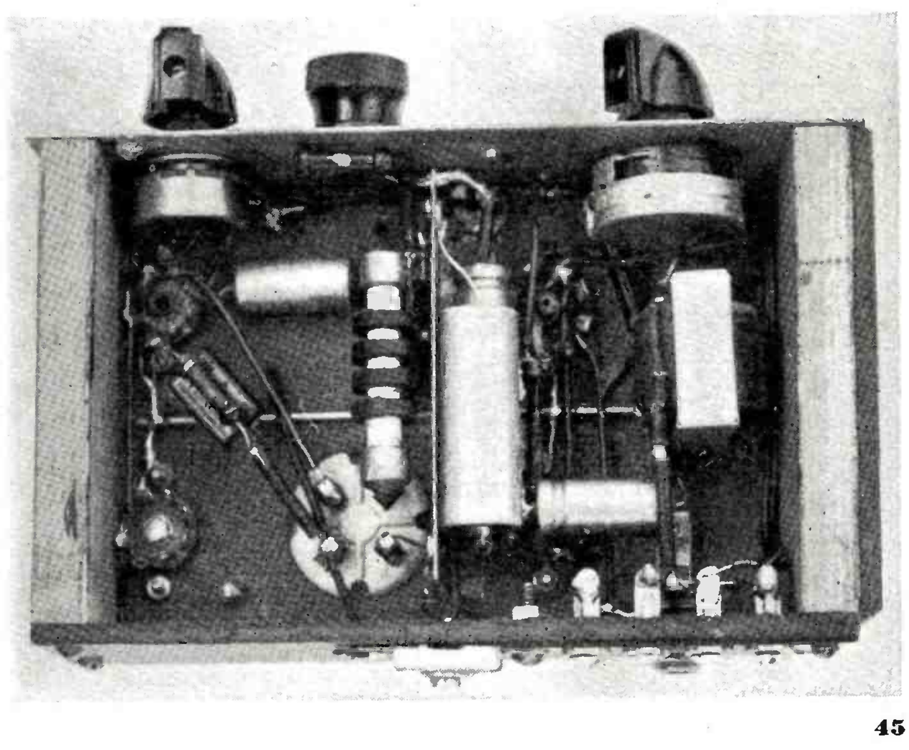


Top-rear view of completed receiver. Shield partition shown is necessary.

Under-chassis view shows neat arrangement of the various component parts.



A 10 KC. SUPPRESSOR

10 kc. filter built by the author. The adjustable resistor permits the complete cancellation of heterodyne squeal. Heavy hookup wire is used.

By J. E. KAUKE

When revamping a radio receiver for higher fidelity, a 10 kc. filter must be incorporated.

TO ADDICTS of high-fidelity radio reception, there is probably nothing quite as objectionable as the annoying 10 kc. interstation squeal. True, it can be eliminated by filters, and one popular high-fidelity coil kit includes such a network, which may be tuned for maximum suppression at 10,000 c.p.s. Most factory-built, high-fidelity receivers have similar filters in the plate circuit of the first a.f. amplifier.

However, most filters used for this purpose begin to cut off around 6000 or 7000 c.p.s., and response is not back to normal until about 15,000 c.p.s., which is beyond the usable range of the set and speaker.

A filter to remove a very narrow band from the audio spectrum without an appreciable effect on adjacent frequencies demands an inductance with very high *Q*. With iron-cored coils, a very high *Q* is hard to obtain. Yet when used in a plate circuit, or in the cathode circuit of an infinite impedance detector, the inductance required is in the order of 2 henries. The cost of such a coil is prohibitive as an air-core inductor, and with the best available core material, a *Q* of 150 is about the maximum attainable. It is clear that some other approach is necessary to find a suitable solution.

In the first place, the *Q* of an air-core coil is roughly proportional to the frequency, provided the coil is wound to optimum dimensions. Secondly, if the circuit in which the filter is placed is of low impedance, the required inductance becomes much lower, and an air-core coil is practicable. Therefore, why shouldn't the filter be placed in the low-impedance speaker circuit? In two-way speaker systems, which are commonly used with high-fidelity receivers, it is still simpler, since it is possible to put the 10 kc. filter in the circuit of the high-frequency unit only. As a series resonant trap is to be used, the coil should have as low a resistance as possible in order that the suppression will be sufficient.

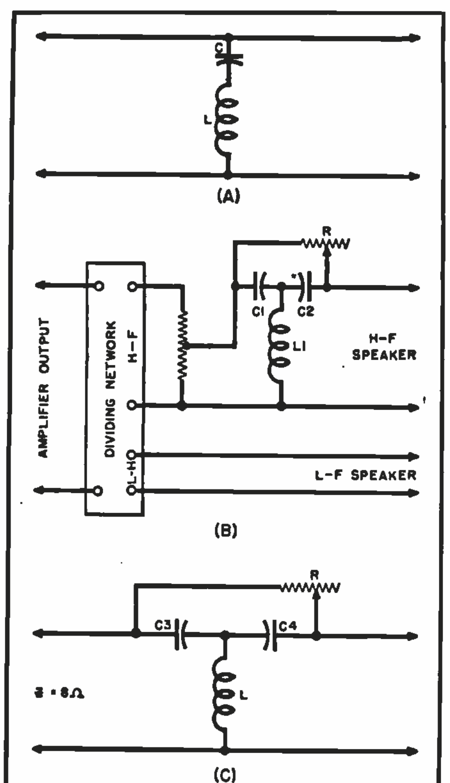


Fig. 1. (A) Basic series-resonant trap circuit used to eliminate 10 kc. whistle. (B) Connection of resistance-compensated trap circuit in high frequency leg of output circuit from dividing network. (C) Recommended filter for use in 8-ohm speaker circuit. L is .6 mh. line filter choke with turns removed to resonate at 10,000 c.p.s. with capacitors C_3 and C_4.

The circuit of Fig. 1A was chosen for a start. The coil has an inductance of 1.02 mh., and the entire filter is placed in the leads going to the high-frequency unit of a two-way speaker system. The coil consists of one pound of #16 d.c.c. wire—wound with two strands in parallel to obtain a minimum of resistance (#13 wire would do just as well, and be much easier to wind). The coil was wound by hand as a "universal" winding, with each turn overlapping the previous one, which is rather a difficult job, but with heavy wire and the judicious use of some small strips of scotch tape, it was found possible to construct such a coil. The "core" was a 2½" paper tube, with the "throw" or width of the coil equal to ¾". The specified amount of wire winds into a coil ¾" thick, these dimensions being chosen to insure a high *Q*. The inductance of the completed coil measured 1.02 mh. with a *Q* of 25 at 1000 c.p.s.

The simple series resonant circuit of Fig. 1A across a 16 ohm high fre-

(*Continued on page 96*)

SONAR—The Submarine's Nemesis

By C. G. McPROUD

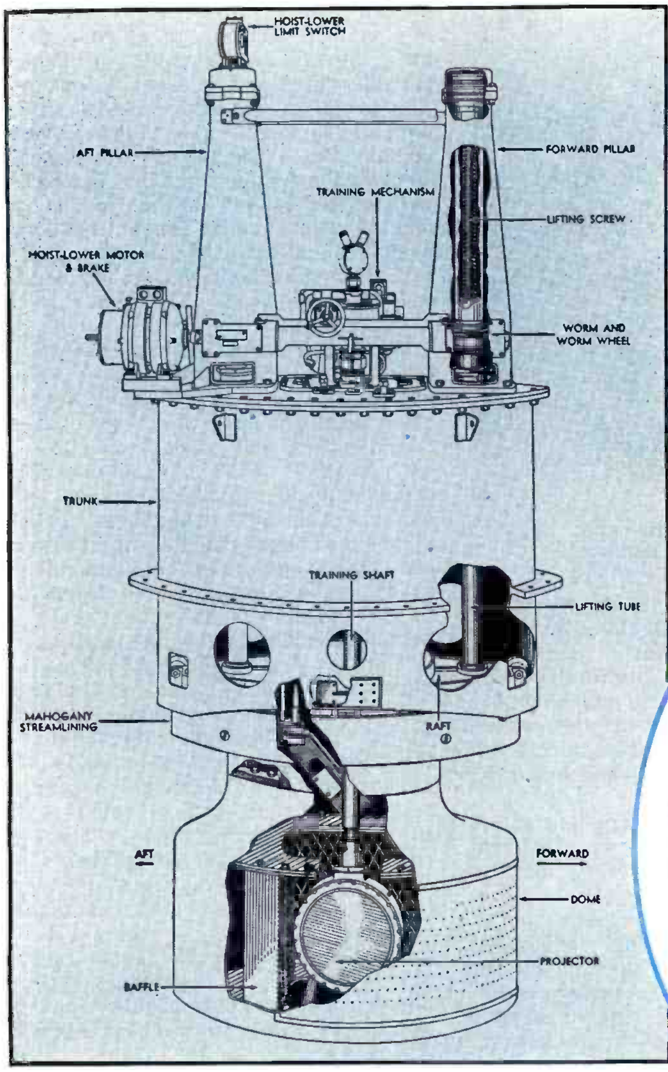


Fig. 1. Cutaway drawing of sonar dome and retracting gear.

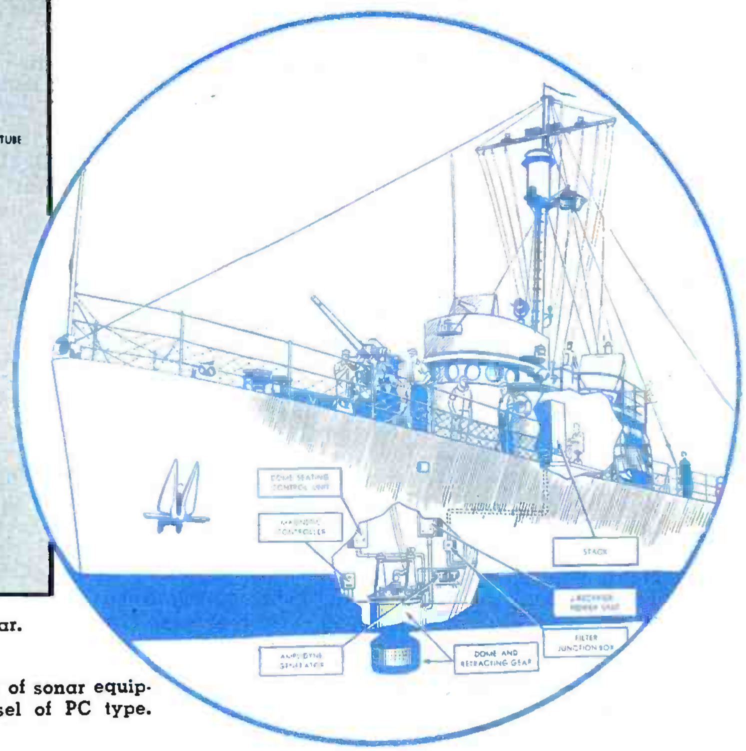


Fig. 2. General arrangement of sonar equipment in anti-submarine vessel of PC type.

The Navy has termed sonar a "major factor in the defeat of the U-boat and the winning of the Battle of the Atlantic" for the Allies.

"CONTACT—zero four zero—sixteen hundred yards," calls the sonar operator. Only seven words, but on an anti-submarine ship they are the signal for the start of a beehive of activity. Five principal performers bend every effort to keep a finger of sound on the enemy submarine until they can put on it a more effective "finger"—TNT. Two hundred other scared, sweating performers are tense with excitement, each doing his own job — readying depth charges, relaying telephoned orders, checking engine gauges, or executing any of the multitude of different jobs on a destroyer, DE or SC. All have only one objective—a successful attack.

The story of sonar cannot be told without acknowledging the efforts of those whose duty it was to handle a maze of electronic equipment. Radar has more glamor; loran is more spectacular; but the Navy calls sonar "a major factor in the defeat of the U-boat and the winning of the Battle of the Atlantic." Nine hundred and ninety-six enemy submarines were sunk during the war. The majority of them were detected by the sonar equipment and attacked on the basis of information supplied by it.

Informed readers are almost as familiar wth radar as they are with radio itself. Sonar has received less publicity in the technical press, yet the methods employed in detecting unseen submarines are just as fascinating as those used to detect unseen airplanes.

Sonar principles are similar to radar —the time is measured between the transmission of a pulse and the reception of an echo bouncing back from the target. Simple as that. But in sonar, the signal is not an electrical wave—it is a sound wave at a frequency between 18 and 24 kc. The transmitter is a typical master oscillator power amplifier with the output feeding a "projector" which converts the electrical signal into supersonic mechanical vibrations.

Projectors of various types are used. In the magneto-striction type, several hundred nickel tubes are imbedded in a one-inch thick diaphragm. Each tube is surrounded by a coil of wire which carries the signal voltages. Fig. 8 shows the construction of the projector used with the QCQ-2 equipment. The varying magnetic field induced by the coil causes the tubes to shorten and lengthen alternately, and this activity causes the diaphragm to vibrate. The resonant frequency of the diaphragm is very sharp, the response being down 50 per-cent at a frequency two per-cent off the peak. Such selectivity results in a high signal-to-noise ratio.

Crystal projectors employ a large number of Rochelle salt or ammonium-

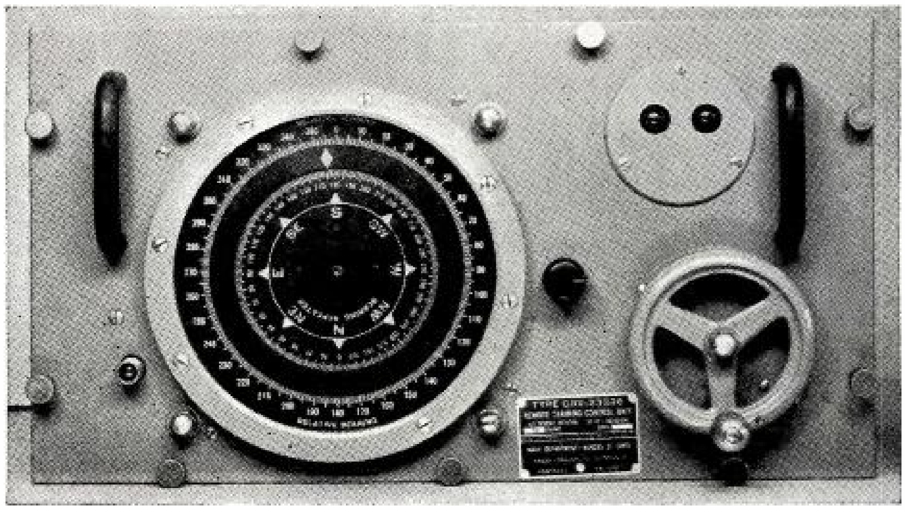


Fig. 3. QCQ-2 training control panel, showing indicator for true and relative bearings, and handwheel for control of projector rotation.

dihydrogen-phosphate (ADP) crystals arranged in rows. Each has two electrodes, and they are connected in parallel. The output of the driver amplifier is fed to these crystals, and the vibration caused by the piezoelectric action is transmitted to the sea water through castor oil surrounding the crystal blocks. A sound-transparent rubber cover keeps the oil in, the water out. The ADP crystal, developed during the war by *Bell Telephone Laboratories* has the same piezoelectric properties as Rochelle salt, but is less subject to rupture from high signal potentials, and may be worked to higher temperatures. Crystal projectors are about 80 per-cent efficient, whereas magneto-striction projectors have an efficiency of around 10 per-cent. A comparison of these figures would seem to indicate

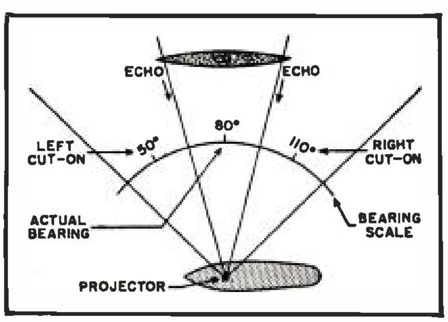


Fig. 4. Determining bearing of target by midpoint between two cut-on points.

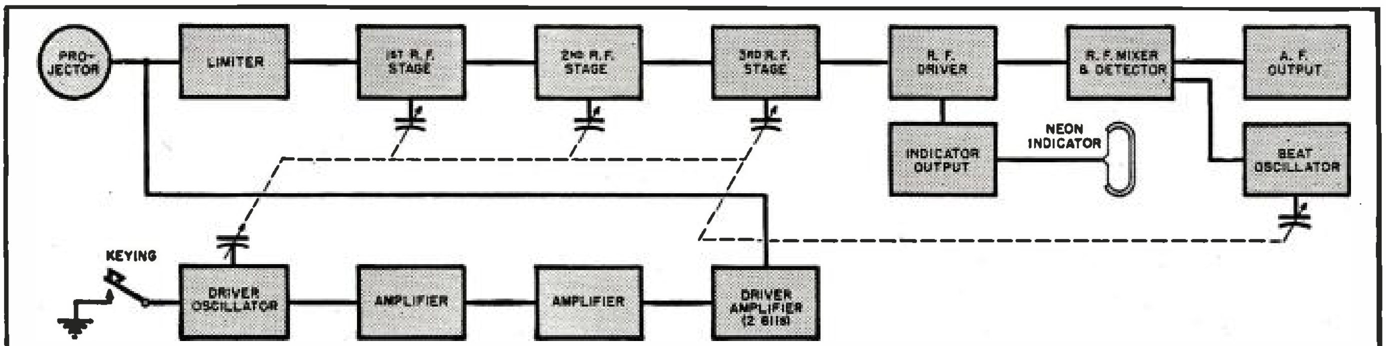
that the crystal projector would be used exclusively, but the added advantage of the greater selectivity is of more importance than efficiency. Recently developed projectors employ a tuned back-plate for the crystal array, with some increase in selectivity, but not to the extent possible in the magneto-striction type.

A typical sonar system consists of a transmitter to furnish the electrical output signal, a receiver to amplify the weak echoes, an indicator to measure the time from the transmission of the pulse or "ping" to the reception of an echo, the projector, and means for rotating the projector under water. The larger anti-submarine ships have the projector mounted in a retractable streamlined dome, located about 30 feet back from the bow. This dome and retracting gear, as it is called, is shown in detail in the drawing of Fig. 1. The illustration also shows the location of the dome and retracting gear aboard ship.

The dome proper is a streamlined structure with a .020" stainless steel sound window, extending on each side about 135 degrees from the forward end. This window is spot welded to expanded metal reinforcing. The entire structure is mounted in an opening in the keel, with the bottom of the dome in the retracted position flush with the bottom of the hull. The dome is carried on a steel raft, which is raised and lowered by means of the lifting screws in the two pillars. The mahogany streamlining is shaped to the contour of the hull to reduce turbulence when the dome is lowered. The projector is carried on its shaft, which is rotated by the training mechanism. Since the top of the dome is open to the water, the dome is flooded with water at all times. In the retracted position, the top of the dome is seated against a gasket, so that the projector may be removed for necessary maintenance while the ship is waterborne.

We have mentioned briefly the transmitter, or "driver," as it is called in sonar. In the QCQ-2 equipment of *RCA* manufacture, the output stage consists of a pair of 811's in class B, with two more 811's as rectifiers. The driver amplifier for this equipment is capable of an output of 400 watts, this power being concentrated in a pulse of one-quarter second or less, transmitted at six-and-a-quarter-second intervals. These pulses are inaugurated by a mechanical keying arrangement which is part of the "indicator." This indicator is used to measure the time required for the sound wave to travel to the target and be reflected back. Since sound travels at a speed of approximately 4300 feet per second in salt water, and since it must make the round trip from the projector to the target and back, it is seen that the time required for the sound wave to "range" an object 1600 yards distant is two seconds. A target at 400 yards requires a half second for the round trip. These are relatively long times—compared to radar, for example—so a simple arrangement will suffice as an indicator. Some equipment uses a disc making one revolution in 1¼ seconds for targets closer than 1000 yards, and a slower rate of revolution in 6¼ seconds for 5000 yard maximum. When the target is at a greater distance than 5000 yards, the keying is made to occur at every other revolution of the disc. A synchronous motor drives the disc which moves behind two scales, calibrated in 0-1000 and 0-5000 yards, around its circumference. A neon light is mounted behind a slit in the disc. As the slit passes the scale "zero," cam actuated contacts energize the oscillator, and a pulse is emitted from the projector. This pulse travels horizontally through the water. If a submarine, reef, or

Fig. 5. Block diagrams illustrating functional operation of RCA QCQ-2 sonar equipment.



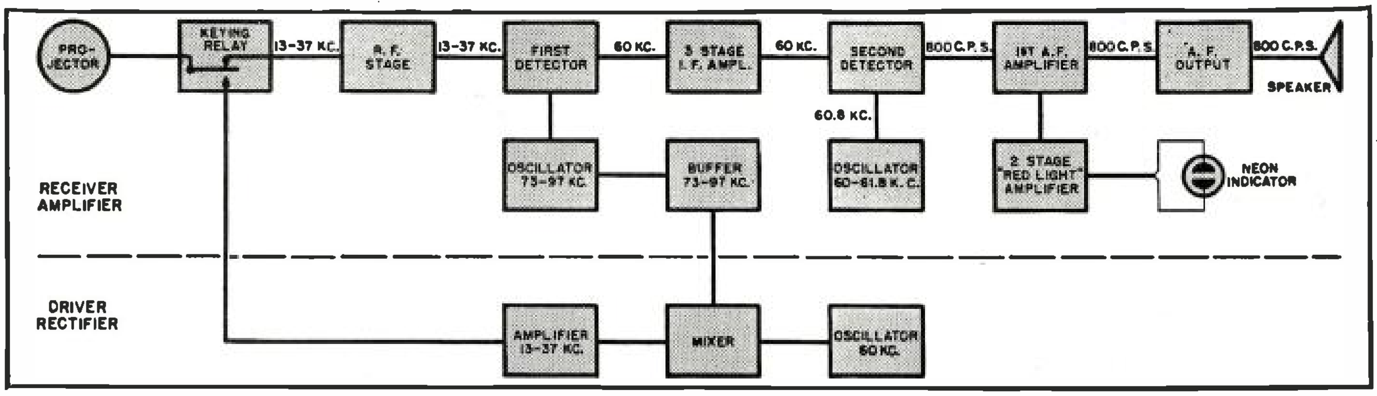


Fig. 6. Block diagram of Submarine Signal Company's WCA-2 sonar equipment. Tuning receiver also tunes driver rectifier, so that both receiver and transmitter are always tuned to the same frequency.

school of fish is in the path of the sound beam, it is reflected back as an echo, received by the projector acting as an underwater microphone, amplified by the receiver, and the output signal causes a flash of the neon tube. During this time, the disc travels a distance proportional to the range of the target, and the position on the scale of the echo flash indicates the range.

Another type of indicator is that used in the QCQ-2 equipment. The principle of operation is the same, although the mechanical construction is considerably different. The flashes of light from a long neon tube are observed through a hole in a thin steel belt, motor-driven at a constant speed.

Both t.r.f. and superheterodyne circuits are used in sonar receivers. Equipment manufactured by the *Submarine Signal Company* uses the superheterodyne, consisting of an r.f. stage, local oscillator, first and second detectors, and i.f. and a.f. amplifiers, shown in block schematic form in Fig. 6. The detectors are copper oxide "varistors," so called from their use as variable resistors. With an i.f. of 60 kc., it is necessary for the oscillator to be tuned simultaneously with the r.f. stage to a frequency 60 kc. above that of the signal. A three-stage i.f. amplifier with variable selectivity feeds another varistor as the second detector, where it is mixed with a heterodyne oscillator frequency of 60.8 kc., resulting in an audio tone of 800 c.p.s. This audio signal is fed through separate amplifiers to the neon indicator, and to a loudspeaker. The audible signal is used to indicate the relative motion of the target with respect to the ranging vessel by means of the Doppler effect.

For an explanation of this, consider the pitch of a locomotive whistle as a train approaches, passes, and recedes from a listener. As the train is approaching, the pitch is higher than when it is passing, and still lower as the train recedes. Sound waves from the approaching train have, besides their own velocity, the additional velocity imparted by the movement of the train; hence, more vibrations reach the ear in a given time, causing a sound of higher pitch. The reverse is true as the train recedes.

Applying this principle to sonar, it is seen that the echo from a stationary object will have the same pitch as the reverberation, both of which are heard by the operator. (Reverberation is the sound reflected back to the projector from air bubbles and infinitesimal particles in the water.) But if the target is moving toward the ranging vessel, the echo gets an extra impetus from this motion, and the pitch is higher. A target moving away will return an echo of lower pitch. Thus the operator can judge the target movement.

Returning to a description of the equipment, the receiver used by the QCQ-2 equipment employs a t.r.f. circuit. A five-gang condenser tunes three r.f. stages, a heterodyne oscillator tracking 800 c.p.s. below the signal frequency, and another oscillator tracking with the r.f. stages. This circuit is the master oscillator for the driver, and two additional stages following the oscillator tube provide enough signal voltage to actuate the driver amplifier. Fig. 5 shows the entire system in block form. With this equipment, the operator can tune

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Fig. 7. QCQ-2 sonar "stack." From top to bottom, receiver-indicator-driver oscillator, training control, and driver amplifier.

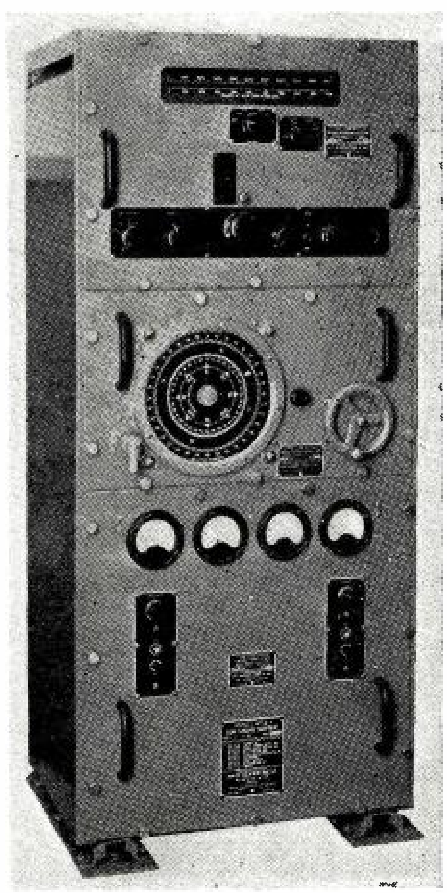
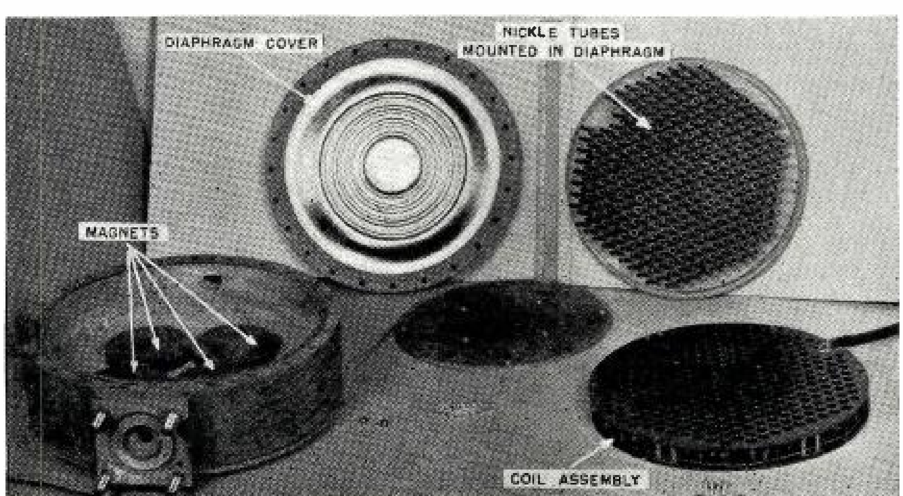


Fig. 8. Disassembled view of QCQ-2 magnetostriction projector.



A Handy 20-Watt Modulator

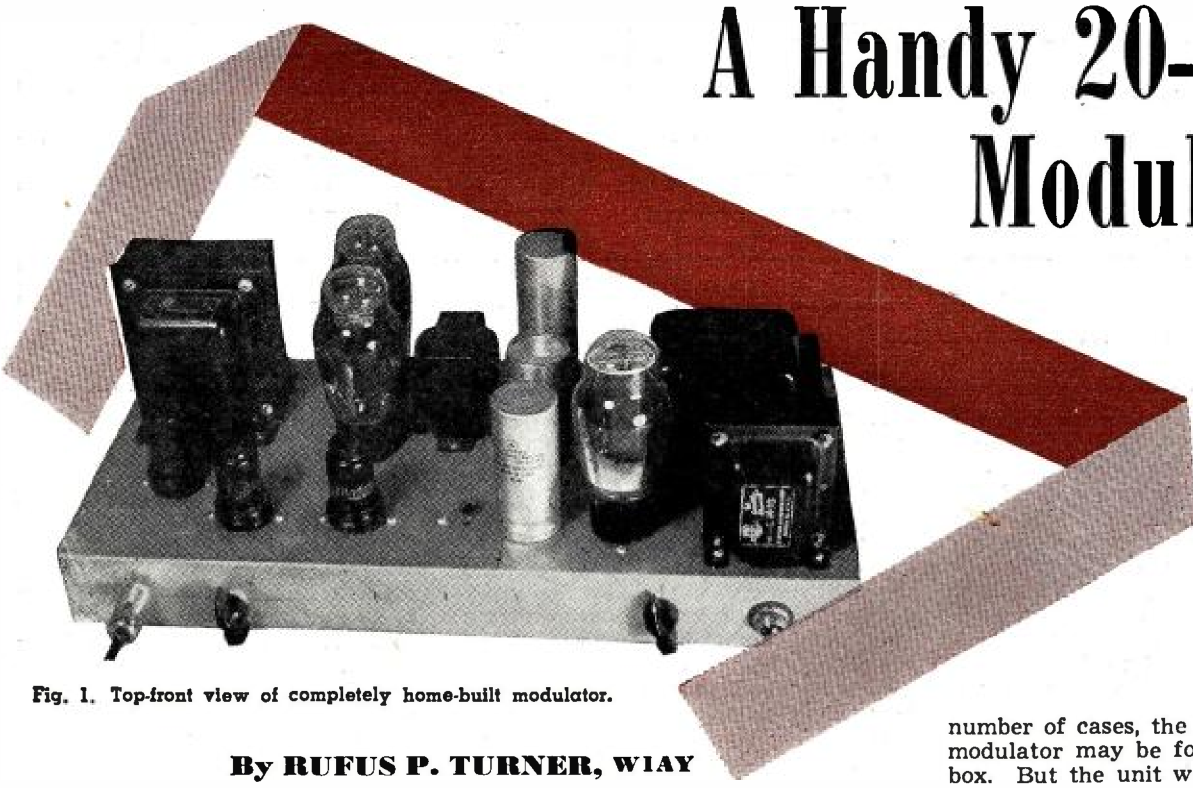


Fig. 1. Top-front view of completely home-built modulator.

By RUFUS P. TURNER, W1AY
Consulting Eng., RADIO NEWS

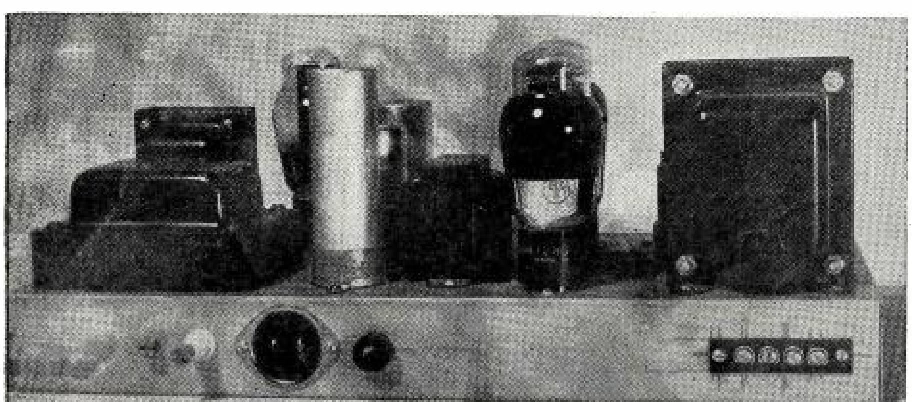
Construction details for an inexpensive modulator that can be used with most types of amateur rigs.

THOSE choice, new ultra-high frequencies certainly are inviting. The thrill of making circuits oscillate or amplify at hundreds—and even thousands of megacycles and of sending out beams with antenna arrays you can hold in your hand is not easily passed up. Lots of hams already are exploring our new territory and firing up on our returned u.h.f. bands, as well. We have a lot of catching up to do.

For some indistinct reason, the usual amateur procedure is to spend days on end developing a new u.h.f. rig, with no thought as to audio, and upon completing the job to discover that almost as much more time must be spent building a modulator. A steady carrier is none too useful! Few hams keep on the shelf a ready-built and rarin' to go audio unit suitable for modulating experimental u.h.f. rigs. Heretofore, your author has been no exception.

The ham who intends to do any amount of experimenting with u.h.f. gear will not question the advisability of keeping a small modulator on hand. Fortunately, most experimental, fixed-station u.h.f. transmitters run plate inputs of 40 watts or less. A complete, self-powered modulator delivering 20 watts or so and accommodating any of the usual amateur microphones will therefore be adequate for amplitude-modulating these rigs 100 per-cent. In a large number of cases, the parts for such a modulator may be found in the junk box. But the unit will not be expensive even if built "from scratch."

Fig. 2. Rear chassis view. From left to right along chassis flange are: two relay contacts, power line receptacle, fuse holder, and terminal strip for modulation output transformer.



The modulator described in this article is simple and foolproof and was built primarily for experimental u.h.f. use. Between experiments, it has been used successfully as a speech amplifier to drive a zero-bias modulator in the big rig (through a coupling transformer for matching a 500-ohm line to zero-bias class B grids) and is recommended as standard equipment for other u.h.f. experimenters. It has enough over-all gain to handle amateur crystal and dynamic microphones and enough wallop to modulate the low-powered gear most likely to be used in u.h.f. experiments. The unit is inexpensive and straightforward in design and requires no coddling to get going or to keep in top operating condition.

General Description

The power output of the modulator is approximately 24 watts. The tube lineup is 6SJ7-6C5-6C5-push-pull 6L6's, class AB_1. The power supply is built on the same chassis, making the unit completely single-packaged. Over-all gain is approximately 100 db. With the layout shown in Fig. 5, hum level is low enough to be of no practical consequence in communication work.

External views of the unit are given in the photographs, Figs. 1 and 2. Fig. 4 is an under-chassis view. These photographs, together with the layout drawing (Fig. 5) show completely the structural aspects of the modulator.

The output transformer employed by the author provides two modulating impedances—500 ohms and 2800 ohms. Lack of additional impedances has caused little trouble, however, since it has been easy to adjust the

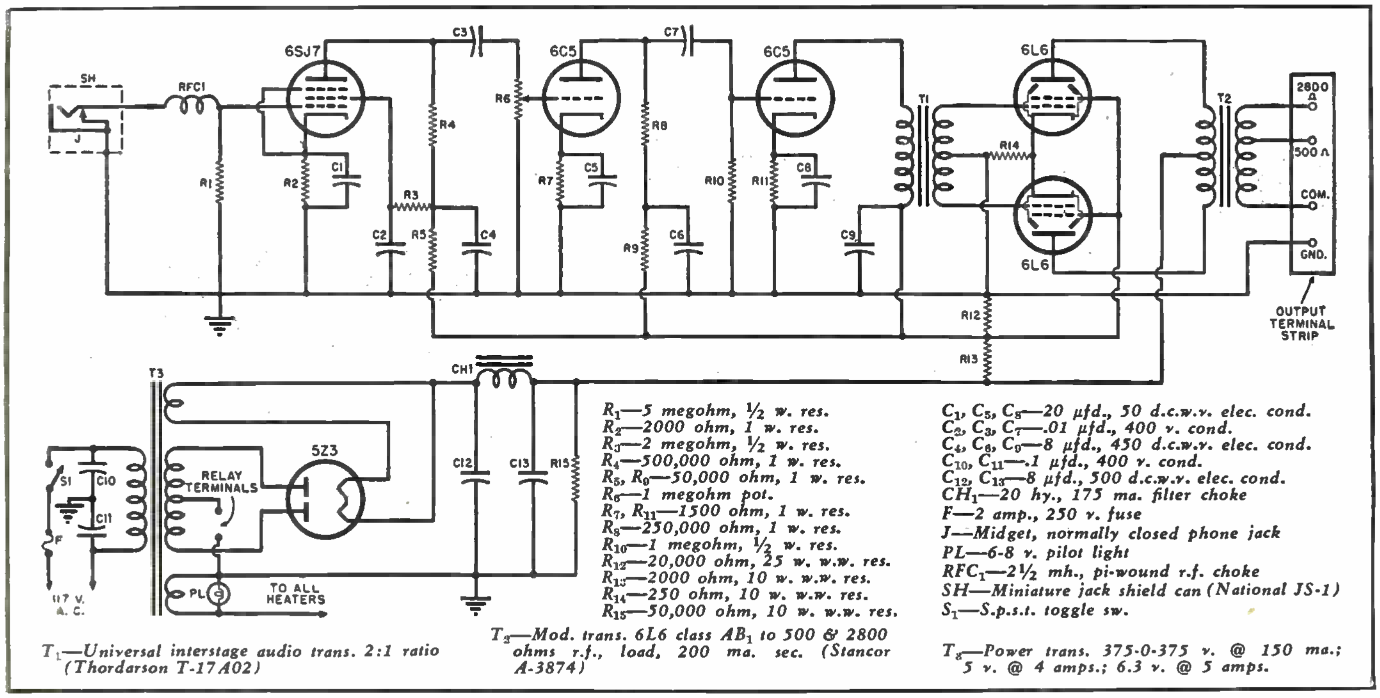


Fig. 3. Schematic diagram of 20-watt modulator. The circuit is simple and no trouble should be experienced in duplicating it.

d.c. plate input of various u.h.f. oscillators and amplifiers to correspond to an impedance of 2800 ohms. The 500-ohm output has been used for cathode modulation and also occasionally to feed the 500-ohm primary winding of an external multimatch modulation transformer or the primary of a 500 ohm to push-pull grids transformer in a *zero bias* modulator.

Operating as it does without degeneration, distortion in the modulator is tolerable. However, an individual builder may, if he desires, add degenerative feedback to the push-pull 6L6 stage with a slight decrease in power output.

Since, for experimental reasons, the author desired complete manual control of gain, no automatic modulation circuit was included. But an individual builder may obtain an a.m.c. simply by rectifying a portion of the audio output (e.g., with a capacitance-coupled 6H6 tube or crystal diode) and feeding a portion of the rectified voltage, regulated by means of a potentiometer, back through a resistance-capacitance filter to the suppressor of the 6SJ7 tube. The suppressor must, of course, first be disconnected from the cathode terminal.

Electrical Details

The complete circuit diagram of the modulator is given in Fig. 3.

The 6SJ7 high-gain input stage provides the highest voltage gain. The two succeeding 6C5 stages each have medium gain. The push-pull 6L6 stage is self-biased and its screen voltage is supplied by the voltage divider R_{12}-R_{13}. Decoupling filters, comprised of 50,000-ohm resistors R_5 and R_9 and 8 μfd. capacitors C_4 and C_6, insure stable operation of the first two amplifier stages.

The self-contained power supply is a conventional capacitor-input circuit comprised of transformer T_3, the 5Z3 rectifier tube, filter section CH_1-C_{12}-C_{13}, and bleeder resistor R_{15}. The power supply components are mounted on the end of the chassis farthest from the amplifier input stages, in order to minimize hum.

Radio-frequency feedback, unusually troublesome at ultra-high frequencies, is discouraged by complete shielding of the microphone jack, *J*, with a small shield can (See *SH* in Fig. 3) and inclusion of a 2½ millihenry r.f. choke, RFC_1. All metal tube envelopes are grounded by connecting the No. 1 socket pins to chassis through the shortest possible leads. If metal 6L6 tubes are used in the output stage, their envelopes *must* be grounded in this same manner.

The 1-megohm potentiometer R_6 is the amplifier gain control. The under-chassis view (Fig. 4) shows this control mounted as close as possible to the control grid terminal of the second 6C5 socket.

All resistors except R_{12}, R_{13}, R_{14} and R_{15} are small-sized carbon units. Each resistor in the latter group is a 10 watt wire-wound unit except R_{12} which is 25 watts wire-wound.

Transformer T_2 was selected because its two output impedances satisfied most requirements. The author has found it easy to adjust the plate input of various u.h.f. oscillators and amplifiers to a value corresponding to 2800 ohms. Thus, a rig operated at 300 plate volts will offer an impedance of 2800 ohms when its plate current is adjusted to 107 milliamperes, a 350-volt oscillator or amplifier shows 2800 ohms at 125 plate mils, etc., etc. (Impedance in ohms equals plate volts divided by plate *amperes.*) The 500-ohm winding is almost uni-

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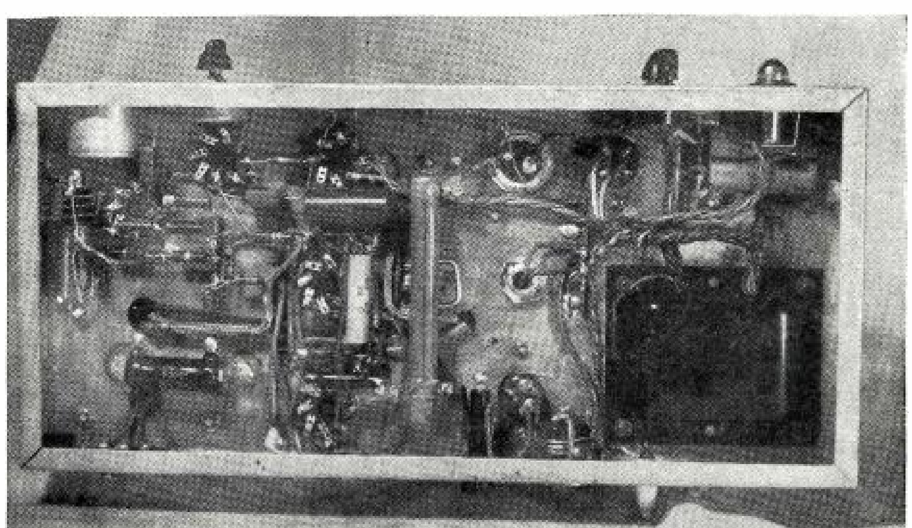
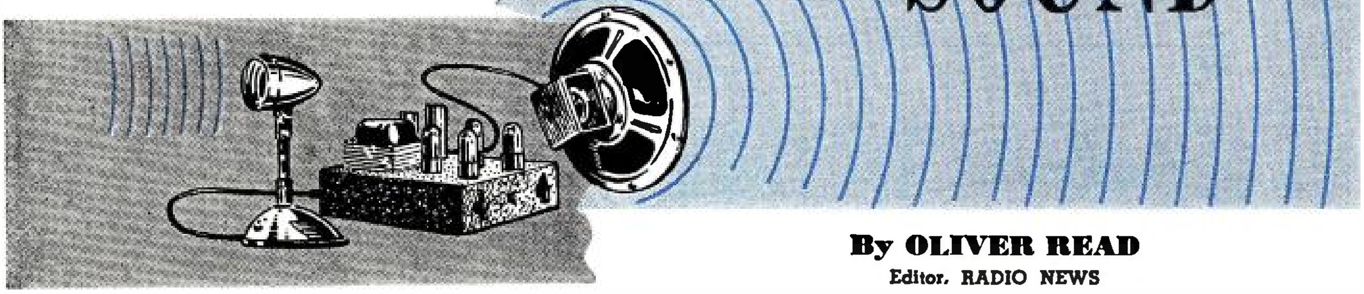
Fig. 4. Under-chassis view shows wiring and position of component parts.



The RECORDING and REPRODUCTION of SOUND



By OLIVER READ
Editor, RADIO NEWS

Part 1. The behavior of sound waves — introduction to a new series of articles covering the history, development, and applications of all currently known methods employed for the recording and reproduction of sound. Mechanical, electrical, and electronic methods will be covered, including sound on wire, disc, tape, film, etc.

TO FULLY understand the many problems which enter into the recording and reproduction of sound, we must first take into consideration the basic concept of sound. We must understand and fully appreciate the characteristics of sound or we cannot apply satisfactory techniques to obtain a true facsimile of the original sounds we expect to reproduce.

Webster defines *sound* as follows: "Sensation due to stimulation of the auditory nerves and auditory centers of the brain, usually by vibrations transmitted in a material medium (commonly air) affecting the organ of hearing—vibration energy which occasions such a sensation. Sound is propagated by progressive longitudinal vibratory disturbances (sound waves)." Thus, it becomes apparent that the source of sound lies in the realm of physics, while the effect of sound is a physiological consideration. The engineering of sound consists of controlling the cause so as to produce the desired effect.

The theory of *sound waves* may be explained in simplified form thusly: If a small stone is dropped into a pool of still water, waves will be set up which will travel in all directions away from the point of impact. If our original stone were small in physical size, only waves small in height would result. However, if a large stone were dropped into the still water, we would discover that we have generated waves having a greater height. The up and down movement of the waves represents the *amplitude* or the intensity of the waves.

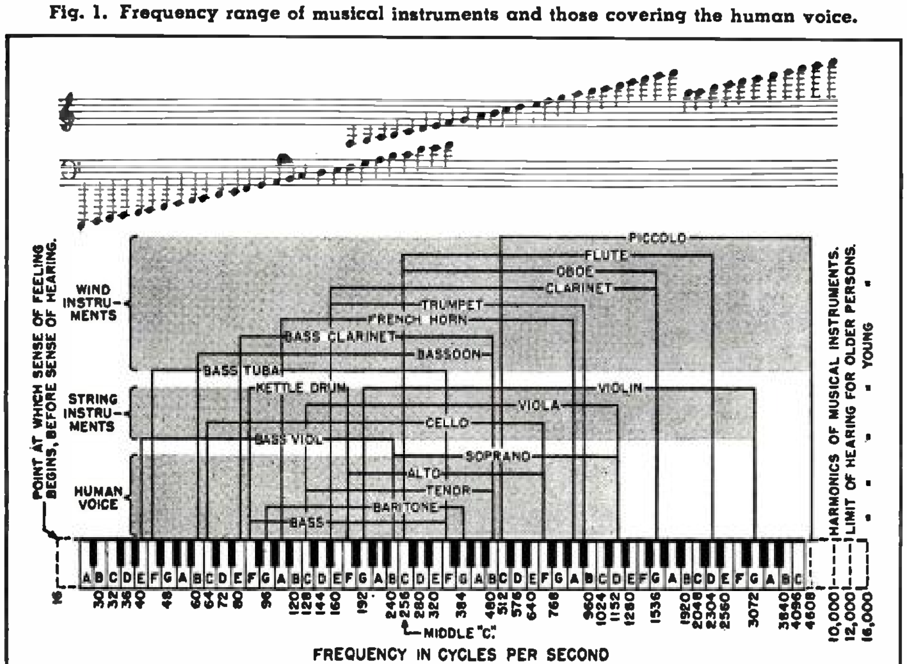
Differing from the behavior of water waves, sound particles of air do not move up and down and across in the pattern in which waves move but all move in the same direction. These particles of disturbed air literally bump one another as they travel through space. The air, therefore, is alternately compressed and rarefied.

The number of waves passing any fixed point per second represents the *frequency* or number of waves per second. Therefore, the *frequency* depends upon the number of waves traveling past one spot during an interval of one second. If we tie a string to a stone which is immersed in still water and move it up and down at the rate of 100 times per second, we will send out waves from the point of impact at the rate of 100 per second. In the study of acoustics we refer to *frequency* in terms of cycles per second, abbreviated c.p.s.

Now suppose we took a large stone and moved it up and down very slowly in and out of the water, we would then set up waves at a lower frequency but, due to the greater displacement of the water by the object, we would create waves of greater amplitude.

The top of the wave is referred to as the *crest,* while the bottom is known as the *trough.* One *cycle,* as far as one wave is concerned, would be one complete wave beginning from its normal still point, building up to a crest, passing again through its still point,

Fig. 1. Frequency range of musical instruments and those covering the human voice.



down to the lowest point, the trough, and its return to its normal position. See Fig. 4D.

Sound waves are not limited to but one frequency. In fact the speaking voice is made up of a variety of *complex waves.* These are continually varying in both frequency and amplitude. In other words, if we raise our voices in *pitch,* we are actually increasing the *frequency* and the *louder* we talk, the greater will be the *amplitude* of the sound waves sent out by our speaking mechanism.

All sound waves are composed of frequency, intensity, periodicity, and waveform.

1. *Frequency* is the speed of vibration or number of complete cycles per second. Frequency also determines pitch. If we double the speed of vibration, we raise the pitch one octave. For example, a note having 1000 vibrations or cycles per second would be raised by one octave if the frequency were doubled to 2000 c.p.s.

2. *Intensity* is the amplitude or power of vibration. Intensity therefore determines the loudness of a sound. If the pressure of a sound wave is doubled in intensity, we increase the power by about 3 decibels. The *decibel* is a ratio of power and not a quantity.

In the behavior of sound waves various ranges of intensities and pressures are so great that it is necessary to have some means which will conveniently measure volume or amplitude. The *decibel* is a unit used for expressing the magnitude of a change in either a sound level or a signal level. One decibel is the amount that the pressure of a pure sine wave tone must be changed in order for the change to be just barely detectable by the average human ear. The amount of change in power level expressed in decibels is equal to ten times the common logarithm of the ratio of the two powers. db. $= 100 \log_{10} P_1/P_2$.

3. *Periodicity* is the lack of, or the existence of, rhythm in sound. Therefore, musical sounds are *periodic,* while street noises, the jingle of keys on a chain, etc. are *non-periodic.*

4. *Waveform* is a direct pattern of vibration. Most fundamental sound waves are modified by secondary vibrations. The *timbre* of sound is determined by the waveform. Thus it is possible to distinguish particular notes played on various musical instruments such as the violin and the flute.

Distortion

If a microphone, radio tuner, pickup, amplifier or speaker is incapable of reproducing a true picture of the original sound waves, *distortion* will occur. This distortion may come from either mechanical or electrical defects in the system. *Mechanical distortion* may be caused from such conditions as having a needle in a phonograph pickup move because it has not been tightened thoroughly by means of the needle set screw. In other words, vibrations set up within the pickup could not transmit or move the needle in perfect cadence with the original electrical vibrations. The needle would be permitted to move freely and to follow vibrations of its own choice instead of moving in perfect unison with the armature in the pickup.

Many reproducer (loudspeaker) cones vibrate at some particular frequency not found in the music that is fed to the speaker for reproduction. The resulting buzzing effect would be a form of *mechanical distortion.* The above illustrations are typical but many others may be encountered throughout the equipment if care is not exercised to adjust each and every part which might cause mechanical distortion.

Generally speaking, a sound is said to be distorted when the waveform is altered in transmission or when the intensity of any frequency is suppressed or exaggerated out of its natural proportions.

Electrical distortion is caused by the inability of the microphone, amplifier or speaker to give a true reproduction (facsimile) of frequency. For example; the delicate diaphragm on a microphone may become warped from excessive heat, etc. As pressure from the sound waves strikes this distorted diaphragm, the resulting currents

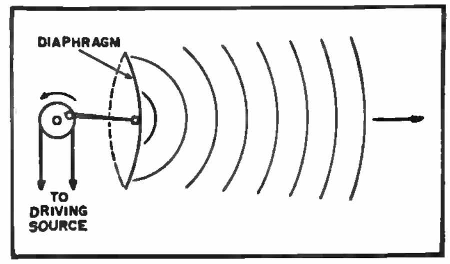


Fig. 2. Sound waves created by the movement of a mechanically-driven diaphragm.

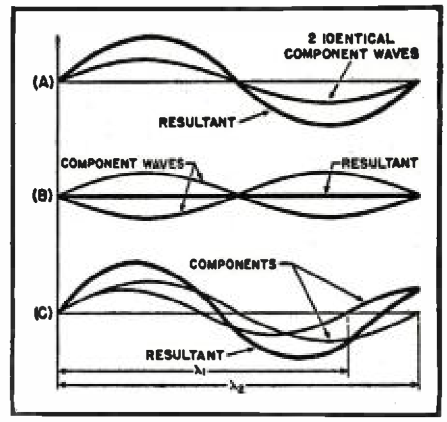
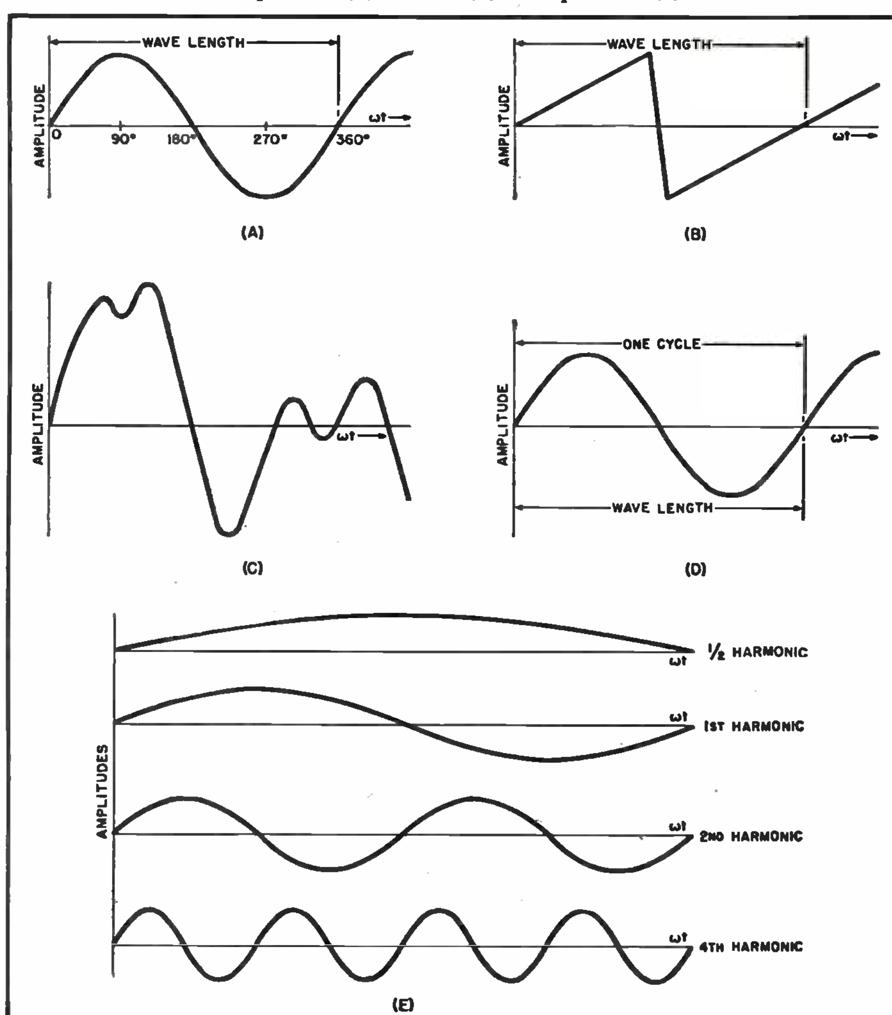


Fig. 3. The combination of two harmonic waves vibrating at the same frequency.

Fig. 4. Illustrating the characteristic behavior of wave motion: (A) sine or cosine, (B) periodic, (C) random, (D) one cycle and (E) harmonics.



would become distorted. There are many forms of electrical distortion. A poorly designed amplifier, overloaded audio stages, impedance mismatching and improper biasing will all result in electrical distortion.

The Ear

There are three main divisions to the human ear: (a) The outer ear, which is made up of the visible portion of the ear and the canal which is not visible. (b) The middle ear, which is the receiver for sound approaching the eardrum and the conducting media for sounds through a chain of three small bones (the ossicles), to the inner ear. (c) The inner ear is the delicate container filled with fluid in which is immersed the nerve ends which perceive sound and which also transmit messages to the brain. The part of the inner ear that perceives sound is called the cochlea. There is still another part of the inner ear in the form of semi-circular canals which give us our sense of balance.

Speech

Speech has a frequency range of from approximately 100 to 8000 c.p.s. There are three principal components to speech. They are listed as follows:

1. The *fundamental* range (or voice). 100 to 400 c.p.s.
2. The *vowel* range. 300 to 2500 c.p.s.
3. The *consonant* range. 2000 to 8000 c.p.s.

The above are approximate ranges and do not necessarily indicate the proportion of sounds that occur in each division. Sounds having very low frequencies possess the most power and result in naturalness and apparent loudness. High frequency sounds provide intelligibility. If we eliminate all sounds below 1000 c.p.s., we take but little from the clarity of the sound, but we do notice that the sound appears to be unnatural. However, if we eliminate sounds above 1000 cycles, we find that the speech is unintelligible but, as far as volume is concerned, there is little, if any, apparent change.

Speech may be considered as a series of *periodic* sound waves, emitted in a certain sequence. Association of particular sound sequences with particular ideas is the distinguishing feature between speech and noise. The so-called "scrambled" speech systems serve as an excellent illustration of this point. In such a system, spoken sounds are distorted by specially designed circuits and then transmitted in the distorted form. The receiver must have a rectifying circuit to convert the wave impulses back to their original undistorted form rendering it intelligible to the human ear.

Music

That sound we choose to call music consists of a sequence of single tones or a sequence of several tones played in unison. Pure single tones are harmonic in waveform and the key or pitch is determined by the frequency (with certain modification to be discussed later). The scale is an ascending series of tones with definite frequency intervals. Fig. 6 shows a portion of a standard piano keyboard for one octave on each side of middle C. The frequencies noted represent a so-called tempered scale which divides an octave into twelve equal intervals. The relative frequencies of the tempered scale (omitting sharps and flats) are shown below for one octave:

Key	Relative Frequency
C	1.000
D	1.122
E	1.260
F	1.325
G	1.498
A	1.682
B	1.887
C	2.000

The combinations of two or more tones make up a periodic composite sound. Here again the psychological phase of music shows up, for if the new sound is pleasing to the ear, it is called harmonious. If, on the other hand, the sound is irritating, the combination of tones is said to be in discord.

Frequency Range

If a tone is maintained at a constant intensity but its frequency is raised and lowered, high and low frequency points will be reached beyond which there will be no sensory perception by the ear. Generally this *frequency range* extends from 30 to 16,000 c.p.s. The frequency range for conversational speech is from about 100 to 8000 c.p.s., as mentioned previously. In terms of power, conversational speech will vary over about 40 db. and the intensity of the loudest sound will be about 10,000 times that of the weakest.

A large symphony orchestra, with instruments producing an abundance of bass notes and overtones extends over practically the entire frequency range of the ear—30 to 16,000 c.p.s. The over-all volume range of a symphony orchestra from the softest passages through the loudest passages and peaks runs about 70 db. or an intensity range of 10,000,000 times.

Reproducing systems for highest fidelity should have a frequency range that is uniform from about 30 to 16,000 c.p.s. and a volume range of 70 db.

Of equal importance, the original sounds must be reproduced at the same power levels as were present in

(*Continued on page* 88)

Fig. 5. Conversion chart for standard 500 ohm db. meter across impedances from 2-4000 ohms.

POWER LEVEL (db.)	VOLTS 500 OHM LINE	POWER WATTS 0 db. = 6 mw.
−20	0.1730	0.00006
−19	0.1990	0.00007
−18	0.2180	0.00009
−17	0.2340	0.00011
−16	0.2730	0.00015
−15	0.3000	0.00018
−14	0.3390	0.00023
−13	0.3890	0.00030
−12	0.4450	0.00039
−11	0.4860	0.00047
−10	0.5477	0.00060
− 9	0.6145	0.00070
− 8	0.6895	0.00090
− 7	0.7737	0.00110
− 6	0.8681	0.00150
− 5	0.9740	0.00180
− 4	1.0928	0.00230
− 3	1.2262	0.00300
− 2	1.3758	0.00370
− 1	1.5437	0.00470
0	1.7321	0.00600
+ 1	1.9434	0.00750
+ 2	2.1805	0.00950
+ 3	2.4466	0.01190
+ 4	2.7451	0.01500
+ 5	3.0801	0.01890
+ 6	3.4559	0.02380
+ 7	3.8776	0.03000
+ 8	4.3507	0.03800
+ 9	4.8680	0.04740
+10	5.4772	0.06000
+11	6.1600	0.07590
+12	6.8100	0.09480
+13	7.7368	0.11970
+14	8.7100	0.15070
+15	9.7400	0.18970
+16	10.9285	0.23880
+17	12.2620	0.30070
+18	13.7578	0.37850
+19	15.4369	0.47660
+20	17.3205	0.60000
+21	19.4340	0.75530
+22	21.8050	0.95090
+23	24.4660	1.19710
+24	27.4510	1.50710
+25	30.8010	1.89740
+26	34.5590	2.3886
+27	38.7760	3.0071
+28	43.5070	3.7857
+29	48.8160	4.7660
+30	54.7720	6.0000
+31	61.4550	7.5535
+32	68.9540	9.5093
+33	77.3680	11.9716
+34	86.8080	15.0713
+35	97.4000	18.9747
+36	109.2850	23.8865
+37	122.6200	30.0710
+38	137.5820	37.8570
+39	154.3690	47.6600
+40	173.2050	60.0000
+41	194.3400	75.5350
+42	218.0500	95.0930
+43	244.6600	119.7160
+44	274.5100	150.7130
+45	308.0100	189.7470
+46	345.5900	238.8650
+47	389.0700	300.7100
+48	435.6000	379.5000
+49	487.0100	474.3700
+50	547.7200	600.0000
+51	616.0300	759.0000
+52	688.7400	948.7500
+53	770.4000	1185.9400
+54	871.2000	1518.0000
+55	974.0300	1897.5000

Impedance		DB.
4000 ohms	Subtract	9
2000 ohms	Subtract	6
600 ohms	Subtract	1
500 ohms	....	0
250 ohms	Add	3
24 ohms	Add	13
15 ohms	Add	15
10 ohms	Add	17
8 ohms	Add	18
6 ohms	Add	19
5 ohms	Add	20
4 ohms	Add	21
2.5 ohms	Add	23
2 ohms	Add	24

$E = \sqrt{WZ}$

where:

E = a.c. volts across load

Z = loaded line impedance.

W = watts.

Cond. in Series with db. meter = .25 μfd.

Applying the 1N34 as Discriminator for FM

The germanium 1N34 crystal provides greater audio output with less residual hum than a conventional 6H6 vacuum tube

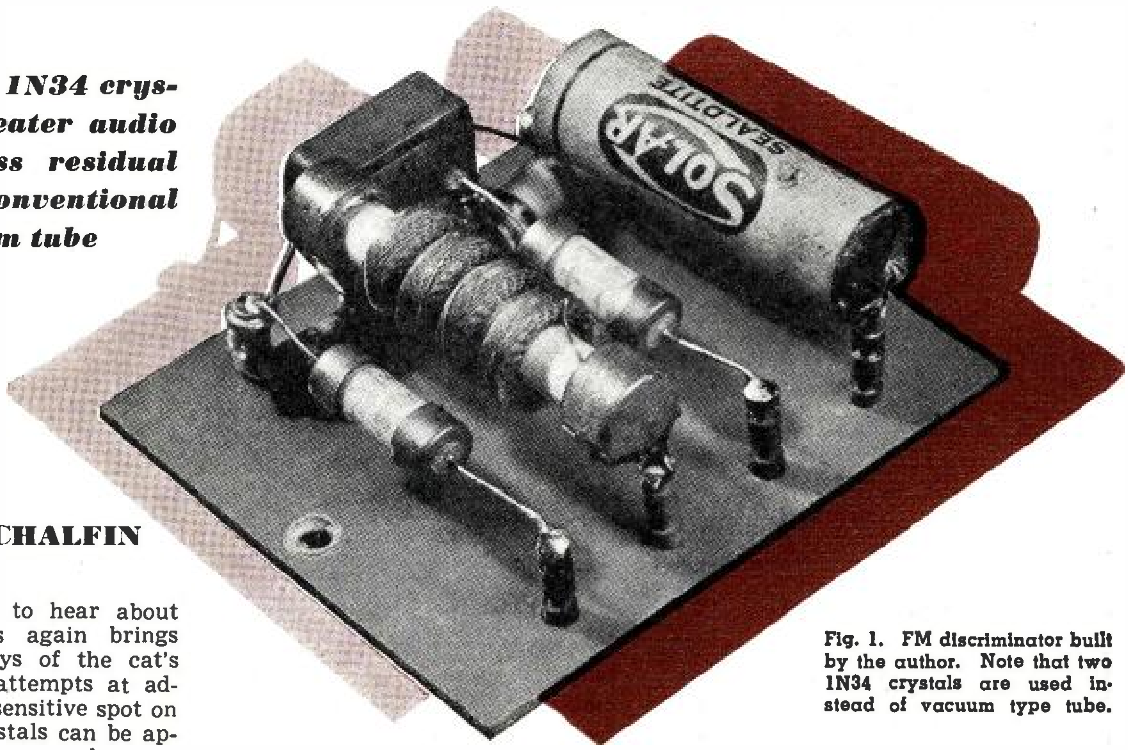


Fig. 1. FM discriminator built by the author. Note that two 1N34 crystals are used instead of vacuum type tube.

By NORMAN L. CHALFIN

FOR most of us, to hear about crystal detectors again brings back the old days of the cat's whisker and tedious attempts at adjustment to the most sensitive spot on the crystal. That crystals can be applied in modern receivers makes one think of clothing style cycles, where the same fashions reappear periodically. The new crystals are of different materials than those the old timers knew. The 1N34 with which this paper is concerned is a germanium crystal. Other crystals of iron pyrites and of silicon have been used in wartime applications, as have uranium oxide crystals. Most applications have been the uses as detectors and mixers at the microwave frequencies. We shall concern ourselves here with their use as a second detector (discriminator) for FM receivers.

Two receivers in the author's home—one for television reception and the other for FM—were rewired to include the unit shown in Fig. 1 in order to determine how well the germanium 1N34 crystal rectifiers could be used as discriminators. The television receiver was built up originally from a kit and its sound channel was designed for AM reception, therefore, the reception of the sound channel, which is FM under present standards, had to be accomplished by "side-slope" detection. This is not a satisfactory way to receive FM signals. In order to improve this condition the sound i.f. coil, which in this receiver was a solenoid coil with primary and secondary on the same form, was made into a discriminator coil by the simple expedient of centertapping the secondary and coupling the hot side of the primary with a 50 μμfd. capacitor to this centertap. The sound i.f. amplifier was pressed into service as a limiter and a pair of 1N34s were wired as the discriminator. The circuit of this arrangement is shown in Fig. 3. A sketch of the detector i.f. coil tuned discriminator is shown in Fig. 5.

For comparison, a 6H6 was wired into the circuit. It was found that the 1N34 delivered more audio to the a.f. amplifier than the vacuum tube. There was no residual hum with the 1N34 while with the 6H6 there was a detectable 60 cycle ripple when observed on the oscilloscope. The hum from the 6H6 could not, however, he heard on the speaker.

Since the experiments herein described were performed, *Sylvania* has announced the 1N35. This comprises two 1N34s in a single assembly. The two units are "matched." The 1N35 can be used exactly as has been described above and as illustrated in the diagrams.

There are also available at many of the parts suppliers' shops 1N21 crystal detectors from wartime sur-

(*Continued on page* 150)

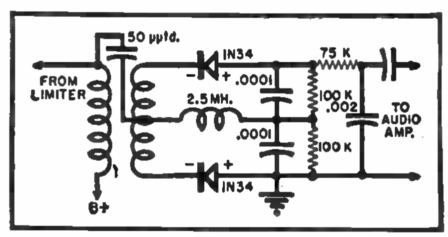
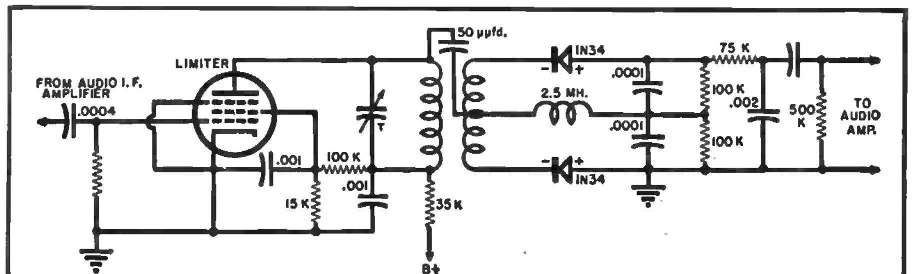


Fig. 2. Circuit diagram of a conventional Foster-Seeley discriminator using 1N34 germanium crystal detectors.

Fig. 3. Circuit diagram of FM broadcast discriminator using two 1N34 crystals. This circuit is similar to a television sound i.f. system except for bandwidth, for television ± 25 kc. deviation is used, while for FM ± 75 kc. deviation is needed.



AROUND THE CLOCK WITH SHORT-WAVE ENGLISH NEWSCASTS

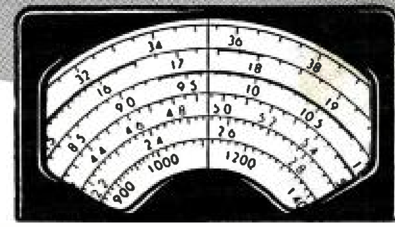
EST	LOCATION	CALL	FREQ.*
7:00 a.m.	Bandoeng, Java	PLP	11.000V
7:00 a.m.	Chungking	XGOY	6.143V 7.152
7:00 a.m.	Montreal, Quebec	CFCX	6.005
7:00 a.m.	Toronto, Ontario	CFRX	6.070
7:00 a.m.	Halifax, Nova Scotia	CHNX	6.130
7:00 a.m.	Sydney, Nova Scotia	CJCX	6.010
7:00 a.m.	Los Angeles (AFRS)	KGEI KCBA/F	9.530 9.750
7:00 a.m.	Melbourne (BBC, Radio Newsreel)	VLR2 VLH3	6.150 9.580
7:00 a.m.	Moscow (To North America)	Radio Centre	11.630 11.720 15.180V 15.360 17.820
7:15 a.m.	Helsinki (Lahti), Finland	OIX2 OIX4	9.505V 15.190
7:15 a.m.	Los Angeles (AFRS, At Dictation Speed)	KGEI KCBA/F	9.530 9.750
7:15 a.m.	London (European Service, At Dictation Speed)	GRI GRX GVU GSE	9.410 9.690 11.770 11.660
7:30 a.m.	Georgetown, Br. Guiana (Caribbean News Bulletin)	ZFY	6.000
7:30 a.m.	Melbourne (To Forces)	VLA8 VLC4 VLB8 VLG9	11.760 15.320 21.600 11.900
7:30 a.m.	Singapore	Radio Malaya	15.300 15.275 11.735V 6.770
7:30 a.m.	Delhi	AIR	4.960 7.290 11.850 15.290
	Bombay		7.240
	Calcutta		7.210 (or 6.010)
	Madras		7.260 (or 4.920)
7:30 a.m.	Colombo, Ceylon	Radio SEAC	11.770 6.075
7:45 a.m. (irreg.)	Pnompenh, Fr. Indo-China	Radio Combade	12.364V
7:45 a.m.	Moscow (To North America, Moscow Newsreel)	Radio Centre	11.630 11.720 15.180V 15.360 17.820
7:45 a.m.	London (European Service)	GRI GWO GVU GVX	9.410 9.625 11.770 11.930
8:00 a.m.	Los Angeles (AFRS)	KGEI KCBA/F	9.530 9.750
8:00 a.m.	Moscow (To North America)	Radio Centre	7.360 11.630 11.720 11.890 15.180V 15.440I
	Via Komsomolsk		9.565V
8:00 a.m.	Melbourne (To East U.S., Canada, South Africa)	VLB VLC7	9.540 11.840
8:00 a.m. (irreg.)	Melbourne (BBC, followed by A.B.C. at 8:05 a.m.)	VLR2 VLH3	6.150 9.580
8:00 a.m.	Perth (BBC, followed by A.B.C. at 8:05 a.m.)	VLW7	9.520
8:00 a.m.	Brisbane (BBC, followed by A.B.C. at 8:05 a.m.)	VLQ2	7.215
8:00 a.m.	Colombo, Ceylon (BBC)	Radio SEAC	11.770 6.075
8:00 a.m.	Tokyo (AFRS)	JLR	6.015 4.880V
8:00 a.m.	London	GSN GRY GSV GSJ GSH	11.820 9.600 17.810 21.530 21.470
8:00 a.m.	London	GSK GRF GSO GSD GSI GVS GRA GSF	26.100 12.095 15.180 11.750 15.260 21.710 17.715 15.140
8:00 a.m.	Georgetown, Br. Guiana (BBC)	ZFY	6.000
8:00 a.m. (Mon., Wed., Fri.)	Makassar, Celebes	Radio Macassar	9.360V
8:00 a.m.	Akashvani, Mysore, India	VU7MC	6.065
8:00 a.m.	Montreal, Quebec	CFCX	6.005
8:00 a.m.	Toronto, Ontario	CFRX	6.070
8:00 a.m.	Halifax, Nova Scotia	CHNX	6.130
8:00 a.m.	Sydney, Nova Scotia	CJCX	6.010
8:30 a.m.	Leopoldville	OTC5 OTC2 (or	17.770 9.745V)
8:30 a.m. (irreg.)	Bucharest	Radio Bucharesti	9.252
8:30 a.m.	Melbourne (To Forces)	VLA8 VLG9	11.760 11.900
8:45 a.m.	Rangoon, Burma	Radio Rangoon	9.543
8:45 a.m.	London (European Service, At Dictation Speed)	GRI GWO GVU GVX	9.410 9.625 11.770 11.930
9:00 a.m.	Chungking	XGOY	6.143V 7.152
	Via Nanking	XGOA	9.730
	Via Canton	XTPA	11.650
	Via Shanghai	XORA	11.695V
	Via Kweiyang	XPSA	7.010
	Via Hankow	XLRA	6.054
	Via Tai-Pei, Formosa	XUPA	9.695 6.015I
9:00 a.m.	Melbourne (To East U.S., Canada, South Africa)	VLB VLC7	9.540 11.840
9:00 a.m.	Colombo, Ceylon	Radio Colombo	4.900
9:00 a.m.	Saigon, Fr. Indo-China	Radio Saigon	11.780 4.810
9:00 a.m. (irreg.)	Kuala Lumpur, Malaya (Relayed from Singapore)	Radio Kuala Lumpur	6.175
9:00 a.m.	Los Angeles (AFRS)	KNBI KNBA KNBX KCBR KGEX KWID	6.060 9.490 11.790 9.700 11.730 9.570
	Via Honolulu	KRHO	9.650
9:00 a.m.	Toronto, Ontario	CFRX	6.070
9:00 a.m. (Sun.)	Halifax, Nova Scotia	CHNX	6.130
9:00 a.m.	Singapore (BBC)	Radio Malaya	4.776
9:20 a.m.	Singapore	Radio Malaya	15.300 15.275 11.735V 6.770
9:30 a.m.	Chungking (Press Dispatches to America, At Dictation Speed)	XGOY	6.143V 7.152
9:30 a.m.	Melbourne (To Forces)	VLA8 VLC4 VLG9	11.760 15.320 11.900
9:30 a.m.	Delhi	AIR	15.160 9.670 9.590 7.210 11.870
	Bombay		3.360V
	Madras		4.920
10:00 a.m.	Los Angeles (AFRS)	KNBI KNBA KNBX KCBR KGEX KWID	6.060 9.490 11.790 9.700 11.730 9.570
	Via Honolulu	KRHO	9.650
10:00 a.m.	Vatican	HVJ	15.095
10:00 a.m.	Vatican	HVJ	9.660 5.970VI
10:00 a.m.	London (GOS, Radio Newsreel)	GRY GSF GSN GSJ GSP GSH GSV GSK GRF GSO GRQ GSD GVS GVP	9.600 15.140 11.820 21.530 15.310 21.470 17.810 26.100 12.095I 15.180I 18.025 11.750I 21.710 17.700
10:05 a.m.	Stockholm (To North America)	SBT SDB-2	15.155 10.780
10:10 a.m.	Rangoon, Burma (Headlines)	Radio Rangoon	9.543
10:15 a.m.	Melbourne (To Britain)	VLC4 VLG9 VLA8 VLB9	15.320 11.900 11.760 9.615
10:15 a.m.	Bandoeng, Java	PLP	11.000V
10:30 a.m.	Delhi	AIR	6.110 9.590 3.495 11.850 9.670 6.190 7.210 11.870
	Bombay		3.360V
	Madras		4.920
10:30 a.m.	New York	WCBN WCBX WCRC	15.270 17.830 21.570
	Schenectady	WGEO	15.330
	Boston	WRUL	15.290
	Cincinnati	WLWL	17.955
10:55 a.m.	Manila	KZPI	9.710
11:00 a.m.	Johannesburg, So. Africa (BBC)		6.007 9.912I
	Capetown (BBC)		5.877V
11:00 a.m.	Colombo, Ceylon (BBC)	Radio SEAC	11.770 6.075
		Radio Colombo	4.900
11:00 a.m.	Delhi (BBC)	AIR	6.110 9.590 3.495 11.850 9.670 6.190 7.210 11.870 7.290
	Bombay (BBC)		3.360V
	Madras (BBC)		4.920
11:00 a.m.	Georgetown, Br. Guiana (BBC)	ZFY	6.000
11:00 a.m.	Melbourne (To West U.S.)	VLG4 VLC6 VLA8	11.840 9.615 11.760
11:00 a.m.	Addis Ababa, Ethiopia (BBC)	Radio Addis Ababa	9.620V
11:00 a.m.	Nairobi, Kenya	VQ7LO	4.950
11:00 a.m.	Hamburg, Germany	BFN	6.060 7.290
11:00 a.m.	Chungking	XGOY	6.143V 7.152
11:00 a.m.	Moscow (To Britain)	Radio Centre	11.630I
11:00 a.m.	London (ES)	GRH GVY	9.825 11.955
11:00 a.m.	London (AS)	GVO GSI	18.080 15.260
11:00 a.m.	London (GOS)	GSN GSB GSP GSH GSV GRF GSO GSF GRQ GSD GVS GVP	11.820 9.510 15.310 21.470 17.810 12.095 15.180 15.140 18.025 11.750 21.710 17.700
11:15 a.m.	Bandoeng, Java	PLP	11.000V
11:30 a.m. (irreg. at 11:00 a.m.)	Accra, Gold Coast (BBC)	ZOY	7.300 4.915
11:30 a.m.	Georgetown,	ZFY	6.000

(*Continued on page 110*)

*Frequencies shown are in megacycles; to convert to meters, divide 300 by the frequency in megacycles, or 300,000 by the frequency in kilocycles; 1000 kcs. equal 1 megacycle.

NOTES: A. B. C.—Australian Broadcasting Commission (domestic network). AFN—Armed Forces Network. AFRS—Armed Forces Radio Service. AIR—All India Radio. AS—African Service. BBC—Relay from London. BFN—British Forces Network. ES—Eastern Service. FES—Far-Eastern Service. GOS—General Overseas Service. I—Frequency used irregularly. NAS—North American Service. PS—Pacific Service. RNE—Radio Nacional de Espana. RNF—Radio Nationale Francais. SABC—South African Broadcasting Corporation. SEAC—Southeast Asia Command. V—May vary in frequency from that noted.

International SHORT-WAVE



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

THIS month we are taking our ISW readers on a brief survey of radio in a picturesque, little country of Europe—Holland—the land of tulips, dykes, and windmills. We dedicate this issue of ISW to the pioneer short-wave broadcaster on the Continent—a voice long heard around the world—PCJ, *"The Happy Station of a Friendly Nation."* To the capable staff of *"The Happy Station"* we extend heartiest congratulations on this *twentieth* anniversary of PCJ, and to *Radio Nederland* goes our sincere best wishes for the future of this *"International World Program Station."*

The Story of PCJ

The history of PCJ actually dates back to 1926, when the first short-wave transmitter was constructed in the Philips Laboratories in Eindhoven, where many expensive experiments were conducted. Of these experiments, Eddie Startz, versatile announcer at the station, relates:

"The object was not record-breaking—in such case a less carefully designed transmitter would have been sufficient—but to find out whether a really reliable wireless transmission over very long distance was possible."

In order that readers may have a few details of the Philips experiments, we quote from a 1929 pamphlet about PCJ, as prepared by Mr. Startz:

"Since we proved that the radio-waves, under 100 meters, possess special advantageous features for radio transmission and make it possible to bridge the biggest distances with small power, radio has been revolutionized. The extraordinary feature of the short waves were soon utilized for telegraph communications; but short-wave radio telephony proved, until recent years, practically impossible.

"To telegraph from Holland to the Indies on the long waves (over a thousand meters) it proved necessary to use a power of some 300 kw. The long wave telephony transmitter of the Transatlantic Service (approx. 500 km.) also used a power of some hundreds of kilowatts.

"For wireless telephonic communications with the Dutch East Indies, on a very long wave, it would be impossible to construct a transmitter of sufficient power to bridge the 20,000 km.

"But the results obtained with short-wave telegraphy made one wonder if it were not possible to establish a telephony service over the same distance with short waves. Only experiments could prove if this were possible, and if so, to what extent.

"The Philips Laboratories at Eindhoven, with their innumerable resources, were certainly the best equipped to conduct such expensive experiments.

"Not only was thought given to a possible two-way connection in the near future with the Indies (which has come into existence in the meantime) but also of a possible worldwide broadcast service. The wavelength (31.28 meters, or a frequency of 9590 kcs.) was chosen with a view to obtaining good universal reception.

"Telephony transmissions on ultra short wavelengths are often unsuccessful, because of the inconsistency of the transmitted wavelength. With the usual modulating and receiving systems the speech currents delivered by the microphone are intended solely to vary the amplitude and not the frequency of the oscillations generated by the transmitter. Unfortunately, if no special precautions are taken, there will be 'frequency-modulation,' as it is called by the engineers, and this would cause a very bad distortion.

"In the Philips transmitter, call-sign PCJ, this difficulty has been overcome by the use of an oscillating quartz-crystal, which keeps the transmitting frequency constant between very close limits.

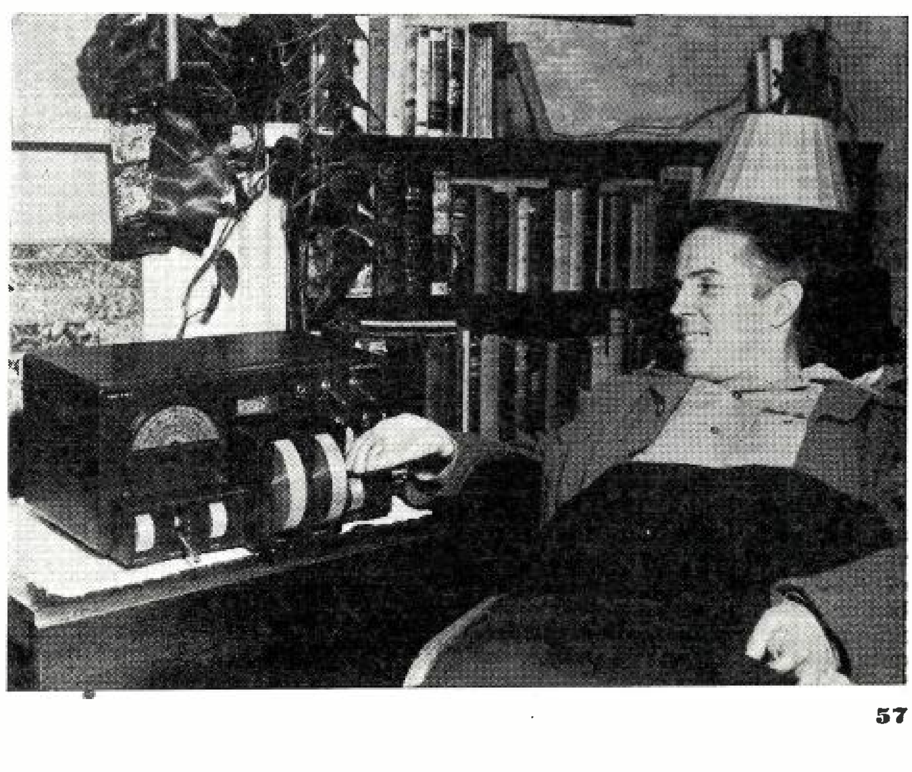
"Some crystals show the so-called piezoelectric effect, discovered by Madame Curie. If such a crystal is compressed, an electromotive force is generated on its surfaces; the reverse is true, too—if an e.m.f. is applied, the crystal contracts.

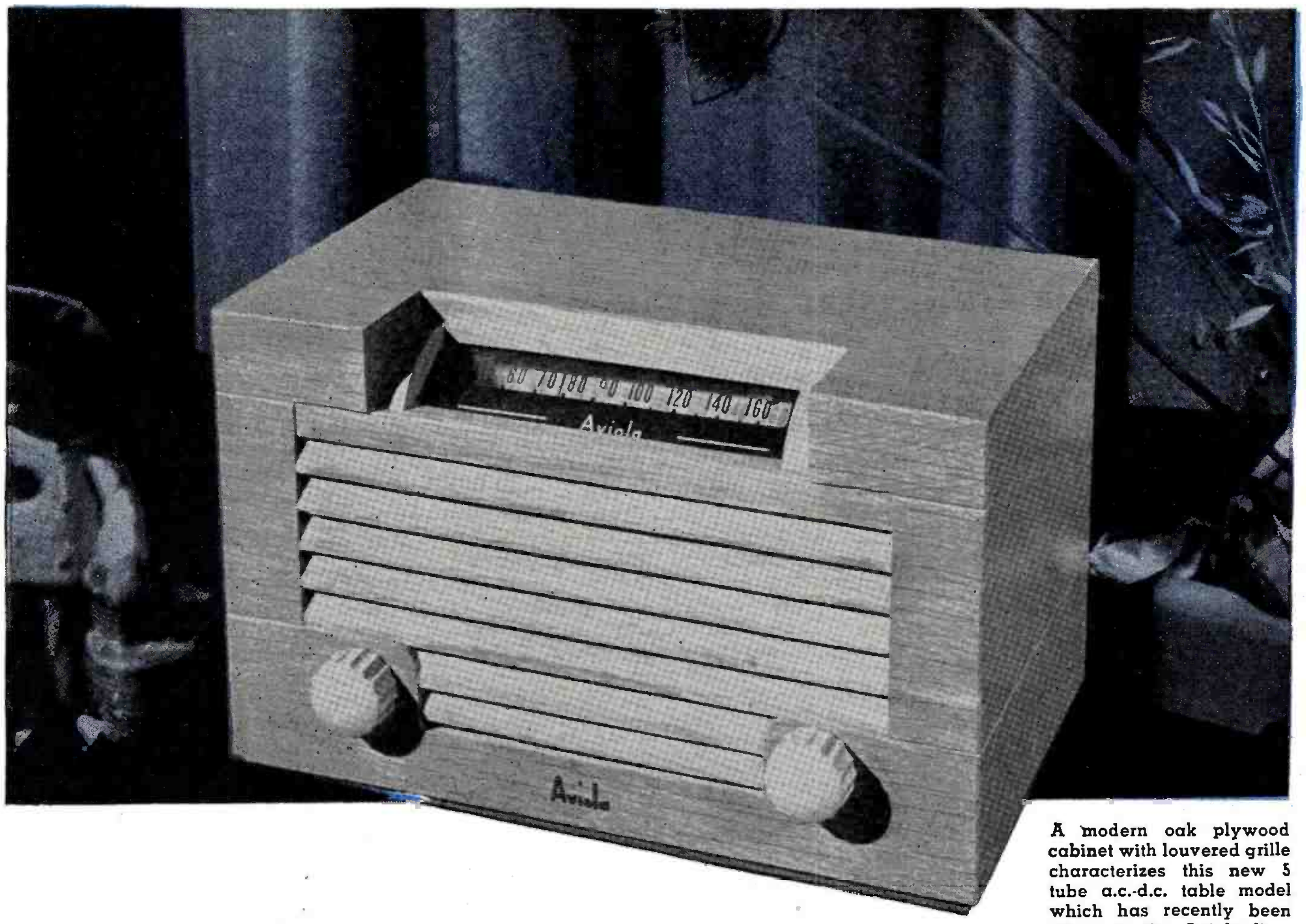
"In a crystal oscillator this property of a thin plate of quartz crystal, capable of oscillating mechanically at a very high frequency, is utilized to generate a current of very constant frequency.

"In the PCJ transmitter the crystal generated high frequency currents are amplified and multiplied several times

(Continued on page 94)

One of the newest devotees among short-wave listeners is David Van Wallace of Mount Clemens, Michigan. David, a former Notre Dame student, is completely paralyzed as the result of a broken neck suffered from a dive into the University pool. Unable to operate a conventional receiver, two former Notre Dame alumni, Raymond Durst and William Maher of Hallicrafters called upon the company engineers to design a special radio chassis with huge wheels and long levers replacing knobs and switches. The slightest brushing movement of Mr. Van Wallace's hand will manipulate the controls. Receiver was donated by The Hallicrafters Company.





A modern oak plywood cabinet with louvered grille characterizes this new 5 tube a.c.-d.c. table model which has recently been added to the Aviola line.

Practical RADIO COURSE

By
ALFRED A. GHIRARDI

Part 52. The i.f. amplifier in superheterodyne receivers; what it accomplishes, and operating characteristics that influence its design.

BEFORE proceeding to study the intermediate frequency (i.f.) amplifier it will be instructive to briefly review the basic operating principle of the superheterodyne receiver so that the important roles played by the i.f. amplifier will be clearly understood. The functional block diagram of a typical AM superheterodyne is illustrated in Fig. 1.

We have learned that the modern superheterodyne usually employs a tuned r.f. preselector stage into which all the signals received by the antenna are fed. The main function of its variable-tuned circuits is the rejection of certain interfering signals that may be present along with the desired signal—particularly those of *image* frequency, since neither the mixer nor the i.f. amplifier following it are capable of discriminating between such signals and the desired signal. Consequently, rejection of all interfering signals of image frequency must be accomplished *ahead* of the mixer. Preselector circuits that when tuned to the desired signal will reject all possible interfering image-frequency signals are employed for this purpose. The variable-tuned signal circuits in the preselector shown in Fig. 1 are assumed to be adjusted to pass mainly the *desired* signal, *B*, of the three incoming signals *A, B, C* appearing simultaneously in the antenna circuit.

Following the preselector is the "frequency-converting" or "translating" arrangement wherein any received signal (unmodulated c.w., audio modulated, or video modulated) transmitted by the preselector is "converted" or translated to a *similarly modulated* signal of new fixed carrier frequency. To perform this change in frequency (*frequency conversion*), an arrangement comprising an adjustable-frequency r.f. oscillator and a mixer is employed. Both units considered together comprise the *frequency converter*. The modulated input r.f. signal voltages and the unmodulated r.f. voltage (of suitable frequency) generated by the oscillator are both properly applied to the *mixer* portion of the frequency converter (see Fig. 1), so as to cause them to heterodyne within the mixer to produce a plate current having several "combination" frequencies. Among these are components of "sum" ($f_{osc.} + f_{sig.}$) and "difference" ($f_{osc.} - f_{sig.}$) frequencies—both of which are really carriers of new frequencies but which still carry the modulations of the input carrier.

Of these, the desired component *of the desired signal* (usually the component of *difference* frequency) is selected by the fixed-tuned plate load circuit and passed on to the highly efficient and selective fixed-frequency *intermediate amplifier* whose function it is to further attenuate all the other (undesired) output components and signals appearing in the output circuit of the frequency converter, and to greatly amplify the desired component of the desired signal (usually called the *i.f. signal*) to the required level

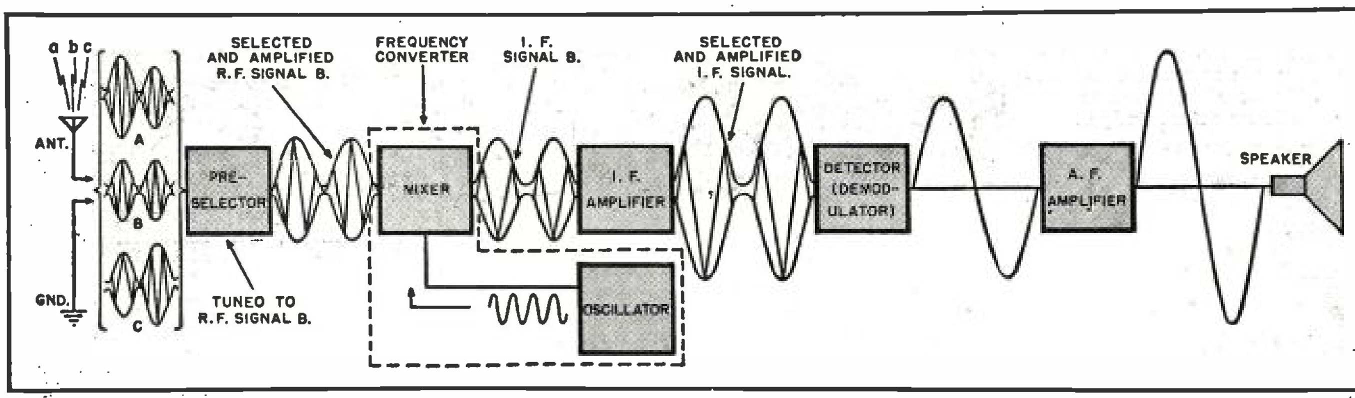


Fig. 1. Functional block diagram of a typical AM superheterodyne receiver showing the successive changes that the desired modulated incoming signal B undergoes as it progresses successively through the preselector, frequency converter, and i.f. amplifier of the receiver.

before it is applied to the detector or demodulator tube.

The I.F. Amplifier

From the foregoing it is clear that the intermediate-frequency amplifier can be defined as that portion of a superheterodyne receiver that lies (electrically) between the plate circuit of the frequency converter and the input of the detector or demodulator. It is essentially a highly efficient and selective fixed-tuned high-frequency amplifier which derives its input signal from the plate circuit of the frequency converter, since this is the point at which the i.f. currents first appear. Since the i.f. amplifier provides the principal gain and adjacent-channel selectivity of the superheterodyne receiver, its operation and design merit careful attention and they will be treated at some length in this and succeeding lessons of this series.

Advantages of Superheterodyne over T.R.F. Receiver System

The advantages of the superheterodyne receiver system over the straight t.r.f. receiver employing an equal number of high-frequency amplifier stages and tuning circuits are:

1. In a properly adjusted and aligned superhet receiver, it makes no difference what the carrier frequency of the desired signal being received is; the frequency converter always converts it to the single frequency for which the i.f. amplifier of the receiver is designed—the i.f.—and most of the amplification and selection is accomplished at this one frequency. Since the signals the i.f. amplifier is called upon to amplify are always of this one carrier frequency, *fixed-tuned* circuits (tuned to this predetermined i.f.) can be employed in it. This results in more nearly constant over-all receiver sensitivity and selectivity over the waveband since their efficiency does not depend on the particular frequency of the received signal as is the case in a t.r.f. receiver.

2. Higher possible gain per stage may be realized in the i.f. amplifier than in a t.r.f. amplifier, especially when the i.f. is a *lower* frequency than the signal frequency.[1]

3. Improved selectivity also results, especially when the i.f. is a *lower* frequency than the signal frequency, since a narrower response curve (higher selectivity) may be obtained than is possible at the signal frequency.[1]

4. Better control of over-all fidelity (as regards sideband cutting) is obtainable because it is more easily possible to control the shape of the over-all resonance curve of the fixed i.f. tuning circuits to a definite desired characteristic for all incoming signals. It is possible, by means of simple tuning adjustments, to shape this over-all

(*Continued on page* 147)

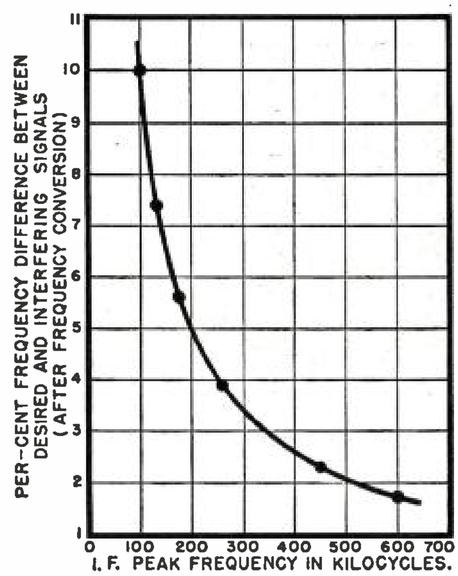
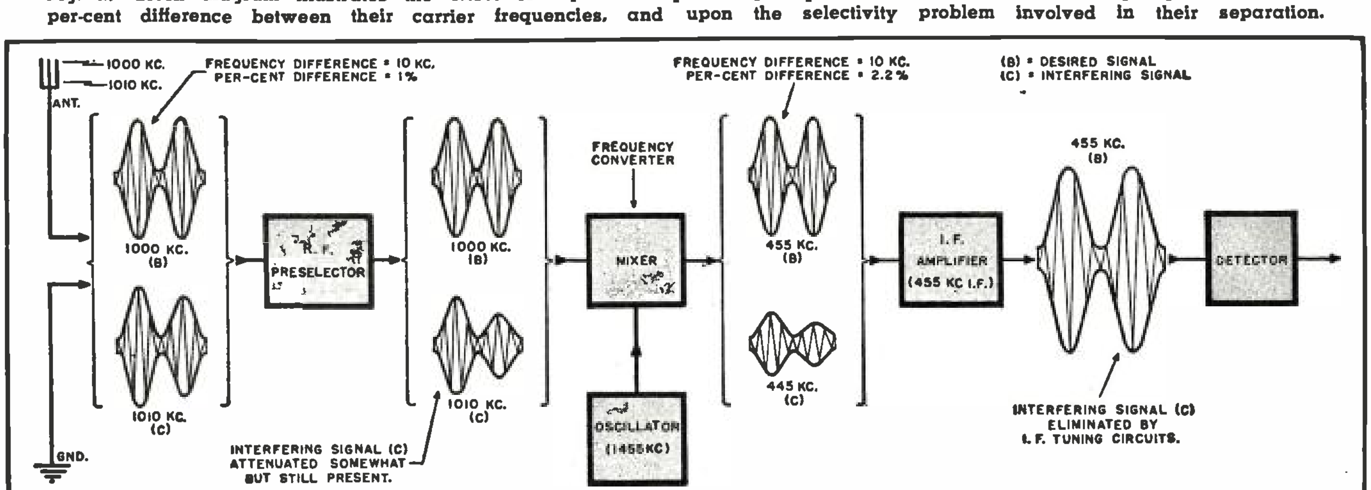


Fig. 3. Graph shows the effect of i.f. values employed in receiver upon the per-cent frequency difference between wanted and adjacent-channel interfering signals (after frequency conversion). The greater this frequency difference the greater will be the selectivity advantage of the i.f. amplifier.

[1] Even when the i.f. is a *higher* frequency than the signal frequency, improved gain and selectivity may be obtained owing to the greater possible efficiency that may be realized in fixed-tuned circuits of proper design as compared with a variable-tuned system.

Fig. 2. Block diagram illustrates the effect of superheterodyne frequency conversion of two interfering signals upon the per-cent difference between their carrier frequencies, and upon the selectivity problem involved in their separation.



↓ Start of disassembly operation. Here, chassis, speakers, record changers are removed from cabinets. Disassembly instructions are prepared from actual study of unit.

↑ Howard W. Sams, originator of PhotoFacts service.

↓ One section of Engineering Analysis Division. Here, each piece of equipment is subjected to an analysis, including replacement parts check, study of parts values and other important items.

↑ Initial preparation of radio receiver chassis includes general inspection of all components and all accessories used with the unit.

By
ROBERT M. ELLIS

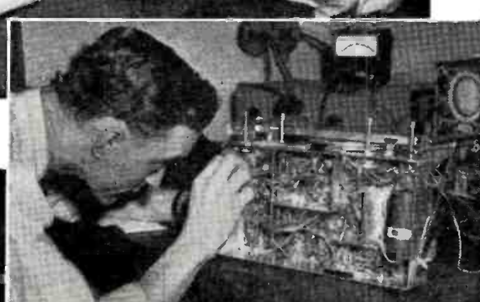
PROBABLY the weakest link in the radio industry for many years has been the absence of a pipe-line between the set manufacturer and the radio serviceman. Millions of dollars have been spent on promotion, advertising, and good will gestures, but only a few manufacturers have undertaken to supply the serviceman with data on his receivers that would offer more than mediocre help. Instead, too much time was spent analyzing the competitive market and the race was run to see who could produce a six-tube job for thirty-five cents less than the guy across the street.

At the end of the war Mr. and Mrs. Public were eager to buy the maze of new sets that had been promised to them. They had been told that the new models would be far better than those they had previously used in their homes. Unfortunately, in many cases, these were but idle rumors and thousands of receivers appeared in the radio servicemen's shops for major repairs after having been in service for but a few hours. Servicemen reported that they had found poor substitutes, "rats' nests" type of construction, innovations in circuit design, and trick tuning assemblies. A further contribution to the sale of aspirin were the many omissions and errors in original parts lists which accompanied the postwar receivers. In fact

↑ Here, original speaker equipment is studied for the purpose of recommending accurate replacement. This is typical of the parts replacement analysis. Replacement recommendations are made only after checking against the actual physical and electrical characteristics of the original component.

↓ Specially constructed copper test booths are used when analyzing and otherwise checking the r.f. and i.f. coils. Findings are cross checked against those given by manuafcturer.

↑ Here, a schematic diagram is being corrected to conform with the actual circuit as it exists in the processed receiver. This particular service precludes errors which may have occurred between the drafting rooms and production lines at the factory.



←This job requires the services of expert personnel. These engineers are shown measuring the stage gain and overall performance of various receivers under analysis.

↑ A tough assignment and one requiring a great amount of patience is the tracing of unknown circuits and the preparation of schematic drawings. The average serviceman could be stumped on this job.

PACKAGED RADIO SERVICE

It takes many specially trained experts and considerable equipment to prepare complete and accurate service data on complicated radio and television sets. Here is how it is done by one alert organization.

many of these sets came through without a schematic.

To solve this dilemma and to make the radio serviceman the really important figure he should be in the industry, *Howard W. Sams & Co., Inc.,* was founded on April 1, 1946. Their objective was to furnish complete pictorial, schematic, and photographic data on all postwar sets and to supply these to the radio repairman in the form of *"PhotoFact Folders."*

To tackle such a tremendous project required highly detailed planning and coordination. It was necessary to build up a staff of experts, each specializing in certain parts of the sets depending upon his particular qualifications and background. From a small beginning, the staff now includes approximately forty-five employees.

The "machinery" needed to compile and publish a single *"Folder"* presents an interesting study in organization and technique. The process of analyzing the set, called the "disassembly process" by the staff, is conducted by a group of qualified men, each specially trained for his job.

Each major group of components is classified—the responsibility being assumed by one man. For example; the capacitor specialist examines all the fixed capacitors in each piece of equipment assigned to him. He lists them all in the order of their use and prepares a separate specification sheet for each capacitor. One of each of these sheets is forwarded to each of the cooperating component parts manufacturers, together with recommendations for proper replacements. Later he checks these for electrical and mechanical specifications and, if practical and workable, he then lists the item as a correct replacement for the capacitor used in the original set.

The same technique is used in analyzing replacements for fixed resistors, volume controls and tone controls. Speakers are measured both electrically and mechanically and the cooperating speaker manufacturers are asked to recommend suitable replacements on the basis of these specifications submitted to them by the speaker specialist. When the replacement speaker is received, it is checked against the original speaker in the set. Power transformers, audio transformers, and chokes are the responsibility of still another analyst. Proper replacements for these are selected by the same process as mentioned.

Of great importance is the measurement and analysis of r.f. and i.f. coils found in the maze of receivers coming into the organization for test. Great care is exercised to see that no errors creep in.

As far as the processing of the receiver itself is concerned, a complete voltage and resistance analysis of the set is made and recorded. Important details, usually overlooked by manufacturers, such as dial-cord stringing, are sketched and marked for future reference and are later incorporated in the finished *"Folder."* This one operation alone has saved countless dollars in valuable time to thousands of servicemen. It is a well known fact that only one out of four possible stringing contortions is correct.

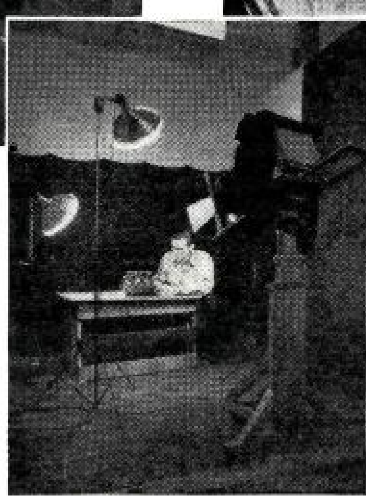
The final step in the analysis consists of an over-all performance check including a study of stage gain and alignment. The manufacturer's schematic diagrams and parts lists (if available) accompany each receiver as it goes through the hands of the various analysts. As a matter of fact, only about 7 out of every 10 receivers are furnished with a parts list. This means, at best, that the servicemen

(*Continued on page* 144)

↑ View of drafting department. Diagrams, retouching and final art work for folders are prepared here under the guidance of Analysis Division experts.

↑ Draftsman coding pictorial diagrams and schematics with identifying parts numbers to provide uniform, easy reference to accompanying service data.

↓ A specialist checks parts functions of a record changer. From the data compiled, "exploded-view" pictorials and repair and adjustment data will be prepared.



Photographing the chassis. A special technique is used so that all parts are readily identifiable in the pictorial diagrams. →

Have you ever spent → a few hours trying to restring the dial cord on a set? The drawing being prepared shows the one and only correct way to do it.

The Farm Market for RADIO and APPLIANCES

By C. R. ELDER

Extension Editor, Iowa State College of Agriculture

Don't overlook the ever-growing farm market as a profitable source of increased income for you.

EVERY time a rural farm home is connected to an electric highline, radio and appliance stores can ring up approximately $700 in their cash registers—in terms of potential business.

That's what a recent survey of some 10,000 Iowa farm users of electricity indicate they spend for electrical equipment and appliances.

This survey, conducted by the Iowa Rural Electric Cooperative Association, in cooperation with the Iowa State College, further indicates that farmers now enjoying electricity intend to buy $260 worth of appliances in addition to those they are now using.

Put these two sources of potential business together and it would appear that the rural market is destined to become the most fertile field in the radio and appliance business.

Electricity on farms is still in its infancy. In Iowa, for example, less than one farm in seven had highline service 10 years ago. Today more than half of the farms have been electrified. Of the 107,000 farms which had power line service in 1940, 56% were serviced by cooperatives under the Rural Electrification Administration. Of the farms now being electrified, 5 are being added to REA lines and one to lines of private utility companies.

During the war years farm income was about twice the average income for the 10-year period from 1934 to 1943. Even if prices decline somewhat, farmers should be in a relatively strong position to maintain high purchasing power during the next few years. Much of the accumulated capital of farm families has been definitely earmarked for farm and home improvements. Many of these improvements, such as installation of running water, modern kitchens, farm ventilation and heating systems, require electric service for their most successful operation. This means that the demand for rural electrification should increase along with the average consumption per farm.

It is anybody's guess as to what extent electricity will eventually be used on farms. The kwh. consumption has been on the constant increase and there is no indication that the peak has been reached.

During the first year that cooperatives operated in Iowa the average consumption was 52 kwh. per month. In the seventh year of operation this average had jumped to 109 kwh.

It must be remembered, too, that many of the farms included in the seventh year of operation (1943) had been connected to the highline for a relatively short time—and at a period when equipment and appliances were practically nonexistent because of war time shortages.

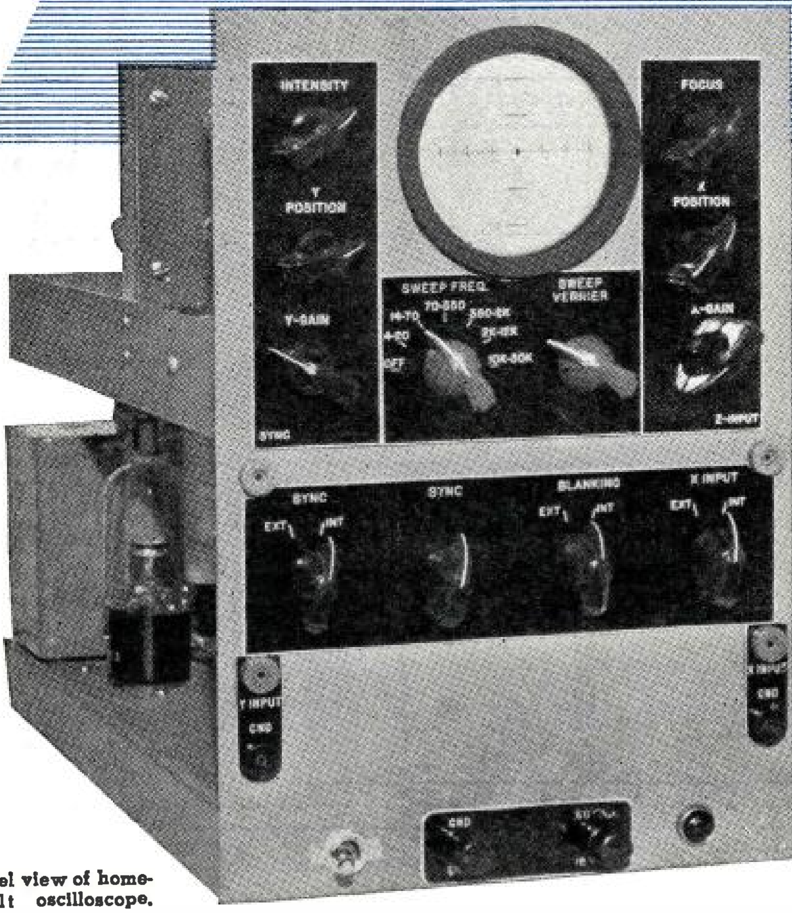
(*Continued on page* 116)

Tabulation of electrical equipment now being used, or to be purchased, as indicated by a survey made among 10,000 users of electricity on Iowa farms.

Home Equipment	Percentage Using Equipment	Percentage That Intend to Buy	Farm Equipment	Percentage Using Equipment	Percentage That Intend to Buy
Radio	95.9	13.9	Separator	52.5	13.3
Washing Machine	94.4	11.0	Barn Lights	60.6	4.5
Iron	87.6	11.1	Poultry House Lights	49.9	12.9
Refrigerator	67.6	29.5	Chick Brooder	39.1	15.8
Toaster	58.3	11.9	Farm Water Pump	29.4	13.3
Vacuum Cleaner	42.4	23.6	Hog House Lights	28.8	11.2
Fans	31.7	14.4	Poultry Water Heater	15.0	13.1
Home Water Pump	26.4	17.7	Milking Machine	12.2	8.2
Clock	26.2	12.3	Electric Fence	14.0	5.7
Waffle Iron	21.4	11.5	Elevator	4.8	8.1
Heating Pad	14.0	8.5	Pig Brooder	6.0	4.6
Range	10.3	16.5	Stock Tank	2.4	7.6
Water Heater	5.5	14.1	Feed Grinder	3.3	6.1
Sewing Machine	6.5	11.1	Fanning Mill	6.2	1.5
Coffee Maker	10.2	7.3	Corn Sheller	3.4	3.3
Freezer Storage Case	.5	6.7	Dairy Water Heater	.9	1.4

3" OSCILLOSCOPE

By
J. CARLISLE HOADLEY



Panel view of home-built oscilloscope.

Complete details for the home construction of a cathode-ray oscilloscope, along with important practical information on the use of this unit.

THE most useful and versatile instrument to be found anywhere for use in a service shop, research lab., or on an experimentor's bench is the cathode-ray oscilloscope. Here in one instrument we have a peak reading voltmeter which does not load a circuit appreciably, an accurate method of comparing or determining frequency, the only method of properly and rapidly aligning wide band AM, FM and television receivers, a method of measuring modulation percentage, and the only means of observing the actual gyrations of alternating current waveforms and the study of transient waveforms. For a large part of electronic work it is indispensable and in the service shop its use is going to become more important and more necessary as FM and television receivers begin to come to the shop for repair.

The best way to fully understand the oscilloscope and realize its capabilities is to build and use one. We, therefore, present a 3" oscilloscope which will be adequate for most jobs. The design is flexible enough to allow additions to qualify it for special uses.

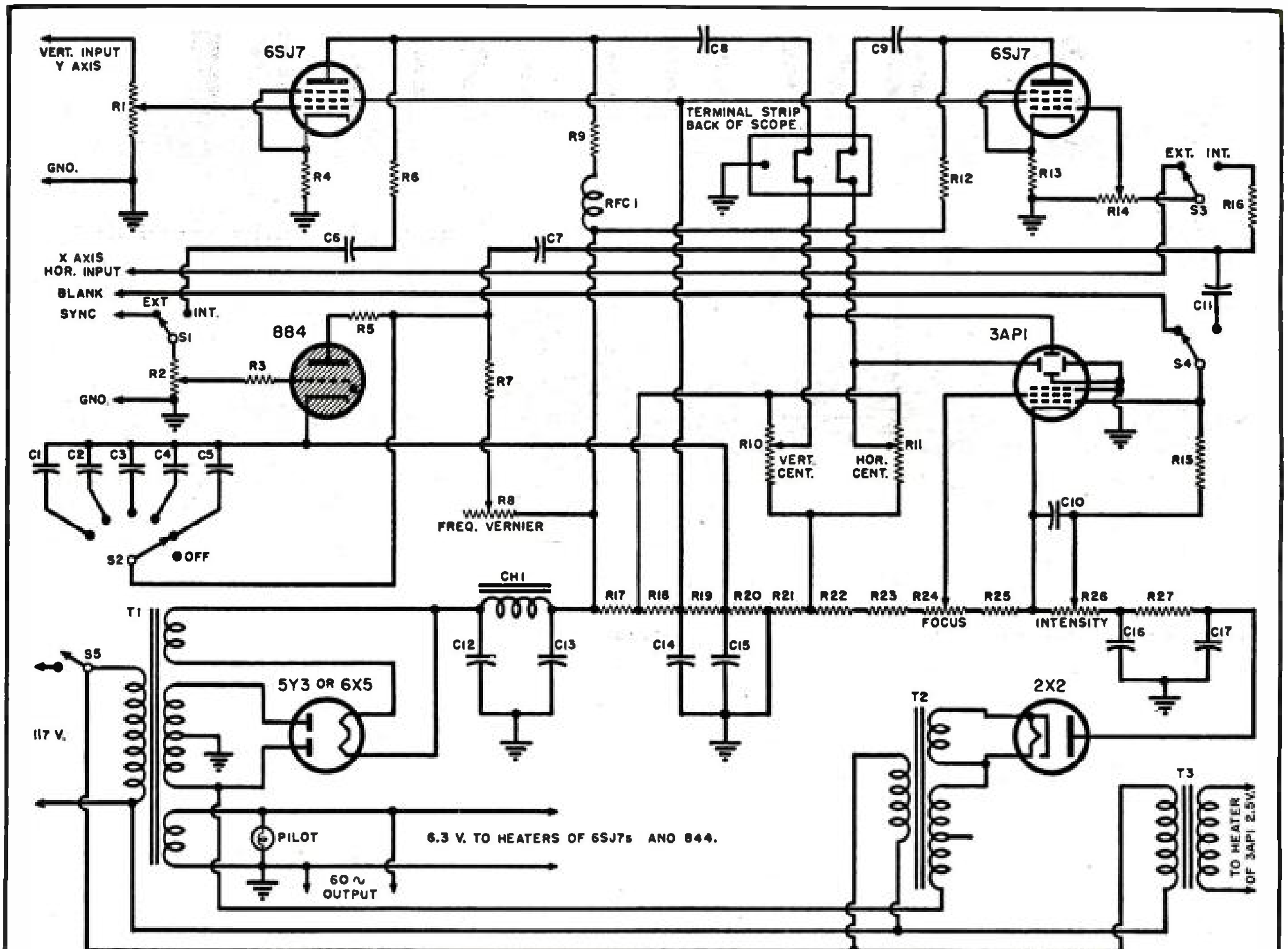
An oscilloscope consists, primarily, of a cathode-ray tube, a sweep circuit, amplifiers, two power supplies and necessary associated controls.

The cathode-ray tube consists of a cathode located at the base end of a long vacuum tube. There are, then, a succession of grids and anodes, four deflecting plates and a fluorescent screen, located at the other end of the tube. Fig. 2 shows the relative arrangement. The electron beam is focused and directed at the center of the fluorescent screen by means of the proper potentials being placed on the tube's elements. The first, or intensity, grid has applied to it a voltage negative in respect to the cathode which may be varied by a potentiometer. This pot is on the front panel and is the intensity control. It effects a change in intensity by varying the amount of electrons flowing from the cathode which are allowed to hit the screen. A positive potential which is also controlled from the front panel is placed on the focusing electrode. The deflecting plates effect electrostatic deflection of the electron beam by the application of external voltages.

As the electron beam may be taken as negative, if a positive potential is put on a deflection plate, the beam will be attracted toward that plate, provided the other plate is grounded. Conversely, if a negative potential is placed on the same plate, the beam will be repelled. As the plates are arranged in pairs at right angles to each other, the beam may be deflected either horizontally or vertically, according to the choice of plates; or, if voltages are applied to the vertical and horizontal plates simultaneously, the deflection will be in both directions at once. Therefore, the spot may be moved, by manipulation of the voltages on the plates, to any point on the face of the tube. If these voltages are d.c. and applied to the tube directly, then the spot will assume a new position, as determined by the magnitude of the voltage.

We have, therefore, what is in effect an electrostatic voltmeter. All that need be done is to put a known voltage on, say, the vertical deflection plates, and observe how many volts it requires to deflect the spot one inch. When we place an unknown voltage on the tube we merely measure the deflection of the spot. Knowing the sensitivity of the tube in volts-per-inch, we accurately determine the unknown voltage. This is a very sensitive method as it draws an almost immeasurable current from the source. One can measure even the voltage across a small charged condenser.

If we place an a.c. voltage of known frequency on one set of plates and an unknown frequency to the other set, we can determine not only the peak-to-peak value of either a.c. voltage, but we can also find the frequency difference between the two a.c. voltages if it is not too great, i.e., 10-1 or less. We will note a pattern on the screen, the shape of which is dependent upon the frequency relation be-



R_1, R_{14}, R_{26}—500,000 ohm pot.
R_2—25,000 ohm pot.
R_3—51,000 ohm, ½ w. res.
R_4—680 ohm, ½ w. res.
R_5—120 ohm, ½ w. res.
R_6—300,000 ohm, ½ w. res.
R_7—200,000 ohm, ½ w. res.
R_8—2 megohm rheostat
R_9, R_{17}—39,000 ohm, ½ w. res.
R_{10}, R_{11}—2 megohm pot.
R_{12}—91,000 ohm, ½ w. res.
R_{13}—820 ohm, ½ w. res.
R_{15}—500,000 ohm, ½ w. res.
R_{16}—62,000 ohm, ½ w. res.
R_{18}—10,000 ohm, ½ w. res.
R_{19}—24,000 ohm, ½ w. res.
R_{20}—1500 ohm, ½ w. res.
R_{21}, R_{25}—1.5 megohm, ½ w. res.
R_{22}, R_{23}—2 megohm, ½ w. res.
R_{24}—1 megohm pot.
R_{27}—100,000 ohm, ½ w. res.
C_1—.002 µfd., 400 v. cond.
C_2—.02 µfd., 400 v. cond.
C_3, C_6, C_{10}—.1 µfd., 400 v. cond.
C_4—.5 µfd., 400 v. cond.
C_5—1 µfd., 400 v. cond.
C_7, C_8, C_9—.25 µfd., 400 v. cond.
C_{11}—100 µµfd. mica cond.
C_{12}, C_{13}—40 µfd., 450 v. elec. cond.
C_{14}—8 µfd., 450 v. elec. cond.
C_{15}—50 µfd., 50 v. elec. cond.
C_{16}, C_{17}—.5 µfd., 1000 v. cond.
CH_1—15 hy., 50 ma. filter choke
RFC_1—25 mh. r.f. choke
T_1—Power trans. 300-0-300 v. @ 30 ma.; 5 v. @ 2 amps.; 6.3 v. @ 2 amps.
T_2—Power trans. 500 v. total @ 30 ma., 2.5 v. @ 2 amp.
T_3—Fil. trans. 2.5 v. @ 3 amps.
S_1, S_3, S_4—S.p.d.t. toggle sw.
S_2—S.p. 6 pos. rotary sw.
S_5—S.p.s.t. toggle sw.
2—6SJ7 tubes
1—884 tube
1—3AP1 tube
1—2X2 tube
1—5Y3 or 6X5 tube

Fig. 1. Schematic diagram of 3" oscilloscope. The frequency range of the sweep oscillator is 6 c.p.s. to 30 kc. Should a 6X5 rectifier be substituted for the 5Y3, it will not be necessary for the power transformer to have a 5 v. winding.

tween the a.c. voltages. If they are the same, we will get an ellipse; if one is twice the other, we get a figure 8. Note that this figure has two loops. As the frequency difference increases the number of loops denotes the factor by which one frequency is greater than the other. This is very useful in calibrating test equipment and works as well at radio frequencies as it does at audio frequencies.

If we wish to examine an alternating current voltage, either sinusoidal or otherwise, it is necessary to place on one set of deflection plates, usually the horizontal ones, an alternating voltage, linear in time and variable in frequency to constitute a time base or sweep. This merely starts the fluorescent spot from the left hand side of the tube and moves it to the right hand side at a constant speed. How many times per second it is moved is variable by means of a panel control. If we apply an alternating voltage to the other set of deflection plates (the vertical ones), the spot will trace out an a.c. wave in its true proportions in respect to time. The horizontal plates are usually referred to as the *X axis* plates and the vertical plates as the *Y axis*. The picture drawn with the above described sweep will appear in the same relation as the assumed *X* and *Y* axis on a mathematical graph.

An important part of an oscilloscope is the sweep circuit. This is the little electronic hand which writes the waveform shapes on the face of the cathode-ray tube. The circuit is shown in Fig. 3.

The heart of the circuit is the tube, in this case an 884. This tube is a gas filled triode. The addition of this gas has the result of changing the characteristics of the triode. For instance, with 5 volts bias on its grid it is cut off and no current flows. As the plate potential is applied, condenser *C* charges up. As it has to charge through resistor *R*, it takes a certain time to reach any given voltage. When it does charge to a certain critical voltage, the gas in the 884 tube ionizes and the tube conducts. Unlike a high vacuum tube, increasing the grid voltage will have no effect on the tube after it has once started conducting. The only way to turn it off is to remove the plate voltage.

Fortunately, this is exactly what happens. The instant the tube conducts, its resistance becomes very low and it rapidly discharges condenser *C*. When the voltage on condenser *C* falls below the critical value, the tube stops conducting. Condenser *C* then starts to charge again to repeat the cycle. Changing the value of R changes the speed at which C can be charged. The resultant waveform is shown in Fig. 4. Therefore, the frequency of the resultant saw-tooth waveform can be changed.

The value of C also has an effect on the frequency. The higher the capacity, the longer it takes to charge it through a given resistor. Therefore, by switching capacitors and providing a variable resistance in series, a wide frequency range may be covered. In the oscilloscope described, the frequency range is 6 c.p.s. to 30,000 c.p.s.

This oscillator is, however, rather unstable, which is undesirable as this would cause the inspected waveform to dance back and forth; but this very instability is put to work. A bit of the signal is injected into the grid of the sweep oscillator tube. The tube will lock in with the fundamental or a multiple of the inspected waveform frequency. This causes the picture to stand still on the face of the tube. The amount of synchronizing voltage is varied by a potentiometer in the grid of the sweep oscillator tube. It is well to note here that too much sync should never be used, as it will distort the waveform under observation.

We could use the entire voltage rise of the condenser as it charges up but for the fact that it is not linear, but tends to charge rapidly at first and then more slowly, actually in the form of an exponential curve. This would not give a time base which was linear with time and would, consequently, distort the waveform under observation. We, therefore, use only the initial fast charging part which is reasonably linear and we amplify this small saw-tooth to the proper size to more than sweep the width of our 3″ tube.

This amplifier tube has in its grid a volume control so that we can vary the amplitude of this sweep voltage and spread out or crowd together groups of waveforms to gain different perspectives on the observation thereof. This control is necessary when we wish to use an external sweep voltage. The amplifier must have a flat frequency response from six to, at least, thirty thousand cycles-per-second so that it will amplify the sweep without distortion. Actually, its response should be several times wider, as the frequency components involved at the discharge time may be as high as 500 kc. or more.

As we increase the frequency of our sweep oscillator, the rise of the saw-tooth becomes shorter and shorter but the fall remains relatively constant. There comes a time, therefore, when they are nearly equal. The forward trace on the tube, then, is no brighter than the back trace. The back trace becomes annoying, as it confuses the waveform that we are inspecting—it may be removed by a blanking voltage.

Simply stated, this voltage reduces the intensity of the cathode-ray tube to zero during the back cycle. A portion of the sweep voltage is fed into the intensity grid of the C-R tube through a small condenser. The positive rise of the sweep only makes the intensity grid more positive and increases the brilliance slightly at the beginning of the sweep. The fall of the saw-tooth, however, is negative and this negative voltage drives the intensity grid negative, shutting off the electron beam and blanking the tube during the flyback time. The coupling condenser must be large enough to couple the flyback voltage but small enough not to pass the saw-tooth rise frequency.

This blanking voltage may be removed at will by means of a switch. The intensity grid is brought out to a binding post so that external blanking or a calibrating voltage may be injected.

If a sine wave of a known frequency is introduced, the tube will be blanked on every other half cycle. This will be apparent by the sweep taking the form of a series of dashes as in Fig. 6. Knowing the frequency of the sine wave, we can determine the frequency of a waveform which we have placed on the vertical deflecting plates. This input to the scope constitutes the *Z axis* input. If the builder desires, a Z axis amplifier may be included, together with an amplitude control. This amplifier may be the same as the Y axis amplifier (Fig. 1) and the values copied. Fig. 7 shows how this would be arranged.

All the waveforms we wish to investigate must be of sufficient amplitude to deflect the electron beam an inch or so. The deflecting plates have a sensitivity of from 40 to 50 volts per inch of deflection, so an amplitude of less than 10 volts is not easy to study, due to its small size.

We must, therefore, provide a Y axis amplifier, the response of which will be determined by the use to which we intend to put the oscilloscope. If we are interested in audio frequencies only, say from 20 to 50,000 cycles-per-second, the amplifier, Fig. 1, will suffice. It will still have some gain at 1 megacycle, although it would be better to feed a frequency this high directly to the deflection plates.

If you are interested in radio frequencies in the order of a megacycle

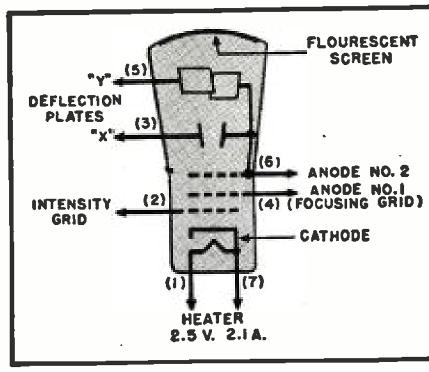


Fig. 2. Illustrating the relative positions of the various elements which make up the 3AP1 cathode-ray oscilloscope tube.

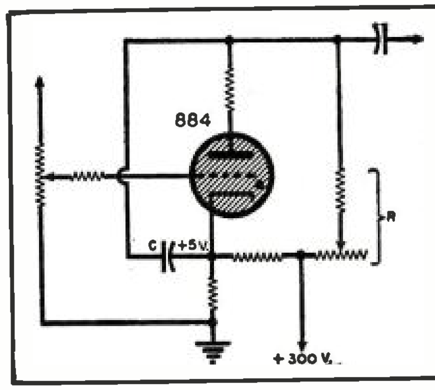
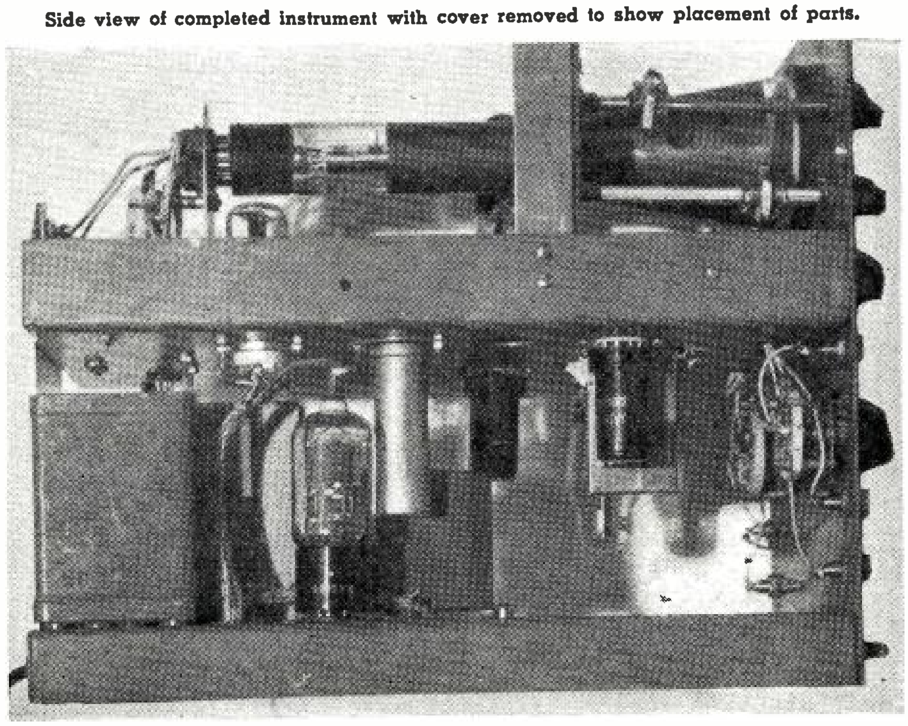
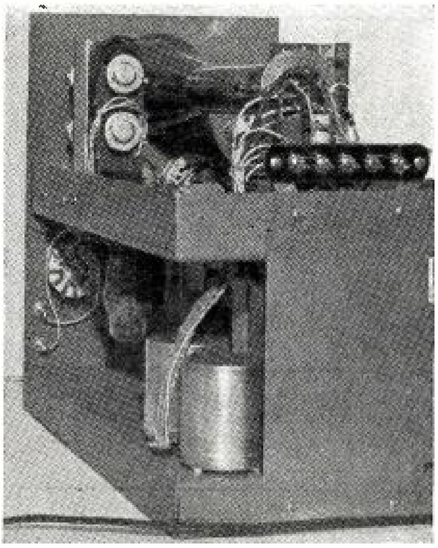


Fig. 3. Diagram of scope sweep circuit.

Side view of completed instrument with cover removed to show placement of parts.





Rear view of completed oscilloscope.

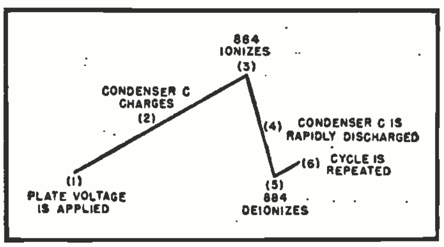


Fig. 4. Wave shape of sweep circuit.

and of an amplitude of five volts or less, then a more extensive *Y* axis amplifier will be necessary. If the proper display of square waves of high recurrence rate is desirable the response should be flat to at least a megacycle.

The conventional methods of controlling amplitude are unusable at megacycle frequencies because of the input capacity of the tube, combined with the series resistance introduced when the amplitude control is in intermediate position. A much superior system consists of a cathode follower and a frequency compensated attenuator. A potentiometer in the cathode circuit of the cathode follower provides continuous variable output. Fig. 5 shows the circuit. The amplifier which follows the cathode follower must fall in the video amplifier class, being flat from 20 c.p.s. to a megacycle or more.

This means not only careful design but extreme care in construction, as wiring capacity can have a profound effect on response. As a matter of fact, a carelessly wired video amplifier may only go to 500 kc., whereas, a properly wired one will go to over two megacycles!

Every wire in the grid or plate circuit must be kept above the chassis to avoid additional capacity. The output capacity is high enough as it is, as it consists of the output capacity of the tube, the capacity of the deflection plates of the cathode-ray tube, plus the wiring capacity. The effect of this total capacity can be reduced by lowering the load resistor in the amplifier tube's plate circuit. This lowers the circuit impedance.

We may also resort to inductive peaking to increase the response. Simply stated, we pick an inductance which resonates with the total capacity at a frequency above which the response has fallen off substantially. The effect of the inductance is to increase the load impedance gradually at the frequency at which the response starts to fall off, until its resonant frequency is reached. Beyond this point we are on the capacitive side of the resonance of the combination coil and capacitance and the response will fall off rapidly. The formula for computing this inductance is $L = KR^2C$. L is the inductance in henries, R is the resistance in megohms, C is the capacity in microfarads and K is an assumed constant, usually between .42 and 0.5.

Of course, to properly use this formula you must know the total capacity in the plate circuit. All these capacities can be found in tube manuals but the circuit capacity must either be measured or assumed. To lower the effect of this capacity we have lowered the plate resistance in the tube's plate. This also lowers the tube's gain, so we will probably need another stage. This puts quite an additional drain on the power supply, not to mention additional filtering and bypassing, so its necessity must be weighed by the individual constructor.

The power supply for our scope must include two d.c. voltages. First, a well filtered 300 volt supply to run the amplifier and the sweep circuit—a 60 milliampere transformer will suffice; second, a supply for the purpose of providing proper accelerating voltages for the cathode-ray tube. This latter supply has an output of about 1000 volts at 2 milliamperes. *This is a dangerously high potential and should be handled with due caution.*

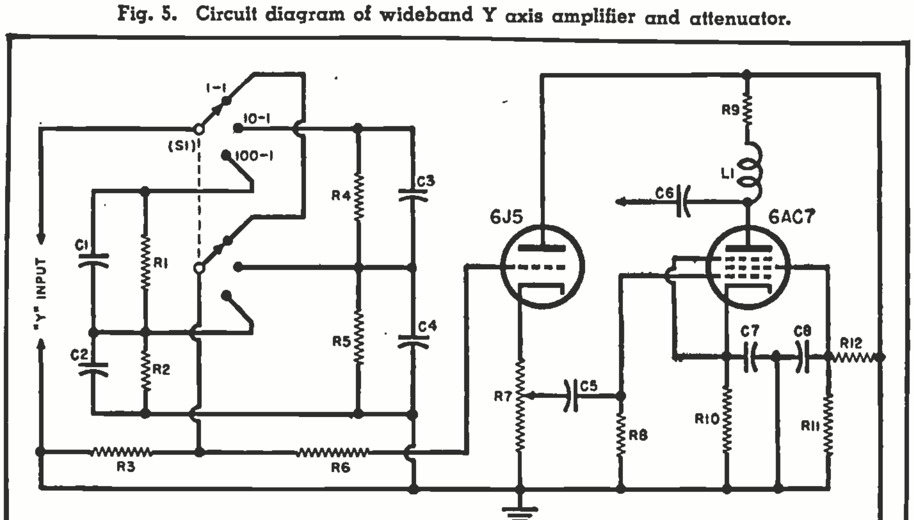
The wiring in the high voltage circuit should be done with well insulated wire. The focus and intensity pots must not be mounted directly to metal but mounted on a piece of bakelite which can then be supported on the chassis. The photographs show this item of construction.

A separate 2.5 volt winding must be provided for the 3AP1 tube, as the cathode is connected to the filament within the tube and the cathode is 1000 volts above ground. A 2.5 volt winding must be provided, also, for the high voltage rectifier, the 2X2. In addition we must provide a filament winding for the low voltage rectifier and a filament winding of 6.3 volts for the amplifier and sweep tube. This is quite an array of windings, but the *Allen B. DuMont Laboratories* (Passaic, N. J.) can supply all these windings on one transformer for about ten dollars. If you desire, two receiver power transformers plus an extra 2.5 volt filament transformer can be used. The filament transformer supplying the 2X2 tube must be insulated for at least 1500 volts, and preferably 2000 volts. This is also true of the winding supplying the 3AP1 and the transformer which supplies the high voltage.

Centering voltage is obtained by applying equal amounts of positive voltage from the low voltage supply and a negative voltage from the high voltage supply across the centering pots so that the trace may be shifted up or down and to either side.

The way that the chassis is arranged was carefully planned. The upper chassis was made from 1/16" soft iron. This provides good magnetic shielding from the power transformers. This is necessary as the 3AP1 is very sensitive to magnetic deflection from an external magnetic field.

Fig. 5. Circuit diagram of wideband Y axis amplifier and attenuator.



R_1, R_3, R_4, R_8—2 megohm, ½ w. res.
R_2—20,000 ohm, ½ w. res.
R_5—200,000 ohm, ½ w. res.
R_6—100 ohm, ½ w. res.
R_7—1000 ohm, w.w. pot.
R_{10}—200 ohm, ½ w. res.
R_{11}—5000 ohm, ½ w. res.
R_{12}—10,000 ohm, ½ w. res.
C_1, C_3—3-12 μμfd. mica cond.
C_2—.001 μfd., 400 v. cond.
C_4—70 μμfd. mica cond.
C_5—.25 μfd., 200 v. cond.
C_6—.1 μfd., 400 v. cond.
C_7—10 μfd., 50 v. elec. cond.
C_8—10 μfd., 350 v. elec. cond.
S_1—S.p.3 pos. rotary sw.
Values for L_1 and R_9 will depend upon bandwidth desired and wiring capacity. For a 2 mc. bandwidth, L_1 and R_9 are approximately 100 μh. and 5000 ohms respectively.

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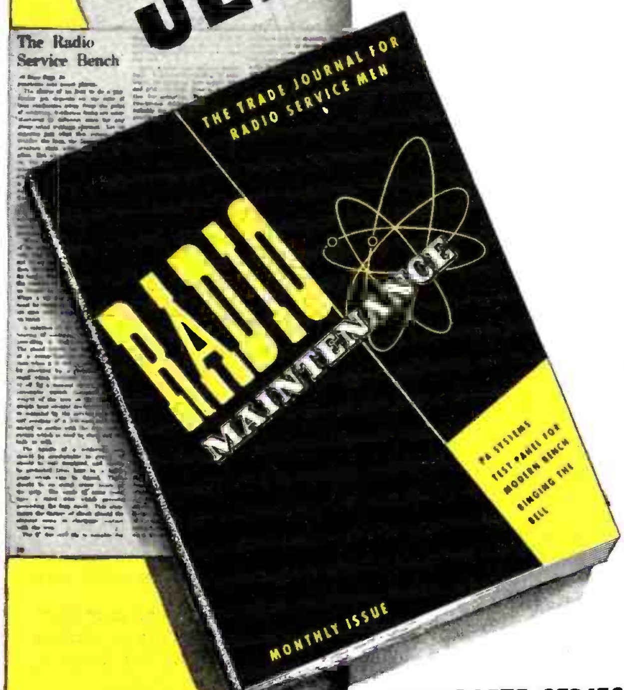

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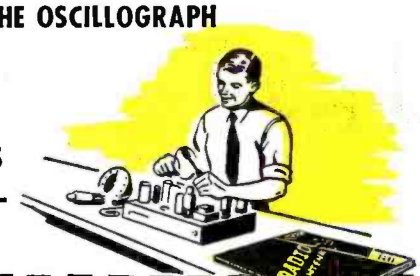

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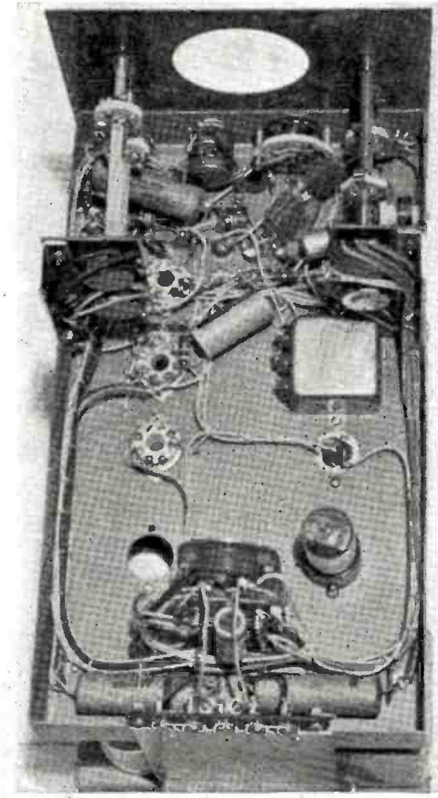
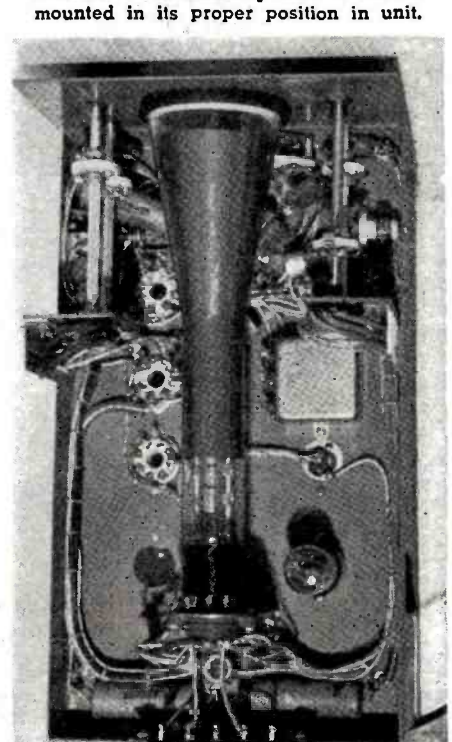
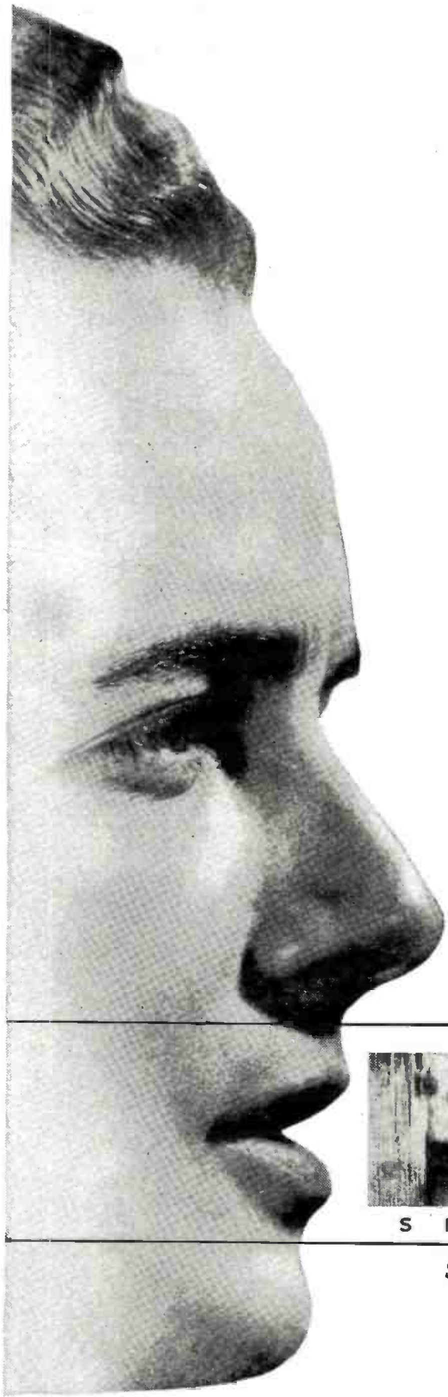


Top view of oscilloscope. The case and cathode-ray tube have been removed to show relative position of parts. Note in particular that the top chassis has been mounted in an inverted position.

Furthermore, the method of mounting the tubes upside down on the upper chassis provides very good shielding from the power supply wiring and also effects short leads from the tubes to the panel controls and from the tubes to the deflecting plates of the cathode-ray tube. Standard commercial chas-

Same view as above with the exception that the 3" cathode-ray tube is shown mounted in its proper position in unit.



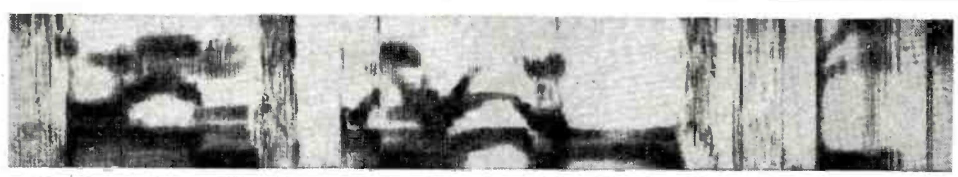


Writing with your voice

Years ago Alexander Graham Bell dreamed of "a machine that should render visible to the eyes of the deaf, the vibrations of the air that affect our ears as sound." He never realized that dream, but his researches led to the invention of the telephone.

Today Bell Telephone Laboratories have turned the dream into a fact — translating the spoken word into readable pictures.

By this new invention of the Laboratories, the talker speaks into a microphone. Vibrations of the voice are unraveled through electronic circuits, and then are reassembled as luminous patterns which travel across a screen. Each syllable of sound has a distinctive shape and intensity.



Science unravels speech

Visible speech is still in its infancy, and is not yet available to the public. But educators of the deaf are now evaluating it. Indications are that the deaf can learn to read the patterns and, by comparing the patterns their own voices make with the patterns of correct speech, can improve their diction.

Patterns of visible speech also provide a means for analyzing and recording sound in the study of phonetics and of languages. Eventually, visible speech may make possible visual telephony for the deaf.

This is but one of many contributions by Bell Telephone Laboratories to the understanding and control of sound.

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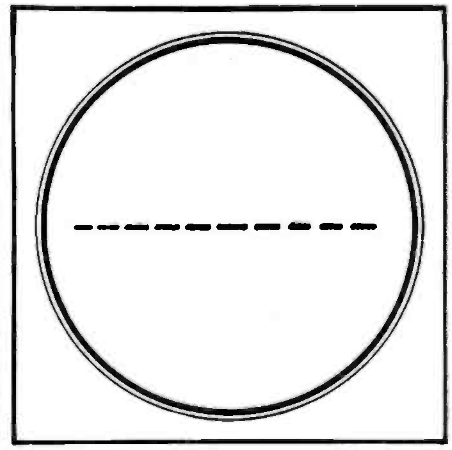


Fig. 6. Horizontal sweep with calibrating wave applied to intensity grid. This wave may be applied direct to intensity grid, or through Z axis amplifier. See Fig. 7.

sis and panel may generally be used.

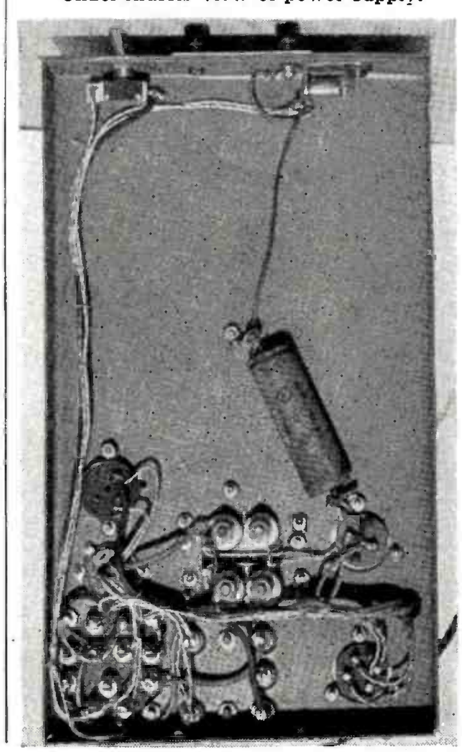
This model used two chassis 8" x 14" x 2", although these dimensions can be changed somewhat without disturbing the operation appreciably. The panel should be of iron or steel. The panel on the back provides access directly to the deflection plates when the jumpers are removed. This facilitates d.c. voltage measurements and introduction of high voltage, high amplitude waveforms directly to the deflection plates. The inputs are made to tip jacks, although the constructor can use binding posts if he so desires.

The front panel in the present model has engraved control labels. The proper lettering can be done with black or white ink directly on the panel and then given coats of clear lacquer to preserve it.

The photographs show clearly the manner of construction and the lay-

(*Continued on page* 163)

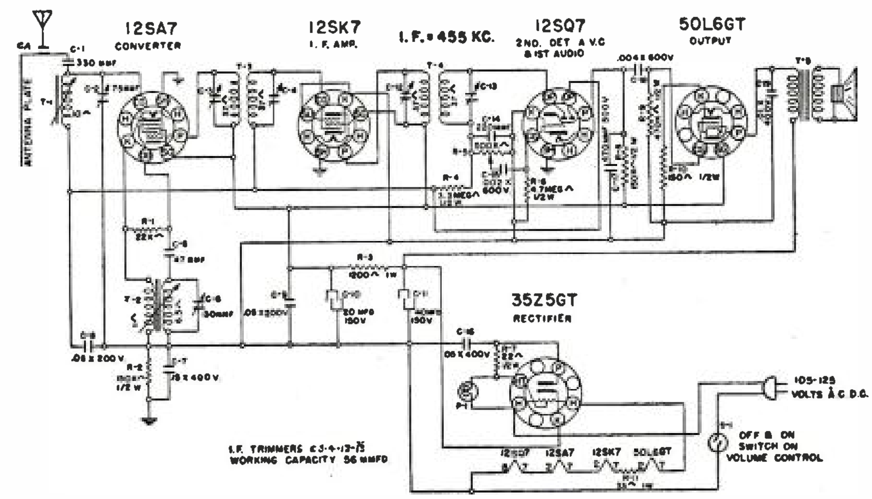
Under-chassis view of power supply.



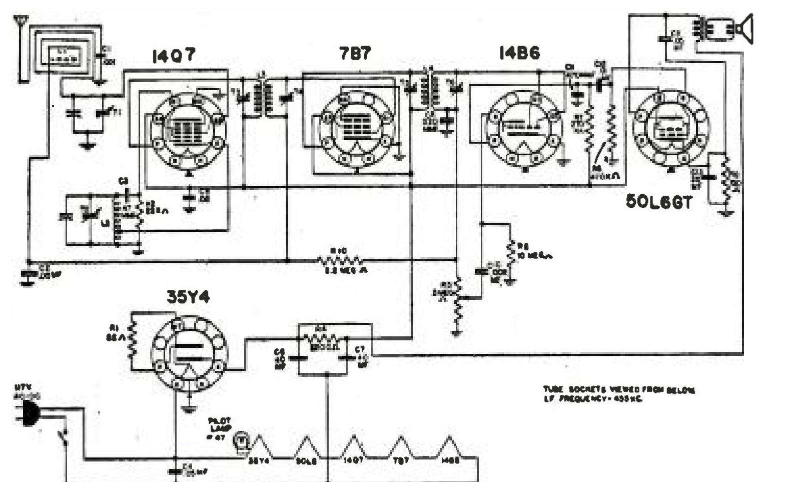
CIRCUIT PAGE

(FOR PARTS LISTS SEE PAGE 86)

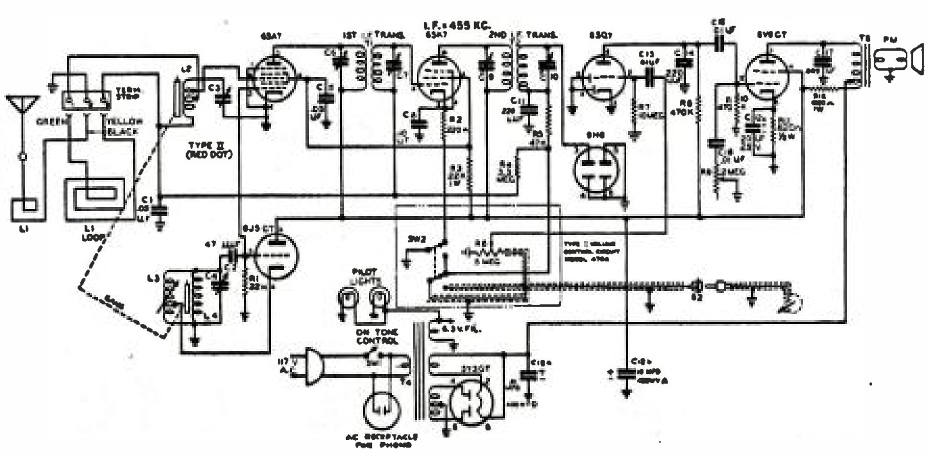
RADIO NEWS, MARCH, 1947 **GRANTLINE MODELS 500, 501**



RADIO NEWS, MARCH, 1947 **AIR KING MODEL 4608A**

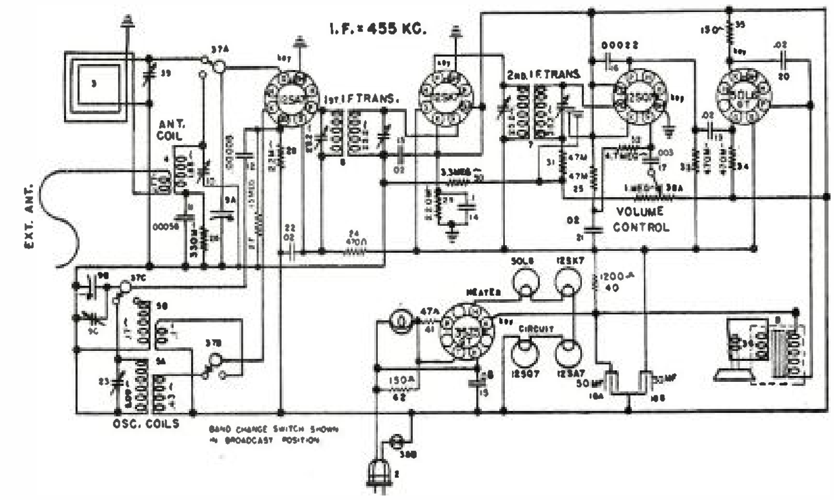


RADIO NEWS, MARCH, 1947 **MAJESTIC MODELS 7C432, 7C447**

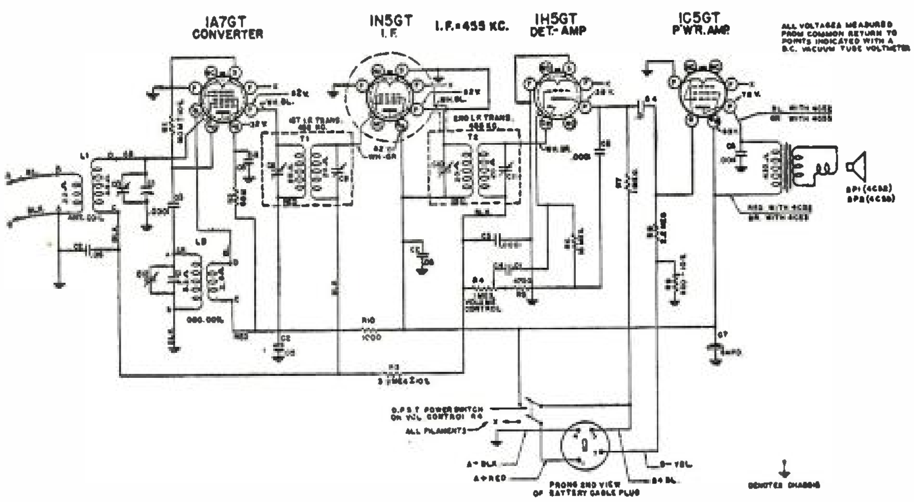


Here, and on following pages, are circuit diagrams and parts lists of many new postwar radio receivers. Radio News will bring to you other circuits as quickly as possible after we receive them from manufacturers.

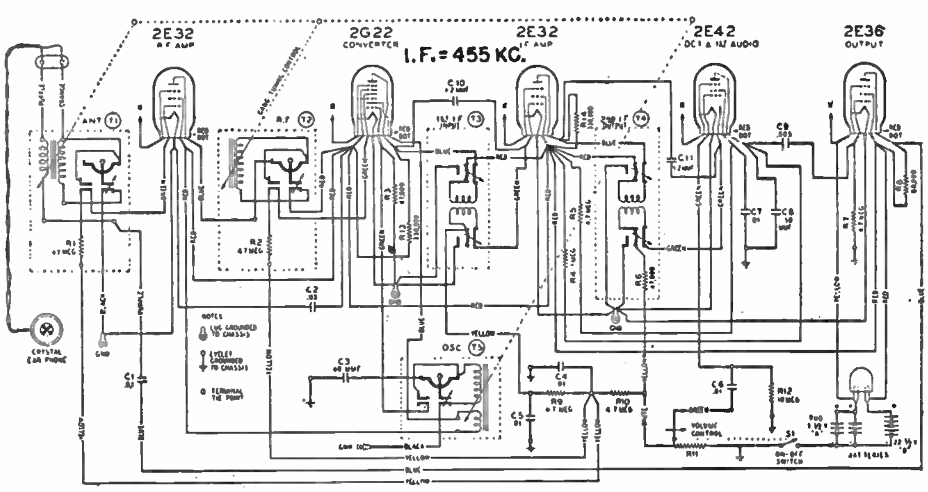
RADIO NEWS, MARCH, 1947 — **CROSLEY MODELS 56XTA, 56XTW**



RADIO NEWS, MARCH, 1947 — **ZENITH MODELS 4K016, 4K035**



RADIO NEWS, MARCH, 1947 — **BELMONT BOULEVARD**



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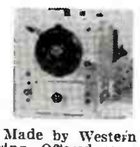

These Army surplus aircraft receivers may be operated from a 24 volt AC filament supply and any low power 250 volt B supply; or the tubes changed to the 6 volt type. There is plenty of room for a power transformer and rectifier tube; in place of the dynamotor. This receiver is very selective and sensitive; has RF stage and BFO. Made by Western Electric and you never saw finer wiring. Offered complete with tubes; 12K8, 3-12SK7, 12SR7 and 12A6, but less 28 volt dynamotor. Specify the frequency you desire. We have about 1500 available.

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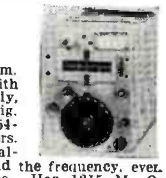

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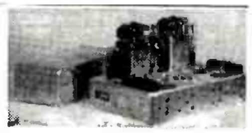

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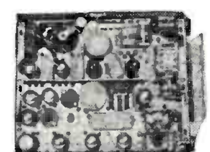

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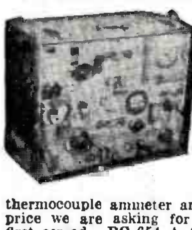

BC-654-A. Transmitter-Receiver 12 watts CW. 8 watts phone. 3800 to 5800 KC $19.95. Used but in apparently good order. Offered with 3-307A tubes but less receiver tubes. The 7 tube superhet receiver has 2 RF stages. Designed for 1½ volt octal tubes. Could be converted to heater tubes. Has built in 200 KC crystal calibrator. The 200 KC crystal and 0-3 RF thermocouple ammeter and 3-307A tubes are worth the price we are asking for the whole unit. First come first served. BC-654-A transmitter-receiver less power supply ....Net **$19.95**

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.001	MFD.	1500V	.29	.0001	MFD.	5000V	.49
.002	MFD.	1500V	.29	.0005	MFD.	5000V	.49
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4	MFD.	600V	.79	3	MFD.	4000V	4.95

These are all new stock of best makes, such as G. E. and CD. Our prices are about ¼ of regular net.

SMALL OUTPUTS

Clamp on Type as Used in Original Equipment.

2,000 ohm for 50L6. $0.59	10,000 ohm $0.59
7,000 ohm .... .59	25,000 ohm Push Pull .69

25,000 ohm especially good for battery sets.

Double 40 Watt Fluorescent Ballast made by General Transformer **$3.98**

McGEE'S RED HOT SPECIALS

JAN OR REGULAR BRAND TUBES CARTONED OR UNCARTONED

SPECIAL at .49			SPECIAL at .69		
39/44	42	6D6	1J6	6F6	1V
76	41	6C6	1D5	6Y6	75
37	27	1S5	1H4	12SF7	77
5Y4G	26	1T4	30	12SQ7	24
5Y3GT	6H6	3S4	5Z3	46	78
6C8G	6AC7	1L4	6SA7GT	38	12SA7
6F8G	6SH7	3A4	6SK7GT	6SJ7	12SK7
1633	56	1R5	6SQ7GT	6G6	12SQ7
1634	6B4G		5U4	6C5	12SR7
12SN7	80		5T4	12Z3	12A6
6SN7	6K7		6K6		
6SD7	12J5				

VERY SPECIAL JAN 6L6M .... **.99**

SCOOP IN RADIO TUBES
6 & 12 VOLT LOCTAL TUBES

7A4	7B7	7B5	7J7	7E6	7Y4	**79c** EACH
7A6	7C7	7B6	7R7	7E7	7Z4	
7C5	7Q7	7C6	7V7	7A7	7H7	
14Q7	14C5	14B6	35Y4			**79c** EACH
14A7	14J7	14B8				
14H7	14R7					

1½ VOLT LOCTAL TUBES

1LD5 1LB4
1LH4 1LN5 **99c** EACH
1LA4

1LA6 1LC6 **$1.49** EACH

Regular net on these tubes is $1.81. These tubes are all Sylvania.

Save 30 to 70% on Vibrators
WAR SURPLUS AND REGULAR CARTONED

Midget 4 prong, for Ford sets........................ $1.49
Delco off set 4 prong 6 volt........................ 1.79
Mallory 5 prong sync. 6 volt........................ 1.95
Oak stan. 6 prong sync. 6 volt........................ 1.95
Utah SP-55, off set 5 prong sync. 6v........................ 2.59
Utah SP-62 reversible 6 prong sync........................ 2.59
Sync. unit only, long leads 6 volt........................ 1.69
Utah SL-5 sync. unit with buffers........................ 2.59
Midget Radiart 6 prong sync........................ 1.49
32 volt standard 4 prong........................ 1.49
General Elec. 7 prong 2 volt sync........................ 1.95
Heavy duty 6 prong sync. for 30 watt 6 volt amplifiers. Special 2.95

SENSATIONAL 4-PRONG VIB. SCOOP

Genuine UTAH NP-42 4 prong 6 volt vibrator. This is the reg. type and size, just like you use every day. Fits Philco and many others. Very special. Net **$1.29**

Mallory Sync. Vibrator Unit Save 75%

Standard size replacement, 6 volt sync., vibrator unit; long leads. Ideal for all types of replacements. Easily fits in any can. Net........................ **$0.99**

McGEE SPECIAL TUBULAR ELECTROLYTIC CONDENSERS

8 MFD 450 V PAPER TUBULAR.......... $0.29
16 MFD 450 V PAPER TUBULAR.......... .39
8-8 MFD 450 V PAPER TUBULAR.......... .49
16 MFD 150 V PAPER TUBULAR.......... .29
40 MFD 150 V PAPER TUBULAR.......... .39
20-20 MFD 150 V PAPER TUBULAR.......... .39
40-30 MFD 150 V PAPER TUBULAR.......... .49
100 MFD 25 V PAPER TUBULAR.......... .24

These are first class electrolytics. Guaranteed 1 year.

McGEE SPECIAL PAPER TUBULARS
600 V TUBULAR

.001 .... $0.07	.02 .... $0.07
.006 .... .07	.05 .... .08
.01 .... .07	.1 .... .09

ASSORTMENT OF 100; TAKE OFF 1c EACH

FINEST QUALITY TUBULAR ELECTROLYTICS IN ALUMINUM CANS. WITH PAPER INS. SLEEVES.

8 Mfd. 450 volt midget tubular........................ $0.39
8x8 Mfd. 450 volt midget tubular........................ .69
16 Mfd. 450 volt midget tubular........................ .64
20x20 Mfd. 150 volt tubular........................ .59
40x20 Mfd. 150 volt tubular........................ .69
50x30 Mfd. 150 volt tubular........................ .79

We guarantee these condensers for 1 year and are as fine as any produced. Money back guarantee.

40 MIL STANCOR POWER TRANSFORMER
Flush mounting 6.3. 5 volts. Special........ **$1.98**

12" G. E. SPEAKER
7 oz. Alnico 5. Beats anything you ever heard.
List $16.50........................Net **$9.50**

10" G. E. SPEAKER
7 oz. Alnico 5.
List $13.50........................Net **$7.50**

SCOOP ON ALNICO—5 PM SPEAKERS

4" 1 oz. $1.49
5" 1 oz. 1.59
5" 1½ oz. 1.69
6" 1½ oz. square........................ 1.95
6½" 1½ oz. round........................ 1.95
8" 8 oz. Alnico 3 .... 2.95

SPECIALS ON BATTERIES

PORTABLE BATTERIES

GENERAL V30B
GENERAL V30A
GENERAL V30AA

SPECIAL **79c** EACH

General 60DL-11L AB Pack. Very Special $3.95

These batteries were made in June and July of '46. Are perfect. Have sold over $10,000 worth. Remember, farm packs weigh 25 lbs. each.

SPECIAL 500,000 ohm volume control with switch and 2½" shaft **$0.59**

SMALL SLIDE RULE DIAL
All assembled. Ready to mount on top of 5" speaker. Special **$0.39**
Small Universal Output Trans.............. .99
Medium Universal Output Trans.............. 1.29
Large Universal Output Trans.............. 1.49

WRITE FOR BARGAIN FLYER

When ordering, Canadian and American possession customers send full remittance and ample postage.

McGEE RADIO COMPANY •

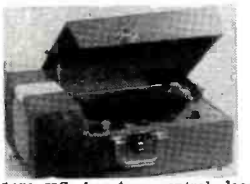
Send 20% Deposit — Bal. Sent C.O.D.
1225 McGEE ST., KANSAS CITY, MISSOURI

McGEE OFFERS YOU THE BEST VALUES IN RADIO AND PHONO-KITS

EVERY KIT COMPLETE • FACTORY ENGINEERED • SIMPLIFIED DIAGRAMS

During the past 15 years, we have designed and sold thousands of complete radio kits. We know that it takes matched parts and correctly designed circuits to please you. We are now going a step further, by offering you, not only schematics, but parts layout sheets. Photographs of the top and bottom of a completed radio kit. This assures you of correct and rapid assembly. All chassis are punched and designed to fit their respective cabinets. All parts, resistors and tubes are furnished, nothing else to buy. Order with confidence.

RADIO-PHONO COMB. KIT



Build this beautiful portable combination radio phonograph. We furnish everything. Beautiful two tone portable case, latest rim drive phono motor. Astatic crystal pick-up. All parts to build high quality 5 tube AC-DC radio. Tunes broadcast 550 to 1650 KC, has tone control, loop antenna, 6" Alnico 5 PM speaker. Tubes 12SA7, 12SK7, 12SQ7, 50L6 and 35Z5. Simple diagram furnished. Kit Model RP-12........................Your Cost **$29.95**

WALNUT CABINET RECORD PLAYER

Beautifully made, highly polished walnut cabinet with hinged lid. Plays 10" records with lid closed. Latest rim drive phono motor and high output. Astatic crystal pick-up. High power JT-5, push-pull 3 tube AC-DC phono amplifier (wired and tested). Heavy duty 5" Alnico 5 PM Speaker. Single record player kit Model WL-3........................Your Cost **$19.95**

SMALL RADIO-PHONO KIT

After carefully designing the record player and cabinet shown above (Model WL-3), we decided that it should also be offered as a radio-phono combination. The cabinet is both attractive and small (12x12x8). The radio kit part of this unit is similar, except for the dial, to our Kit Model KP-48 shown in column 3 of this page. We furnish all parts, tubes, phono motor, pick-up, etc. Easy to follow diagram. Kit Model WL-3R. Net....................**$29.95**

New 8 tube P. A.—Radio Kit PRK-8

Build this High-Fi Radio-Amplifier

- **Standard Broadcast Superhet 550 to 1650 KC**
- **New Positive Drive Permeability Tuner**
- **12" Dynamic Speaker**
- **Push-Pull 6V6 Output Stage 15 Watts**
- **456 KC I. F.'s**
- **Dual Tone Controls (Bass and Treble)**
- **Phono and Crystal Mike Inputs**
- **A Fine Power Amplifier and Radio Kit**
- **All Parts and Simple Easy-to-Follow Diagram Furnished**

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 mike. And on the same chassis, a standard superhet radio receiver. We furnish all parts, knobs, escutcheon plate and tubes: 6SA7, 6SK7, 6SR7, 6SN7, 6SJ7, 2-6V6, and 5Y3. No Cabinet. An actual photo of top and bottom of completed chassis makes wiring and assembly very easy.
Model PRK-8. Your Net....................**$24.95**
Crystal Mike and Stand $7.95 extra

20 WATT UTILITY AMPLIFIER KIT

Build this 20 watt utility 110 volt AC, 20 Watt power amplifier. Ready punched aluminum 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, controls, transformers and easy-to-follow diagram furnished, including tubes: 2-6SN7, 6J5, 2-6L6GA, 5Z3.
Kit Model 20-LX. Net....................**$17.95**
12" G. E. 12 watt Alnico 5 PM speaker, $9.50 extra.
Astatic crystal mike and desk stand, $7.95 extra.

3-WAY PORTABLE KIT

Build this powerful, 5-tube, 3-way portable kit. Operates on 110 volt AC or DC, or self contained batteries. Receives broadcast 550 to 1650 KC. Incorporates a standard superhet circuit with A.V.C. and loop. Has 5" Alnico 5 PM speaker, 2 gang condenser. All parts, batteries and diagram furnished, including tubes: 117Z6, 1R5, 1T4, 1S5 and 3S4. This kit was engineered too late to show a picture of the attractive portable walnut cabinet, which is approx. 7 x 9 x 4½ inches. A real kit. Remember, we furnish everything.
Kit Model 3-ZA. Your Net....................**$17.95**

PHONO-MOTORS—PICKUPS—CART

RIM DRIVE PHONO MOTOR 9" TURNTABLE.
SPECIAL **$3.95**

LATEST GENERAL INDUSTRIES DUAL SPEED TURNTABLE. MODEL D. YOUR NET..$15.90

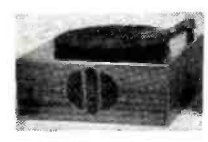
NEW SHURE GLIDER PICK-UP; NO NEEDLE NOISE. REGULAR $3.50 VALUE.
SPECIAL AT **$2.29**

NEW CURVED ARM ASTATIC AS USED ON MOST 1946 equipment. Reg. $3.50 value.
SPECIAL **$2.29**

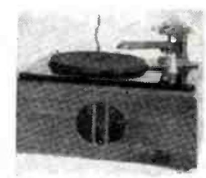
LATEST IN PHONO-KITS

High Power Push-Pull Amps

You can save money by assembling your own record players. All the kits listed below are complete; nothing else to buy. In 15 or 20 minutes any of these kits will be ready to sell to your customers.
*The model JT-5 high power push-pull 3 tube AC-DC amplifier is furnished with all record player kits complete; wired and tested and furnished with tubes and speaker. The push-pull circuit assures good base response even at low volume. For servicing convenience and connecting to pick-up, a schematic diagram is furnished.



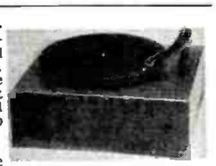
KIT J-15 SINGLE RECORD PLAYER. Attractive ready cut walnut finished cabinet with latest 78 RPM phono motor and light weight crystal pick-up and *JT-5 push-pull AC-DC amplifier and 4" alnico 5 PM speaker. This player will surprise you in appearance and performance.
Kit J-15 Dealers..............Net **$15.95** complete



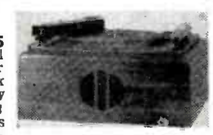
KIT J-16 AUTOMATIC RECORD PLAYER. Beautiful walnut finished, made to fit cabinet; latest single post automatic record changer and *JT-5 high power push-pull AC-DC amplifier (wired and tested) and heavy duty 5" alnico 5 PM speaker. This kit makes a deluxe home record player.
Kit J-16 Dealers..............Net **$29.95** complete
KIT J-16A. Same as J-16 except with leatherette base instead of walnut. Dealers....Net **$26.95** complete

KIT J-17 PORTABLE SINGLE RECORD PLAYER. Attractive tan leatherette covered portable case with latest 78 RPM rim drive phono motor and light weight crystal pick-up and push-pull AC-DC amplifier *JT-5 (wired and tested) and 5" heavy duty alnico 5 PM speaker. A red hot special.
Kit J-17 Dealers........
..Net **$19.95** complete

KIT J-18 PORTABLE AUTOMATIC RECORD PLAYER. Beautiful portable leatherette case and latest single post automatic record changer and *JT-5 3 tube AC-DC push-pull amplifier (wired and tested) and heavy duty 6" alnico 5 PM speaker. We have sold hundreds of these to our dealers and they keep coming back for more. A real value. Kit J-18 Dealers......Net **$33.95** complete



KIT J-19 SINGLE RECORD ATTACHMENT. Attractive walnut finished base with motor cut out, latest 78 RPM rim drive phono motor and light weight, high output crystal pick-up. Easily attached to any radio or amplifier.
Kit J-19 Dealers........
...Net **$9.95** complete
Model B-4 phono oscillator (fits under base).
Dealers ....Net **$3.69**



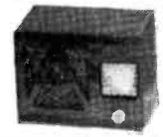
HOME RECORDER KIT J-K6.
Dealers......Net **$59.95**
Consists of latest General Industries dual speed 33 or 78 RPM record-play-back mechanism. Beautifully made to fit walnut cabinet and a complete kit of parts to build a high quality recording amplifier with push-pull 6V6 outputs. All parts, tubes, 5" PM speaker, Astatic crystal mike and diagram furnished. This amplifier can also be used as a 15 watt PA system. Provisions made to connect 12" PM Speaker. (12" G. E. PM Speaker and wall baffle **$16.95** extra). Net Kit J-K6 **$59.95.**

G.I. RECORDER MECHANISMS

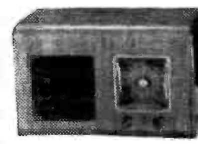
Latest 1947 General Industries recording assemblies with 4 ohm magnetic cutters and crystal play back arms.
Model 12445—78 RPM. Net **$24.50**
Model 13700—33 and 78 RPM. Net........ **28.95**
Model 13810—Automatic changer with cutter, 78 RPM. Net....................... **40.10**

Write for latest bargain flyer of radios, parts kits, tubes and war surplus.

1947 — COMPLETE RADIO KITS

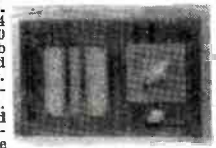


SENSATIONAL PEE WEE AC-DC KIT Model K-PW. Size 6½x5x3½ inches. Very small in size; uses pee wee tubes 1R5, 1T4, 1S5 and 3S4 and new dry disc rectifier. Conventional superhet circuit with AVC; 2 gang condenser. Receives broadcast 550 to 1700 KC. This set when wired according to our diagram will make a hot little personal radio. This kit is priced complete; just as all our kits are, with tubes, cabinet and speaker; nothing else to buy..........................Net **$11.95**



5-TUBE AC RADIO KIT superhet circuit using new permeability tuning unit. Covers broadcast 550 to 1700 KC. Beautiful walnut cabinet 12x7x6 5" A5 PM speaker. Everything complete, includes 6SA7, 6SK7, 6SQ7, 6K6 and 5Y3 and diagram Model K-5A.
Net **$16.95**

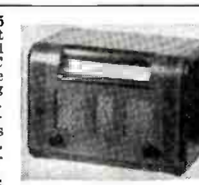
KIT K-7A 7 tube AC superhet 550 to 1700 KC. Has push-pull audio stage with tone control and 6½ in. alnico 5 PM speaker. Conventional circuit with AVC. Similar in appearance to model K-5A except has slightly larger cabinet. Everything complete including diagram and tubes 6SA7, 6SK7, 6H6, 6SN7, 2—6G6, 5Y3. A real value..................Net **$19.95**



OUR LEADER KIT $9.95. 2 gang cond. AC-DC 4 tube TRF kit 550 to 1600 KC Kit K-4R, a TRF job with a walnut cabinet and 5" alnico 5 PM speaker. All parts furnished; including tubes and diagram. Has direct drive dial and a very simple standard circuit. An ideal kit for the student or experimenter. Just a few hundred to sell
.......................Very Special at only **$9.95**

NEW PLASTIC CABINET AC-DC SUPERHET KIT. Cabinet size 7x6½x10½". Attractive slide rule dial. Positive drive permeability tuner. Receives broadcast 550 to 1650 KC. Has latest Alnico 5 PM speaker; Loop antenna; all parts, simplified diagram and tubes 12SA7, 12SK7, 12SQ7, 50L6 and 35Z5 furnished. ....Kit P-48 Net **$12.95**

4 TUBE 1½-90 VOLT FARM RADIO KIT. Offered in same cabinet as the above Kit Model P-48. The same high gain broadcast superhet circuit. Complete with 4 tubes: 1R5, 1T4, 1S5, 3S4 and diagram. Less battery pack. Kit model PB-48. Your Cost **$10.95**



DELUXE AC-DC KIT J-D5 Beautiful walnut cabinet and all the parts to build a broadcast 5 tube AC-DC radio. Superhet with slide rule dial, 2 gang tuning condenser and loop aerial. Everything furnished; includes speaker and tubes 12SA7, 12SK7, 12SQ7, 35Z5 and 50L6 and diagram. Kit J-D5.
Net **$14.95**

SHURE GLIDER CARTRIDGE. SPECIAL...$1.79
LATEST ASTATIC CARTRIDGE............ 1.79

TWO-TUBE PHONO OSCILLATOR, $3.69

Complete, wired and tested. 800 to 1500 KC. Model B-4. Has audio gain stage for proper power output. Complete with tubes ready to operate. **$3.69.**
Mike Oscillator model C-4 is similar to model B-4 except has added gain stage for crystal mike. Complete with 3 tubes and fader control **$4.95.** Crystal mike **$4.90** extra.

ASTATIC CRYSTAL PICK-UP WITH NEW NYLON NJ1. Cartridge and replaceable Sapphire needle.
Very Special **$5.95**

FLUORESCENT BED LAMP. 110 Volt AC. All Plastic construction. Complete with 8 watt lamp. Offered in walnut or Ivory. Dealers..................Net **$5.40**
Power supply to convert 1½-90 volt or 2-90 volt farm and portable radio to 110 volt AC operation. Easily wired to set. Completely wired and tested; with tube and instructions. J-P2. Dealers........Net **$5.95**
2 Gang condenser, oscillator coil and loop; all matched. Special **$1.95**
2 Gang condenser, ⅜" shaft, cut back section. Special **$1.49**
456 K.C. First and Second high gain I. F. Trans. Special ....Each **.49**
3 or 4 wire 456 oscillator coils.................. **.24**
Small loop antennas.............................. **.39**

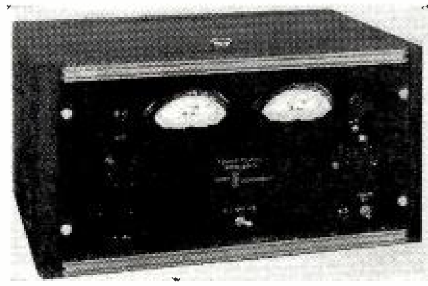
McGEE RADIO COMPANY • *Send 20% Deposit — Bal. Sent C.O.D.* 1225 McGEE ST., KANSAS CITY, MISSOURI

What's New in Radio

POWER SUPPLIES

Two new models of their line of electronically regulated power supplies have been introduced by *Furst Electronics* of Chicago.

Models 310-A and 310-B have been specifically designed for production and laboratory tests of a.c.-d.c. receivers, sound amplifiers and similar electronic equipment, universal motors and appliances powered by such motors, and other equipment designed to operate from d.c. power lines.



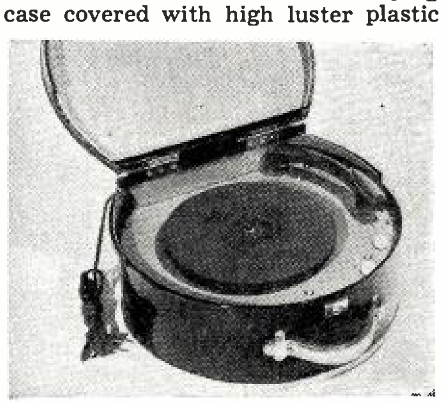
Output voltage is continuously adjustable over a range which exceeds the variations of line voltages usually encountered. The adjustment may be made by means of a control knob on the front panel. The adjusted output voltage will remain constant regardless of load variations or voltage variations in the a.c. power line, according to the manufacturer.

Full details on either or both of these units will be supplied upon request to *Furst Electronics,* 800 W. North Avenue, Chicago 22, Illinois.

PORTABLE PHONOGRAPH

Lewyt Corporation of Brooklyn, New York has recently introduced several new models of radios, phonographs and radio-phonograph combinations.

One of the unique presentations in this line is the "Hat Box" phonograph, Model 215. This portable unit is housed in a well-constructed carrying case covered with high luster plastic patent similar in appearance to patent leather and trimmed in russet, saddle stitched leather. The interior of the case is lined in red morocco grain. A three tube amplifier, a 5″ Alnico V magnetic speaker and a featherweight "glider" crystal pickup, equipped with a permanent, genuine sapphire needle provides faithful reproduction of recorded music. The phonograph operates on 105-125 volts, a.c.



Information about this model and others in the company's line will be forwarded to those requesting it from *Lewyt Corporation,* 60 Broadway, Brooklyn 11, New York.

COMBINATION UNITS

Dearborn Industries of Chicago is currently offering two automatic radio-phonograph combinations for distribution to radio dealers.

Both of the units, the Model 500W console and the Model 100W table model, are available in either Swedish modern wheat finish or a rich walnut finish.

The 500W includes storage space for record albums, a six tube superheterodyne receiver and automatic record changer. The unit stands 35″ high, is 19″ deep and 21″ wide.

The 100W table model combination has a five tube superheterodyne receiver and an automatic record changer which will handle ten and twelve inch records. This unit is 18″ x 14″ x 14″.

Prices and delivery data on these and other combination radio-phonographs in the company's line will be sent to dealers upon application to *Dearborn Industries,* 122 W. Hubbard Street, Chicago 10, Illinois.

FM-AM TUNER

A new FM-AM tuner which provides high-fidelity reception in the high frequency FM band as well as the standard broadcast band has been announced by *Browning Laboratories, Inc.* of Winchester, Massachusetts.

Incorporating a number of modern features, this unit has separate r.f. and i.f. systems for both bands and the entire r.f. section for the FM band uses miniature tubes for highest efficiency.

The tuning range on the FM band extends from 87 to 109 mc. and on the broadcast band from 530 to 1650 kc. The Armstrong circuit is employed in the FM section with two cascade limiters to ensure maximum noise rejection. Bandwidths of i.f. amplifiers are such that high fidelity audio output is realized, according to the manufacturer. Provision is made for using the

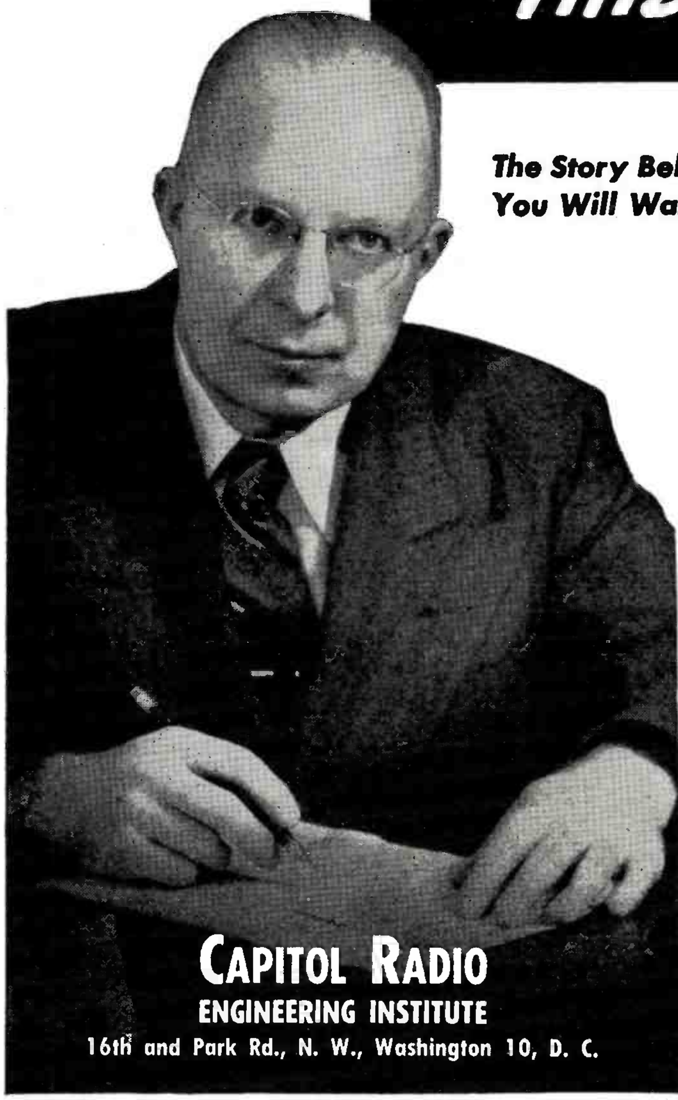
E. H. Rietzke, President of CREI, Invites You to Write for this

Free Significant Analysis of Job Opportunities in Radio-Electronics

EVERY RADIOMAN

Who Wants to Hold His Job or Advance to a Better Job

WILL WANT TO READ THIS LETTER!



The Story Behind This Interesting Letter You Will Want to Read . . . Our advertising agents, realizing that vital changes are taking place in the radio industry, asked me to give them a factual report of the unprecedented job opportunities created by the almost unbelievable expansion of the radio industry.

My letter to them contains some pertinent viewpoints on the subjects of COMPETITION—INDUSTRY EXPANSION—OPPORTUNITIES. These are first-hand observations based on my own experiences . . . a great deal of time spent in the field and constant contact with leaders in the radio industry.

The immediate reaction of our agency upon reading this letter was that it contained so much inspiration and information that it should be reproduced for thousands of radiomen to read. Therefore, this unusual advertisement to invite you to send for, and read, this letter.

It is doubtful if many radiomen realize the actual things that are happening. That is why I think *you* will want to read this letter. You are invited to send for your personal copy today.

E. H. Rietzke
President, CREI

MAIL COUPON FOR FREE COPY • NO OBLIGATION

Capitol Radio Engineering Institute
16th and Park Road, N. W., Dept. RN-3
Washington 10, D. C.

Gentlemen: Please send me FREE, Mr. E. H. Rietzke's Analysis of Job Opportunities in Radio-Electronics.

NAME...

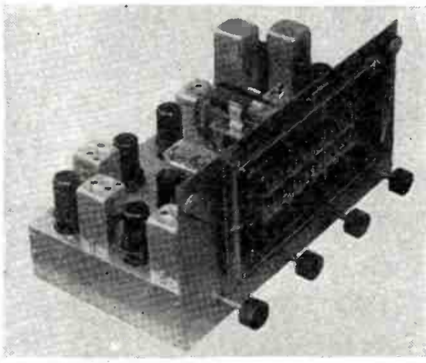
POSITION.................................AGE...............

ADDRESS..

CITY..........................ZONE..........STATE..............

new 300 ohm twin lead cables for antenna systems. The same antenna is used for both FM and AM obviating the necessity for separate lead-ins.

The tuner, exclusive of power supply, is 7⅜" x 13½" x 9". The power



supply is a small separate unit designed to be mounted in cramped quarters.

When the same unit is provided for professional installations, the tuner comes in leatherette with rack panel mounting. Space has been provided in this unit for the power supply.

Browning Laboratories, Inc., Winchester, Massachusetts will furnish additional data upon request.

CEMENT AND SOLVENTS

JFD Manufacturing Company of Brooklyn, New York are now offering their line of radio cements, solvents and carbon tetrachloride in four new sized packages which have been redesigned for the convenience of the user.

All of the items in the line are now available in 4, 8, 16 ounce and 1 gallon sizes. The radio cement line comes with brush affixed directly to the metal cap.

Additional details on these newly packaged items will be furnished by *JFD Manufacturing Company,* 4117 Fort Hamilton Parkway, Brooklyn 19, New York.

PORTABLE BRIDGE

Especially designed to facilitate production testing and radio servicing, *General Electric Company's* Electronics Department has recently announced the availability of a new portable condenser-resistor bridge, Type YCW-1 which is capable of measuring a wide range of capacity, resistance and other electrical characteristics of condensers.

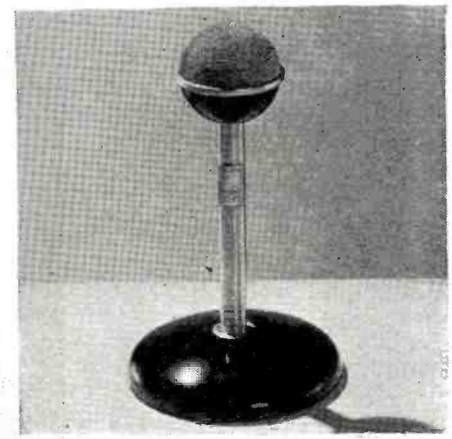
The instrument which features push-button switching will also measure the turns ratio of transformers.

The YCW-1 will measure capacity from .000005 to 200 μfd. in three convenient ranges and resistance from 5 ohms to 20 megohms in two ranges. Using the Wien bridge principle with standards of plus or minus one for capacitance and plus or minus two percent for resistance, bridge balance is indicated by a sensitive visual indicator tube. Measurements are obtained by varying a potentiometer with a knob and a pointer until a maximum shadow angle is obtained on the indicator tube; capacitance and resistance values are also indicated by the pointer.

Further information and specifications sheets on this new instrument will be furnished by the Specialty Division, *General Electric Company's* Electronics Department, Wolf Street Plant, Syracuse, New York.

ACOUSTICEL MICROPHONE

Of interest to amateurs and servicemen handling recording and p.a. work is the new BA-105 "Acousticel" microphone recently added to *The*



Brush Development Company's line of crystal mikes.

The new unit provides essentially flat response from 40 to 6000 c.p.s. with high output. The output level is

(*Continued on page* 157)


ESSE Specials!
Brand New Meters
2" 0-100 Ma. DC McClintock Co. $3.45
2" 0-150 V. DC Gruen 3.45
3" 0-10 Ma. DC Westinghouse 4.50
3" 0-500 Ma. DC Westinghouse 4.50
PE-103 Dynamotor Unit
Brand new. Used to power your field or mobile transmitter. Designed for use with the BC-654 transmitter and receiver. Input—6 V. DC. 21 amps.; 12 V DC. 1 1amps. Output—500 V DC. 160 Ma. Filtered output, Hi-Current relay switches, and overload protect switches self contained in unit. Shipped in original overseas moisture-proof container. Wt of unit 53 lbs.
Price, brand new, each $ 9.95
Ohmite
150-watt Model L Potentiometer, 7.5 and 500 ohms.
Price, brand new, each $1.95
Ohmite
Model J — 50-watt Potentiometer, 6 ohm.
Price $1.25
Ohmite
Model H — 25-watt Potentiometer, 350 ohm.
Price $0.85
Filter Choke
20 Henry, 50 Ma., 200 ohms DC.
Price 75¢
Thordarson T-92R21, Plate and Filament — Secondary 389-0-389 at 200 Ma. 5 V 3 amp., and 6.3 V 5 amp 110 V. 60 cycle pri. A real replacement transformer for large sets.
Price, brand new $3.75
Thordarson—1060 V. CT secondary 300 VA. Pri — 200, 220, 240 V 60 cycle AC
Price, brand new $6.50
Electromode Hot Air Heater
This is a heater used to heat the trucks of the SCR-299 mobile units — which proved highly successful during the war. Operates from 110 V. AC or DC—1,500 watts. Contains blower unit for forced air heating which can also be used for fan during warm weather. Thermostatically controlled with motor protect Thermotron.
Price $29.50
SCR-522 100-156 Mc. Receiver and Transmitter
One of the most interesting and useful pieces of surplus equipment. Designed for plane and ground station use, this unit offers remote control of any four pre-selected crystal controlled frequencies in the spectrum of 100-156 Mc. This spectrum covers facsimile, air navigation aids, airport control, railroad, police, urban telephone, as well as the amateur band 144-148 Mc. October Radio News gives details for converting the SCR-522 receiver section, BC-624.
Transmitter section, BC-625, is voice amplitude modulated and has an output of 8-9 watts.
Tubes used and included: 2—832, 3—12A6, 1—6G6, 2—6SJ7, 1—12J5GT, 3—12SG7, 1—12C8, 1—9002, 3—9003, 1—12AH7GT
Used, with tubes, less dynamotor and remote control.
Price $29.75
Triplett Model 650-SC-AC Voltmeter and Output Meter —Scale 1.5, 6, 15, 60 and 150 V 4000 ohms res.
Price, brand new, with test leads
$13.50
Thordarson—110 V 60 cycle pri. sec. 440 V CT 150 Ma. and 5 V 3 amp
Price brand new $2.25
Selsyn Motors
Use in pairs for direction indicators of beams, wind, etc. Operate from 10-15 V., 60 cycle AC.
Price, each $1.75
Includes plug.
T-17-B Microphone
Brand new $1.35
A single button, carbon mike, hard to beat—and at the price. When ordering without additional merchandise, enclose 25c additional for postage and handling.
Same as above but used, either bakelite or aluminum model.
Each 95¢
Filament Transformer
5 V. CT. 7.5 amp. 110 V. 60 cycle pri.
Price, brand new
$1.50
BC-654-A Receiver and Transmitter
Truly the best buy of Army surplus. Frequency range 3800 to 5800 KC.—calibration every 10 KC.—with crystal oscillated check every 200 KC.—power output 17 watts, voice or CW. Shipped as received from Signal Corps Repair Laboratories. Some in new condition with spare tubes, others lacking some tubes. Weight, 45 lbs.
Price $17.95
PE-104 Vibrator Power Supply for operation of BC-654-A receiver from 6 V. or 12 V. storage battery.
Price, new $4.95
Headphones
Signal Corps 4,000 ohm magnetic and headband.
Price $1.87
Headphone Extension Cords for Signal Corps phones. PL-55 plug on one end, JK-26 on other. 60" length—used.
Price $0.75
Ceramic Stand Off Insulator
Use for stand off or mount two base to base for feed-thru insulator. Size 1½" high, base diameter 2⅛". You can't afford to be without them at the price.
Sold in dozen lots only
Price, each $0.05
Leach Relay — 24 V. DC
Res. 160 ohms. Poles 3 and 4 make when magnetized. 5 and 6 when unmagnetized.
Price, brand new, each $1.95
Relay – SPDT Type
6 ma. 5000 ohm DC resistance.
Price $0.85
AN/ART-13 Collins Autotune Transmitter
A modern, compact, lightweight, high-powered transmitter. For frequency range 2-18.1 Mc. on any of its 11 auto tune crystal controlled or master oscillator channels. December Radio News gives conversion details for converting 24 V. DC operation to 117 V. AC. These units removed from planes. Checked and guaranteed. Weight, 67 lbs.
Price $134.50
! COMPLETE WITH DYNAMOTOR UNIT !
TERMS:
CASH with ORDER
or 25%
BALANCE C.O.D.
All Items
Shipped Collect
ESSE Radio Company
130 W. New York St.-Indianapolis 4, Ind.

EXTERNAL S-METER FOR HALLICRAFTER S20R AND S40 RECEIVERS

By GUY DEXTER

A LARGE number of *Hallicrafters* S20R Sky Champion receivers are in use at amateur stations. A very useful accessory for this receiver is an external S-meter. The Sky Champion has a 5-pin socket in the rear for plugging-in an external S-meter; but since the war, few of these meters have been obtainable. In view of the shortage, no ham would object to building his own S-meter if the circuit and calibration data were offered to him.

Fig. 1 gives the circuit diagram of an external S-meter that works excellently with the S20R receiver. Table 1 gives the calibration data. In all ordinary cases, the reader may mark off his own meter scale according to the data given in Table 1, no further calibration being necessary. The only parts required to build this useful instrument are a 0-1 d. c. milliammeter, five 1-watt carbon resistors, a 10,000-ohm wirewound potentiometer, and a standard 5-pin plug. The entire instrument may be built into one of the small sloping-front meter boxes. If an illuminated meter is employed, the 6.3-volt dial light may be connected through the cable leads to pins 1 and 5 of the plug. This circuit may be used also with the new *Hallicrafters* S40 receiver which apparently has superseded the S20R Sky Champion.

Potentiometer R_2 is used to set the meter initially to zero. Resister R_3 is a shunt used to multiply the meter range to 0-2 milliamperes. If a milliammeter having an internal resistance of some value other than 100 ohms is employed, a different value must be used for R_3. Shunt resistor R_3 always must equal the internal resistance of the milliammeter. It is best to select and adjust the value of R_3 for any individual meter very carefully in a test circuit (until a standard 1-milliampere d. c. input deflects the meter half-scale) before wiring the meter and R_3 into the S-meter circuit.

The author's calibration points were obtained in this manner: After connecting the S-meter to the receiver, a laboratory standard signal generator was connected to the input terminals of the receiver, and both generator and receiver were set to 3 megacycles (a convenient lower-frequency test point). The weakest readable input signal was found to be 2½ microvolts. This deflected the milliammeter to its first scale division (0.02 ma.) and this point was designated S-1. The test signals corresponding to the other S points then were predetermined according to 6 db. spacing (2 to 1 microvolt ratios) between each two successive points from S-1 to S-9, and 5 db. spacings (1.78 to 1 microvolt ratios) between each two successive points above S-9. The signal gen rator output then was set successively to these levels and the meter deflections recorded. If the reader has access to a microvolt-calibrated signal generator, he may repeat the calibration process with his own receiver. It is advisable to use a test frequency lower than 4 megacycles and one on which no radio stations are apt to be picked up during the tests. However, as pointed out earlier in this article, the meter scale may in all ordinary cases be marked off simply according to the data given in Table 1.

SIGNAL STRENGTH	MILLIAMMETER DEFLECTION
50 db. above S-9	0.87
45 " " "	0.85
40 " " "	0.83
35 " " "	0.80
30 " " "	0.78
25 " " "	0.76
20 " " "	0.73
15 " " "	0.70
10 " " "	0.66
5 " " "	0.64
S-9	0.54
S-8	0.48
S-7	0.41
S-6	0.34
S-5	0.28
S-4	0.20
S-3	0.14
S-2	0.06
S-1	0.02

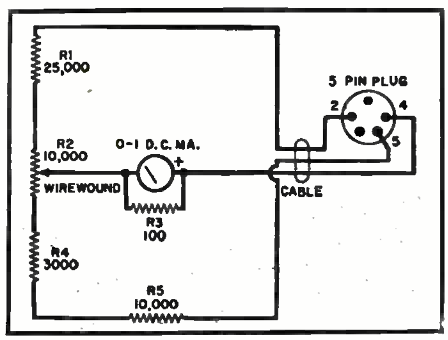
Table 1. Dial calibration of S-meter.

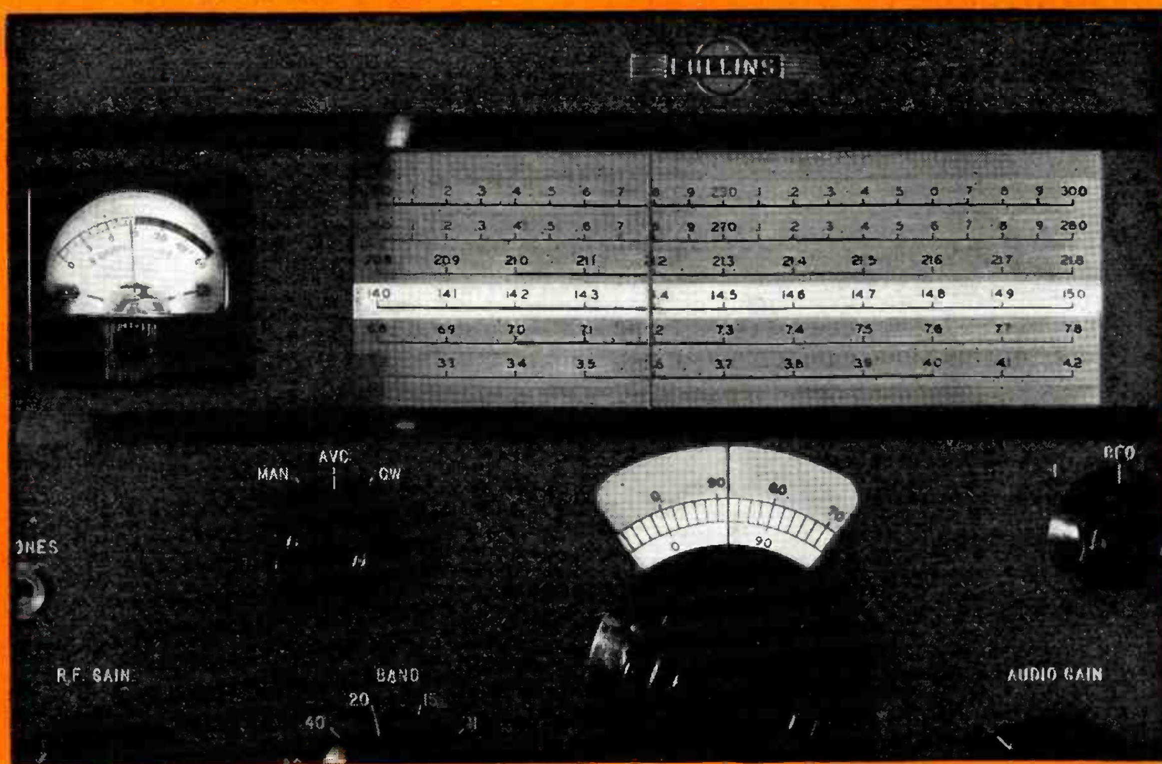
The meter is simple to use: (1) Insert S-meter plug in meter socket in rear of receiver. (2) Switch-on receiver, throwing receiver standby switch to "*RECEIVE*." (3) Switch-on a. v. c. (4) Switch b. f. o. off. (5) To turn on S-meter, advance receiver r. f. gain control all the way to the right until switch on this control clicks. (6) Temporarily ground receiver antenna terminals to prevent signal pickup, and set meter to zero by adjusting potentiometer R_2 in S-meter circuit. *At frequent intervals during normal use of receiver, S-meter zero should be inspected, always grounding antenna terminals temporarily or detuning receiver dial to prevent signal pickup, and R_2 should be adjusted to return meter pointer to zero.* (7) After setting meter to zero, tune in signal and read its intensity on meter scale.

Whenever the S-meter is used, a. v. c. must be switched on and b. f. o. off, and the r. f. gain control must be advanced all the way to the right until the S-meter switch on this control is heard to click on. The positions of the audio gain control, noise limiter switch, and tone control do not affect indications of the S-meter.

This S-meter does not give flattering indications of signal strength, neither is it especially "scotch" in perform-

Fig. 1. Circuit diagram of S-meter. All resistors are 1 watt and the internal resistance of meter movement is 100 ohms.





The Collins Band-Lighted Dial Gives You *Added Pleasure*

Wherever the Collins 75A receiver is shown—hamfests, fairs, club meetings—the band-lighted dial wins enthusiastic endorsement from all who can crowd close enough to see it. And no wonder! It's so easy to use, both visually and mechanically, that once you've used it you'll see why it ranks high among the many new features of this receiver.

Here's how it works. The dial amply covers six amateur bands—80, 40, 20, 15, 11 and 10 meters. When you turn on the filament supply, the dial lights are turned on. *But only the band selected for use is lighted!* There's no band pointer to get out of adjustment, no feeling for the detent action, *and no scanning the dial to see where the frequency indicator is!* With only one band lighted at a time you just naturally read the correct figures at first glance.

The vernier dial, which gives you directly the exact frequency to within 1 kc (2 kc on 11 and 10 meters), works the same way. Only the band you're listening to is lighted. The frequency shown in the photograph is 14,394 kc.

The band-lighted dial is further proof of Collins interest in amateurs. In every equipment designed and built for amateurs by Collins, you'll find engineering that advances the art of amateur radio.

FOR RESULTS IN AMATEUR RADIO, IT'S . . . COLLINS

COLLINS RADIO COMPANY, CEDAR RAPIDS, IOWA

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ance. Several hundred tests made by the author in the laboratory and on received signals both in the broadcast and amateur bands (as well as comparison with S-meter response in a number of competitive receivers) indicate that the calibration data given in Table 1 is fair in every respect.

An individual builder who cannot afford to tie up his one and only 0-1 milliammeter in an S-meter can mount all of the parts in a small box and provide a small jack for plugging-in the meter when needed for this purpose.

-30-

60-Watt Transmitter
(*Continued from page 43*)

ically on all sides and no difficulty is experienced from stray feedback. Since the oscillator tank circuit is quite close to C_{13} such feedback could present a problem.

The value of meter shunts for the various stages will depend upon the size meter used. Any meter having a full scale reading between 1 ma. and 10 ma. may be used. The meter shown in Fig. 1 is one purchased from Army surplus and happened to read 7 ma. full scale. Since the meter scale was calibrated from 0 to 3, the shunts were wound to make the full-scale milliampere reading a multiple of the scale reading; i.e., 9, 60, 150, and 300 ma. The shunts are wound of 1-ohm per foot resistance wire and the actual value determined by connecting the meter and shunt in a calibrating circuit. The calibrating circuit consists of a variable resistor, 1½-volt battery, and a calibrated meter which covers the ranges desired.

Operation

Tune up of the transmitter is done in the conventional manner. While tuning the oscillator and buffer-multiplier stages and neutralizing the final, switch S_5 should be kept in the *"Tune"* position. Switch S_4 should be in the *"Send"* position.

With no crystal in the circuit, the oscillator cathode current will be approximately 6 ma. With crystal in the circuit and oscillating, the oscillator cathode current will be approximately 18 ma. The current during non-oscillating periods is limited by cathode resistor R_1. The best method of tuning the oscillator is to tune for maximum grid current on the final. The oscillator can be roughly tuned by adjusting for maximum plate current on the buffer-multiplier stage, and later the tuning can be touched up to give maximum drive to the final.

The cathode current of the buffer-multiplier with no excitation will be approximately 8 ma. With excitation the cathode current will rise to about 20 ma. The best method to use for adjusting the buffer-multiplier stage to resonance is to tune for maximum grid current on the final stage.

When using the 6AG7 as a buffer, 10 to 15 ma. grid current can be obtained on the 815. When operating under this condition it will be neces-

RELAYS

A. DPST N.CL. Leach 1355. 115v/60c coil. 10a contacts, coin silver..........$1.59

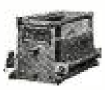
C. SPDT contacts; coil rated 115v/60....................$1.39

D. SPST Latching relay made by Kurman. Make coil 115v/60c; DCR 1500 ohms. Break coil 115vdc 10 ma; DCR 5000 ohms...................... 2.95

E. DPST Telephone type; 2p, 1 cl; 1 open cont. rating 5a at 50v, coil rating 3.5 ma (at 12K ohms), 1000 vac............. 1.05

F. DPDT Steatite insulated 10 amp silvered contacts, made by Leach...................... 1.95

G. SPDT Struthers-Dunn sensitive keying relay, 5 MA-DC Coil. 110v/60 cycles—2 Amp contacts..................... 1.49



Cardwell Split-Stator type PK-200-QD. 200-30 mmf per section. Special Hi-Volt with 2" spacing.$9.95 Johnson type 500D35, 500-35 mmf. .08" spacing. (Listed at $11.75)..$4.75

Instruction books for the BC-191, same as 375 SCR-528, SCR-508, SCR-538, and the ZA-1 equipments. Each.....50c

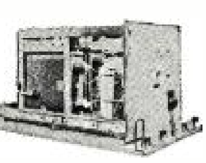
BC-610 TUNING UNITS $4.95. We have just received a limited supply of Tuning Units for the BC-610. They are all in NEW or very good condition. When ordering specify frequency range.

Ohmite Wire-Wound Rheostat

Model H	250 Ohms	25 Watt...	$0.98
Model H	125 Ohms	25 Watt...	.98
Model J	1800 Ohms	50 Watt...	1.25
Model K	3000 Ohms	100 Watt...	1.98
Model L	250 Ohms	150 Watt...	2.25
Model N	22 Ohms	300 Watt...	3.00
Model P	1200 Ohms	225 Watt...	2.75

TOP TRANSMITTER PARTS VALUES

RA-58-A HI-VOLTAGE POWER SUPPLY



Ideal for breakdown insulation testing, or as a source of power for a pulse transmitter. This unit supplies continuously variable voltages between 500 and 15,000 volts DC at 35 ma. A voltage Doubler circuit using two 705a rectifiers and two 1 mf condensers is employed. RMS ripple voltage at maximum power is 6%. THIS UNIT OPERATES FROM 115 v/60c. Variable voltage is obtained by means of a Variac in the primary circuit of the high voltage transformer. Size is 21"x17½"x29" deep. Net weight 314 lbs. This unit sells for the low price of $116

SONAR SOUND DETECTION UNIT

Ideal for detecting underwater sounds, such as fish swimming in schools, within a 15 mile area. Using a Rochelle salt crystal, which is about 1000 times more sensitive than quartz, as the active unit the sound is transmitted up a 60 ft. length of cable. It is completely enclosed in a solid rubber sheath. This sound detector was originally used in harbor defense. Coupled to an audio amplifier, this can be found to have many valuable applications. Ask for SD-1.... $9.95

NEW POWER SUPPLY for LM-18 freq. meter. Output: 290 v @ 20 ma; 13 v @ 600 ma. Input: 105-125 v @ 60 cps; 260 ma; 27.6 W. type 84 rectifier tube; shock mounted. Complete with input and output plugs, tube included.................. $14.75

HI-VOLT OIL CONDENSERS

.15-.15 mf 6000vdc GE pyranol 26F435....$4.50
.1-.1 mf 7000vdc GE pyranol 26F435.... 1.50
In lots of 50....... 1.00
.15-.15 mf 8000vdc Sprague Vitamin Q. 5.25
G.E. Pyranol 23F47 2mf 4000v. List $30. 5.25
G.E. Pyranol 23F49 2mf 5000v. List $27........... 4.75
C-D TC-50010 1mf 5000v. List $30. 4.50
G.E. 14F191 .1mf 10000v. List $37. 6.75
G.E. Pyranol .06 mf 15,000 vdc. List $25...................... 5.00
G.E. 14F136 Pyranol .75mf 20KV 22.00

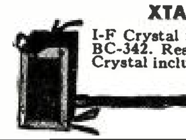
New USN Navy Model RAK-7 Ship Receiver $69.95

15 kc to 600 kc. 6-tube receiver with: AVC-Band pass filter-Audio filter—Noise limiter—Precision tuning with a Vernier dial—Voltage regulated power supply, with three tubes, for 60 cycle, 115 volts. Can be battery operated. Complete with spare parts box weighing 73 lbs., tubes and instruction book.

SPECIAL ITEMS

Visors for 5 inch 'scopes..........$0.75
Tube shields for 2AP1........... .98
Broadcast band push-button tuning units inductive or capacitive types. $1.49
Hand generator, type GN-45B. Output: 6v-3a/500v-.14a rated speed 60 cps...........................$5.95
Mushroom rubber earphone cushions for lightweight set—2 pair for........$0.89
Oscilloscope chassis, completely punched, for use with a 2 inch tube. Octal sockets included 15"x11"x9"......$1.50
Sonde UHF transmitter, complete, less battery.......................$3.75
Microphone element T-30-K for throat mike selling 2 for................$0.50
Microphone unit MC-419 for lip microphone..........................$0.98
140 mmf split stator variable midget condenser......................$1.49
Silver button mica condensers. 175-180-185 mmf...................ea. $0.05
Lots of 100...................... 4.50
Silver button mica condensers: 400 and 500 mmf......................ea. $0.10
Lots of 100..................... 9.50
Feed-through glass insulator 7½" long. Beehive external section..........$1.10
Black crackle finished cabinet for relay rack mounting 19" W x 25" H x 15" D with hinged door in back....$6.00

XTAL FILTER



I-F Crystal filter for BC-312. BC-342. Resonant at 470 kc. Crystal included.

$6.95

MICROWAVE PARTS AND EQUIPMENT

Magnetrons!! Type 2J32 (JAN.) just released. The 2J32 is designed for 10 cm. operation. Rated at 300 kw peak pulse power. Complete information supplied. Brand new, packed in individual protective cartons. The 2J32 is listed at $200.
OUR PRICE..$25.50

3J31's just received. One cm. magnetron listed at $95.00. OUR PRICE......$20.00

KLYSTRON oscillator tubes 2K25/723ab, designed for 3 cm. operation. New. With complete data. Listed at $38.00....... 7.75
Duplexer using 1B24 3 cm.............. 10.00
30 mc oscillator-amplifier with 2 6AC7's. Uses 723ab, Waveguide input, xtal detector. With 6AC7's................. 10.00
With 6AC7's and 723ab.............. 16.50
Thermistor Beads (D-170396), for use with UHF and Micro-Wave Equipment (List $3.00). In separate sealed containers.... .95
Magnets for Magnetrons, ea............ 12.00

3 CM WAVE GUIDE SECTIONS

Silver Plated Directional Couplers with a 20 DB drop with:

A. Wave guide 90° bend 15" long........$ 4.00
B. 15° bend in wave guide 15"........... 4.40
C. 30° bend in wave guide 10" long...... 3.95
D. 90° bend in wave guide 15" long also 90° bend in coupler..................... 5.50

SECTIONS

E. T Section with choke terminations.... $5.00
F. 2½ foot silver plated with 90° bend (2" radius)........................... 4.50
G. 150° bend with 90° twist 3½" radius with pressurizing nipple and coax coupler.............................. 3.95
H. 2½ foot 3 cm wave guides choke to cover fitting....................... 4.95
J. 5 foot 3 cm wave guide section per foot.............................. 1.95
K. Slotted dipole antenna 3cm.......... 4.00

HI-VOLTAGE TRANSFORMERS

3200 volts. AC 150 M.A. 115 volt. primary, 60 cycles. Designed for half wave operation with 150 M.A. output each, two transformers hooked up with secondaries in series and primaries in parallel will give 3,000 volts, output at 300 M.A. from a full wave rectifier. These are conservative, continuous commercial ratings.....................$7.25
Jefferson Power Transformers 115 v 60cy/660 vct-85 mc/6.3v-7.3A/5v-2A/6.3v—.3A...................$3.50
Power supply transformer. Made by Subsig. Pri. 115/60 cps Sec. 1:750vct-.113a; Sec. 2:6.3vct-5a; Sec. 3:5v-3a. 2500TV specially priced at.......................$5.95

CHOKES

2 hy @ 160 ma. Made by GR................2 for $1.00
12 hy-12 hy @ 150 ma., 15 amp. rating, each price.....3.35
12 hy @ 165 ma 200 ohms DCR made by Thordarson. Price.. 2.00
59 hy @ 100 ma 850 ohms DCR made by Jefferson. Price.. 2.00
2.6 hy @ 800 ma stud and terminals at bottom made by G.E...................................... 5.95

AUDIO TRANSFORMERS, MODULATORS, ETC.

Modulation xfmr: typical for 211's cl. A50W........$1.35
Modulation xfmr: 807 to pr 807's................. 1.00
Modulation xfmr: pr. 811's to 813................ 5.00
Audio output transformer Split pri. 1500 OHMS each side. Secondary impedance 85 ohms center-tapped —6:1 ratio. 100 watts output.................. 5.50
Line to Voice coil transformer. Pri 600 ohms. Sec 6 ohms. 1200 Test volt.......................... 1.45
INPUT: Single Button to grid 20:1................ 1.00

MICA CONDENSERS

F3L .0003 mfd 8000v list $29.00.......$3.75
Solar type SX .0015 mf 3000v list $9.95.. .75
Sangamo G-4 .004 mf 20kv list $110.00..25.50
Sangamo G-3 .006 mf 10kv list $87.50.............$19.50
.0008 mf 5000vdc C-D No. 599-6H.................. .80
.0002 mf 5000vdc Aerovox......................... .75
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OIL FILLED CONDENSERS

1 mf 300 vdc.....$0.25	1 mf 1000 vdc....$0.85
2 mf 300 vdc..... .30	2 mf 1000 vdc.... .98
4 mf 300 vdc..... .35	1 mf 1500 vdc.... 1.05
4 mf 400 vdc..... .55	.4 mf 1500 vdc.... .30
5-5 mf 400 vdc..... 1.45	2 mf 600 ac/1000. .95
2 mf 550 vdc..... .30	4 mf 1500 vdc.... 1.30
.25 mf 600 vdc..... .25	1 mf 2000 vdc.... 1.20
.85 mf 600 vdc..... .30	.1 mf 2500 vdc.... 1.20
1 mf 600 vdc..... .35	
2 mf 600 vdc..... .40	
3 mf 600 vdc pyr .65	
4 mf 600 vdc pyr .70	
6 mf 600 vdc pyr .95	
8-8 mf 600 vdc......1.49	
15 mf 600 vdc..... 1.75	

DRY ELECT. COND.

500 mf 200 vdc...$1.95
2000 mf 50 vdc... 2.00
4000 mf 30 vdc... 2.25

TUBE SPECIAL

Tube Type	Appro. List	Your Cost	Tube Type	Appro. List	Your Cost
2AP1	$12.00	$3.75	5FP7	$32.00	$4.25
3BP1	15.00	3.95	5JP2	48.00	8.98
3FP7	27.00	2.98	837	2.80	1.35
5BP1	20.00	4.95	872A	7.50	2.45
5BP4	29.00	7.95	705A	22.50	6.75
5CP1	45.00	4.95	241B-WE	85.00	40.00
5CP7	48.00	6.00	861	155.00	85.00
5FP4	35.00	4.95	304PL		8.00

Sockets for 5CP1, 5BP1, 3BP1, 705a, 829....$0.95 ea.

Test Set EE65—Made by Conn. T & E Corp. $29.50

This unit is used for checking and maintaining field telephone systems by testing for all types of failures in the lines, such as opens, shorts, grounds, crosses with other lines, capacity between lines, insulation resistance, and many of the other faults possible in a phone system.

NEW ARC-5 SUPERHET RECEIVERS

Tubes (included) 3—12SK7; 1—12K8; 1—12SR7; 1—12A6. Freq. range: 190 kc.-550 kc. Complete with control box, dynamotor, rack, shock mounts, and all the necessary plugs. Tubes and schematic are included....$12.00

(SCR-274-N) TRANSMITTERS

ARC-5 Transmitters; 25 watts CW; 15 watts phone. Tubes: 2—1625; 1—1629; 1—1626; 1 crystal. Range (specify frequency desired); .5-.8 Mc; .8-1.3 Mc; 1.3-2.1 Mc; 4-5.3 Mc; 5.3-7 Mc; Power: 24-28 VDC. Remote control. Rack&plugs. Less dynamotor. $12.00

Modulator unit; (with tubes) 1—1625; 1—VR150; 1—12J5...................... $8.00

These units are BRAND NEW!!!

LIMITED QUANTITY!!

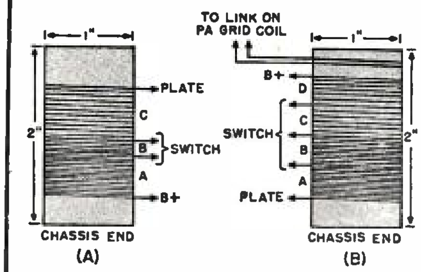


Fig. (A)
A—15 t. #22 e. close wound
B—6 t. #22 e. close wound
C—11 t. #22 e. space twice diam. of wire

Fig. (B)
A—12 t. #22 e. close wound
B—11 t. #22 e. close wound
C—6 t. #22 e. double spaced
D—6 t. #18 e. double spaced
Link—2 t. #18 hook-up wire

Fig. 5. Coil data. (A) Oscillator coil. L_1. (B) Buffer-multiplier coil. L_2.

sary to reduce the grid current to the rated value of 3 to 4 ma. by detuning the grid circuit of the final slightly. Approximately 8 ma. grid current can be obained when doubling in the 6AG7 stage, and approximately 4 ma. when quadrupling.

After the tuning of the 815 grid circuit has been completed, the stage should be neutralized. Neutralization will not be found critical, and a spacing of about ⅜ inch between each neutralizing plate and the tube envelope will be approximately correct. This will, of course, depend upon the individual circuit construction.

For tuning the final plate circuit, set the meter switch to read final plate current, throw switch S_5 to *"Operate"*, and tune the final tank capacitor for minimum plate current. Resonant plate current will be 10 to 15 ma. The final can then be loaded to rated plate current of 150 ma. The final screen-grid current under loaded conditions will be approximately 15 ma.

The plate current of the modulator should be checked before beginning operation, and the bias adjusted so that the no-signal plate current is 20 ma.

When operating c.w., the key is connected between terminals 3 and 4 of the relay terminal strip on the rear of the transmitter. Switch S_5 is placed in the *"Tune"* position. For phone operation switch S_5 is placed in the *"Operate"* position. Switch S_4 controls the carrier for both c.w. and phone. With c.w. operation, S_4 in the *"Send"* position places the exciter stages in operation and closing the key then puts the final amplifier on the air. With phone operation S_4 puts all stages in operation.

The transmitter has been in use on the 10 meter and 80 meter bands for several months with very pleasing results. Even on 75-meter phone where the QRM is plenty bad this little transmitter has stepped right out. Reports received from England averaged an S7 or better. So it is no joke—you can work out with low power.

—30—

Parts Lists

(FOR CIRCUIT DIAGRAMS APPEARING ON PAGES 72 AND 73)

BELMONT BOULEVARD

Part No.	Code and Description
C-9B9-82	R_3—47,000 ohm, 1/5 w. res.
C-9B3-98	R_4—1 megohm, 1/3 w. res.
C-9B9-106	R_5, R_7—4.7 megohm, 1/5 w. res.
C-9B9-84	R_8—68,000 ohm, 1/5 w. res.
C-9B3-37	R_{12}—10 megohm, 1/3 w. res.
C-9B9-92	R_{13}, R_{14}—330,000 ohm, 1/5 w. res.
A-8J-10295	C_1, C_2—.03 µfd., 150 v. cond.
A-8G-11083	C_3—40 µµfd. cond.
A-8J-10297	C_6, C_7—.01 µfd., 150 v. cond.
A-8J-10298	C_8—50 µµfd., 150 v. cond.
A-8J-10296	C_9—.005 µfd., 150 v. cond.
A-13G-11303	C_{10}, C_{11}—1.2 µµfd., ±.2 µµfd. (two wires)

CROSLEY MODELS 56XTA, 56XTW

Part No.	Code and Description
AW-134994	4—Ant. coil
AW-134993	5A, 5B—Osc. coil (two sections)
AW-137495	6—First i.f. trans.
AW-134158	7—Second i.f. trans.
B-135165	9A, 9B, 9C—Variable cond.
AB-135088	10—Trimmer cond.
GC-210685-143	11—580 µµfd. mica cond.
39004-5	12—50 µµfd., mica cond.
39001-80	13, 19, 20, 21, 22—.02 µfd., 600 v. cond.
39001-19	14—.1 µfd., 600 v. cond.
39001-17	15—.05 µfd., 600 v. cond.
39004-9	16—220 µµfd. mica cond.
39001-76	17—.003 µfd., 600 v. cond.
B-137649	18A, 18B—50/30 µfd., 150/150 v. elec. cond.
	23—Trimmer (part of item #10)
39294-11	24—470 ohm, 1/2 w. res.
39294-17	25—4700 ohm, 1/2 w. res.
39294-28	26—330,000 ohm, 1/2 w. res.
39294-38	27—15 megohm, 1/2 w. res.
39294-27	28—22,000 ohm, 1/2 w. res.
39294-27	29—220,000 ohm, 1/2 w. res.
39294-34	30—3.3 megohm, 1/2 w. res.
39294-23	31—47,000 ohm, 1/2 w. res.
39294-35	32—4.7 megohm, 1/2 w. res.
39294-29	33, 34—470,000 ohm, 1/2 w. res.
39294-8	35, 42—150 ohm, 1/2 w. res.
AD-137664	36—Speaker and trans. assembly
W-135808	37A, 37B, 37C—Band change sw. assembly
C-46846-6	38A, 38B—1 megohm vol. control and sw.
	39—Trimmer cond. (part of item #3)
39015-26	40—1200 ohm, 1 w. res.
39015-9	41—47 ohm, 1 w. res.

MAJESTIC MODELS 7C432, 7C447

Part No.	Code and Description
9-184	R_1—22,000 ohm, 1/3 w. res.
9-208	R_2—220 ohm, 1/3 w. res.
9-320	R_3—22,000 ohm, 1 w. res.
9-206	R_4—3.3 megohm, 1/3 w. res.
9-201	R_5—47,000 ohm, 1/3 w. res.
13-19	R_6—.5 megohm vol. control
9-160	R_7—10 megohm, 1/3 w. res.
9-211	R_8—470,000 ohm, 1/2 w. res.
14-6	R_9—2 megohm tone control (on sw.)
9-207	R_{10}—470,000 ohm, 1/3 w. res.
02-83	R_{11}—820 ohm, 1/2 w. res.
9-169	R_{12}—1000 ohm, 1 w. res.
9-269	R_{13}—18,000 ohm, 1/4 w. res.
5-40	C_1—.05 µfd., 200 v. cond.
6-159	C_2, C_{18}—47 µµfd., 500 v. cond.
	C_3, C_4—Trimmers (part of tuning unit)
5-77	C_5—.05 µfd., 600 v. cond.
	C_6, C_7—Trimmers (part of T_1)
5-39	C_8—.1 µfd., 200 v. cond.
	C_9, C_{10}—Trimmers (part of T_2)
6-151	C_{11}, C_{14}—220 µµfd., 500 v. cond.
19-26	C_{12A}, C_{12B}, C_{12C}—30/10/20 µfd., 400/400/25 v. elec. cond.
6-112	C_{13}—.01 µfd., 200 v. cond.
6-132	C_{15}, C_{16}—.01 µfd., 400 v. cond.
5-61	C_{17}—.005 µfd., 600 v. cond.
5-57	C_{19}—.01 µfd., 200 v. cond.
3-159	T_1—First i.f. trans.
3-160	T_2—Second i.f. trans.
12-27, or 12-26	T_3—Output trans.
2-16	T_4—Power trans.

GRANTLINE MODELS 500, 501

Part No.	Code and Description
C-9B1-78	R_1—22,000 ohm, 1/2 w. res.
C-9B1-26	R_2, R_6—150,000 ohm, 1/2 w. res.
C-9B2-63	R_3—1200 ohm, 1 w. res.
C-9B1-34	R_4—3.3 megohm, 1/2 w. res.
101196	R_5, S_1—500,000 ohm vol. control and sw.
C-9B1-35	R_6—4.7 megohm, 1/2 w. res.
C-9B1-42	R_7—22 ohm, 1/2 w. res.
C-9B1-29	R_9—470,000 ohm, 1/2 w. res.
C-9B1-52	R_{10}—150 ohm, 1/2 w. res.
C-9B2-44	R_{11}—33 ohm, 1 w. res.
C-8F3-6	C_1—47 µµfd. mica cond.
124100	C_2, C_6—Ant. and osc. trimmers
108157C	C_3, C_4, T_3—Input i.f. coil assembly
C-8F3-11	C_5—330 µµfd. mica cond.
C-8D-10953	C_7—.15 µfd., 400 v. cond.
C-8D-10770	C_8, C_9—.05 µfd., 200 v. cond.
119-92	C_{10}, C_{11}—20/40 µfd., 150/150 v. elec. cond.
108157C	C_{12}, C_{13}, T_4—Output i.f. coil assembly
C-8F3-10	C_{14}—220 µµfd. mica cond.
C-8D-10761	C_{15}, C_{19}—.01 µfd., 400 v. cond.
C-8D-10813	C_{16}—.05 µfd., 400 v. cond.
C-8F6-121	C_{17}—470 µµfd. mica cond.
C-8D-10788	C_{18}—.004 µfd., 600 v. cond.
111136B	T_1—Antenna coil assembly
110126	T_2—Osc. coil assembly
B-18A-11124	T_5—4" PM dynamic speaker and trans.

ZENITH MODELS 4K016, 4K035

Part No.	Code and Description
63-654	R_1—180,000 ohm, 1/4 w. res.
63-594	R_2—68,000 ohm, 1/4 w. res.
63-669	R_3—3.9 megohm, 1/4 w. res.
63-1235 or 63-1351	R_4—Vol. control
63-587	R_5—4700 ohm, 1/4 w. res.
63-976	R_6—15 megohm, 1/4 w. res.
63-271	R_7—1 megohm, 1/4 w. res.
63-600	R_8—2.2 megohm, 1/4 w. res.
63-634	R_9—820 ohm, 1/4 w. res.
63-583	R_{10}—1000 ohm, 1/4 w. res.
22-1453 or 22-1454	C_1—Two-gang var. cond.
22-829	C_2—.05 µfd., 200 v. cond.
22-162	C_3—.0001 µfd., 600 v. cond.
22-196	C_4—.01 µfd., 600 v. cond.
22-448	C_6—.004 µfd., 600 v. cond.
22-684	C_7—8 µfd., 150 v. elec. cond.
	C_8—First i.f. trans., pri. (on T_1)
	C_9—First i.f. trans., sec. (on T_1)
	C_{10}—Second i.f. trans., pri. (on T_2)
	C_{11}—Second i.f. trans., sec. (on T_2)
	C_{12}—Broadcast osc. (on C_1)
	C_{13}—Broadcast ant. (on C_1)
S12024	L_1—Antenna coil
S12014	L_2—Osc. coil assembly
95-814	T_1—First i.f. trans.
95-839	T_2—Second i.f. trans.

AIR KING MODEL 4608A

Part No.	Code and Description
	R_1—22 ohm, 1/2 w. res.
	R_2—22,000 ohm, 2 w. res.
	R_4—2200 ohm, 1/2 w. res.
	R_5—Vol. control & sw.
	R_6—10 megohm, 1/4 w. res.
	R_7—270,000 ohm, 1/2 w. res.
	R_8—470,000 ohm, 1/4 w. res.
	R_9—150 ohm, 1 w. res.
	R_{10}—2.2 megohm, 1/4 w. res.
	C_1—.005 µfd., 400 v. cond.
	C_2, C_4, C_5, C_9—.05 µfd., 400 v. cond.
	C_3—47 µµfd., 500 v. cond.
	C_6, C_7, C_{13}—40/40/25 µfd., 150/150/25 v. elec. cond.
	C_8—220 µµfd., 500 v. cond.
	C_{10}—.002 µfd., 400 v. cond.
	C_{11}—470 µµfd., 500 v. cond.
	C_{12}—.01 µfd., 400 v. cond.
	L_1—Loop aerial
	L_2—Osc. coil
	L_3—First i.f. trans.
	L_4—Second i.f. trans.

—30—

NOISELESS RECEIVER CHECKING

SERVICEMEN may welcome this suggestion for cutting down the noise usually present in the service shop when several receivers are undergoing intermittent checks or routine operating tests.

In order to eliminate noise, unsolder the speaker voice coil leads and put a little pilot light socket across the transformer. Screw a small Christmas tree light bulb or a 6-volt pilot bulb in and let it wink.

Connect the signal generator in the usual manner. Turn up the volume so the lights are fairly bright, then any variation in the output will be easily discernible . . . . H.H.

Sound Recording

(Continued from page 54)

the studio. This is important if proper *balance* between the lower and higher frequencies is to be maintained.

When a sound is reproduced at a higher level than that of the original, the low bass frequencies will appear to be *accentuated.* If the sound is reproduced at a lower level than the original, bass frequencies will appear to be *attenuated* (suppressed) with respect to other portions of the frequency spectrum.

Noise

Noise is usually considered to be *random* sound waves with little or no periodicity. That does not completely define noise for certain "noises" are associated with certain commonplace events; for instance, the creaking of doors or gates, the clicking sound made by walking on a hard surface with leather heels, etc. The hum of an electric motor is considered noise, yet an analysis of the sound by means of an oscillogram would indicate a definite periodicity. Again it seems that the distinction between the classification of sounds is psychological in origin and relative to the observer.

The Technical Aspects of Sound

Sound is usually characterized as wave motion of which there may be three forms, namely, harmonic, periodic, and random.

Waves are propagated disturbances and may be *transverse* or *longitudinal,* depending upon the direction of the disturbance.

In a *transverse* wave, the particles of the medium vibrate in a direction perpendicular to the direction of propagation. For example, in a water wave, the individual particles of water move up and down, while the direction of wave motion is along the surface, or perpendicular to the particle motion. Thus, a water wave is a transverse wave.

A *longitudinal* wave is so named because the particles of the medium vibrate in a direction parallel to the direction of propagation. In a sound wave, for example, the individual particles of air move back and forth in the same direction that the wave is traveling. Thus, a sound wave is a longitudinal wave.

A *wavefront* may be classified as *plane* or *spherical.* Since a wave in general spreads out uniformly in all directions from its source or origin, the wavefront will be spherical close to the source. However, at some distance from the source the curvature is practically zero, and the wave is considered to be a plane wave. If a pebble is dropped in a still pond, circular waves will spread out in all directions, but by the time they have traveled a considerable distance, the waves will be essentially straight. Thus, a wave which starts out spherical (or circular in two dimensions) eventually becomes essentially a plane wave.

Harmonic Motion is a wave pattern of the sine or cosine curve type as in Fig. 4A. All harmonic motion can be described by an equation of the form: $y = A \sin \omega t$ where: y = displacement of the disturbance, A = maximum displacement (which occurs at 90° and 270°), ω = circular frequency (to be defined in detail) in degrees per second, t = time after disturbance is initiated.

Periodic Motion is a wave pattern compounded from two or more harmonic motions of different frequencies as in Fig. 4B. Periodic motions are analyzed by determining the various harmonic components. The character of any periodic motion is controlled by the number and magnitude of its various harmonic components.

Random Motion is a conglomeration of harmonic motions exhibiting little or no periodicity. Speech, squeaks, scraping, etc., all produce random motion unless they are sustained for long periods. The number of harmonic components is so great and their duration is so irregular as to make the harmonic analysis of random motion a practical impossibility. A typical wave pattern of random motion is shown in Fig. 4C.

Harmonic and periodic motions have certain defining characteristics which must be considered. These are:

Cycle, which is a sequence of events or motions that recur in exactly the same order in certain time intervals. For example, the motion of a pendulum started from one side, allowed to swing to the opposite and back to the starting side, comprises one complete cycle. This is illustrated in Fig. 4D.

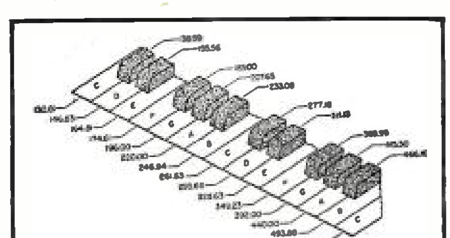
Period is the time required for the motion to complete one set of recurring values, or one cycle. It is usually defined by the symbol T.

Frequency is the rate at which the cycles recur and is usually presented in one of two ways. If the frequency is given as ω, it is known as the circular frequency and has the dimensions, radians per second. The frequency may also be given as cycles per second or the symbol f in which case it is connected to the circular frequency by the relation: $f = \omega/2\pi$

Wavelength is the distance between two corresponding points on harmonic or periodic waves (Fig. 4A) and is denoted by the symbol λ.

Fundamental Frequency is the low-

Fig. 6. Diagram illustrates section of a piano keyboard and shows tempered scale for one octave on each side of middle C.



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5CPI Cathode ray tube	ea.	$6.95
Socket for 5CPI	"	1.98
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Xformer, 1600v at 4ma., 700v ct at 150ma., 6.3v at 8A. 115v 60 cyc.	"	8.50
Condenser, oil .5-2000v	"	2.10

ORDER SEPARATE OR COMPLETE KIT..........Special **$16.95**

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4 mfd. 600v	.75	3 mfd. 2000v	2.95
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10 mfd. 600v	1.40	10 mfd. 2000v	6.95
1 mfd. 1000v	.90	.05 mfd. 3000v	1.95
2 mfd. 1000v	1.05	.25 mfd. 3000v	2.95
4 mfd. 1000v	1.10	1 mfd. 3000v	3.50
8 mfd. 1000v	2.00	1 mfd. 5000v	6.85
10 mfd. 1000v	2.40	2 mfd. 4000v	7.60
15 mfd. 1000v	2.60	.1 mfd. 7000v	3.95
25 mfd. 1000v	5.95	1 mfd. 9000v	14.95
24 mfd. 1500v	6.95	.0056 mfd. 9000v	14.95

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1000 mfd.—15WVDC	.99

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1E7G	$1.25	836	$2.95
2AP1	4.95	837	3.75
2C40	3.95	829A	3.99
2D21	1.50	838	3.95
2V3G	1.75	841	1.75
211	6.95	861	89.95
3AP1	5.95	866	.99
3BP1	6.95	872A	2.75
311	6.95	814	7.95
5BP1	6.95	884	1.50
5BP4	6.95	885	1.50
6AB7	1.25	8003	9.95
6AC7	.95	8005	4.95
6AG5	1.10	8016	1.95
6AG7	1.25	8025A	4.95
6AJ5	1.98	9JP1	14.95
6AK5	1.60	954	.99
6AL5	.99	955	.99
6AR6	1.29	956	.99
6AS6	1.29	957	.99
6AS7	1.29	9001	1.19
6C4	.75	9002	.99
6C5	.90	9003	.99
6F6	.99	9004	.99
6J4	2.25	9005	1.10
6J5	.90	9006	1.15
6J6	.99	15E	4.95
6L6	1.59	1619	.99
6Q4	1.25	1625	.89
6SL7	.99	1626	.89
6SN7	.99	250TH	14.95
6V6	1.19	2050	1.50
6SH7	.89	2051	1.50
7A4	1.45	257B/8001	
801	2.30		14.95
802	1.15	28D7	1.95
803	9.95	30	.89
804	8.95	35T	3.50
805	5.50	304TH	16.95
807	1.05	726A/C	7.50
809	2.25	100TH	7.95
810	3.55	1N21	.49
811	2.95	1N23	.49
813	7.95	2C26A	.99
815	3.95	3E29	3.75
VR90/30	.99	CK1006	1.98
VR105/30	.99	HF200	14.95
VR150/30	.99	HK24G	1.49

VT 127A. 3.00

3½ KILOWATT TUBE (New)

JAN-128A (Federal).
SPECIAL $75.00

MODULATION XFORMER Government Rating

40 watt audio (Westinghouse). Separate plate and screen windings. Z ratio 3:1—can use push-pull 803's, 100TH's 813's, HK254's.
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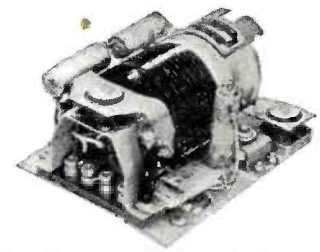
Input	Output		
18v ac	12v dc	5-Amp	$4.95
18v ac	12v dc	10-Amp	7.95
18v ac	12v dc	15-Amp	10.95
18v ac	12v dc	30-Amp	16.95
36v ac	28v dc	5-Amp	7.95
36v ac	28v dc	10-Amp	13.95
36v ac	28v dc	15-Amp	19.95

Federal's New Midget Selenium 1.60
Immediate Delivery

CARBON PILE REGULATOR



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12 Hy.—100 ma.	$2.35	12 Hy.—300 ma.	$3.95
4 Hy.—250 ma.	3.95	15 Hy.— 30 ma.	1.95
10 Hy.—150 ma.	3.95	20 Hy.— 90 ma.	2.25
4 Hy.—600 ma.	5.95	75 Hy.— 8 ma.	1.95

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est component frequency of a periodic wave motion.

Harmonic Frequency or overtone, when applied to music, is that component of a periodic wave motion whose frequency is an integral multiple of the fundamental frequency.

Sub-Harmonic Frequency is that component of a periodic wave whose frequency is an integral submultiple of the fundamental frequency.

An *Octave* is the interval between two waves whose frequencies are in the ratio of 1:2.

Each of these above four terms is illustrated in Fig. 4E.

Behavior of Sound Waves

From a purely physical concept, sound can be considered as an alteration in pressure, displacement of particles, or the velocity of particles in elastic media. These pressure or velocity changes are produced by a *transducer,* which is an electro-mechanical or electro-acoustic system for converting electrical vibrations into mechanical or acoustical vibrations respectively. Microphones and loudspeakers are typical transducers as is the sounding diaphragm of Fig. 2. The motivating source for the diaphragm can be mechanical (as shown) or electrical as in the case of a loudspeaker. Since sound is a particular type of wave motion, it becomes desirable to consider particular behavior of waves.

1. If two harmonic waves pass through the same point while vibrating at the same frequency, the resultant wave formed by adding the displacements will also be a harmonic wave.

2. Conversely, any harmonic wave can be resolved into a number of component harmonic waves. This principle is covered by *Fourier's Theorem.*

3. If two harmonic waves start at the same point and experience similar displacements at the same time, they are said to be *in phase* with each other. However, if one wave lags or leads the other, then they are said to be *out of phase* (Fig. 3B). It is customary to denote phase difference in angular units as that part of 360 degrees or 2 π radian.

Almost everyone has witnessed some example of wave interference. For instance, in Fig. 3A, the component waves (both are identical and appear as one) form a harmonic wave at twice the original amplitude. This is said to be *constructive interference.* In Fig. 3B the component waves are of the same frequency and amplitude but 180 degrees out of phase, and therefore, cancel each other in what is called *destructive interference.* The resulting wave caused by the superposition of two waves of almost, but not quite the same frequency as in Fig. 3C has the characteristic of *beats,* i.e. alternate periods of constructive and destructive interference. Beat phenomena are particularly important in their application to superheterodyne reception.

When two identical waves travel with the same speed but in opposite

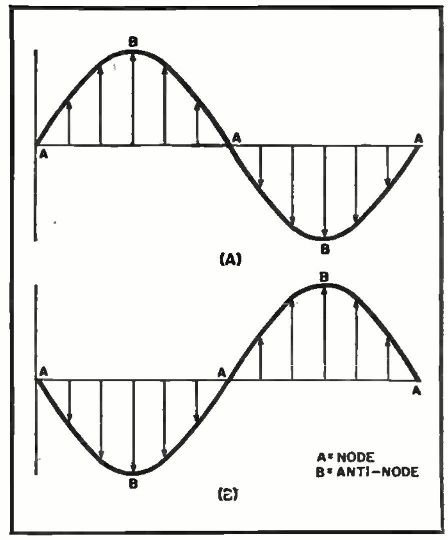

Fig. 7. Illustrates displacement of waves.

directions, the resulting wave is known as a stationary or *standing wave.* While there is no translational motion, the vibratory displacements persist. The displacements are of equal magnitudes for distances one-half wavelength apart and the wave takes the form shown in Fig. 7A at some particular time and then reverses as shown in Fig. 7B. As can be seen from the figure, certain portions of the wave experience little or no displacement. The points of maximum displacement are called *anti-nodal points* or *loops* and the points of zero displacement are called *nodal points.* Standing waves are of great importance in the theory of antenna design.

The Speed of Sound

The speed of sound in any medium is a function of the density and elastic qualities of the medium.

The variation of the speed of sound with temperature is expressed by the formula:

$$v_t = v_o \sqrt{1 + \frac{1}{273} t}$$

where:

v_t = velocity at temperature t
v_o = standard velocity at 0° C
t = temperature in degrees C

The speed of sound in air at one atmosphere pressure at 0° C is approximately 1088 ft/sec. while at 100 atmospheres the speed of sound is 1150 ft/sec.

Pitch and Intensity

The pitch of a sound is best characterized by its frequency, except for certain psychological effects. The audible range is known to be between 16 and 20,000 cycles per second, but the average ear does not hear below 30 cycles per second nor above 16,000 cycles. However the pitch, as received by the human ear, is not a direct function of the frequency and varies with the intensity. This effect has been investigated in considerable detail by Fletcher.[1]

[1] Fletcher, H., "Speech and Hearing," D. Van Nostrand, New York, 1929.

NEW . . . Simpson Model 305RC Tube-Tester with "No Backlash"* Roll Chart

With the addition of the new Simpson "No Backlash"* Roll Chart to the 1947 version of our Model 305, this famous instrument becomes beyond question the finest tube-tester on the market in its price range. Read the description of this new Roll Chart in the panel below.

Model 305RC provides for filament voltages from .5 volts to and including 120 volts. It tests loctalc, single ended tubes, bantams, midgets, miniatures, ballast tubes, gaseous rectifiers, acorn tubes, Christmas tree bulbs, and all popular radio receiver tubes.

Like other Simpson tube-testers, the Model 305RC incorporates 3-way switching which makes it possible to test any tube regardless of its base connections or the internal connections of its elements. This method, the result of exhaustive research and expensive construction, protects the Model 305RC against obsolesence to a degree not enjoyed by competitive testers. No adapters or special sockets are required. In addition to having a complete set of sockets for every tube now on the market, this tester has a spare socket, to provide for future tube developments.

The Model 305RC has provision for testing pilot lamps of various voltages as well as Christmas tree bulbs. It tests gaseous rectifiers of the OZ4 type—also tests ballast tubes direct in socket for burnouts and opens. Has neon bulb of proper sensitivity for checking shorts. This tube-tester is fused, and has the latest improved circuit. It provides for line adjustment from 100 to 130 volts, with smooth vernier control.

Model 305RC is distinguished for its beautiful exterior. It has a two-tone metal panel in red and black on a satin-finished background. Sockets and controls are symmetrically arranged for quick operation. The large, modern, fan-shaped instrument has an exceptionally long scale. It has "good" and "bad" English markings, also a percentage scale for matching and comparing tubes. Cases, both portable† and counter style, are made of strongly built hardwood, durably and beautifully finished.

Size, 11"x11"x6". Wt. 10 lbs. Shipping wt., 15 lbs.
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*6 Exclusive Features Make This the Finest Roll Chart Ever Designed for Tube-Testers . . . . .

- "No Backlash" feature of this Roll Chart automatically takes up all slack in the paper chart and, by keeping it in constant tension, makes it impossible to turn the selector wheel without turning chart. Gives precision selection at all times. Also prevents chart from tearing or getting out of alignment.
- Gearing is such that only 6 turns of selector wheel will run the entire length of the 12½ ft. chart.
- Easy to read. The clear Lucite window is just wide enough to show 2 tube settings, or both settings on a multi-purpose tube.
- Entire unit removable by taking out four screws. Just lift from receptacle to make new entries or install new chart.
- Chart ingeniously fastened to rollers, affording easy replacement and constant alignment.
- Rigid, light-weight construction. Gear driving mechanism incorporates heavy-duty precision brass gears and parts.

Counter Model 305RC. Same instrument as portable model, but set in fine walnut finished hardwood case, with tilted, easy-to-use panel.

†Finished hardwood cases are standard on portable models. When these are not available, the instrument is housed in attractive simulated-leather covered case.

Simpson

INSTRUMENTS THAT STAY ACCURATE

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While intensity is popularly considered to be synonymous with loudness, a distinct difference exists between the two. The former is a pure physical quantity while the latter is psychological in origin. In a strict physical sense, intensity is defined as the average rate of flow of energy per unit area in a direction normal to the rate of flow. It is expressed by the formula:

$$I = \frac{1}{2} \frac{(p_{max})^2}{\rho_o c}$$

where p_{max} = the maximum pressure developed above the steady pressure for no disturbance, c = wave velocity, ρ_o = medium density, I = intensity in watts/sq. cm.

The equation may also be written in the form:

$$I = \frac{1}{2} \rho_o c \omega^2 d_{max}$$

where d_{max} = maximum displacement and ω = circular frequency = $2\pi f$.

For acoustic measurements, the choice of the equation depends on whether the recording instruments respond to pressure or displacement variations.

Current practice now employs the decibel as a relative measure of intensity. The bel (so named after Alexander Graham Bell) is defined as follows:

$$b = \log_{10} \frac{I_1}{I_2}$$

where I_1 and I_2 are the absolute intensities.

The bel is a large unit, an intensity ratio of 10 to 1 being equivalent to only 1 bel. This would mean dealing with rather small numbers, so it is customary to use the decibel, which is one tenth of a bel. Thus the numbers with which we deal are 10 times as large when speaking of decibels as they are when speaking of bels. To convert to decibels, the value in bels must be multiplied by 10. Thus:

$$\text{db.} = 10 \log_{10} \frac{I_1}{I_2}$$

An intensity ratio of 10 to 1 would thus be equivalent to 10 db., and 3 db. would be equivalent to an intensity ratio of 2 to 1.

On the other hand, the loudness of a tone is a function of its frequency and intensity and can be defined as the magnitude or stimulus it creates in the auditory system. This implies a relative measure of loudness and some reference level must be established for comparison. The tone emitted at 1000 cycles at 0 db. is taken as this level and the loudness of any particular tone is determined by adjusting the reference tone until it sounds as loud as the one being tested. The increase in intensity of the reference tone is interpreted in terms of loudness units. Fletcher and Munson have done much work along this line and their results have been published in the *"Journal of the Acoustical Society of America."* Obviously, a certain amount of human error is bound to be injected into such measurements, however, correlation by statistical methods has yielded some very valuable information.

The db. meter used for measuring sound levels has a scale which is usually calibrated from −10 to +6 db. This type of meter is usually calibrated for use across an impedance load of 500 ohms and is actually a voltmeter of the rectifier type. Many systems do not standardize on 500 ohm lines and there are many occasions when it is desirable to use a standard meter across voice coils of speakers, etc. having different impedances.

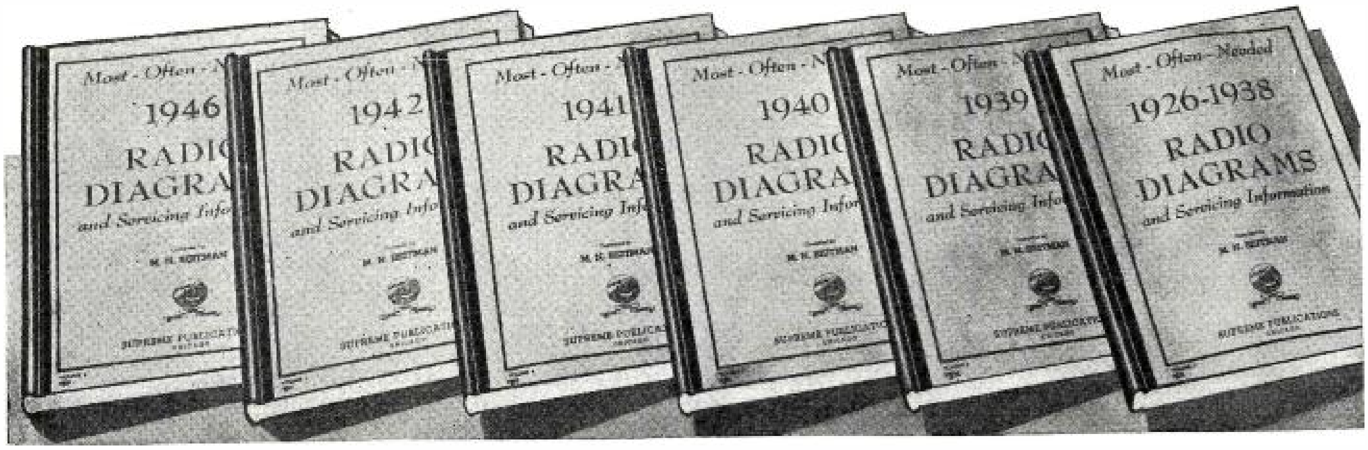
Fig. 5 shows how such meters may be used across loads of from 2 to 4000 ohms. For example, reference to the table in Fig. 5 will show that if a 500 ohm meter is used across a speaker voice coil of 8 ohms, 18 db. must be added to the meter reading.

Multipliers are needed, as with any other voltmeter, if an additional range over +6 db. is desired. For average meters, the resistance required will be approximately 5000 ohms-per-volt.

In the transmission and reproduction of sound, consideration must be given to the human ear as a transducer (here the sound waves are transformed into a stimulus for the auditory system.) The ear exhibits certain non-linear characteristics which affect the fidelity with which sounds are received. For instance,

(*Continued on page* 157)

RADIO DIAGRAMS



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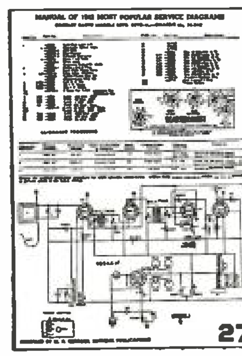

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International Short-Wave
(*Continued from page 57*)

until the desired transmitting frequency is obtained. These currents are applied to a large watercooled transmitting valve (tube) type TA 12/20000 K having an input of 25-27 kilowatts at a plate voltage of 8000-12000 volts.

"The generation of high powered short waves only became possible by the use of watercooled transmitting valves (tubes), a Philips specialty."

The Results

For an account of PCJ's appearance on the air, we quote from a front-page story in *"The Wireless World and Radio Review,"* London, of April 27, 1927:

"For the second time in the short history of broadcasting it has been left to Holland to steal a march on this country and, in fact, on Europe, generally. It will be remembered that some long while before broadcasting here was introduced, British amateurs were accustomed to listen to the broadcasting station at The Hague which, with the call-sign PCGG, sent out regular Sunday afternoon concerts, mainly for the benefit of listeners here. Now again Holland sets the example by leading the way to short-wave broadcasting. On the 15th of March the station PCJ, established at the Philips Lamp Laboratories at Eindhoven, in Holland, communicated by wireless telephony with the Dutch station at Bandoeng, in the Dutch East Indies. The transmission was carried out on a wavelength of approximately 30 meters.

"Since that initial success fairly regular broadcasting has been conducted. Now, as we go to press, comes the announcement that the Sydney station, 2BL, has successfully rebroadcast one of the programs. We congratulate Holland, and the Philips Company in particular, on the enterprise shown in establishing this broadcasting record, more especially so as the purpose is apparently to provide a means for long-distance broadcasting, and advantage has been taken of the peculiar suitability of the 30-meter wavelength.

"It will be of interest to observe whether this example set by Holland will be followed by other countries in Europe."

Eddie Startz tells me that "the very first transmissions of PCJ during March 1927 became a huge success, as next morning a telegram was delivered in Eindhoven stating that the transmission was received with incredible strength, steadiness and purity by a radio-amateur at Bandoeng (Java, Dutch East Indies). Subsequent transmissions proved that this result was not due to sheer luck, but that a really reliable communication was established. The stream of reports began to flow to the transmitter at Eindhoven. Reports were received from all parts of the world.

"During 1927, several relays of the Daventry (England) station, destined for the British Dominions, were successfully carried out.

"And in June 1927, the PCJ station had the great honor of receiving H.M. the Queen of Holland and H.R.H. Princess Juliana in its studio. The royal address to the Dutch East and West Indies was received with perfect clearness as stated in a radiogram received at Eindhoven exactly eight minutes after the last word was spoken by Her Majesty. On April 28 of that year, Beethoven's 9th Symphony, played by the Amsterdam orchestra and conducted by Dr. Willem Mengelberg, was broadcast to the world.

PCJ Today

The PCJ transmitter is now situated at Huizen, near the shores of the Zuider Zee. It has ten stages, with an output of some 30 kw. and a cooling-tower is used to keep the water-temperature of the cooling system at a constant low level.

The two antennas in use are both of the directional type. The first consists of a system of 8 sets of 3 vertical doublets, which are fed in phase, thus having the result of concentrating the energy. This beam is supported by two fixed masts and is oriented towards the Dutch East Indies.

The second antenna is of unique construction—the only one of its type in the world. This antenna is supported by a pair of 200-ft. wooden masts, fixed together on one undercarriage. This is fitted with 8 sets of two wheels, so that the whole structure can revolve upon two circular rails by means of two electric motors. In cases of need, two or three men can do the job. (One day in 1944, the station engineers loosened the brakes—and a fresh breeze did the rest!)

This revolving antenna consists of four sets of three vertical dipoles and as many reflector dipoles for 9590 kcs. One quarter-wavelength behind this system there is a similar one acting as reflector, which is fed with a voltage 90 degrees ahead in phase as compared with the antenna itself. The feeder is connected with the antenna feeder led over the rails by means of a bridge.

Studios from which the programs of PCJ emanate are located at Hilversum, about 20 miles southeast of Amsterdam, where the medium-wave broadcasts are also prepared and radiated.

Mr. Startz points out that "at the present time the transmitters are no longer operated by the Philips Laboratories, but by a semi-State institution called *Radio Nederland,* but all the credit for putting the Overseas Services from Holland into motion—until the war broke out—is due to the enterprise, foresight, and perseverence of Philips Radio, a thoroughly Dutch concern, with which I am still in close contact."

As to medium-wave radio service in Holland, two medium-wave transmit-

ters are operated on 400 m. and 300 m., respectively. The programming is made by a half dozen independent associations—a neutral, a socialistic, a Catholic, a Protestant, and some smaller ones, all representing some major cultural current prevailing in Holland. There is a tax on radio sets from which the costs for the programs are derived. Broadcasting in Holland is still in the process of reorganization following war's end.

PCJ During the War

And that brings us to an important question that has ofttimes been asked: *"What happened to PCJ during the war?"*

Our answer to this question comes from a broadcast made by Mr. Startz shortly after PCJ returned to the airwaves after Germany's defeat:

"Here is the story in a nutshell. It began on the night of May 10th, 1940. The starlit sky over Holland was filled with the roar of planes. At 4 o'clock in the morning, PCJ's chief engineer broke the bad news . . . we were at war with Germany!

"There it was! The worst had happened!

"I slipped on my clothes and five

(*Continued on page* 129)

10 KC. Suppressor

(*Continued from page* 46)

quency speaker gave an attenuation of 14 db. as shown by the dotted curve of Fig. 2. This was not considered sufficient. Reference to an article entitled *"Graphics of RC Networks"* by Robert C. Paine in the May, 1944 RADIO-ELECTRONIC ENGINEERING edition of RADIO NEWS indicated a higher possible attenuation at the resonant frequency by the use of a resistor to balance out the resistance of the coil. The resulting circuit is shown in Fig. 1B, and the curve obtained with the final form of the filter is shown in Fig. 2 as the solid line. Figure 3 shows the curve plotted on the more conventional semi-log paper, and shows to better advantage the extreme sharpness of the filter network. C_1 and C_2 together resonate with the induct-

STANDARD WARRANTY PLAN

AT a recent meeting of the Association of Electronic Parts and Equipment Manufacturers recommendations were made for the adoption of a standard warranty to be used by manufacturers who sell radio parts distributors.

The proposed warranty contains certain provisions intended to bring out uniformity in the handling of defective products. The period of warranty is left for determination by the individual manufacturer.

The warranty has been submitted to the Sales Managers Club, Eastern Group, for its comments and will then be submitted to the Radio Parts Coordinating Committee for further discussion.

—30—

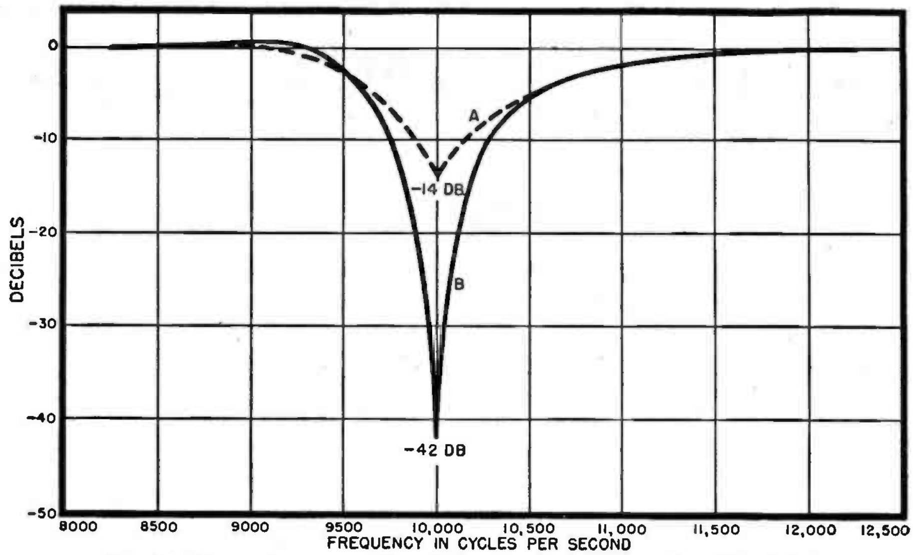


Fig. 2. Attenuation curve (dotted) for circuit shown in Fig. 1A. Solid curve shows attenuation obtained for properly adjusted circuit in Fig. 1B.

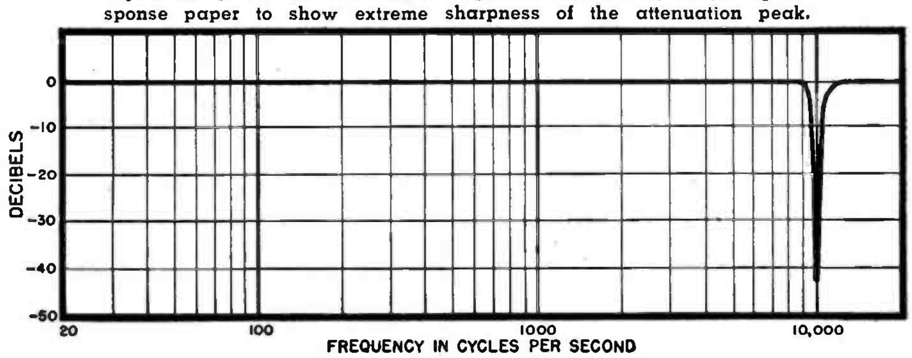
ance at 10,000 c.p.s. With the circuit set up as in Fig. 1B, with a 15 ohm rheostat in place as *R* and adjusted for maximum suppression at 10,000 c.p.s., the solid curve of Fig. 2 was obtained, showing a loss of 42 db., which very effectively eliminates the objectionable frequency. This curve was obtained with a value of 10 ohms for *R*. Since *R* is equal to four times the effective resistance of the coil, the resistance of coil *L* is therefore 2.5 ohms. At 10,000 c.p.s., the coil has a reactance of 64 ohms, and the *Q* is therefore *X/R*, or 64/2.5, or approximately 26. Referring to the curve of Fig. 2, it will be noted that it is flat to 9200 c.p.s., and only down 6 db. at 9600 c.p.s. On the other side of the resonant frequency, the curve is down 6 db. at 10,600 c.p.s., down 2 at 11,000 c.p.s., and flat at 12,000 c.p.s. Thus it is seen that a very small part of the frequency spectrum is "clipped" out of the over-all response.

This sounds almost ideal, but there *is* a disadvantage to this filter. There is a loss of about 2 db. in the main pass band of this filter. In the original circuit, the filter was inserted in the high-frequency leads of a speaker system in which the impedance was 16 ohms. *R* was determined to be 10 ohms. The reactance of each capacitor at 1000 c.p.s. for example, is 1280 ohms, so the shunting effect of the capacitors is negligible. But the resistor *R* is in series with the circuit, and the loss due to it is approximately 2 db. When used in the circuit of a high-frequency horn, this disadvantage may be overlooked since the high efficiency of the high frequency speaker is such that there is generally some attenuation in that circuit between the dividing network and the speaker itself. This attenuation can be reduced by the necessary amount to compensate for the loss in the filter.

A Practical Filter and Circuit

To avoid the necessity of winding the coil, it is entirely possible to make this filter from standard parts. The *J. W. Miller Company* of Los Angeles makes a line filter coil, #7825, which will serve for the inductance in speaker circuits having an impedance of around 8 ohms. This coil has an inductance of .6 mh., which calls for a capacitor of .42 μfd. to resonate at 10,000 c.p.s. Since this value is not a standard commercial size, C_3 and C_4 are each .25 μfd. paper capacitors. Connect them as in Fig. 1C, using a 15 ohm, 10 watt adjustable resistor (*Ohmite* #1007). If an audio oscillator and a sensitive a.f. voltmeter is available, the variable resistor can be adjusted for maximum suppression with very little effort. This combination of coil and capacitors will resonate at around 9200 c.p.s., assuming they have values close to their ratings.

Fig. 3. Curve shown is the same as that illustrated as a solid curve in Fig. 2 except for the fact that it is plotted on semi-log frequency response paper to show extreme sharpness of the attenuation peak.



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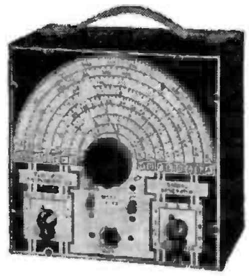

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Direct reading—all calibrations are etched on the front panel. Complete with shielded test lead, self-contained, batteries and instructions.
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E-200—A.M.-F.M. and Television Signal Generator........ 64.15
EV-10P—6000 volts AC and DC Vacuum Tube Multi-Range-Meter........ 71.81
920P—Combination Dynamic Mutual Conductance Tube Tester, Battery Tester and 33 Range AC-DC Multi-Range Set Tester........ 84.22
954P—Combination Dynamic Mutual Conductance Tube Tester, Battery Tester and 37 Range Super-Sensitive AC-DC Multi-Range Set Tester, 20,000 ohms per volt DC........ 99.20

(2) SUPREME INSTRUMENTS

543—Multi-Tester........ $18.95
589—Tube and Battery Tester with Roll Chart........ 48.95
599—Tube and Set Tester with Roll Chart........ 62.50
565—Vacuum Tube Voltmeter........ 63.50
576—Signal Generator........ 68.95
805—Combination Tube and Set Tester with Roll Chart........ 89.50
546—Oscilloscope........ 89.75

(3) McMURDO SILVER CO.

905—"Sparx" Dynamic Signal Tracer........ $39.90
904—Capacitance Resistance Bridge........ 49.90
900—"Vomax" Vacuum Tube Voltmeter........ 59.85
906—A.M.-F.M. Signal Generator........ 89.90

(4) RADIO CITY PRODUCTS

447—Multi-Tester........ $17.95
448—Multi-Tester........ 24.50
322—Dynoptimum Tube Tester........ 41.50
461-P—Sensitive Multi-Tester 20,000 ohms per volt DC........ 42.63
664—Electronic Multi-Tester........ 45.00
705—Signal Generator........ 49.50
315—Rollchart Tube Tester........ 59.50
802N—Combination Tube and Set Tester........ 59.50
668—V.T.V.O. Capacity Meter........ 73.01
805—Combination Tube and Set Tester........ 89.50
665A—V.T. "Billionaire" Insulation Tester plus VTVM........ 92.61

(5) SUPERIOR INSTRUMENTS

CA-11—Signal Tracer........ $18.75
670—Super Meter........ 28.40
CA-12—Audible-Visual Signal Tracer........ 34.85
450—Tube Tester........ 39.50
650—Signal Generator........ 48.75
400—Electronic Multi-Tester........ 52.50
600—Combination Tube and Set Tester........ 62.50

(6) SHALLCROSS MFG. COMPANY

Decade Resistance Boxes........ $13.50
Portable Galvanometers........ 27.50
630—Wheatstone Bridge........ 75.00
637—Kelvin Wheatstone Bridge........ 100.00
638-2—Kelvin Wheatstone Bridge........ 150.00

(7) ALLEN B. DUMONT LABORATORIES

185A—Electronic Switch and Square Wave Generator........ $105.00
274—5" Oscilloscope........ 115.50

(8)
WATERMAN "Pocket" Oscilloscope........ 55.00
MONITOR Crystalliner Signal Generator........ 57.50
Bliley Crystal Controlled Signal Generator........ 69.50

WESTON—689-1F Ohmmeter, including leather carrying case, list $25.50.... 14.85
200—Electronic Measurements Mutual Conductance Tube Tester........ 49.85

TERMS: 25% deposit, balance C. O. D. or Full Payment with order

SEND FOR FREE CATALOG!

Metropolitan **ELECTRONIC & INSTRUMENT CO.**
Dept. R, 6 MURRAY STREET
NEW YORK 7, N. Y., U. S. A.
Cable Address: METRONICS
Phone: BArclay 7-5556

To resonate at 10,000 c.p.s., remove a few turns at a time from the coil until the circuit offers a maximum suppression at 10,000 c.p.s. If no a.f. oscillator is available, this will have to be done by ear, using the station from which the most trouble with the 10 kc. whistle is encountered. The number of turns to be removed will be somewhere between 8 and 12, so it is suggested that it be done very carefully.

If an accurate bridge is available, connect the two capacitors in parallel, and measure their capacitance. Then calculate the required inductance by means of the formula (for a frequency of 10,000 c.p.s): $L = .254/C$ where L is in millihenries and C is in microfarads. Then using the bridge, the coil may be adjusted to the required inductance.

The same circuit can be used in 500 or 600 ohm lines, using good coils with an inductance in the order of 300 to 500 mh. When the resistance is adjusted for the coil selected, the rejection is theoretically infinite at the resonant frequency. Both capacitors should have the same value, and the adjustment of the resistance is critical.

When connected in low-level circuits, it is simple to compensate for the insertion loss by increasing the gain of the following amplifier by the required amount.

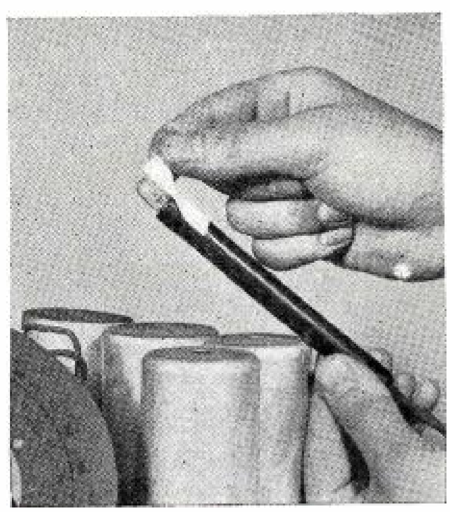
This filter is not recommended for use in speaker circuits where a large amount of power is being supplied, since the losses are too great, but for ordinary residence radio use, it will generally be satisfactory to install it in this manner, since the speaker power requirements are rarely high enough for the losses to be objectionable.

—30—

ELIMINATE GLARE FROM PROBE LAMP

A PROBE lamp of the type shown, unless shielded, is difficult to look past at a near point—such as in a dark corner of a radio chassis.

A small piece of adhesive or friction tape applied on one side as illustrated will improve the usefulness of this tool. . . . . H.L.



4-Watt Amplifier
(*Continued from page 40*)

The actual wiring of the tube sockets, etc., is done first. As much of the wiring on the underside of the top plate as possible is completed before this plate is placed on the main part of the utility box. Wires going to the two volume controls, the power switch, the two input jacks, the output transformer, and the filter choke are terminated at solder lug terminal strips located at strategic places to be connected to those components after the top plate is in place.

Adequate filtering and shielding within the amplifier is necessary to keep hum at a minimum. The filtering is provided for by the filter choke with two 50 μfd., 150 w.v. filter condensers bypassing it, and by the 25,000 ohm decoupling resistor R_{11}, and the 20 μfd., 150 w.v. decoupling condenser bypassing it. Shielding is provided by placing a small coil shield can over the underside of the 6SJ7 tube socket after all wiring connections have been completed. The wires to the cathode resistor and condenser, the screen bypass condenser, the "B" plus decoupling condenser ("B" plus power supply), and also to the coupling condenser C_3 are brought out from under this shield can by making small notches around its edge to clear each of these wires. The wire to the microphone jack is brought out through a grommet inserted in the top of this shield can. Several things should be carefully noted in the manner of shielding and grounding the various wires in the amplifier. The wires running between the two gain controls,

RADIO SHOP AT BARKER BROS.

By MARK McMILLIN

BARKER BROS., Los Angeles, recently opened its newly enlarged and decorated Radio Shop, which has at once established itself as one of the finest on the Pacific Coast. One-half block in length, and conveniently situated on the huge oblong mezzanine, the new shop is extremely spacious, colorfully decorated in the modern style, and unusually complete in every detail.

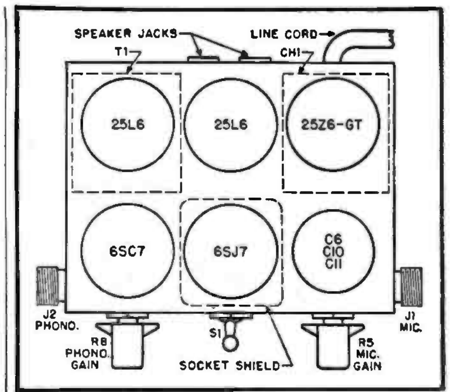
Beige and soft turquoise, with touches of off-white, are the colors used in the handsome decorations. The carpeting is of light beige, with chairs of a lighter shade. The woodwork and walls are of soft turquoise, trimmed with off-white. Likewise the counters and display racks are of the same tones. All lighting is indirect.

At one end of the department are eleven audition rooms, five large and six small. The shop is equipped with all the leading makes of radios, phonographs, and combination sets, including Hoffman, General Electric, Zenith, Crosley, Westinghouse, Tempo-Tone, Musaphonic, Sentinel, Packard-Bell, RCA Victor, Emerson, Echophone, and others. In addition, the shop carries a complete line of records and record albums and all the other accessories to appeal to radio and phonograph fans.

At the far end of the department, the entire wall is covered with a huge frosted glass map of the world, showing the radio waves joining the various hemispheres. This is indirectly lighted from behind, and is especially appealing to patrons and other visitors. The new Radio Shop is so comfortable, handsome, and completely equipped that it has rapidly become one of the favorite shopping spots of Los Angeles shoppers.

-30-

The well-planned Radio Shop at Barker Bros., Los Angeles, is one-half block in length and handsomely decorated in modern style. The world radio map, to be seen on the rear wall, is a feature which has found wide appeal among the store's patrons.



Mechanical layout shows relative position of the various component parts.

and from the gain controls to the amplifier assembly proper should be shielded. All ground connections in the microphone pre-amplifier circuit (the 6SJ7) should be *grounded at one place.* Hum will be introduced if this instruction is not carefully followed. It should be noted that the shielding on all wires, and the ground return circuit from the microphone and phonograph jacks, is connected to the *amplifier* ground and not the *chassis* ground. The only shielding connected to the chassis ground is the can covering the base of the 6SJ7. All other shielding is connected to the amplifier ground. Since this is a.c.-d.c. equipment and the amplifier ground must necessarily be connected directly into one side of the line power cord, the chassis is isolated from the amplifier ground by the condenser C_9. The microphone and phonograph input jacks must be insulated from the chassis by fiber grommets. These jacks, as has been already stated, are grounded to the amplifier ground.

Beyond the observations that have just been made, the points in the construction of this amplifier are conventional. It should be noted that the filter condenser is grounded to the amplifier ground, and is mounted on the chassis by an insulating fiber plate.

—30—

SERVICEMEN GET RAISE

SEATTLE, Washington radio and appliance servicemen have been granted a 15% wage increase and a 40-hour week for all shops by terms of a new contract recently signed by the Association of Appliance Dealers and the Radio Service Unit, Local B-77 of the I.B.E.W.

The new agreement affects nearly 250 servicemen employed by approximately 175 radio and appliance dealers, service shops and furniture stores with service departments. Department stores are covered by another contract.

Retroactive to October 1, 1946, the wage rate for full-time and part-time journeymen was raised from $1.30 to $1.50 per hour while the rate for shop managers was lifted from $1.45 to $1.65, thus maintaining the 10% differential over the journeyman wage.

Other contract changes further define holiday pay and shop manager provisions. —30—

Manufacturers' Literature

Readers are asked to write directly to the manufacturer for the literature. By mentioning RADIO NEWS, the issue and page, and enclosing the proper amount, when indicated, delay will be prevented.

OHM'S LAW CALCULATOR

Ohmite Manufacturing Company of Chicago has announced the availability of their new Ohm's Law Calculator which incorporates several unique features.

The new calculator, like the previous ones, provides a simple and handy means of evolving resistance calculations. With one setting of the slide it gives the answer to any Ohm's Law problem. It will also solve parallel resistance and series capacitance problems and will multiply, divide, and find squares and square roots. The range covers all currents, resistances, voltages and wattages commonly encountered in industrial and radio work.

All computing scales of the new calculator are printed on one side. On the opposite side are given the Composition Resistor Color Code and the catalogue number of stock resistors and rheostats of various resistance values manufactured by the company.

Copies of this calculator are selling for 25 cents and may be secured from *Ohmite Manufacturing Company,* 4937 Flournoy Street, Chicago, Illinois.

APPLIANCE PROMOTION

Of interest to radio dealers who handle an appliance line is the new 24-page, full-color book issued by *General Electric Company.*

The booklet, entitled "Does Your Home Have a Place for Living," covers suggested plans for various appliance installations in the modern home. The planning of various service areas is discussed fully and completely illustrated.

Dealers who wish to secure a copy of this handy guide to electrical living should address their requests to the Advertising Division, *General Electric Company,* Bridgeport, Connecticut. The booklet carries a charge of ten cents per copy.

RECEIVING TUBES

Radio Corporation of America has recently issued a new 16-page booklet entitled "Receiving Tubes for Television, FM and Standard Broadcast" which is currently available for distribution.

This booklet charts the characteristics and socket connections of the company's line of receiving tubes, including projection and direct-view kinescopes. All types are listed in numerical-alphabetical sequence of type designations for the convenience of the user. Metal and miniature types are separately identified. Information on discontinued tube types has been included for the benefit of radio servicemen.

An added feature is the special chart which classifies *RCA* receiving tubes according to their functions and their cathode voltages.

Copies of Form 1275-B are 10 cents each and may be obtained from *RCA* distributors or direct from Commercial Engineering, Tube Department, *Radio Corporation of America,* Harrison, New Jersey.

SERVICE MANUAL

A complete service manual, covering every model of "Porta Power" together with full parts lists, is being offered by *General Transformer Corporation* of Chicago.

Designed specifically to aid radio servicemen and dealers, this manual contains full servicing information to speed repairs.

Copies will be sent to those who request them from *General Transformer Corporation,* 1260 West Van Buren Street, Chicago, Illinois.

ELECTRONIC COMPONENTS

Of interest to design engineers and purchasing agents is the new Catalogue 200 recently issued by *Cambridge Thermionic Corporation* of Cambridge, Massachusetts.

This new 20-page, tabbed-section catalogue contains specification sheets covering the company's line of terminal lugs, terminal boards, slug-tuned coils and swagers.

Copies of Catalogue 200 will be forwarded upon request to Department 8, *Cambridge Thermionic Corporation,* 445 Concord Avenue, Cambridge, 38, Massachusetts.

TUBE BOOKLET

Just off of the press and available from the company's distributors is the new *RCA* 16-page booklet, "Power and Gas Tubes for Radio and for Industry."

This booklet contains technical information on 138 *RCA* water- and air-cooled power tubes, voltage regulators, thyratrons, ignitrons and gas rectifiers. Each tube is covered by a text description and ample tabulated data, together with a terminal diagram.

Copies of this publication (PG-101) are available at *RCA* distributors or from Commercial Engineering, Tube Department, *Radio Corporation of America,* Harrison, New Jersey. The booklet is priced at 10 cents a copy.

HYTRON TUBE GUIDE

Hytron Radio and Electronics Corporation is currently distributing copies of their new "Reference Guide for Miniature Electron Tubes."

Designed to be inserted in regular servicing binders, this guide lists in

easy-to-read tabular form the tube type, description, ratings, circuit applications and typical operation and characteristics of over fifty miniature tube types. Basing diagrams are also included on this single chart.

A copy of this guide may be secured by writing *Hytron Radio and Electronics Corporation,* Salem, Massachusetts.

MULTI-ANALYST

Details of the company's new "Multi-Analyst" are contained in a four-page bulletin being distributed by *Electronic Instrument Co., Inc.* of Brooklyn, New York.

This test instrument, which is suitable for all types of radio servicing including AM, FM and television receivers, is completely described and its operation explained in this free bulletin.

Copies of this publication are available from *Electronic Instrument Co., Inc.,* 926 Clarkson Avenue, Brooklyn, 3, New York.

TECHNICAL BULLETINS

Division Lead Company of Chicago has announced the availability of four new technical bulletins covering two models of wire strippers, their rosin core solder and the company's line of rosin fluxes.

Details of the wire strippers are contained in Bulletins 1-A and 2-A, while the solder is described in Bulletin 3-A. Information about the fluxes is contained in the publication designated Bulletin 4-A.

Any or all of these bulletins is available to RADIO NEWS readers upon request to *Division Lead Company,* 836 West Kinzie Street, Chicago, 22, Illinois.

FM PROMOTION KIT

General Electric Company's Transmitter Division is currently distributing a new, complete promotion kit for FM stations to be used in the building of local audiences.

Bound in an easy-to-handle portfolio-type cover, the kit outlines proved methods of building audiences for new FM stations. Titled "How to Build an Audience for Your New FM Station," the package covers such subjects as promotion, programming, advertising, publicity, and personnel information.

Among the ready-to-use material is a complete set of spot announcements, window banners for radio-dealer tie-ins, newspaper advertisements and the first issue of a publicity clip sheet which will be published and distributed monthly as a continuing service to purchasers of *General Electric* FM transmitters.

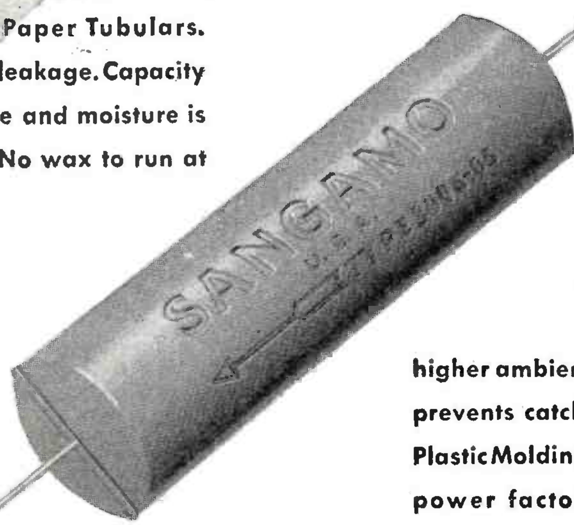
Prospective FM station owners and those already on the air with *GE* equipment should contact the Receiver Division, *General Electric Company,* Bridgeport, Conn. for their copy of this kit.

—30—

SANGAMO PAPER TUBULAR CAPACITORS

ARE NOW MOLDED IN PLASTIC

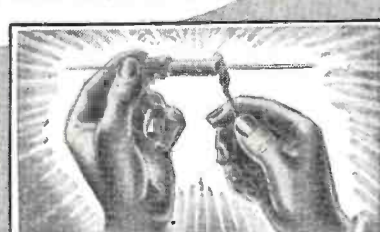
...just like micas!



Paper Tubular Capacitors, molded in Thermo-Setting Plastic! Designed for use in all circuits calling for Paper Tubulars. Plastic Molding means no leakage. Capacity values remain more stable and moisture is completely sealed out. No wax to run at higher ambient temperatures. Smooth finish prevents catching dirt and dust. All in all, Plastic Molding assures longer life and lower power factor. Specify Sangamo Plastic Molded Capacitors wherever you use Paper Tubulars.

...try these tests WITH SANGAMO PLASTIC TUBULARS ....

WRITE NOW for the New Sangamo Capacitor Catalog for full information on the Sangamo Line.



NO WAX TO MELT....even heat as intense as is encountered in soldering, will not cause leakage in the case or at the lead joint.

LEADS WILL NOT PULL OUT...Plastic Molding so tightly seals the leads in place, that under all conditions of normal use, leads will stay put.

SANGAMO ELECTRIC COMPANY SPRINGFIELD ILLINOIS

Around the Clock

(Continued from page 56)

EST	LOCATION	CALL	FREQ.*
	Br. Guiana (Caribbean News Bulletin)		
12:00 noon	Quarry Heights, Canal Zone	AFRS	2.390
12:00 noon	Moscow (To Britain)	Radio Centre	9.610 9.740 15.360 11.630
12:00 noon	New York	WCBN WCBX WCRC	15.270 17.830 21.570
	Schenectady	WGEO	15.330
	Boston	WRUL WRUW	15.290 17.750
	Via Munich, Germany		6.100 6.170 7.290
12:00 noon	Munich (Frankfurt), Germany	AFN	6.080
12:15 p.m.	Hamburg, Germany	BFN	7.290
12:30 p.m. (Thurs. *only*)	Omdurman, Anglo-Egyptian Sudan	Radio Omdurman	13.320 9.650I
12:30 p.m. (except Sun.)	Johannesburg, So. Africa		6.095 3.450
12:40 p.m.	Stockholm	SBT SDB-2 SBP	15.155 10.780 11.705I
12:45 p.m.	Ankara, Turkey	TAP	9.465
1:00 p.m.	Nairobi, Kenya (BBC)	VQ7LO	4.950 6.060
1:00 p.m.	Hamburg, Germany	BFN	7.290
1:00 p.m.	Accra, Gold Coast (BBC)	ZOY	4.915
1:00 p.m.	Salzburg, Austria (AFRS)	KOFA	7.220
1:00 p.m.	London (GOS, Twenty-Four Hour News, followed by Home News from Britain at 1:10 p.m.)	GVR GWG GSP GVX GSO GRF GSF GRH GSD GVS GVZ	21.675 15.110 15.310 11.930 15.180 12.095 15.140 9.825 11.750 21.700 9.640
1:00 p.m.	London (AS)	GSI GVW GRY GSN	15.260 11.700 9.600 11.820
1:00 p.m.	Montreal, Que.	CFCX	6.005
1:15 p.m.	Vatican	HVJ	9.660 5.970V 15.095I
1:25 p.m.	Nairobi, Kenya	VQ7LO	4.950 6.060
1:30 p.m.	Winnipeg, Manitoba	CKRX	11.720
1:45 p.m.	Brazzaville	FZI	9.440 11.970 17.530VI
1:50 p.m.	Milan (Originating in Rome)	Radio Italiana	11.810 9.630
2:00 p.m.	Cincinnati	WLWR1 WLWO WLWR	15.250 15.350 17.800
2:15 p.m.	Montreal, Quebec (To Europe)	CKCS CHOL	15.320 11.720
2:20 p.m. (except Sat.)	Bern (To North America)	HEI7	15.325V
2:30 p.m.	London (AS, Radio Newsreel)	GVW GRY GSN	11.700 9.600 11.820
2:45 p.m.	Montreal, Quebec (To Europe, Canadian Commentary)	CKCS CHOL	15.320 11.720
2:55 p.m.	Lourenco Marques, Mozambique	CR7AA CR7BJ CR7AB CR7BD	5.860 9.645I 3.493 15.230
3:00 p.m.	Capetown, So. Africa (SABC)		5.877V
(except Fri.)	Johannesburg (SABC)		6.095 3.450
3:00 p.m.	Hamburg, Germany	BFN	7.290
3:00 p.m. (Sun. 3:35 p.m.)	Madrid	RNE	9.369
3:00 p.m.	London (GOS)	GWG GRF GSB GWA GRH GSD GRW GVZ GSO	15.110 12.095 9.510 6.125 9.825 11.750 6.150 9.640 15.180
3:00 p.m.	Georgetown, Br. Guiana (BBC)	ZFY	6.000
3:00 p.m.	Halifax, Nova Scotia	CHNX	6.130
3:30 p.m.	Sofia, Bulgaria	Radio Sofia	9.350 7.670
3:30 p.m.	Belgrade, Yugoslavia	Radio Belgrade	6.100V
3:30 p.m.	Prague	OLR2A	6.010
3:45 p.m.	London (AS)	GVW GRY GSN	11.700 9.600 11.820
3:45 p.m.	Brazzaville	FZI	9.440 11.970 17.530V
3:45 p.m.	Munich, Germany		6.100 6.170 7.290
3:45 p.m.	Capetown, So. Africa (BBC)		5.877V
	Johannesburg (BBC)		6.095 3.450
3:50 p.m.	Bern	HER5	11.865
3:50 p.m.	Warsaw	Polskie Radio	6.115V
4:00 p.m.	United Network, U.S.A.	KNBA KCBF KWID KNBX KCBA	21.610 17.850 17.760 15.340 15.240
4:00 p.m.	Melbourne (To Britain, Europe)	VLA4	11.770
4:00 p.m.	London (GOS, Radio Newsreel)	GRF GWA GVZ GRW GVY	12.095 6.125 9.640 6.150 11.955
4:15 p.m.	New York	WCBX WCRC	9.490 11.830
	Schenectady	WGEO	15.330
	Boston	WRUL WRUW	15.290 11.730
4:30 p.m. (Mon., Thurs. to Britain; Sun., Postbag)	Ankara, Turkey (Talk)	TAP	9.465
4:30 p.m.	London (European Service)	GSW GWL GRO GRG	7.230 7.210 6.180 11.680
4:45 p.m.	Montreal, Quebec (To Europe)	CHOL CKLO	11.720 9.630
4:45 p.m.	London (NAS)	GWH GSC GRH	11.800 9.580 9.825
4:45 p.m.	Melbourne (To Forces) (To Britain, Europe)	VLB6 VLC10 VLA4	15.200 21.680 11.770
5:00 p.m.	Los Angeles (AFRS)	KGEI KGEX	15.130 15.210
	Via Honolulu	KRHO	17.800
5:00 p.m.	United Network, U.S.A.	KNBA KCBF KWID KNBX WBOS KCBA	21.610 17.850 17.760 15.340 15.250 15.240
5:00 p.m.	Hamburg, Germany	BFN	7.290
5:00 p.m.	Moscow (To Britain)	Radio Centre	6.160 7.300 7.330 9.680
	Via Kiev		6.020
5:00 p.m.	Halifax, Nova Scotia	CHNX	6.130
5:00 p.m.	Munich (Frankfurt, Germany)	AFN	6.080
5:00 p.m.	Salzburg, Austria (AFRS)	KOFA	7.220
5:00 p.m.	Quito, Ecuador (Relayed from United Network, U.S.A.)	HCJB	12.455 15.115 9.958
5:05 p.m.	Los Angeles (AFRS, At Dictation Speed)	KGEI KGEX	15.130 15.210
	Via Honolulu	KRHO	17.800
5:15 p.m.	Brazzaville (To Britain)	FZI	9.440 11.970 9.984 6.024
5:15 p.m.	Kingston, Jamaica (World News)	ZQI	4.700
5:30 p.m.	Halifax, Nova Scotia	CHNX	6.130
5:30 p.m.	St. John's Newfoundland	VONH	5.970
5:30 p.m.	Edmonton, Alberta	VE9AI	9.540
5:30 p.m.	London (European Service)	GSA GRJ	6.050 7.320
6:00 p.m.	London (GOS)	GSB GSD GVY	9.510 11.750 11.955
	Via Georgetown, Br. Guiana	ZFY	6.000
6:00 p.m.	Los Angeles (AFRS)	KNBA KNBI KCBR	21.610 17.770 15.330

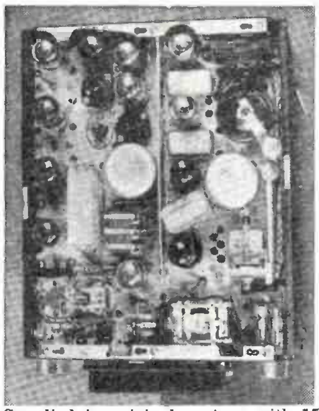
(Continued on page 112)

EST	LOCATION	CALL	FZEQ.*
		KWIX	15.290
		KGEI	15.130
		KGEX	15.210
	Via Honolulu	KRHO	17.800
6:00 p.m.	United Net-	KCBF	17.850
	work, U.S.A.	KWID	17.760
		KNBX	15.340
		WBOS	15.250
		KCBA	15.240
6:00 p.m.	Salzburg, Aus-	KOFA	7.220
	tria (AFRS)		
6:00 p.m.	Quarry	AFRS	2.390
	Heights,		
	Canal Zone		
6:00 p.m.	Halifax, Nova	CHNX	6.130
	Scotia		
6:25 p.m.	Kingston,	ZQI	4.700
(except Sun.)	Jamaica		
	(Headlines)		
6:25 p.m.	Moscow (To	Radio	11.890V
	North	Centre	9.480
	America)		7.240V
			7.300
			7.360
	Via Komsomolsk		15.230
	Via Kiev		6.020
6:30 p.m.	Montreal,	CKRZ	6.060
	Quebec (To	CKRA	11.750
	Latin America)		
6:30 p.m.	Sydney, Nova	CJCX	6.010
	Scotia		
6:30 p.m.	Toronto,	CFRX	6.070
	Ontario		
6:30 p.m.	St. John's	VONH	5.970
(irreg.)	Newfoundland		
	(Messages)		
6:45 p.m.	London (NAS)	GWH	11.800
		GSC	9.580
		GRH	9.825
7:00 p.m.	Brazzaville (To	FZI	9.440
	North		11.970
	America)		9.984
7:00 p.m.	London (GOS,	GSB	9.510
	Radio	GSD	11.750
	Newsreel)	GVY	11.955
		GRW	6.150
7:00 p.m.	Los Angeles	KNBA	21.610
	(AFRS)	KNBI	17.770
		KCBR	15.330
		KWIX	15.290
	Via Honolulu	KRHO	17.800
7:00 p.m.	United Net-	KCBF	17.850
	work, U.S.A.	KWID	17.760
		KNBX	15.340
		WBOS	15.250
		KCBA	15.240
		WLWO	11.790
		WRUW	9.550
7:00 p.m.	Melbourne (To	VLA9	21.600
	East U.S. and		
	Canada)		
7:00 p.m.	Moscow (To	Radio	11.890V
	North	Centre	9.480
	America,		7.240V
	Moscow		7.300
	Newsreel)		7.360
	Via Komsomolsk		15.230
	Via Kiev		6.020
7:08 p.m.	Prague (to	OLR5A	15.230
(irreg.)	North America)		
7:15 p.m.	Helsinki (Lah-	OIX2	9.505V
(or 7:25 p.m.)	ti), Finland		
	(To North	OIX4	15.190
	America)		
7:15 p.m.	Leopoldville	OTC2	9.745V
	(To North		
	America)		
7:15 p.m.	Georgetown,	ZFY	6.000
	Br. Guiana		
	(Caribbean News		
	Bulletin)		
7:30 p.m.	Winnipeg,	CKRX	11.720
	Manitoba		
7:30 p.m.	Moscow (To	Radio	7.300
	North	Centre	7.240V
	America)		9.480
	Via Kiev		6.020
7:30 p.m.	London (NAS,	GWH	11.800
	Radio	GSC	9.580
	Newsreel)	GRH	9.825
		GSL	6.110
8:00 p.m.	Los Angeles	KNBA	21.610
	(AFRS)	KNBI	17.770
		KCBR	15.330
		KWIX	15.290
	Via Honolulu	KRHO	17.800
8:00 p.m.	United Net-	KCBF	17.850
	work, U.S.A.	KNBX	15.340
		WBOS	15.250
		KCBA	15.240
		WLWO	11.790
		KWID	9.570
		WRUW	9.550
8:00 p.m.	St. John's	VONH	5.970
	Newfoundland		
8:00 p.m	Quarry	AFRS	2.390
	Heights, Canal		
	Zone		
8:00 p.m.	Moscow (To	Radio	7.300
	North	Centre	7.240V
	America,		9.480
	Moscow Newsreel)		
	Via Kiev		6.020
8:00 p.m.	Colombo,	Radio	5.120
	Ceylon	SEAC	6.075
	(BBC)		7.185I
8:00 p.m.	London (NAS)	GWH	11.800
		GSC	9.580
		GRH	9.825
		GSL	6.110
8:00 p.m.	London (GOS,	GSB	9.510
	followed	GRW	6.150
	irreg. by	GSD	11.750
	Home News	GWA	6.125
	from Britain		
	at 8:10 p.m.)		
8:00 p.m.	Georgetown,	ZFY	6.000
	Br. Guiana		
	(BBC)		
8:05 p.m.	Stockholm (To	SBU	9.535
	North	SDB-2	10.780
	America)		
8:10 p.m.	Leopoldville	OTC2	9.745V
	(To North		
	America)		
8:15 p.m.	Colon, Panama	HP5K	6.005
8:30 p.m.	Moscow (To	Radio	7.300
	North	Centre	7.240V
	America)		9.480
	Via Kiev		6.020
8:30 p.m.	Rangoon,	Radio	9.543
	Burma	Rangoon	
	(Headlines)		
8:45 p.m.	Bern (To	HER3	6.165I
(except Sat.)	North	HEI4	9.539
	America)	HER5	11.865I
9:00 p.m.	Honolulu	KRHO	17.800
	(AFRS)		
9:00 p.m.	United Net-	KCBF	17.850
	work, U.S.A.	KNBX	15.340
		WBOS	15.250
		KCBA	15.240
		KCBR	11.790
		KWID	9.570
9:00 p.m.	Colombo, Cey-	Radio	4.900
	lon (BBC)	Colombo	
9:00 p.m.	Quarry	AFRS	2.390
	Heights,		
	Canal Zone		
9:00 p.m.	Edmonton,	VE9AI	9.540
	Alberta		
9:00 p.m.	Paris (To	RNF	9.550
	North		11.845V
	America)		9.520I
9:00 p.m.	Kingston,	ZQI	2.330
(Sun. only?)	Jamaica		
9:00 p.m.	St. John's,	VONH	5.970
	Newfoundland		
9:00 p.m.	Sydney, Nova	CJCX	6.010
	Scotia		
9:20 p.m.	St. John's	VONH	5.970
(irreg.)	Newfoundland		
9:30 p.m.	Delhi	AIR	15.190
			7.290
			6.190
			9.670
			11.760
	Bombay		6.150
	Madras		6.085
	Calcutta		6.010
9:30 p.m.	London (GOS)	GSB	9.510
		GVY	11.955
10:00 p.m.	Colombo,	Radio	15.120
	Ceylon	SEAC	6.075
10:00 p.m.	Colon, Panama	HP5K	6.005
10:00 p.m.	Quarry	AFRS	2.390
	Heights,		
	Canal Zone		
10:00 p.m.	Honolulu	KRHO	17.800
	(AFRS)		
10:00 p.m.	Sydney, Nova	CJCX	6.010
	Scotia		
10:00 p.m.	Vancouver,	CBRX	6.160
	B. C.		
10:00 p.m.	London (GOS,	GSB	9.510
	Twenty-	GSD	11.750
	Four Hour	GRW	6.150
	News)	GSL	6.110
		GRH	9.825
		GWA	6.125
10:00 p.m.	Melbourne	VLG5	11.880
	(To Forces)	VLC9	17.840
		VLA9	21.600
10:30 p.m.	Paris (To	RNF	9.550
	North		11.845V
	America)		9.520I
10:30 p.m.	Delhi	AIR	15.190
			21.510
			17.830
			15.160
			11.870
10:45 p.m.	Panama City	HOXA	15.100
11:00 p.m.	Honolulu	KRHO	17.800
	(AFRS)		
11:00 p.m.	Quarry	AFRS	2.390
	Heights,		
	Canal Zone		
11:00 p.m.	London (GOS,	GWA	6.125
	followed by	GRY	9.600
	Home News	GRX	9.690
	from Britain	GSB	9.510
	at 11:05	GSD	11.750
	p.m.)	GWO	9.625
		GSN	11.820
11:00 p.m.	Colombo,	Radio	15.120
	Ceylon	SEAC	6.075
11:00 p.m.	Winnipeg,	CKRO	6.150
	Manitoba		
11:15 p.m.	London (GOS,	GWA	6.125
	Radio	GRX	9.690
	Newsreel)	GSB	9.510
		GSD	11.750
		GWO	9.625

(*Continued on page* 114)

BUFFALO RADIO SUPPLY, 219-221 Genesee St., Dept. 3N, BUFFALO 3, N. Y.

General Electric RT-1248 15-Tube Transmitter-Receiver



TERRIFIC POWER (20 watts) on any 2 instantly selected, easily pre-adjusted frequencies from 435 to 500 Megacycles. Transmitter uses 5 tubes including a Western Electric 316 A as final. Receiver uses 10 tubes including 955's as first detector and oscillator, and 3—7H7's as IF's, with 4 slug-tuned 40 MC. IF transformers, plus a 7H7, 7E6's, and 7F7's. In addition unit contains 8 relays designed to operate any sort of external equipment when actuated by a received signal from a similar set elsewhere. Originally designed for 12V operation, power supply is not included, as it is a cinch for any amateur to connect this unit for 110V AC, using any supply capable of 400V DC at 135 MA. The ideal unit for telephone use as in a taxicab, or for any kind of remote control applications as with drone airplanes. Instructions and diagrams supplied for running the RT-1248 transmitter on either code or voice, and for using the receiver as either an AM or FM set. As an FM set, the receiver section of the 1248 is capable of better results than almost any of the commercial FM sets on the market, largely as a result of the superb engineering and meticulous workmanship employed in constructing the converter, oscillator and IF sections. Supplied in original cartons with 15 tubes. Your cost **$29.95.**

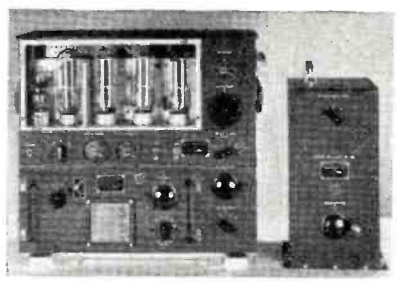
10% less if ordered in lots of 2 or more. If desired for marine or mobile use, the dynamotor, which will work on either 12 or 24 V.D.C. and supply all power for the set, is only $15.00 additional.

BENDIX SCR-522—Very High Frequency Voice Transmitter-Receiver—100 to 156 MC. This job was good enough for the Joint Command to make it standard equipment in everything that flew, even though each set cost the Gov't $2500.00. Crystal Controlled and Amplitude Modulated—High Transmitter Output and 3 Microvolt Receiver Sensitivity gave good communication up to 180 miles at high altitudes. Receiver has 10 tubes and transmitter 7 tubes, including 2—832's. Furnished complete with 17 tubes, and D.C. Dynamotor power supply for 12 or 24 volts, also remote control boxes and cable connectors. We include complete diagrams and instructions for the simple conversion of the 522 to full 110 Volt 60 Cycle operation. Your cost—**$44.50.**

General Electric 150-Watt Transmitter

Cost the Government $1800.00. Now Only $44.50!!!

(Can be used by amateurs without any changes or modifications!)



This is the famous transmitter used in U. S. Army bombers and ground stations during the war. Its design and construction have been proved in service, under all kinds of conditions, all over the world. The entire frequency range is covered by means of seven plug-in tuning units which are included. Each unit has its own oscillator and power amplifier coils and condensers, and antenna tuning circuits—all designed to operate at top efficiency within its particular frequency range. Transmitter and accessories are finished in black crackle, and the milliammeter, voltmeter, and RF ammeter are mounted on the front panel. Here are the specifications: **FREQUENCY RANGE:** 200 to 500 KC and 1500 to 12,500. (Will operate on ten and twenty meter band with slight modification). **OSCILLATOR:** Self-excited, thermo compensated, and hand calibrated. **POWER AMPLIFIER:** Neutralizes class "C" stage, using 211 tube, and equipped with antenna coupling circuit which matches practically any length antenna. **MODULATOR:** Class "B"—uses two 211 tubes. **POWER SUPPLY:** Supplied complete with dynamotor which furnishes 1000 volts at 350 MA. Complete instructions are furnished to operate set from 110V AC. **SIZE:** 21½x23x9¼ inches. Total shipping weight, 250 lbs., complete with all tubes, dynamotor power supply, seven tuning units, antenna tuning unit and the essential connector plugs. These transmitters are priced to move fast; order today, and be the proud owner of one of the finest rigs obtainable.

Six Band Communications Receiver BC-348 R

Featuring coverage from 200 to 500 KC and 1500 to 1800 KC on a direct reading dial with the finest vernier drive to be found on any radio at any price—extreme sensitivity with a high degree of stability—crystal filter—BFO with pitch control—antenna compensation—standard six volt tubes. Contains a plate supply dynamotor in compartment within the handsome black crackle finish cabinet, the removal of which leaves plenty of room for installation of a 110V, 25 or 60 cycle power supply. These receivers, which make any civilian communications receiver priced under $200.00 look cheap and shabby by comparison, are only **$44.50.** Power supply kit for conversion to 110V, 25 or 60 Cycle is only **$8.50** additional.

274 N COMMAND SETS, including 3 separate 6 tube superhet receivers, 2 separate transmitters, each with 40 watts output, and a 24 V. dynamotor unit. Bargain price for all 6 pieces complete with tubes—**$39.95.**

Instrument Bargains of a Lifetime!!!!

NEW BC-221 FREQUENCY METERS with calibrating crystal and calibration charts. A precision frequency standard that is useful for innumerable applications for laboratory technician, serviceman, amateur, and experimenter, at the give-away price of only **$39.95.**

RADAR OSCILLOSCOPES—Complete with 27 tubes including 5" cathode ray tubes—**$39.95.**

RADAR RECEIVER INDICATOR OSCILLOSCOPES—Complete with 29 tubes including 3" cathode ray tubes—**$39.95.**

AIRCRAFT MARKER BEACON RECEIVER—Complete with 3 tubes and sensitive relay to control external circuits from received signals. Just the receiver you have been waiting for to control models, open doors from a distance, etc. Priced at only **$4.95.**

AIRPLANE INTERCOM AMPLIFIER—Complete with 4 tubes in aluminum case—**$4.95.**

BC-654 Transmitter-Receiver—Brand new, complete with 200 Kc. calibrating crystal and 17 tubes—**$39.95.**

SERVICEMEN

Check This Column for Lowest Prices on Quality Parts

TUBES: A warehouse full, including the new miniatures. Order all types you need. We'll try to supply you completely. **Special this month: Sylvania 6V6gt—3 for $2.00;** RK-75 or 307 Transmitting tubes only **$2.50 each;** 6L6G—99c; 6SD7 (replaces 6SK7)—59c.

POWER TRANSFORMERS—Half-shell type, 110V 60 cy. Centertapped HV winding. Specify either 2.5 or 6.3V filament when ordering.

For 4-5 tube sets—650V, 40MA, 5V & 2.5 or 6.3V....$1.49
For 5-6 tube sets—650V, 45MA, 5V & 2.5 or 6.3V.... 1.75
For 6-7 tube sets—675V, 50MA, 5V & 2.5 or 6.3V.... 1.90
For 7-8 tube sets—700V, 70MA, 5V & 6.3 or two 2.5.. 2.35
For 9-11 tube sets—700V, 100MA, 5V & 6.3 or two 2.5V 2.85
For 9-15 tube sets: 600V, 150MA; 5V & 6.3V.......... 2.95

TRANSFORMERS—All types in stock. **AUTO-TRANSFORMERS;** Steps up 110v to 220v, or steps down 220v to 110v—$1.95. **FIL. TRANS.;** 6.3v, 8 Amps.—$1.98; 5v, 10 Amps.—$1.98; Universal Output Trans. 8 Watt—89c; 18 Watt—$1.29; 30 Watt—$1.69. **AUDIO TRANSFORMERS:** S. Plate to S. Grid. 3:1—79c; S. Plate to P.P. Grids—79c; Heavy Duty Class AB or B, P.P. inputs—$1.49; Midget Output for AC-DC sets—69c; **MIKE TRANSFORMER** for T-17 Shure microphone, similar to UTC ouncer type—$2.00.

MICROPHONES—All types, nationally known brands. Bullet crystal—$5.45; Bullet Dynamic—$7.45; Mike Jr.—60c; Handy Mike—90c; Lapel Mike—93c; Shure T-17 Mikes, with push to talk switch—99c.

CONDENSERS — PAPER TUBULAR 600 WV—.001—8c; .002—8c; .005—8c; .01—9c; .02—9c; .05—10c; .1—10c; .25—23c; .5—36c; **ELECTROLYTICS:** 8mfd. 200v—20c; 10mfd. 35v—20c; 30mfd. 150v—23c; 20/20mfd. 150v—35c; 30/20mfd. 150v—46c; 50mfd. 150v—43c; 8mfd. 475v—35c; 16mfd. 350v—65c: **OIL-CONDENSERS:** 4mfd. 600v—49c; **VARIABLE CONOENSERS:** 3 gang 350mmfd.—83c; 7.5-20mmfd. 1750v. Extra long shaft Hammarlund—only 69c; Miniature Variable condensers: 25mmfd.—39c; 50mmfd.—49c; 75mmfd.—49c; 100mmfd.—54c; 140mmfd.—69c.

PERMEABILITY TUNERS—Attractive slide-rule dial, compactly replaces dial, tuning condensers, oscillator and antenna coils in broadcast band receivers. Special $3.43.

WILLARD rechargeable 2 volt storage batteries for G.E. portable radios $2.95.

SPEAKERS-PM dynamic type-4"—$1.55; 5" $1.55; 6"—$1.95; 8"—$3.95; 10"—$5.95; 12"—$7.50.

CRYSTAL PICK-UPS—Two nationally known makes, one $1.90, the other at $2.29.

PHONO-MOTORS—110V, 60 Cycle, with turntable—$4.25.

HEADPHONES—Highest quality Signal Corps headsets with sponge rubber ear cushions. 12" cord and plug $1.00. 5' rubber covered patchcords with phone plug and socket—25c.

RELAYS—Guardian SPST 12-24v, has heavy duty 15 Amp. Contacts—$1.25; Guardian 12 to 24v D.C. triple make, single break relay, 5 for $3.75; Sigma supersensitive 2000 ohm D.C. SPDT Relay. (May be adjusted to operate on less than 1 Milliampere)—$2.50.

SELENIUM RECTIFIERS—Dry disc type 1½" by 1", 1.2 Amp. maximum, suitable for converting DC relays to AC, for supplying filament source in portable radios, converting DC meters to AC applications, and also may be used in low current chargers—90c.

METER RECTIFIERS—Full wave, may be used for replacement, or in construction of all types of test equipment—$1.25. Half Wave—90c.

FILTER CHOKES—200, 300, 400, 500 ohm light duty—59c; 200 ohm hvy. dty.—99c; 250 MA, 35 ohms DC res. Made for U. S. Navy. Fully shielded—$1.95.

LINE FILTERS—110V—each unit contains two 2 mfd. oil filled condensers and a 15 amp. iron core choke. This filter has innumerable uses such as oil burner line filter, etc. A ten dollar value for 98c.

PHONO AMPLIFIERS—A real AC, 110V, 60 Cycle, 6 Watt Amplifier suitable for PA systems and phonographs; with a husky power transformer. Complete with tubes—$12.95.

PUBLIC ADDRESS AMPLIFIERS—25 Watts peak output, 5 tubes, separate controls for Microphone and Phono Inputs. $65.00 value for only $32.00.

WIRE—No. 18 POSJ 2 conductor parallel zipcord, brown. 250' spools—$5.25, 500' spools—$9.95, No. 18 PO brown rayon covered parallel lampcord, 500' spools—$12.25. No. 18 SV round rubber covered double wire for wash machines, vacuum cleaners, etc. 250' spools—$6.95. Rubber covered mike cable 250' Spools—$25.00. All kinds hook-up wire 1c per ft., transmission line, 50 ohm impedance RG8U, cut to any length, 8c per ft. Single stranded conductor shielded lead with brown rubber over shield, super special, $1.20 per 100 ft., $10.00 per 1000 ft.

PORTABLE AIR COMPRESSOR—Attaches to any ¼ H.P. motor. Just the thing for refinishing radios, painting cars, blowing out chassis, etc. 100 lb. gauge and syphon type gun with 12½ feet of rubber hose included. Pressure adjustable to stay constant at any value up to 100 lbs.—Net price—$22.25 prepaid.

Famous Collins Autotune Transmitter

This is the well known unit used in Army and Navy planes that features automatic motor tuning of any of 11 front-panel pre-selected frequencies up to 18,100 Kc., as well as the manual tuning possible any time. The transmitter operates on voice, CW, and MCW on all frequencies. This beautifully designed unit uses an 813 final, and push-pull 811's as modulator, measures 23½ x 13¼ x 11, and weighs 70 lbs. Estimated average power output is 150 Watts. Plans provided for easy 110v. conversion. Complete with 24v. dynamotor & all tubes & connectors, only $139.95.

110 Volt Power Plant

110V, 60 Cycle generator direct-connected to gasoline engine. Worth a million for emergency or standby service for hospitals, theaters, hotels or for general service in hunting lodges, camps or boats. A gift at $175.00. We can also supply the above unit for the same price with a direct coupled 32 volt D.C. generator, in which case we include absolutely free our $29.95 32 Volt D.C. to 110 Volt A.C. converter which can also be used to supply 110V. A.C. from batteries or farm lighting plants.

RADIOMEN'S HEADQUARTERS ❋ WORLD WIDE MAIL ORDER SERVICE!!!

EST	LOCATION	CALL	FREQ.*
		GSN	11.820
		GRF	12.095
		GRN	6.195
		GRY	9.600
12 midnight	Honolulu (AFRS)	KRHO	17.800
12 midnight	Edmonton, Alberta	VE9A1	9.540
12 midnight	Vancouver, B.C.	CBRX	6.160
12 midnight	Munich (Frankfurt), Germany	AFN	6.080
12:15 a.m.	Melbourne (To West U.S.)	VLG7	15.160
		VLC4	15.320
		VLA4	11.770
		(or VLA8	11.760)
		VLB9	9.615
		(or VLB8	21.600)
	(To South Africa)	VLC9	17.840I
12:30 a.m.	Brazzaville (To West U.S., Australia, New Zealand)	FZI	11.970
			9.440
12:30 a.m.	Delhi	AIR	15.190
			15.160
			21.510
			11.870
			17.830
12:30 a.m.	Colombo, Ceylon	Radio	15.120
		SEAC	6.075
12:55 a.m.	Winnipeg, Manitoba (Night Final)	CKRO	6.150
1:00 a.m.	Singapore	Radio Malaya	7.220
1:00 a.m.	Capetown, So. Africa (BBC)		5.877V
	Johannesburg (BBC)		6.007
			6.095
			4.377
1:00 a.m.	Edmonton, Alberta	VE9AI	9.540
1:00 a.m.	Calgary, Alberta	CFVP	6.030
1:00 a.m.	Vancouver, B.C.	CBRX	6.180
1:00 a.m.	London (European Service)	GRO	6.180
1:00 a.m.	London (GOS)	GRF	12.095
		GWG	15.110
		GSD	11.750
		GST	21.550
		GSB	9.510
		GSF	15.140
		GWE	15.435
		GVQ	17.730
		GSO	15.180
		GRY	9.600
		GRH	9.825
		GWA	6.125
1:00 a.m.	London (PS)	GRX	9.690
		GSN	11.820
		GSP	15.310
		GVZ	9.640
		GRQ	18.025
1:00 a.m.	Melbourne (BBC)	VLR	9.540
1:30 a.m.	Delhi	AIR	15.190
			15.160
			21.510
			11.870
			17.830
			15.290
	Calcutta		9.530
1:30 a.m.	Rangoon, Burma	Radio Rangoon	6.035
1:30 a.m.	London (PS, Radio Newsreel)	GRX	9.690
		GSN	11.820
		GSP	15.310
		GVZ	9.640
		GRQ	18.025
1:30 a.m.	Colombo, Ceylon	Radio	15.120
		SEAC	6.075
2:00 a.m.	Edmonton, Alberta	VE9AI	9.540
2:00 a.m.	Hamburg, Germany	BFN	7.290
2:00 a.m.	London (GOS, At Dictation Speed)	GRF	12.095
		GWG	15.110
		GVT	21.750
		GSD	11.750
		CST	21.550
		GSB	9.510
		GSF	15.140
		GVQ	17.730
		GSO	15.180
		GSV	17.810
		GRH	9.825
		GWA	6.125
2:15 a.m.	London (European Service)	GSA	6.050
		GRO	6.180
		GWN	7.280
		GRI	9.410
		GWO	9.625
		GSE	11.860
2:30 a.m.	Melbourne (To Britain)	VLA9	21.600
		VLB3 (Except Sat.)	11.770
		VLA4 (Sat. only)	11.770
		VLC10 (Sat. only)	21.680
2:45 a.m.	Colombo, Ceylon	Radio Colombo	4.900
2:45 a.m.	Vancouver, B. C.	CBRX	6.160
3:00 a.m.	Colombo, Ceylon (BBC)	Radio	15.120
		SEAC	6.075
3:00 a.m.	Perth (BBC)	VLW3	11.830
3:00 a.m.	Delhi	AIR	9.590
			17.760
			9.670
			15.190
			15.290
	Bombay		9.630
	Madras		9.565
3:00 a.m.	London (GOS)	GWG	15.110
3:00 a.m.	London (PS)	GRX	9.690
		GRQ	18.025
		GRD	15.450
		GSN	11.820
		GSP	15.310
		GVS	21.710
		GVZ	9.640
3:15 a.m.	Salzburg, Austria (AFRS)	KOFA	7.220
3:45 a.m.	Singapore	Radio	15.300
		Malaya	15.275
			11.735V
			6.770
4:00 a.m.	Komsomolsk, U.S.S.R.		9.565V
4:00 a.m.	Honolulu (AFRS)	KRHO	9.650
4:00 a.m.	Melbourne (To Forces)	VLB8	21.600
		VLA6	15.200
		VLC4	15.320
		VLG10	11.760
4:00 a.m.	Melbourne (A.B.C.)	VLR2	6.150
		VLH3	9.580
4:00 a.m.	Brisbane (A.B.C.)	VLQ2	7.215
4:00 a.m.	Tokyo (AFRS)	JLR	6.015
			4.880V
4:30 a.m. (or 5:00 a.m.)	Delhi	AIR	21.510
			15.160
			15.290
			11.870
5:00 a.m.	Saigon, Fr. Indo-China	Radio	11.780
		Saigon	4.810
5:00 a.m.	Shanghai	XORA	11.695V
5:00 a.m.	Los Angeles (AFRS)	KNBA	9.490
		KNBI	6.060
		KNBX	11.790
		KCBR	9.700
		KGEX	11.730
	Via Honolulu	KRHO	9.650
5:30 a.m.	Manila	KZRH	9.640
5:45 a.m. (irreg.)	Djokjakarta (?), Java		12.002V
6:00 a.m.	Los Angeles (AFRS)	KGEI	9.530
		KCBA/F	9.750
6:00 a.m.	New York	WNRA	18.160
		WNRE	15.280
		WNBI	17.750
		WOOW	11.810
	Boston	WRUA	15.130
		WBOS	15.210
6:00 a.m.	London (GOS, followed by Home News from Britain at 6:10 a.m.)	GSG	17.790
		GSN	11.820
		GSV	17.810
		GSJ	21.530
		GSH	21.470
		GRF	12.095
		GSO	15.180
		GSD	11.750
		GSI	15.260
6:00 a.m.	Georgetown, Br. Guiana (BBC)	ZFY	6.000
6:00 a.m.	Colombo, Ceylon (BBC)	Radio	15.120
		SEAC	6.075
6:00 a.m. (irreg.)	Shanghai	XORA	11.695V
6:00 a.m.	Toronto, Ontario	CFRX	6.070
6:00 a.m.	Hong Kong (BBC)	ZBW	9.540V
6:00 a.m.	Melbourne (To Forces)	VLB8	21.600
		VLA6	15.200
6:00 a.m.	Melbourne (A.B.C.)	VLR2	6.150
		VLH3	9.580
6:00 a.m.	Brisbane (A.B.C.)	VLQ2	7.215
6.00 a.m.	Perth (A.B.C.)	VLW7	9.520
6:00 a.m. (irreg.)	Hanoi, Fr. Indo-China	Radio Viet Nam	9.660V
6:10 a.m.	Melbourne (To Forces)	VLB8	21.600
		VLA6	15.200
6:15 a.m. (irreg., may be 5:15 a.m. now)	Bangkok, Siam	HS8PD	5.990V
6:15 a.m.	Capetown, So. Africa		9.608
			9.912
	Johannesburg		4.377
6:30 a.m.	Teheran, Iran	EQB	6.155
		EPB	15.100
6:30 a.m.	Delhi (To Africa and East Indies)	AIR	17.630
			15.190
			21.510
			11.870
	Calcutta		6.010
6:30 a.m.	Singapore	Radio	15.300
		Malaya	15.275
			11.735V
			6.770
6:30 a.m.	China (Shanghai or Yenang?)	XMTA	12.215V
6:45 a.m.	London (FES)	GVP	17.700
		GRZ	21.640
		GRH	9.825

—30—

Farm Markets

(*Continued from page 62*)

An indication as to the possible consumption of electricity on farms might be found in Benton County, Iowa. This relatively prosperous county has had power-line service to a large percentage of its farms for several years. The monthly consumption of rural electricity users in that county is 462 kilowatt hours each. And even in this county, users indicate that they are not using as many appliances as they would like, or will be using once equipment becomes available. Many Benton County farm homemakers, for example, are anxiously awaiting the day when they can replace the old cob burner in the kitchen with a fancy new electric range.

In spite of the most optimistic estimates of possible farm consumption, many farmers now find their original wiring installations are already falling far short of carrying the load—both in the home and around the farm buildings. Right now, thousands of farmers are having their service installations revamped—heavier wire, more circuits, more power outlets. They find needs for electric power that they never dreamed of when electricity first came to their farms.

Then they were thinking of electric lights, a few small motors, and household gadgets—maybe even an electric refrigerator. Nowdays, they're thinking about large motors on the elevator and feed grinder, a milk cooler, welding equipment, ventilating systems and artificial drying for hay and grain crops. And the good woman is thinking about electric ranges, automatic water heaters and freezer-storage cabinets.

If the figures of the Iowa survey are

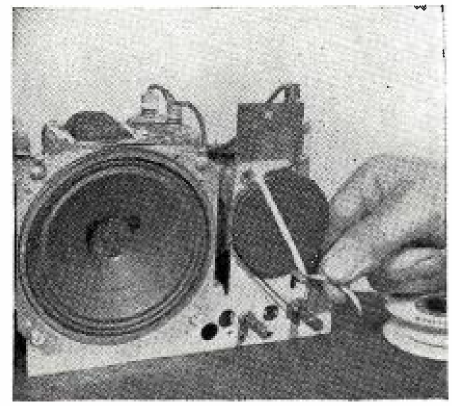
(*Continued on page 120*)

DIAL POINTER ON PORTABLE RADIO

SOME portable radios do not have a dial lamp and use a white line on a disk behind a translucent dial face.

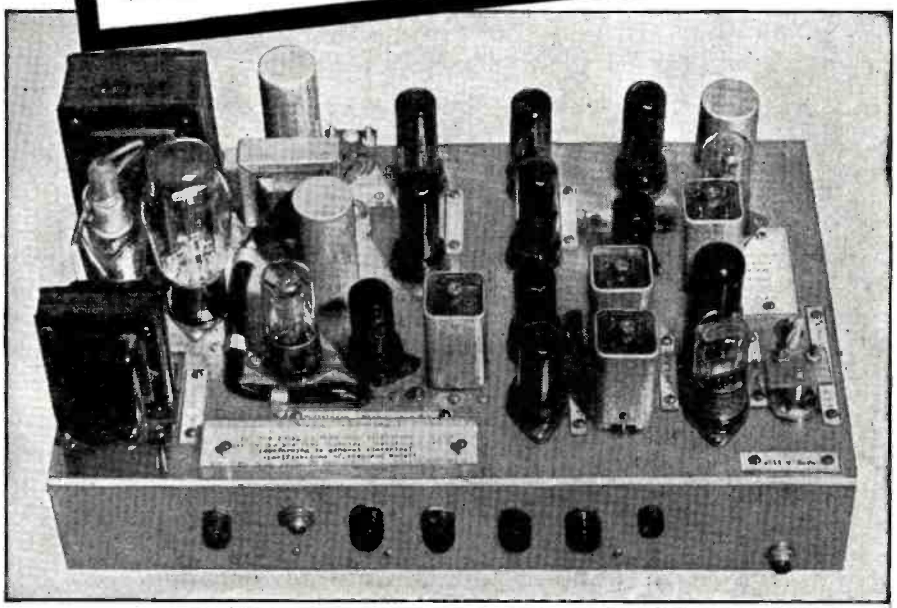
This white line fades out in time—making station identification difficult.

A narrow strip of white adhesive tape placed in the position of the original white line is easy to see and makes dialing easy. . . . . H. L.



Build a TELEVISION

To stimulate its radio and television training programs, this famous resident radio and television school is offering men interested in television this unusual opportunity.



IF you are unable to leave home to go to a resident school, N.Y.T.I. of N.J. can supply you with all the parts to build a television chassis in your own home. You will be supplied with exactly the same instructions and directions with which the school's resident students are equipped, when they reach the stage in their training that calls for television set construction. If you already have a sound radio background, with experience in building radio receivers, you will be surprised to find how much you can learn about television by studying the directions, and building this set.

N.Y.T.I. of N.J. is one of America's leading resident schools in television for men seeking dependable, thorough, up-to-the-minute training in the various fields of radio and television.

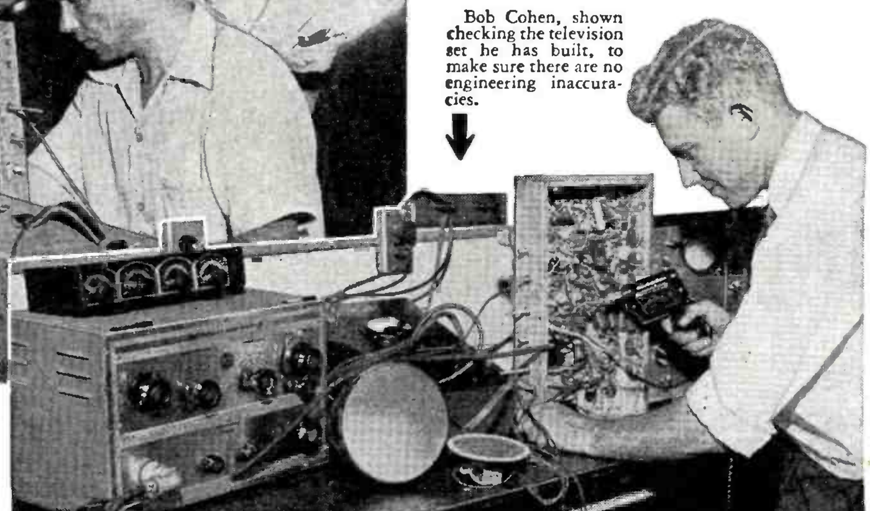
The schooling offered by N.Y.T.I. of N.J. is particularly useful to those who recognize the high-earning possibilities of technical training in radio and television and are willing to tackle the class and laboratory work offered.

A grammar school education definitely is required. Moreover, N.Y.T.I. of N.J. requires that a student be earnest, sincere and radio-minded. Students without proper mathematical backgrounds are taught the radio and television mathematics and theory they need.

A considerable number of out-of-

You can build a direct viewing television chassis similar to the one pictured above, complete with all tubes, including speaker and 7-inch picture tube right in your own home by following carefully the exact instructions sent to you by this famous television school, located square in the HEART of America's television manufacturing and broadcasting industry. Mail the coupon on the next page to get full details.

Here is a typical scene showing an instructor checking the construction completed by the two students in the background.



Bob Cohen, shown checking the television set he has built, to make sure there are no engineering inaccuracies.

MAIL THE COUPON TO GET FULL

SET *Right in Your Own Home!*

Instructor demonstrating theory of light in connection with study of optical systems used in projection type television receivers.

state students attend the school because of its excellent, practical type of radio and television courses, so difficult to get anywhere else. Living quarters are obtainable by single students. Married students are requested not to bring their families until they can find suitable accommodations for them.

You Put Into Practice Everything You Learn

Students at N.Y.T.I. of N.J. particularly like the way the school puts into practice what it teaches. You may actually build a 17-tube television chassis. You also help build as many as 7 radio receivers of different types, a total of 75 electronic educational devices. Class study and laboratory study, in the proper combination, increase interest—and your hands get as smart as your head.

A 17-tube, experimental, television chassis may be built by all resident students of television, and may be kept as their own property, if they so choose.

Located in the Heart of the Radio, Electronic and Television Industry

The New York Technical Institute of New Jersey is in Newark, N. J., just across the river from New York City (only 20 minutes from Broadway by subway or train). The school is located in the heart of America's great radio and television industry. Such leading television, radio and electronics manufacturers as R.C.A., Western Electric, DuMont, Federal, Westinghouse and Edison are nearby. This means that the school offers numerous advantages, as it is in touch with the most recent developments.

Highly qualified television and radio instructors are here in abundance. Equipment is easier to get. Television students are offered exceptional advantages in this great electronic center.

Coupon Brings Full Information — FREE

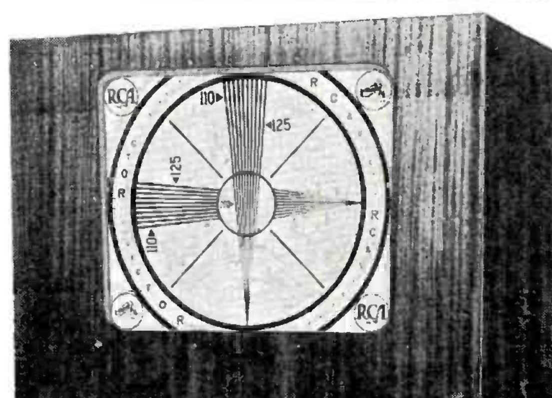
The school issues a special Bulletin which illustrates and describes its truly exceptional laboratory facilities and equipment. This Bulletin also describes classes that may be attended, housing conditions, costs, hours, etc. If you are interested in Television—you will want to read this Bulletin. You can have it *free,* merely by mailing the coupon at right.

The school will also be happy to send you complete information about the television kits and directions which are now available to you if you desire to build your own television chassis at home.

Just fill out the coupon at right and mail it NOW to: *New York Technical Institute of New Jersey, Dept. 1B, 158 Market Street, Newark, N. J.*

INFORMATION *Free*

Big picture television, 16"x21¼", "in the flesh" at N.Y.T.I. of N.J. All types of television receivers are available for student use and instruction in the resident school.



Standard laboratory type test pattern used for testing all types of television transmitters and receivers. (You can see it at N.Y.T.I. of N.J.)

New York Technical Institute of New Jersey, Dept. 1B
158 Market Street, Newark, New Jersey

☐ Check here if you wish to receive the Special FREE Bulletin describing the resident school of the New York Technical Institute of New Jersey located in Newark, N. J.—including its facilities, equipment, courses offered, costs, hours, etc.
☐ Check here if you wish complete information about building a television chassis in your own home.
☐ Check here if you are a War Veteran.

Name.. *Age*..........

Address..

City.................................. *Zone (if any)*.......... *State*..............

(N.Y.T.I. of N.J. employs no salesmen to call.)

any indication, there's a billion dollar business waiting for radio and appliance dealers in that one state alone. And, incidentally, those figures should be fairly reliable as an indication of farmers' buying intentions. They were carefully checked by the Statistical Laboratory at Iowa State College which operates in cooperation with the Bureau of Agricultural Economics. To that billion dollars add the potential business from 47 other states and what it adds up to is not peanuts! Then there is normal replacement business to think about.

Four electrical appliances far outshadow all others in terms of popularity, the Iowa survey shows. When the juice is turned on the first things the family buys are a radio and a washing machine, an iron and an electric refrigerator.

A radio is No. 1 in popularity. In Iowa 96% of all farm families with electricity have radios. Some families have more than one receiver and a radio in the dairy barn is not uncommon. About 14% of the families said they intend to purchase new radios soon. While you occasionally see a swanky console model receiver in farm homes—most of them can be classed in the low priced bracket.

An electric washer is more popular even than an electric iron. More than 94% of the farm families surveyed have electric washers. Many of these are older machines which have been converted to electric power by the replacement of the gasoline motor with a quarter-horse electric job. Today one farm family out of every 10 which has highline power is in the market for a new washer.

However nearly all farm homemakers have an electric iron to go with their washer—87.6% of all electrified farm homes. Here again, more than one farm housewife out of every 10 wants a new iron. Chances are she has the nickels and dimes stored away for its purchase—in the teapot on the top cupboard shelf.

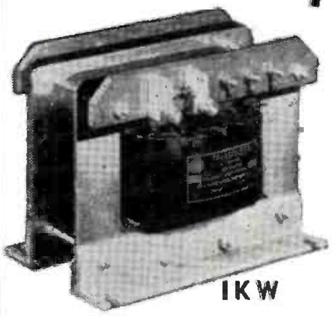
The first really good sized cash layout for electrical equipment goes for a refrigerator. Over two-thirds of the families with current available have refrigerators. The other 29.5% are going to buy them as fast as they come off the assembly lines. Refrigerators for farm families run a little larger in size than those the average city dweller buys. A 9-cubic foot box is not uncommon. Most folks, however, wish they had purchased a larger refrigerator than they did. Shopping for groceries is largely a once-a-week job for the average farm housewife. So the refrigerator should be large enough to store a week's supply of perishables. There are more mouths to feed and it takes more to fill them up.

Home-freezer-lockers? Probably the sale of this much talked and promoted postwar dream will come a little slower than most manufacturers realize. Nearly every farm family would like to have one, it's true. But there are so many other things that they would like to have that the freezer storage case will have to wait for a while. Furthermore, farm families being rather shrewd and sometimes conservative—would just as soon have their city cousins try them out first. The cost—both initial and operational—looks a little high to a lot of folks, too. In Iowa about one farm home in 200 now has a home locker and about one family in 15 indicated they hope to purchase one. One appliance dealer in eastern Iowa kept a list of people who made inquiries for lockers during the war years. He had 125 people on that

Charles Golenpaul of Aerovox, Sam Poncher of Newark Electric, and Margaret McGowan of the Show Staff draw the slips which assigned 158 manufacturers' booths and the 10 half-booths which will be used in the exhibition hall at the Radio Parts and Electronic Equipment Show to be held at Hotel Stevens in Chicago, May 11th to 16th.

SAVE! ON THESE AND THOUSANDS OF OTHER BARGAINS IN STOCK FOR

IMMEDIATE DELIVERY



IKW

Modulation Transformer

SPECIALLY PRICED AT **$14.95**

We have a real value in a modulation transformer. This item, made by RCA TO BROADCAST SPECIFICATIONS, is conservatively rated at 550 Watt audio to modulate that new KW rig. Really rugged construction with protective flashover gaps which are adjustable. Terminals and gaps are mounted on a "Mycalex" terminal board: The laminations that make up this transformer are of high audio quality and are extremely thin, making it impossible for the core to "chatter or talk." Audio Watts—550 Sec. #1—450 Mils Sec. #2—80 Mils Turns Ratio—Pri: Sec. #1-1:1 Pri: Sec. #2-5:1 Pri: Sec. #2 Tap-25:1 Impedance Ratio—Pri: #1-1:1 Sec. Pri: Sec #2-25:1 Pri: Sec #2 Tap-625:1 OC Resistance—Pri., 135 ohms Sec: #1 112 ohms; Sec. #2 99 ohms Transformers insulation tested: Pri. 8000V.; Sec. #1-11-000V; Sec. #2-2000V. to the rest of the coils and core. Primary center-tapped for Class "B" modulators. Secondary #2 will carry 80 Mils to modulate screens of beam power or screen grid tubes. Primary will match any Class "B" tubes up to 10,000 ohms plate to plate, such as 810's, 75T's, 8005's, ZB120's, 203's, HY51Z's, 211's, 813's, 828's, 805's 203Z's. Size 9½" wide, 7½" deep, 7¼" high. Heavy channel iron mounting brackets. Weight approx. 40 lbs.—Cat. No. MT-100

Something You Can't Be Without

PIN STRAIGHTENER

For miniature tubes—Gov't cost $4.80 our price—Cat. No. P10 **49c**

MICA CAPACITATOR

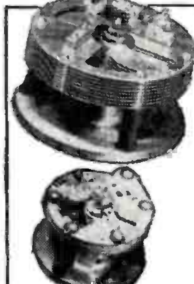
Mica capacitator .002 MFD 3000 WVDC Cat. No. RT-101 **49c**

IF TRANSFORMER

IF transformer, mounted in aluminum shield can, 1500 KC, with air trimmer, impedance coupled type—Cat. No. T-19 **95c**

30MC IF TRANSFORMER

30 MC IF transformer in square aluminum can, silver slugged tuned—Cat. No. T-20. **29c**



Butterfly Condensers

Ideal for high frequency work.

Type A—frequency range 76 to 300 megacycles to be used with 955 tubes. Cat. No. BC-1

Type B—frequency range 300 to 1000 megacycles to be used with 368AS doorknob tube. Cat. No. BC-2

Sockets part of assembly on both.

95c each

Order by Catalog Numbers!

CONDENSERS

CATALOG NO.	CAP. MFD.	WORKING VOLTS	YOUR COST
C110	1	5000 OIL	$3.95
C111	3	4000 OIL	$4.95
C112	1	1000 OIL	44c
C113	4	500 OIL	49c
C114	8	600 OIL	95c
C115	2	600 OIL	49c

VARIABLE CONDENSERS

100 MMFD variable APC type—Cat. No. T-21. **59c**

30 MMFD variable APC type—Cat. No. T-22. **25c**

12 MMFD variable ¼" shaft—Cat. No. T-23. **30c**

CHOKES

Thordarson 8 HY 150 M choke—Cat. No. FC-201. **95c**

Thordarson 8 HY 175 M choke—Cat. No. FC-202. **$1.49**

Thordarson 12 HY 25 M choke—Cat. No. FC-203. **39c**

Thordarson 8 HY 350 M choke—Cat. No. FC-204. **$4.95**

Thordarson T48003

Thordarson 2H-7H 550 MA swing choke size 4½ x 5½ x 5½ square black crackle case. Cat. No. FC-205

$5.95

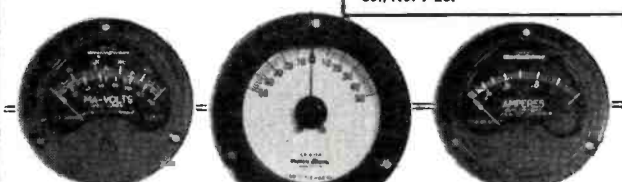
Filament Transformers

Thordarson 6.3 V—4 amps., 6.3 V—4.5 amp., 9.7 V—.5 amp., pri. 110 V AC 25 or 60 cy—Cat. No. FT-11 **$1.95**

Thordarson pri. 110 V 60 cy.—sec. 6.3 V 6 A, CT—Cat. No. FT-12 **$1.49**

Thordarson 110 V 60 cy. pri., sec. #1—2.5V 10 A CT, 3000 V ins., sec. #2 10 V, 3.25 A, Two 5 V 3 A; 6.3 V 1 A—Cat. No. FT-13 **$4.95**

All Orders F.O.B. Detroit



Westinghouse meter, 0-1 MA movement, 2" round case, scale calibrated 0-140 and 0-500. Includes mounting hardware. Cat. No. M-101. **$2.95**

Western Electric meter, 4" round, zero center, 0-½ MA each side. Cat. No. M-102. **$3.95**

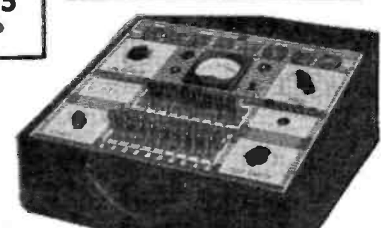
Westinghouse meter, 0-1 RF amps, 2" round case, internal thermocouple, in original box. Includes mounting hardware. Cat. No. M-103. **$2.95**

SHALLCROSS ACRA-OHM WIRE WOUND RESISTORS

2,000 ohm	60,000 ohm
3,300 ohm	65,000 ohm
9,000 ohm	70,000 ohm
15,000 ohm	75,000 ohm
18,000 ohm	100,000 ohm
25,000 ohm	160,000 ohm
30,000 ohm	600,000 ohm
50,000 ohm	

±1W **39c each** 3 for $1.00

1 MEG. .89c



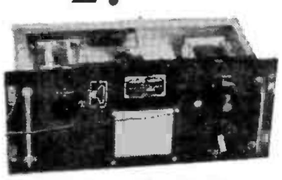
R.L.T. TUBE TESTER

Tests all tubes up to 117 V. • Tests shorts and leakages. • Tests individual sections. • Works on 90-125 V 60 cycle AC. • Comes in portable cabinet complete with all operating instructions with lid. Cat. No. TT-100

PRICED AT ONLY **$49.95**

SELSYN MOTORS

The ideal way of indicating the position of rotary beams, wind indicator, etc. (400 cycle). Line cord and instructions for 110 VAC operation furnished.—Cat. No. SM-100. **2 for $3.95**



TUNING UNIT

Tuning unit BC 375. Approx. 65 MMFD cond., coils, RF chokes, dials, asstd. mica condensers 2500 WVDC, over $50.00 in parts. Cat. No. TU-101. **$3.75**

PHOTO FLASH TUBE

Photo Flash Tube. High speed photo flash tube, 12,000,000 lumens light output. Stops all action. Ignition coil included on back of bulb. 10,000 flashes. Diagrams furnished on request. Your cost Cat. No. PF-101. **$8.95**

DYNAMOTOR

Power supply—inputs 6 or 12 V, output 500 VDC at 160 MA, mounted on box with circuit breakers, relays, interference filter and two 10 ft. cables. U. S. Govt. surplus. Cat. No. DM-101. **$9.95**

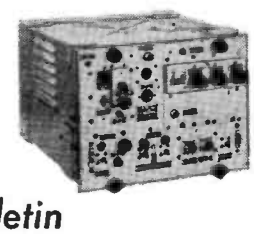
Hot Spot Specials

- Asst. resistors ½ watt fully insulated in popular ohmages per 100—Cat. No. R-5. $1.49
- Asst. mica condensers per 100—Cat. No. C-12. $1.95
- Wafer sockets 4-5-6-7 & 8 prong per 100 Cat. No. WF-4. $2.95
- 12" Utah P. M. Speaker Alnico #5 with 6F6 output transformer—Cat. No. ST-100. $6.95
- Asst. knobs push on wood & plastic per 100—Cat. No. KP-100. $1.95
- 6J4—$1.50, 6J6—95c.
- Johnson sockets #210—25W—Cat. No. JS-210. 49¢
- 75,000 ohm 200 W bleeder—Cat. No. B-75. 49¢
- 955-9004 tubes—Cat. No. T-99. 65¢
- Sockets for acorn tubes—Cat. No. AT-10. 19¢
- 8-8 MFD 350 WVDC, 20 MFD 150 WVDC, round can—Cat. No. RC-88. 69¢

Receiver and Transmitter

SCR-522 USED In good cond.

100-156 MC receiver and transmitter complete with 18 tubes. Cat. No. RT-10 **$29.95**



Transmitter and Receiver

Has been widely used on the 144 MC band. Shipping wt. 100 lbs. U. S. Govt. surplus. Your price, less tubes and power transformer. Cat. No. RT-102. **$14.95**

Write for **FREE** Bulletin

HERSHEL RADIO CO.

5249 GRAND RIVER DETROIT 8, MICHIGAN

20% DEPOSIT REQUIRED ON ALL C.O.D. ORDERS list. A few weeks ago his manufacturer queried as to how many of the new appliances he could use immediately. He got out his list of potential customers and started calling them on the telephone. How many people do you suppose were ready to place an order? Not one!

High on the homemaker's priority list are a toaster and a vacuum cleaner. Of the homes where electricity is now available, you'll find a toaster in 58% of them; a vacuum cleaner in 42%. It would seem that the vacuum cleaner salesman will have a lot of places to sell his wares. Nearly one farm family in four wants to buy one.

About one family in four has a water system with an electric pump. Another 18% plan to install them just as soon as they are available.

The automatic water heater business should also be good. Only 1 family in 20 now has one in operation, but 14% have indicated they intend to make such a purchase soon.

One electrified farm home in 10 has an electric range. But if farm women have their way there will be an electric range in one out of four farm homes.

Other items that the farm homemaker has her eye on are ironers, sewing machines, waffle irons, coffee makers, heating pads, clocks, and automatic furnaces. In fact, a door-to-door salesman should be able to make a sale for each of the items in one out of 10 calls.

Farm homemakers haven't thought too much about such items as dishwashers. They seem quite a luxury to her as yet. She is still trying to get used to the convenience of such things as push-button lighting and not having to fight a balky gasoline engine when she washes.

When it comes to the farm production side of the picture, chick brood-

FCC PRELIMINARY PROPOSAL REGARDING THE CITIZENS' BAND

THE Federal Communications Commission is interested in securing the cooperation of manufacturers and others in preparing technical requirements for equipment to be used in the Citizens' Radiocommunication Service.

The Commission proposes, through subsequent regulations to be adopted, that the 460-470 mc. band be used as follows: 460-462 mc., Class A stations at fixed locations exclusively; 462-468 mc., Class A and Class B stations; 468-470 mc. Class A stations exclusively. It is proposed that Class A stations be permitted a frequency tolerance of .02 per-cent, whereas Class B stations would be given much wider latitude with a permissible tolerance of .2 per-cent. All Class B transmitters, however, would be initially adjusted by the manufacturer or the individual builder of composite equipment to operate within .2 per-cent of the center-band frequency of 465 mc.

Controls for adjustment of the carrier frequency of the transmitter shall not be accessible from the exterior of any unit unless such accessibility is specifically approved by the Commission.

Class A transmitters shall be designed, constructed, and adjusted by the manufacturer to operate on a frequency or frequencies within the band 460-470 mc. subject to the condition that the communication band shall not at any time extend beyond the limits of the 460-470 mc. band. Under all conditions of use in the Citizens' Radiocommunication Service, the transmitter shall be inherently incapable of emitting electromagnetic waves of interference field strength outside the band 460-470 mc.

Class B transmitters shall be designed, constructed, and adjusted by the manufacturer to operate initially, under average conditions, within .2 percent of the frequency 465 mc. Under all conditions of use in the Citizens' Radiocommunication Service, the transmitter shall be inherently incapable of emitting electromagnetic waves of interference field strength outside the band 462-468 mc.

The operating frequency at any time during the period of test shall not deviate more than .02 per-cent for Class A transmitters or more than .2 per-cent for Class B transmitters from the operating frequency measured as soon as possible during the initial period of test operation, under any or all of the following test conditions: gradual and sudden ambient temperature variations from 0 to 150 degrees F.; barometric pressure variations corresponding to those from sea level to 12,000 feet above sea level; relative ambient humidity from 5 to 95 per-cent; atmosphere containing high saline content such as encountered on oceans; movement of objects in the immediate vicinity of the equipment under test; power supply voltage variations normally encountered under actual operating conditions; length of test periods to be equivalent to those which will be encountered under the most severe conditions of operation for which the unit may be used.

The transmitting equipment shall be inherently incapable of operating at a power input of more than 50 watts to the anode (plate) circuit of the electron tube or tubes which supply energy to the radiating system.

The transmitter shall not be capable of producing emissions of any type other than A-0, A-1, A-2, A-3, A-4 or FM unless it is shown after operation under an experimental license that another type of emission is necessary for a definite purpose in the Citizens' Radiocommunication Service.

When radiating amplitude-modulated waves of any type, the percentage of modulation shall not exceed 100 at any time.

When radiating any type of authorized emission, including FM emission, the communication band of the emitted waves shall not exceed .2 mc.

Controls for any adjustment of the receiver which might result, due to improper adjustment thereof, in the radiation of interfering emissions should not be accessible from the exterior of any unit.

-30-

ing and poultry house lighting seems to get first call. It is rather surprising to note that 40% of the electrified farms have electric chick brooding equipment. It is not so surprising that 15% of the farms are ready to buy a brooder—largely because of the safety factor. About half of the farms have lights in the poultry house to stimulate winter egg production. Another 13% have poultry lighting equipment on their postwar lists.

It is interesting to note that only 60% of the farms with electricity available have the barn wired. About 30% have lights in the hog house. In this connection one farmer in 16 uses electric pig brooders, but the practice is growing rapidly.

Nearly 30% of the farms have running water in the farm buildings. But 15% more farmers intend to buy electric pumps soon.

One farm in 8 has an electric milking machine. Another 8% is in the market.

Electric poultry water heaters are popular and stock tank heaters are becoming more so.

Only one farm in 8 has an electric powered cream separator. But here again is a wideopen opportunity. One farmer in two intends to buy a separator.

Most of the equipment to be purchased on the strictly farm side of the picture are those that are powered by small motors. Power equipment for the farm shop with an electric tool grinder at the top of the list, will be popular. Since farming is becoming more and more a highly mechanized business, electric welders are going to be in great demand.

But don't expect a great number of large motors for stationary power to be purchased very soon. A few grain elevators are being electrified, as are fanning mills and corn shellers. But until a hammer mill can be put on the market that can be powered by a three-horse electric motor, and operate automatically, they will not be too popular. Mark Collier, a Muscatine County, Iowa, farmer, explains that he can hardly afford to own a large electric motor for a few jobs, when he already has a big investment in his farm tractor.

The farm market is a quality market. Farmfolks for the most part will be buying dependable equipment made to stand up under the strain of hard everyday use without breakdown interruptions. They will be buying from established or reputable dealers with a record of service. What's more they will want equipment and appliances made by manufacturers with a record for dependability—who will stand solidly behind their dealers.

State College, the U. S. Department of Agriculture, Rural Electric Associations and Public Utilities all are making every effort to provide farmers with information that will enable them to make wise selections. They will also attempt to provide information that will assist the new purchaser to get the most out of the particular price of equipment purchased.

Utility concerns, both public and private, are urging land grant colleges to provide complete and unbiased information relative to the selection, use and operation of electrical equipment. And further, that necessary research be conducted to determine the required facts.

It is of course well recognized that by far the greatest majority of manufacturers are desirous of producing a reliable product. But it must also be recognized that the large potential purchasing power of farm people will induce a few manufacturers to place some new equipment on the market before it has been adequately tested.

And remember, too, farmers are the best judges of quality in the world. They are shrewd bargainers and are not easily misled by the smooth "high-pressure" salesman. They've seen him before.

—30—

Generating Microwaves
(Continued from page 37)

where electrons leaving the cathode later than others actually travel faster and overtake slower electrons.

The magnetron is a diode functioning by the effect of a powerful fixed or electromagnet through which electrons leaving the cathode must pass or cut through in order to reach the anode. The magnetic field causes the electrons to have the following behaviors: *a.* If electron travel is parallel to the magnetic field flux, it will have little or no effect on the electrons in their transit from cathode to anode. *b.* If electron travel is at an angle to the magnetic field flux it will be subjected to efforts of the magnetic

OLD TIMERS' NITE

THE Delaware Valley Radio Association of Trenton, New Jersey will sponsor its Third Annual Old Timers' Nite, and banquet on Saturday evening, March 22, 1947.

The affair will be held in the Terrace Room of the Stacy-Trent Hotel, West State Street and Willow in downtown Trenton. A turkey dinner will be served promptly at 6:30 p.m.

Guest speakers will include Old Timers in the wireless field and men who have been prominent in all branches of radio for many years. W2ZI's (ex-W3ZI) famous collection of old time wireless gear will be on display. Many Old Timers of the area are expected to turn out for the event. Door prizes will be awarded and a special award will go to the "Grand OM" whose radio experience dates back to the earliest days of wireless.

Reservations must be made before March 15th with Ed. G. Raser, W2ZI, Secretary, Delaware Valley Radio Association, 315 Beechwood Avenue, Trenton 8, New Jersey. The tariff is $4.00 per person up until March 15th, with late comers being assessed $5.00 for tickets purchased at the door.

—30—

field. This will cause the electron to deviate from a straight course. It will take a spiral or circular course depending on the speed of the electron and the strength of the magnetic field. It can even travel in a circle in the intervening space between cathode and anode and not even reach the plate. This deviation, due to the effect of the magnetic field, is called the electron's "trajectory path."

The lighthouse or disc seal tube is similar to a conventional tube except that the cathode, grid and anode are constructed in simple, parallel planes or layers instead of being fitted axially one around the other. Such tubes make it possible to reduce the inter-electrode distance between the elements to a very few thousandths of an inch. The electron transit time therefore becomes very small so that a tube working by conventional principles can reach a much higher frequency before phase shift becomes excessive.

Conventional tubes in special circuitry may generate microwaves by either the Barkhausen-Kurz or the Fonda-Freedman techniques. The former has been abandoned because of its low efficiency while the latter is becoming increasingly important as the information is made public after war-time secrecy requirements.

The Barkhausen-Kurz method develops microwaves by reversing the potentials normally used in conventional vacuum tubes. The grid is made highly positive while the plate is made zero or even slightly negative in potential with respect to the cathode. The behavior is as follows:

When no signal is present

1. Electrons from cathode are accelerated by the highly positive grid.
2. Some electrons pass through the grid wire openings and continue in the direction of the plate due to their acceleration by the grid.
3. The plate being slightly negative with respect to the cathode, as well as very much negative with respect to the grid, the electron slows down and stops before it can reach the plate.
4. The electron then is attracted back to the highly positive grid.
5. If it misses the grid wire again, it may reach the cathode.

When signal is present

1. Electron leaves the cathode as in the no signal case.
2. It is accelerated by the positive grid which is now increasingly positive or negative by the amount of the signal voltage so that it has a corresponding acceleration or deceleration.
3. The electron passes through the grid wires (except for those which strike the grid) and may manage to reach the plate if the grid was more positive. If the grid was more negative it will stop further from the plate.
4. Those electrons which do not reach the plate will turn back as in the no-signal case.

The efficiency of this type of oscillator is 1 to 5% and therefore unpopular.

Electric Utilities.
Gas Utilities.
Water Utilities.
Fixed Public Services.
Geophysical Services.
Bus Communication.
Truck Communication.
Taxi Communication.
Common Carrier Urban Mobile Services.
Common Carrier Highway Mobile Services.
Coastal Telegraph and Telephone Services.
Coastal Harbor Stations.
Provisional Radio Stations.
Motion Picture Radio Stations.
Rural Radiotelephone Services.
Television.
Facsimile.
Relay Press Services.
Police/Fire/Forestry/Sheriff Conservation, etc.
Transit Utilities.
Educational Broadcasting.
Citizens Radiocommunication Service.
Radar.
Amateur Radio.
Meteorological Radio Stations.
Aviation Glide Path Stations, Localizers, Markers, etc.
Railroad Radio.

Table 2. FCC allocation of frequencies in the microwave region between 300 and 30,000 mc. that may be utilized by these services.

The Fonda-Freedman technique which some Navy patent attorneys have called the "Electron Grouping" principle utilizes conventional tubes energized in the normal way. The voltages applied may be exactly those specified in manufacturer's tube manuals for tubes used on lower frequencies. Correct functioning is obtained by either of two methods:

Out-of-phase Method

$$\text{Transit time} = \frac{n}{f}$$

In-phase method

$$\text{Transit time} = \frac{2m+1}{2f}$$

where: n is any number not including zero.
m is any number including zero.
f is the frequency.

In the case of the out-of-phase method, the tube will generate ultra- and super-high frequencies if the transit time is equal to any number of periods of oscillation such as 1, 2, 3, etc.

In the case of the in-phase method, the tube will also generate ultra- and super-high frequencies if the transit time is equal to any odd number of half periods of oscillation such as ½, 3/2, 5/2 etc.

The efficiency of the Fonda-Freedman technique is high. Its disadvantage or advantage, depending upon the utilization, that causes much concern is the fact that the tube develops a series of discrete frequencies. This series may be shifted to reach any part of the frequency spectrum but will not exist as a single frequency except where resonating provisions are made available. Half the frequencies in the discrete series may be highly attenuated and eliminated with their power going into the remainder by simple condenser tuning provisions. More elaborate control requires special provisions such as wave guides and cavities correct for the desired frequency and incorrect for the superfluous frequencies. Strong indications are currently being obtained in the range of 100 to 1000 megacycles. Feeble indications have already been detected as high as 50,000 megacycles from a 6N7 tube even though no more than a pair of headphones to which was attached a silicon or galena crystal detector, was the method used to measure the maximas and minimas in terms of wavelength.

Little information has thus far been disclosed on the Fonda-Freedman developments as the inventors are not free to discuss same since patent arrangements are not as yet completed.

In appreciating the use of microwaves or in preparing to procure such facilities, readers are cautioned that the most satisfactory techniques and equipment have not yet been made known or sold to the public. Much secrecy has existed and continues to exist as firms invent, develop and compete in order to have a complete and more novel microwave communication system. They have their sights trained on the microwave relay networks, radar, and two-way radio communication fields.

Table 1 compares the various tubes and techniques which have successfully generated microwave frequencies to date. The Federal Communications Commission has allocated frequencies in the microwave region between 300 and 30,000 megacycles which may be utilized by the services or groups shown in Table 2.

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DELUXE PHONOGRAPH OSCILLATOR*

THIS simple, easy-to-build unit will give high-quality performance when used either with a crystal phono pickup or a crystal microphone. Output is sufficient to operate a radio receiver located 50 to 75 feet away.

The oscillator portion utilizes the control grid, screen grid, and plate of a 12SK7 tube. The audio modulating voltage is impressed on the suppressor grid, and the per-cent of modulation may be varied by adjusting R_3, which controls the cathode potential of the 12SK7.

The power supply consists of a selenium rectifier and filter circuit, and provides d.c. for both the plate and heater of the 12SK7 tube. This reduces the possibility of hum modulation due to a.c. operation of the heater, eliminates the need for a transformer, and reduces the amount of heat dissipated within the unit. The total d.c. current drain is under 200 ma., so a 200 ma. rectifier or two 100 ma. units in parallel may be used.

To adjust for proper operation, the unit is turned on and a phonograph record played. The radio receiver is tuned to a clear spot on the dial, preferably in the neighborhood of 1600 kc. Condenser C_6 is then adjusted until the signal is heard at maximum loudness on the radio receiver. This means that the radio receiver and the tuned circuit L_1-C_6 are both tuned to the same frequency. R_3 is adjusted for maximum clarity of the audio signal, and the unit is ready for operation.

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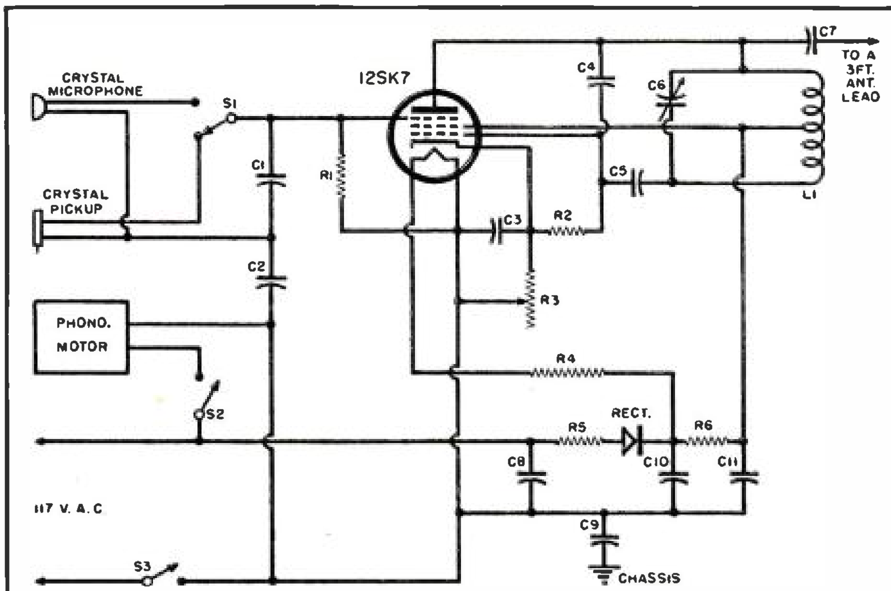
* Schematic diagram for this unit was supplied through the courtesy of Federal Telephone & Radio Corporation.

Either voice or recordings can be transmitted with this simple phono oscillator.



R_1—4.7 megohm, ½ w. res.
R_2—47,000 ohm, ½ w. res.
R_3—10,000 ohm rheostat (adjust. for % of modulation)
R_4—740 ohm, 20 w. res.
R_5—22 ohm, ½ w. res.
R_6—7000 ohm, 1 w. res.
C_1—500 μμfd. mica cond.
C_2, C_8, C_9—.05 μfd., 400 v. cond.
C_3—10 μfd., 25 v. dry elec. cond.
C_4, C_7—25 μμfd. mica cond.
C_5—250 μμfd. mica cond.
C_6—20-160 μμfd. var. cond.
C_{10}, C_{11}—40 μfd., 150 v. elec. cond.
S_1—S.p.d.t. sw.
S_2, S_3—S.p.s.t. sw.
L_1—Broadcast ant. coil c.t. (1000 to 1700 kc.)
Rect.—200 ma. selenium rectifier (or two 100 ma. rect. in parallel)
1—12SK7 tube

International Short-Wave
(*Continued from page* 96)

minutes later—though still with a peacetime beard—I sat behind the wheel, driving full-throttle to the station. We went on the air and told a stunned world what was happening. Like thieves at night, the German Wehrmacht, armed to the teeth, flooded over our borders and the peaceful soil of Holland resounded with the rattle of tanks and the heavy thud of hobnailed, ugly Kraut-boots. The brutes were coming. They dropped out of the air, machine-gunned our roads, bombed our towns, while Goebbels' poisonous propaganda bombarded us with lies and threats: 'We come as friends . . . or we shall smash you!'

"For four days and nights, PCJ reported the coming of the hordes and the stubborn resistance of a small army that fought bravely to stem the onslaught of a vastly superior enemy. Then came the blow that shook the earth for miles . . . PCJ was blown up in the air by ourselves—rather than let it fall into the hands of the enemy! And what was not destroyed by the explosion was consumed by the flames of a roaring fire. Our pride, the big rotating beam antenna—the only one in the world—a masterpiece of skill and engineering, lay pole-axed along the ground. It was a ghastly sight. After 12 years of short-wave pioneering and goodwill programs to the world, PCJ, the *'Happy Station,'* was no more . . .

"'Vat happened here,' asked two Nazi officers who came to see the destruction. 'Oh, somebody must have pushed the wrong button,' I suggested, wild with rage inside.

"'The 'rong button? . . . what do you mean?' said the Boche, giving me a dirty look. He pointed to the sky where a squadron of German bombers flew in westerly direction. They were flying low showing their crosses on the wings to rub in their prowess and their power. 'See that,' said the German. 'They are heading towards England and in a few weeks we'll be standing on the ashes of London.' 'Sez you!' I thought, while trying to find a German equivalent, which I did not. Instead, I simply said, 'I doubt very much you will ever get there!'

"The Nazi took my remark with arrogant superiority. He was convinced the Fuehrer had calculated every possibility and every trick. But the Dutch knew better. As a seafaring people, they instinctively knew that the little stretch of water and the Bulldog behind it could do more than all the Goebbels' propaganda ever concocted.

"The war went on and the Gestapo moved in. PCJ had to be rebuilt by forced labor, to pump the German propaganda overseas. That's when yours truly beat it, retiring from radio for the entire period of the war. A broadcaster became a listener—outside listening in. How he squirmed through the intricate net of endless Nazi trickery is a story for some other time.

"Shortly before the invasion came in 1944, a storm swept through the high antenna masts of PCJ's rotating beam, putting the directional mechanism on the circular rails out of order. Through clever sabotage of the engineers, the mechanism proved irreparable with the result that for the remainder of the war, all Nazi broadcasts were directed to the North and South Poles, where polar bears enjoyed excellent reception!

"When the armies got locked near Arnhem in the. starvation winter of 1944-45, the retreating enemy pillaged and looted everything that they could lay their hands on. So after four and one-half years of hiding it, PCJ's ample file and fine records—collected from all parts of the globe for the enjoyment of its listeners—was carried away and was never seen again.

"Finally, when after many years of anxious waiting, liberation came to starving Holland, PCJ was demolished again—now by the Germans. Yet, fortunately, they had no time to blow it up entirely, while some idiots even thought they would be back. And so after a few good meals with allied rations, PCJ's engineers spit in their palms and went to work to rebuild in record time the *'Happy Station'* to bring again to the world that well-known spirit of Peace, Cheer and Joy (PCJ)—thanks to the great Allied Victory!"

And so it was that once again PCJ took its rightful place among the greatest of short-wave broadcasters! Once again its *"Happy Station Program"* is the star feature on the Netherlands Overseas Services, having such a far-flung audience of assidious friends that it can easily be considered as one of the most popular features aired on short-waves around the globe. Eddie tells me "the audience is growing by the month, and the underlying spirit being the fostering of friendly and peaceful relations by mixing music with human-interest stories, is once more proving the reason for its success."

Mr. Startz is planning for a worldwide PCJ Birthday Party—celebrating the 20-year jubilee of the station—this spring, probably some time during March. Announcement will be made well in advance over the microphone, in the *"Happy Station Programs,"* which are now radiated as follows:

Sundays and Wednesdays—10:30 a.m.-12 noon, 15.22, 11.73, 6.02, to East and Near East; 4-5:30 p.m., 11.73, 9.59, 6.02, to Africa and Mediterranean; 9:30-11 p.m., 11.73, 9.59, 6.02, to the Americas. *Tuesdays*—3-4:30 a.m., 11.73, 9.59, 6.02, to Pacific, Australia, and New Zealand. (These times are EST.)*

Reports to PCJ are always wel-

* Unless otherwise indicated, all times mentioned herein are American EST, 5 hours BEHIND GMT.

comed and an attractive verification card answers all correct reports; address, PCJ, Postbox 150, Hilversum, Holland (Nederlands).

Facts About Holland

Before a closing comment from Mr. Startz, here are a few pertinent points about The Netherlands.

The Kingdom of the Netherlands *(Koninkrijk der Nederlanden),* in northwestern Europe, has an area of 12,862 square miles, with a population (estimated, January 1, 1944) of 9,090,000. Amsterdam is its capital.

Holland is bounded by Germany on the east, Belgium on the south, and the North Sea on the west and north. Its surface is flat, with an average height above sea level of 37 feet, and with about one-fourth of its land below sea level, reclaimed and protected by dykes, of which there are 1500 miles. Drainage of half of the shallow Zuider Zee, which covers 1350 square miles, with an opening into the North Sea about 19 miles wide, designed to add 900 square miles to the cultivable land—"polders"—has been under way since 1920.

The Hague is the official residence of H.M. Queen Wilhelmina and the seat of her Government—but Amsterdam is the sole capital of the Kingdom and the inauguration of the King or Queen—in accordance with the constitution—takes place in that city.

Cereals, potatoes, sugar beets, and other crops are raised. Dairy products are an important industry; the cheese products are famous and the cattle high grade. On the very special type of soil found on the edge of the polders and the sand dunes along the coast, tulips and other flowering bulbs and roots are grown. The Dutch bulb is not indigenous to Holland but originated in Persia, whence it was taken to Holland 375 years ago. The village of Boskoop, with 600 nurseries, is the largest center in the world for flowers and ornamental plants, it is claimed.

Most important industries before World War II were shipbuilding, the manufacture of machinery, textiles (including rayon), and chemical products; also brewing and distilling and flour milling. Amsterdam is famous for diamond cutting; Delft, for pottery.

Canals, of which there are 4817 miles, are most important in internal communication and transportation; elaborate systems are in the cities and feed the harbors. The Rhine and the Scheldt reach the sea through the Netherlands and carry enormous traffic, the Scheldt carries traffic including that from Antwerp (Belgium).

The Dutch Constitution assures a hereditary constitutional monarchy. Executive power rests exclusively in the Sovereign and the States-General of two Chambers. Universal suffrage for citizens of both sexes over 25 years of age and proportional representation are in force.

The reigning Sovereign is Queen Wilhelmina Helena Pauline Maria who succeeded on the death of her father (Willem III), November 23, 1890, and who was crowned September 6, 1898. Heir to the throne is Princess Juliana, only daughter, who is married to Prince Bernhard of Lippe-Biesterfeld.

Germany invaded The Netherlands on May 10, 1940, and occupied the country. Queen Wilhelmina and her cabinet escaped to England and established the Government in London. The Netherlands declared war on Japan, December 8, 1941, and on Italy, December 11, 1941. German troops surrendered on May 4, 1945.

Army service is compulsory with every man liable from the ages of 20 to 40.

Entire liberty of worship and conscience is guaranteed.

Education is obligatory from ages seven to thirteen; instruction is free or subject to a small fee, in both public and denominational schools; teachers are paid by the State. There are several fine Universities.

Tribute to SW Radio

In closing, we leave with you a tribute to short-wave radio as paid by Eddie Startz in an early publication of PCJ (1929):

"Short-wave broadcasting as we know it today is the outcome of many years' indefatigable research and profound study of short-wave technique and propagation phenomena. The larger short-wave stations radiate their programs to every corner of the world, building a mysterious bridge between the loneliest spots of the earth and civilization, from Arctic to Antarctic, from Continent to Continent. Short waves encircle the world, they convey messages of all kinds from and to every conceivable spot, conquering the old enemy, distance, that used to be such a barrier to the progress of mankind. That is why papers write, people talk, and engineers think about it. Short-wave broadcasting means that a long-cherished dream of mankind—the elimination of distance—has come true in the fullest sense of the word. Listeners are scattered over the entire earth and are particularly numerous in the tropics and in the isolated regions where man is deprived of the comforts of civilization. That is where short waves reign supreme, as the longer waves do not reach so far, or if they do, they are drowned by the severe atmospherics which are such a distress to the listener.

"In the remote corners of our world, at the outposts of civilization, in the desert or on the high seas, up in the peaks of the Himalaya mountains or the Cordilleras de los Andes wherever man is shut off from the rest of the world, there we shall find the short-wave fan. For him short waves are the only link with his fellowmen at home and are his only diversion. For him stations like PCJ mean home and all it stands for, conjured up and made audible by the mere turning of a tiny knob of his short-wave receiver . . .

the magic portal beyond which lies the outside world . . .

"It cannot be denied that in long-distance transmission there is a fascinating something decidedly worthy of the term 'romance.' There is a thrill for both listener and speaker, through the personal contact that is maintained between two people who are separated from each other by such tremendous distances as only short waves will bridge."

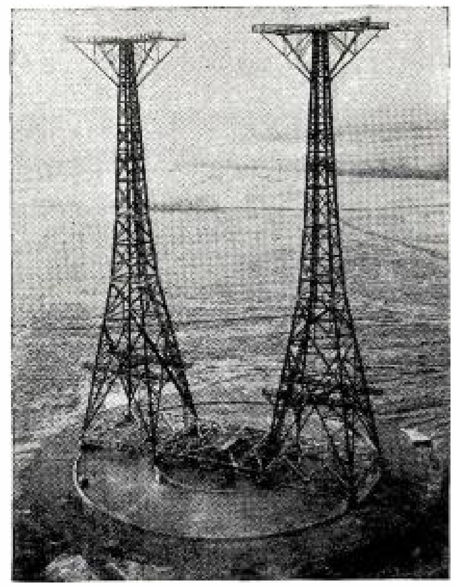
Of his long years before the PCJ microphone, Eddie Startz reports that one of his most interesting early experiences "was the rebroadcast of the 1929 PCJ Christmas program for the United States. This transmission was picked up with perfect strength in America and was rebroadcast by the National Broadcasting Company over a large network of stations extending over the entire country. So successful was this experiment that we received over 3000 letters from listeners, enthusiastically expressing their appreciation of our efforts. A good many of these communications were from our countrymen abroad, who were deeply moved when listening to their mother-country over such a great distance. Another remarkable feature in the history of the station was when the old world was again linked up with the new—but this time with the South American Continent. Under the auspices of the Brazilian Ambassador in Paris, a concert played in the French metropolis was transmitted by PCJ to Brazil, where it was successfully rebroadcast at Pernambuco, Rio de Janeiro, and Sao Paulo."

As to his method of conducting the *"Happy Station Programs,"* Eddie makes this comment: "Although I can safely say that short-wave listeners are a very grateful and appreciative audience, experience shows that they like to be treated individually. Listeners appreciate hearing their countries and towns mentioned during the programs (especially at *Mailbag* time), and it is often difficult to do justice to everyone at a time, considering the innumerable listeners of the station. . . . But in my mind I have been with listeners all over the globe, talking to them in their own language, while interposing personal remarks and calling many by name, thanking them for their reports and cooperation. The PCJ family is large and a universal spirit of sportsmanship prevails among the listeners.

"It is indeed a great satisfaction to note the interest and sympathy for the '*Happy Station Programs,*' which is so distinctly reflected in the thousands of letters pouring in from listeners all over the world. Not only do these reports and messages of appreciation contain valuable material for our engineering staff, but they are equally valuable as a stimulus to our future efforts in broadcasting. The communications might be compared to the spontaneous response of a theatre audience without which the actor would be unable to play his role effectively.

"Through this reaction on the part of the listener, the enthusiasm is continually kept alive. It is for this reason that when addressing the microphone I know that I am not merely talking to a lifeless instrument *but that my words are heard by countless numbers of short-wave friends in almost every country under the sun!*"

* * *



PCJ's rotating beam antenna, the only one of its kind in the world. The prewar one was destroyed by the Dutch rather than let it fall into the hands of German invaders.

NAVE Will Verify

From H. H. Holton, Commander, U.S.N., Officer in Charge, Radio-Television Section, Office of Public Information, Navy Department, comes this official information regarding NAVE, the transmitter of the Navy Antarctic Expedition:

"The Navy Antarctic Expedition has provided aboard the U.S.S. *Mount Olympus* broadcasting facilities for equal use among the four major (U.S.) radio networks.

"Since Navy responsibility for the broadcast ends once the signal has left the *'Mount Olympus'* antenna, the networks have arranged to pick up the signal through RCA and Press Wireless. The frequencies allotted for use by the Naval Communication Service are 9.280, 9.670, 12.265. 15.930, 17.820, and 20.040. In addition, RCA has been utilizing its own frequencies. Naturally, the use of any one frequency has not been standardized yet because of varying and unpredictable atmospheric conditions.

"Considerable thought had been given communication with radio amateurs, but since the communication personnel with the expedition are fully engaged with normal operating communications, audio-radio broadcasts to the American people through the four major networks, radio-teletype, radio-photo, and establishing communication with the Navy airplanes making reconnaissance flights over the Antarctic continent, time and personnel are just not available for amateur radio communications.

"If radio listeners and amateurs wish to verify reception of 'NAVE,' it is requested that they mail their requests to the Radio-Television Section, Office of Public Information, Navy Department, Washington 25, D. C., U.S.A.

"It must be borne in mind that the operating radio log is being maintained aboard the *'Mount Olympus'* and that there is no mail service to the Antarctic. *Therefore, answer to requests for confirmation of radio reception will require five to six months. Please advise your readers not to send requests for confirmation to the 'Mount Olympus.' Such requests will be handled here. It is also urged that amateurs refrain from trying to raise NAVE in view of the expedition's present work-load."*

Information on reception of NAVE comes from Bill Arthur and Lynn McLaughlin, Charleston, West Virginia, who have been carefully monitoring NAVE:

"NAVE has been using a transmitter which they rate as 350 watts, but a 2.5 kw. transmitter was picked up in the Canal Zone and is probably now in use. While schedules of NAVE are for the most part irregular, they usually contact the United States around 7:30 a.m. and 6:30 p.m. EST (1230 and 2330 GMT), daily.

"Thus far, the 17.82 frequency has been heard more here than the others, although it usually suffers interference from U.S. broadcasters in the 16-meter band.

"Apparently, NAVE uses a variable frequency oscillator—or equivalent—as frequencies can be shifted by small amounts in order to avoid too much interference from other nearby transmitters.

"At times the contacts have not been too successful, in fact sometimes have not been completed. However, we have usually been able to read both sides here.

"Press Wireless contacts have included WBE, 19.580; WBH, 22.780; WHJ, 17.440; WBG-5, 15.610; WJS, 15.700; WJQ, 10.010; WRP-2, 23.450. RAC contacts have included WBU, 21.26; WQE, 18.920; WLL, 17.900; WQD, 18.960; WQV, 14.800; KQZ, 17.980; KEL-2, 21.220; KES-3, 10.620; KLL, 13.720; and others."

If tests on the 20.040 frequency are successful, I believe it is quite likely that it will be used a great deal in the future. Watch for this "high" one!

* * *

Re Newscast Table

The *English* newscast table compiled for this issue of the ISW Department was prepared with a view of serving readers in many countries. Not all stations listed will be audible in any given area. Since this table should also serve to some extent as a worldwide log, an effort was made to include all *known English* news periods. It must be remembered, however, that station schedules are subject to change without notice, and that changes are taking place almost daily.

Especial thanks go to Paul Dilg and August Balbi, California, and to Roger Legge, New York, for their valuable assistance in the preparation of the table.

* * *

Australia's DX Sessions

Direct via airmail from Ernest H. Suffolk, DX editor for *Radio Australia*, comes this timely information:

"*Radio Australia* seeks DXers reports on signals, guarantees to verify all correct reports, and will answer all letters. An old-time DXer, Graham Hutchins, has been engaged to attend to this matter and is now on the staff of *Radio Australia* for this purpose alone. I will acknowledge and give a 'cheerio' over *Radio Australia* for all reports addressed to the DX Editor, Radio Australia, Melbourne, Victoria, Australia.

"Current schedules for the DX programs are:

"Saturday, to Eastern U.S. and Canada, 7:20 p.m. over VLA9, 21.600; Sunday, to Western U.S., 12:25 a.m., over VLB8, 21.600 (or VLB9, 9.615), VLC4, 15.32, VLA4, 11.770 (or VLA8, 11.760), and VLG7, 15.160; Saturdays, to British Isles, 5:15 p.m., over VLB6, 15.200, VLA4, 11.770, and VLC10, 21.680."

* * *

Addresses

The following station addresses were sent us by Pat Casey, New York:

HH3W, P.O. Box A117, Port-au-Prince, Haiti; CFCX, 1231 St. Catherine Street, W., Montreal, Quebec, Canada. Reports to CMAN, CMCY, COCY, CMHI, COHI, CMJN, CMKV, CMKN (some of these are medium-wave outlets) may be addressed to Radio Havana Cuba, Apartados 770-799, Havana, Cuba.

* * *

Spanish Stations Skeds

From K. Dobeson, England, official agent for the Spanish Broadcasting Network, we have received this information:

"Spain is desirous of receiving reports on Spanish radio stations, either sent to them direct at Radio Nacional de Espana, Madrid, Spain, or to me at Globe Hotel, Chichester, Sussex, England. All queries will be answered.

"Madrid, Radio Nacional de Espana, 40 kw., 32.02 m., 9.369, is scheduled 2:45-5 p.m. and 6:30-9 p.m.; in Russian at 2:45 p.m.; *English,* 3 p.m.; Arabic, 3:30 p.m.; Spanish, 3:45 p.m., to African colonies; French, 4 p.m.; Portuguese, 4:30 p.m.; German, 4:45 p.m.; Italian, 4:52 p.m.; at 6:30 p.m. is beamed directly to *Hispanoamerica* in Spanish. Other programs are being planned, including one to North America; there are irregular broadcasts to North America now, such as on November 2 when there was a talk by the Scotsman, Halliday Sutherland.

"Alicante, Radio Falange de Alicante, 37.7 m., 7.940, is scheduled 8:30-10 a.m. and 3-6 p.m.

"Madrid, Radio SEU, approximately 42.55 m. (sometimes changes frequency because of interference), usually is heard around 7.010, is scheduled 10 a.m.-2 p.m. and 3-6:30 p.m., irregularly to 7 p.m.

"Cuenca, Radio Nacional de Espana en Cuenca, 42.25 m., 7.100, is scheduled 8-10 a.m. and 3-7 p.m.

"Oviedo, FET22, Emisora de la Falange de Oviedo, 42.6 m., 7.042, is scheduled 6-7 a.m., 7:30-9 a.m., and 2-6 p.m.

"Valencia, Radio Mediterraneo de Valencia, 3 kw., 42.63 m., 7.0372, is scheduled 7-9 a.m. and 2-6 p.m.

"Malaga, Radio Nacional de Espana en Malaga, 42.79, 7.012, is scheduled 8-10 a.m. and 3-7 p.m.

"Valladolid, FET1, 6 kw., is scheduled 7:30-9 a.m. and 3-6 p.m.

"Tenerife, 'Club Tenerife,' EAJ43, 20 kw., 41.28 m., 7.267, is scheduled 6:30-8 a.m. and 12:30-5 p.m.

"Spanish Morocco, Tetuan, 'La Voz de Espana en Africa,' 49.45 m., 6.070, 20 kw., is scheduled 2-7 p.m.

"Tangiers, approximately 42.5 meters (7.059) and on one other frequency in the 41-m. band, uses Spanish, opens at 1:30 p.m., is heard at 3 p.m. in England, and is presumed to closedown either at 6 or 7 p.m.; this one may not belong to the Spanish Broadcasting Network, but is received with good strength here in England."

* * *

Last Minute Tips

Direct from Dr. Siegmund Guggenberger, Public Administrator of the Austrian Broadcasting System *(Radio Wien),* comes this late news of broadcasting activities in Austria: "All these last months we had to contend with almost unsurpassable difficulties, and still we attained remarkable success with the reconstruction of the Austrian Broadcasting System. This was due to a great extent to the amicable attitude of all the foreign broadcasting organizations. We were spurred in our work, however, by another idea still: Although Austria is but a little country, it is within the focus of world political interests. Foreign countries generally get their information from authorities who—in spite of their friendly disposition—might not always have the necessary insight into Austrian affairs which might enable them to judge fairly. The voice of Austria itself—its radio—shall speak to the world again. We expect to reconstruct our big radio station—Bisamberg—and to realize the reunion of all the Austrian broadcasting stations in the near future. Then we shall make it our noblest task—following the good Austrian tradition—to offer a standard program which will find an echo in all foreign countries."

Overseas radio journals report that "a powerful new short-wave station, to be called *'Radio Haiti,'* is to commence operation early in 1947. It will be the most powerful station in the West Indies, having a power of 150 kw. There will be three transmitters, providing beam services to Europe, Africa, North, Central and South America. Programs will be radiated in four languages—French, *English*, Spanish, and Portuguese. The following channels have been allocated: 6.077, 6.200, 9.563, 9.620, 11.815, 11.820, 15.300, 17.150, 21.500, and 21.670." (*Short Wave News, London*) (*Your ISW editor would appreciate further information on "Radio Haiti," as it becomes available.*)

At last report, the two short-wave transmitters long reported under construction in New Zealand had not taken to the airwaves, the holdup being the building of suitable antenna arrays. Site of the transmitters is at medium-wave 2YA, just outside Wellington.

Around the New Year the following interesting letter was sent out by Yves Samsioe, an official of *Radiotjanst* (The Swedish Radio), Stockholm: "Hereby just a few lines from the Swedish Broadcasting Corporation to thank you for your collaboration this year and for the excellent reports of reception you sent us. A new year is now coming, a year, we hope, of peace and prosperity. We don't know yet what we can offer you in radio questions, I mean programs a.s.o., but we can assure you that we are doing our best to make this year of 1947 a better one than 1946. We shall still be working with our 12-kilowatt transmitters even this year, but the programs will be a little bit different, more music and especially more announcements telling: 'This is the Swedish Broadcasting Corporation.' Please continue listening to us and send us reception reports. They are, we assure, most useful to us. Address is Radiotjanst, Kungsgatan 8, Stockholm, Sweden (Sverige)."

Mr. Samsioe has informed me that *Radiotjanst* is considering the possibility of a weekly "goodwill" DX session for short-wave listeners "around the world." The pattern would probably include good music and acknowledgement of letters and reception reports received from listeners. Details will be announced as soon as they are available.

Incidentally, Stockholm is now using SDB-2, 10.780, to parallel SBT, 15.155, in the daily North American beam (*English* and Swedish), 10-10:55 a.m.

An unknown Chinese station has been heard lately between 9:15-11 a.m. on about 6.390; call sounds something like "XPRA"; sign-off is with the Chinese National Anthem. XGOUS, Nanking, has been heard around 8:30-9:15 a.m. lately on various frequencies, including 6.935, 7.530, 7.548, and 7.090; relays press dispatches and appears to be experimental. (Dilg)

The Chinese station (listed by Australians as XMTA) on about 12.115 is being heard in Sweden around 5:45-7 p.m., usually with news in Chinese at about 5:45 p.m.; uses various calls so is evidently relaying a number of stations; among calls heard are XGON, XGNC, XNGR, XNTX, XNY, and XNTR. (N. Johnson) Other Swedish reporters list location as Yenan; if so, may be Communist-controlled. From "Down Under," location is reported as Shanghai, and is said to have *English* news irregularly around 6:30 a.m. Has been heard irregularly by Paul Dilg, California, early mornings, but *no English has been noted.*

A Chinese station on 9.555, believed to be Chungking, is being heard in Sweden between 8:45-9 a.m. (N. Johnsson) XOPD, Hangchow, is listed on this frequency.

On about 4.230, Paul Dilg, California, has recently been hearing an AFRS station in Nanking, China, giving an "XM.." call, around 9 a.m.-12 noon. May be a harmonic.

Early in January, time of the "evening" *Radio Australia* beam to Eastern North America was changed; is now heard 6:30-7:45 p.m., with news at 7 p.m., over VLA9, 21.600. Officials of *Radio Australia* inform me that this change was effected that "reception might be more clear." Tests conducted on VLC4, 15.320, late in December, in an effort to find a satisfactory outlet to parallel VLA9 in this transmission, were poor, due to interference from a U.S. transmitter.

SVL, 7.295, Athens, Greece, has poor signal due to interference; scheduled 2:58-3:45 p.m. with Greek news at 3 p.m.; program is interspersed with swing records, off with march; *no English noted.* (Bromley)

ZBW, Hongkong, appears to be on 9.540 currently; has weak to fair signal here in the East around 6-7:45 a.m. (when carrier of Australia's VLB comes on); uses mostly Chinese dialects, is scheduled to relay the BBC news from London at 6 a.m.

LKQ, 11.735, Fredrikstad, Norway, relaying Oslo, is verifying reports from Administration of Telegraphs, Radio Dept., Broadcast Division, Oslo, Norway (Norge). Is heard in New

York with a fair signal from 5:45 to about 7 a.m. fadeout. (Beck) LKJ, 9.540, Oslo, is heard with bad QRM in Sweden at 1:35 p.m.; on about 6.180, Oslo is heard between 4-4:15 p.m. (N. Johnsson). The Oslo transmitter on about 6.180 is heard in New York signing off at 5 p.m. (Beck) Also heard in Sweden around 12:30 p.m. (B. Nilsson)

Radio Dakar, Fr. West Africa, listed on 15:345 but now operating on about 15.388, is being heard widely from 1:30-5 p.m. daily, sometimes longer; has especially good signals in the East. Strong signals are still being heard from this station on its 11.712 frequency, 2:15-2:30 a.m.

Acknowledgements

In order to provide more space for "Last Minute Tips," individual acknowledgements are being omitted. Our sincere thanks go to each person who contributed to the ISW Department this month. For location of reporters credited with individual items herein, please refer to "Acknowledgements" in previous issues.

—30—

Sonar—Sub's Nemesis

(*Continued from page* 49)

both the receiver and the driver with one control, and adjustment of both to the resonant frequency of the projector is greatly simplified.

In the *Submarine Signal Company's* WCA-2 equipment, often used on submarines, part of the h.f. oscillator voltage is fed to the driver amplifier, where it is mixed with a frequency generated by another oscillator tuned to the i.f. of the receiver, as shown in the block diagram of Fig. 6. In this equipment, the operator can tune both the receiver and oscillator simultaneously, as in the QCQ-2, but the driver amplifier for the WCA-2 equipment is generally installed in another part of the ship from the receiver and indicator stack.

Since the sound beam from the projector is highly directive, having a width of about 20 degrees, it is possible to use it as an indication of the bearing of the target. Even with a beam of this width, it is necessary to define the edges of the target by determining the "cut-on" points, as shown in Fig. 4. The midpoint between the cut-on points is then considered the bearing of the target.

A synchro system actuates a motor control circuit, such as an amplidyne, to direct the sound beam to any desired bearing. The operator turns a hand wheel which rotates a synchro generator. Another synchro is geared to the training motor. One of the rotors is supplied with 115-volt, 60-cycle, a.c., while the other is connected to the amplidyne amplifier. When the two rotors are 90 degrees apart electrically, no voltage is induced in the second one. When the control synchro is turned by the operator, the

Front view of WCA-2 "stack."

voltage induced in the rotor of the second synchro is applied through a transformer to the grids of two tubes. The plates of these tubes are fed with a.c. The amplifier is essentially a grid controlled rectifier circuit, and the direction of rotation of the training motor is controlled by whichever tube is conducting. This explanation is considerably simplified, since the amplifier controls the amplidyne generator, which in turn furnishes armature current of the correct polarity for the desired rotation of the training motor armature. This type of control is used in much of the sonar equipment, the most common being the QCS, QCT, and QCQ-2 models. The *Western Electric* QBF employs a three-arm "potentiometer" device which supplies a.c. voltage of correct amplitude relationships to a large synchro training motor directly, thus simplifying the control circuits. The "potentiometer" is actually a transformer with the brushes making contact with the windings at the proper points to furnish the necessary motor voltages.

All of these systems employ a separate synchro link between the training gear and the operator's stack. This bearing indicator shows the projector bearing, with respect to the ship's heading, on a fixed scale, and the absolute bearing on another scale rotating in synchronism with the ship's gyro-compass system. The training panel for the QCQ-2 equipment is shown in Fig. 3.

So far we have described some of the equipment used for echo ranging of submerged objects in a horizontal direction from the ship. If, however, the projector were turned 90 degrees around a horizontal axis and directed downwards, the equipment could indicate the depth of the water below the ship. This is exactly what is done in echo sounding equipment. Since the projector used for sounding does not need to be rotated, it becomes a fixed unit mounted flush with the hull. In many such installations, one projector is used as the transmitting unit, and another is used for receiving. Simplified equipment of this type is in general use on all ships, some being equipped with continuous recorders, making a permanent record of the depth of the water as the ship pursues its course.

Sonar, like radar, is rapidly finding peacetime uses. Compact sounding equipment is being developed for even the smallest pleasure cruisers; powerful systems are capable of locating schools of fish for commercial fishermen; sunken ships can be located with sonar equipment; in one case, even, a sunken airplane was located in 160 feet of water at the bottom of a lake.

Numerous types of circuits are required to make a complete sonar system effective. In some models, a cathode-ray tube is used to indicate to the operator when he has the projector trained directly on a target, or when it is one or two degrees to the right or left. This equipment is known as the Bearing Deviation Indicator, and it is a great help to the operator in giving accurate target bearing to the conning officer. To make an effective attack, the target information must be obtained quickly and accurately; the bearing, course, and speed of a submarine must be known, and there can be no guesswork. How well sonar has done this is evidenced by the number of submarine sinkings—nine hundred and ninety-six submarines would make a formidable fleet for any country. But those, at least, will never fire another torpedo, thanks largely to sonar.

—30—

REPAIRING HINT

IN MANY of the older types of receivers you may be called upon to service, the ganged tuning condenser plates short out or scratch against each other causing the set to be dead or noisy. Sometimes no amount of mechanical "juggling" will separate the misaligned plates. The cause seems to be inconsistent plate spacing on the rotor shaft and/or the stator. The spacing usually is normal in the center but misaligned in opposite directions at one or both ends. The last resort seems to be one of bending plates—a bad practice and one which, if successful, is time consuming.

By disconnecting the coil from the bad section or sections and connecting a 6-volt storage battery across the section, the touching edges can be burnt with no damage to the condenser or the battery. However it is not a recommended procedure when the plates rub firmly together. Be sure and rotate the plates while the battery is connected so that too much burning will not occur.

To give more clearance and to prevent the job from "bouncing back" the rotor can be swung through its range a second time with a slight pressure against the spring.

If this procedure does not clear the plates, it will at least give a good indication where the plates are touching.
. . . . A.M.P.

LETTERS *from our readers*

REQUEST GRANTED

"I MAKE a special point of mentioning RADIO NEWS magazine to new classes to encourage and stimulate interest in radio.

"Its over-all accuracy in diagrams and illustrations is remarkable, as I well realize errors can creep into any drawing and are not, always, very apparent.

"The request for more 'semi-technical' articles on test equipment is on behalf of large classes who besiege me during my spare time for such information.

"Your fine magazine has printed many good v.t.v.m. designs, but few have told how to use a meter of different sensitivity in the same circuit.

"A question that comes up repeatedly is how to design high resistance multiplier for vacuum tube voltmeters. I am sure an article on this information would interest thousands in the radio field who have the equipment but not quite enough 'know how.'"

George W. Kelly
Chicago, Illinois

We have long recognized the need for certain material designed for those new radio men who are daily joining the "fraternity." Now that the RADIO NEWS *staff is back to its prewar strength, we will be able to build, design, test and describe new equipment suitable for the beginning or intermediate radio man. This service will be furnished in a monthly department and should provide plenty of practical, easy-to-built equipment for our readers.*

* * *

SERVICE DATA

"I AM prompted by your recent editorial in the January issue about servicemen and service data to blow off a bit of long-pent up steam on the same subject. I have been in this somewhat bewildering business ever since 1928, and practically all of that period has been spent wondering if there wasn't something we could do about that same headache.

"This chronic condition has been aggravated by the 1946 and 1947 receivers. With everyone else I have had the troubles you mention with the new jobs. A goodly part of it, in my opinion, can be attributed to faulty engineering. I have seen cases of dial-drive design that could be improved on by a NRI graduate on his first set! I have long wished that all design engineers could be made to serve a year in the field, repairing some of their (or rather others') creations, before they were permitted to commit some of the atrocities they foist upon us. The rest of the trouble can be attributed to nothing but sloppy workmanship. If the average service shop put out the class of solder joints, etc. that are being found in quantities in the new receivers, they would be out of business in a month. This condition can, and definitely should be, corrected. The new receivers are a long way from coming up to past standards of material and workmanship.

"Having relieved myself of fifteen years' gripes, here are a few constructive suggestions.

"1. Paste in each cabinet a chart showing the location of various trimmers, especially for the multi-band sets. Leave out of service manuals, etc., the long alignment processes. Most reputable servicemen are familiar with this process. Better still, stamp trimmer numbers, etc., on the chassis by the holes.

"2. Make parts which need most frequent replacement more accessible. Filter condensers, coupling condensers, etc. are often buried beneath a mass of wiring, or even transformers, chokes, etc.

"3. Mark i.f. frequencies on transformer cans. This has been done by some manufacturers for years and I consider it a great help.

"4. Simplify some of the horribly complicated dial drive systems now in use. It seems to me the same result could be accomplished without the maze of pulleys, dingbats, etc. on some sets.

"5. Mark limits of pointer travel and alignment frequencies on backs of "blind" dial faces. In other words, when you take the set out of the cabinet and leave the dial scale in it, it is really aggravating to have to spend an unnecessary half-hour shoving the set in and out of the box to find out where you are on the scale.

"6. Make all speaker leads, phono pick-up leads, etc. plug into the chassis and leave the wiring on the speaker, etc. (Also the loop antenna leads.) This would make for much easier handling of the chassis after removal from the cabinet.

"Thanks for bearing with me thus far. I would like to see some more discussion on this subject, just to see what some of the other boys think about it.

Jack Darr
Ouachita Radio Service
Mena, Arkansas."

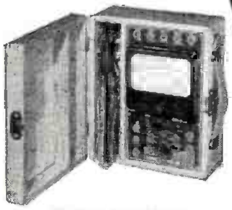
Well, what do the rest of you servicemen think about Mr. Darr's suggestions?

* * *

METAL LOCATORS

"I HAVE been a constant reader of RADIO NEWS for the last ten years or more. There have been very

Available for Immediate Delivery!



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Price $24.95

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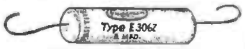

GUARANTEED TUBULAR CONDENSERS

8 MFD—450V—
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10 or more..........26c ea.
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10 or more..........45c ea.
Less than 10..........49c ea.
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"Cub" A.C.-D.C. Amplifier

The "CUB" works with phono pickup, mike, or stringed instrument on A.C. or D.C. current. Its small size and extreme portability makes it the ideal unit for bingo games and is a source of constant amusement at small gatherings. The "CUB" is contained in a heavy gauge steel case with a baked golden lacquer finish. Dimensions 8¼x8¼x4¼. Wght. 7 lbs. A real buy at an amazingly low price.

With tubes $23.46

SIGNAL CORPS OUTPUT METER "146"

A war surplus bargain made by Triplett for the U. S. Army.

Meter has 5 ranges, 1½v, 6v, 15v, 60v, 150v. Meter resistance 4000 ohms. Can be used on A.C. voltmeter as well as an output meter. Used in conjunction with a signal generator, the "146" is an invaluable aid in "souping" your alignment jobs by indicating the intensity of the output of the radio, thus eliminating guesswork involved in trying to peak a set with ear alone. Complete with high quality test leads with clips and black moulded bakelite case measuring 6" x 3" $11.95

"A-200" Reliable Signal Generator

A conventional type generator, ruggedly built for maximum stability. Covers a range of 100 K.C. to 25 M.C. on fundamentals, 18 M.C. to 50 M.C. on 2nd harmonic and 27 M.C. to 75 M.C. on 3rd harmonic and 400 cycle audio. Its grey crackle finish case with multicolored scales gives this generator an attractive finish. Priced for immediate sale $49.50

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MODEL 130. Slide switch operation. For all standard 4, 5, 6, 7, octal miniature series with two spare positions. Filament selective. D.C. voltmeter range 0 - 10 - 100 - 1000. Portable model—leatherette covered wood case with cover.

$51.00

TUBES

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5" ALNICO #5. Net.......... 1.98
6" ALNICO #5. Net.......... 1.98
LATE SPECIAL.....4" LSL Army Type P.M.
Portable phono-record changer leatherette cabinet $8.95

6' A.C. parallel rubber cord sets with molded plug. 10 for..........$1.80

1 meg. volume control with switch. (Knurled shaft) $0.69

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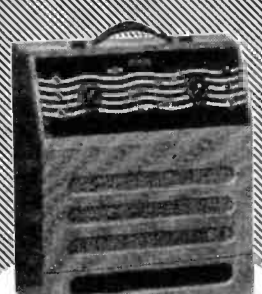

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- Inputs: One Mike, Two Instruments.
- 110 Volts - 60 Cycles - 95 Watts.
- Heavy Duty 12" Dynamic Speaker.

Unsurpassed for realistic reproduction of reed, string and percussion instruments. Complete with tubes but less contact microphones.

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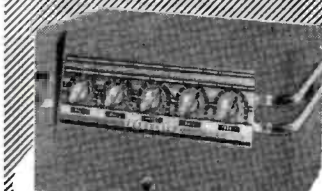
Thordarson 25 WATT BEAM POWER AMPLIFIER

- Inputs: Two Microphone, One Phono.
- Output to Speaker or Line 4, 8, 15, 125, 250 and 500 Ohm.
- Mike and Phono Mixing.
- Frequency Response - Plus or Minus 1 db from 30 to 10,000 Cycles.
- 110-120 Volts - 50-60 Cycle - 128 Watts.

Complete with tubes.

MODEL T-31W25A $125.00 LIST PRICE



MASCO 25 WATT 6 and 110 Volt AMPLIFIER

- Phono Operation on both 6 Volts D.C. and 110 Volts A.C.
- Two Mike Inputs.
- Outputs: 2, 4, 8, 15, and 500 Ohm.
- Extra Heavy Duty Vibrator.

A truly universal amplifier for sound car, outdoor or indoor use. Complete with tubes.

MODEL MC-25P $138.00 LIST PRICE

BELL PORTABLE 15 Watt P.A. System

- 15 Watts Undistorted Output.
- Three Input Channels.
- Illuminated Sloping Control Panel.
- Twin Heavy Duty 10" Speakers.
- Inverse Feedback Stabilizer.

Complete with tubes, 25 ft. speaker cables, crystal microphone with 15 ft. cable and desk type mike stand.

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SEND FOR LIST OF ALL AVAILABLE SOUND EQUIPMENT few copies missed, even though most of them were purchased at local newsstands. Even during my stay in the service (44 months), some of the boys had the magazine mailed to the ship from the States.

"I was a Radio Tech in the Navy, having completed Navy schools in radio, radar, and sound gear. I finished my secondary at Navy Pier in Chicago.

"For a long time I have been interested in radio metal locators. With interest I have followed the two articles of recent months by Osborne.

"I am especially interested in the final article to appear, using radar methods, or pulsing. When will the article appear—or has publication been cancelled? It seems such a long time to wait—or am I impatient?

Carl Spiner Phyln
Misenheimer, North Carolina."

For Reader Phyln and the many others who have asked for more information on metal locators we have tentatively set another article on the subject for April.

-30-

Packaged Radio Service

(*Continued from page* 61)

would have no technical information on 3 out of every 10 receivers if he depended solely upon the manufacturer for service data and literature.

To fill this gap, engineers draw up a schematic diagram of every set for which no drawings are available before the set is processed. These are checked for accuracy and for the proper selection of replacements by direct comparison with those in the actual receiver. Many errors are uncovered in the process of analysis, either in the diagrams or parts lists. Careful tabulation shows that about 60% of all receivers analyzed are accompanied by data that is in error. Many reprint services or manuals which merely copy and reproduce the original manufacturer's diagrams and data will have the same high percentage of errors, as has been proven in thousands of cases. This has long been a plague to the serviceman.

To offset any possibilities of error, each piece of equipment received for processing is carefully unpacked and a series of photographs is made of the external cabinet. If any difficulty is encountered in removing the chassis from the cabinet, a disassembly instruction sheet is made up for inclusion in the folder covering that piece of equipment. It is a fact that many table models are much more difficult to disassemble than their big brothers, the consoles.

The next step is the taking of additional photographs of the top and bottom of the chassis. The technique employed has been worked out so as to assure the easiest identification of each component. After the set is processed through the disassembly line, two men re-draw and re-work the schematic diagrams and any necessary corrections are made. They cross-check their findings against those provided by the analysts.

Another man devotes his full time to the identification and proper coding of each component shown on the pictorial diagrams or photographs. Thus it is possible to identify every item in the receiver from any or all of the following sources; the schematic diagrams, the parts list, and the pictorial diagram. Many "exploded view" diagrams are included. These are vital in the identification of parts used in complicated record changers, etc.

Data covering corrections, additions, and modifications on receivers made subsequent to their original production runs is published in the form of separate sheets and issued as such information becomes available.

Every effort is made to provide the radio serviceman with complete and accurate information when new receivers start coming into his shop. But there are additional problems of both a specialized and general nature which need to be solved. To answer these problems, and as a supplementary service to the *"Folders,"* the *Howard W. Sams Institute* has been established and it maintains a complete library of factory service literature, circuit diagrams, service hints and kinks that cover nearly every radio receiver ever manufactured in the U. S. This information is made available free to subscribers to the *"Photo-Fact Folder"* service.

New techniques were employed by the armed forces during the war to illustrate complicated mechanical and electrical equipment. No time could be wasted on old hunt-and-pick methods. No one can deny that a picture is worth a thousand words and not only do photographs explain the subject simply but an over-all picture is gleaned which makes for a more complete understanding of what makes the thing tick. We here at the Institute believe that the service provided by our organization is destined to streamline the profession of radio servicing.

—30—

OUTPUT TESTER FOR MICROPHONES AND PHONOGRAPH REPRODUCERS

FREQUENTLY it is desirable to know whether a microphone or a sound reproducer is satisfactory. Unfortunately this can not be done by a simple continuity test; however an equally simple test may be performed if one has a crystal earphone at his disposal. The method follows.

Disconnect the unit to be tested from the amplifier and connect to earphones. If the unit is a phonograph reproducer, place the pickup arm on a record and operate in the usual manner. When testing a microphone, a slight tapping on the microphone will serve as a sound source. If the tested unit is satisfactory, the reproduction in the phones will be of excellent quality, clear and distinct.

. . . . W. L. F.

CHART OF WORLD TIME DIFFERENCES

Adjustments of local clocks to accord with the adoption or abandonment of daylight-saving time have now been made in most countries where the additional hour during summer-time is the rule, those in the northern hemisphere moving back an hour, those south of the equator an hour forward.

The chart below includes changes in clock-time up to and including October 31, 1946. Both the standard and current clock-time differences are given. The standard time of any area is governed, of course, by the local longitudinal difference from the Greenwich meridian, each 15 degrees of longitude equalling a time difference of *plus* one hour *east* of the meridian: *minus* one hour *west* of it. Adjustments of the standard variation to meet local convenience have been allowed for iu the standard-time references below.

Area	Difference in hours from GMT: Standard Time	Difference in hours from GMT: Clock Time
ABYSSINIA	+ 2	+ 3
ADEN	+ 3	+ 3
ALASKA:		
(a) Ketchikan—Skagway	− 8	− 8
(b) Skagway—141 w. long	− 9	− 9
(c) 141 w. long.—162 w. long.	−10	−10
(d) 162 w. long.—westernmost point	−11	−11
ALGERIA	GMT	GMT
ANGLO-EGYPTIAN SUDAN	+ 2	+ 2
ARGENTINA	− 4	− 3
AUSTRALIA:		
(a) Victoria. New South Wales, Queensland. Tasmania	+10	+10
(b) N. Territory. S. Australia	+ 9½	+ 9½
(c) W. Australia	+ 8	+ 8
AUSTRIA	+ 1	+ 1
BALI	+ 7½	+ 7½
BELGIAN CONGO	+ 1	+ 1
BELGIUM	GMT	+ 1
BERMUDA	− 4	− 4
BOLIVIA	− 4	− 4
BORNEO (British)	+ 7½	+ 7½
BORNEO (Dutch)	+ 7½	+ 7½
BORNEO (Islands East of and including Dutch Timor)	+ 7½	+ 8
BRAZIL:		
(a) East, including all Coast	− 3	− 3
(b) West	− 4	− 4
BRITISH GUIANA	− 3¾	− 3¾
BRITISH HONDURAS	− 6	− 6
BRITISH SOMALILAND	+ 3	+ 3
BULGARIA	+ 2	+ 2
BURMA	+ 6½	+ 6½
CANADA:		
(a) ATLANTIC ZONE: New Brunswick, Nova Scotia, Prince Edward Island, Quebec (East of Pied de Mont)	− 4	− 4
(b) EASTERN ZONE: North-West Territory (East), Ontario. Quebec (West of Pied de Mont)	− 5	− 5
(c) CENTRAL ZONE: Manitoba. North-West Territory (Central)	− 6	− 6
(d) MOUNTAIN ZONE: Alberta, North-West Territory (Mountain), Saskatchewan	− 7	− 7
(e) PACIFIC ZONE: British Columbia. North-West Territory (West)	− 8	− 8
CEYLON	+ 5½	+ 5½
CHILE	− 4	− 4
CHINA:		
(a) Manchuria	+ 9	+ 9
(b) 110 e. long. and 125 e. long.	+ 8	+ 8
(c) 95 e. long. and 110 e. long.	+ 7	+ 7
COLOMBIA	− 5	− 5
CYPRUS	+ 2	+ 2
CZECHOSLOVAKIA	+ 1	+ 1
DENMARK	+ 1	+ 1
DUTCH GUIANA	− 3½	− 3¾
ECUADOR	− 5	− 5
EGYPT	+ 2	+ 2
FALKLAND ISLANDS	− 4	− 4
FIJI ISLANDS	+12	+12
FINLAND	+ 2	+ 2
FRANCE	GMT	+ 1
FRENCH CAMEROONS	+ 1	+ 1
FRENCH EQUATORIAL AFRICA (BRAZZAVILLE)	+ 1	+ 1
FRENCH GUIANA	− 4	− 4
FRENCH GUINEA	− 1	GMT
FRENCH INDO-CHINA	+ 7	+ 8
FRENCH WEST AFRICA:		
(a) Mauretania	− 1	− 1
(b) French Sudan	GMT	GMT
(c) Niger Territory	+ 1	+ 1
THE GAMBIA	− 1	GMT
GERMANY	+ 1	+ 1
GIBRALTAR	GMT	+ 1
GOLD COAST	GMT	GMT
GREECE	+ 2	+ 2
GREENLAND	− 3	− 3
GUATEMALA	− 6	− 6
HAWAIIAN ISLANDS	−10½	−10½
HOLLAND	GMT	+ 1
HONGKONG	+ 8	+ 9
HUNGARY	+ 1	+ 1
ICELAND	− 1	− 1
INDIA:		
(a) India generally	+ 5½	+ 5½
(b) Assam	+ 6½	+ 6½
(c) Bengal	+ 6½	+ 6½
IRAQ	+ 3	+ 3
ITALY	+ 1	+ 1
JAPAN	+ 9	+ 9
JAVA	+ 7½	+ 7½
KENYA	+ 2¾	+ 3
LEBANON	+ 2	+ 2
LIBERIA	− ¾	− 1
LIBYA:		
(a) Western	+ 1	+ 2
(b) Eastern	+ 1	+ 3
MADAGASCAR	+ 3	+ 3
MALAYA	+ 7½	+ 7½
MALTA	+ 1	+ 1
MAURITIUS	+ 4	+ 4
MEXICO CITY	− 7	− 6
MOROCCO (French)	GMT	GMT
MOROCCO (Spanish)	GMT	+ 1
MOZAMBIQUE	+ 2	+ 2
NATAL	+ 2	+ 2
NEWFOUNDLAND	− 3½	− 3½
NEW GUINEA (British)	+10	+10
NEW GUINEA (Dutch)	+ 9	+ 9
NEW ZEALAND	+12	+12
NICARAGUA	− 5¾	− 6
NIGERIA	+ 1	+ 1
NORWAY	+ 1	+ 1
NYASALAND	+ 2	+ 2
PALESTINE	+ 2	+ 2
PANAMA CANAL ZONE	− 5	− 5
PARAGUAY	− 4	− 4
PERSIA	+ 3½	+ 3½
PERU	− 5	− 5
PHILIPPINE ISLANDS	+ 8	+ 8
POLAND	+ 1	+ 1
PORTUGAL	GMT	GMT
PORTUGUESE GUINEA	− 1	GMT
RHODESIA:		
(a) Northern	+ 2	+ 2
(b) Southern	+ 2	+ 2
RUMANIA	+ 2	+ 2
SAUDI ARABIA	+ 3	+ 3
SEYCHELLES	+ 4	+ 4
SHANGHAI	+ 8	+ 9
SIAM	+ 7	+ 7
SIERRA LEONE	− 1	GMT
SINGAPORE	+ 7½	+ 7½
SPAIN	GMT	+ 1
SPANISH GUINEA	GMT	+ ½
SUMATRA	+ 6½	+ 6½
SWEDEN	+ 1	+ 1
SWITZERLAND	+ 1	+ 1
SYRIA	+ 2	+ 2
TANGANYIKA	+ 2¾	+ 3
TANGIER	GMT	+ 1
TRANSJORDAN	+ 2	+ 2
TRIPOLITANIA	+ 1	+ 1
TUNISIA	+ 1	+ 1
TURKEY	+ 2	+ 2
UGANDA	+ 2¾	+ 3
UNION OF SOUTH AFRICA	+ 2	+ 2
U.S.S.R.:		
(a) Moscow	+ 2	+ 3
(b) Kuibyshev	+ 3	+ 4
(c) Transcaucasia	+ 3	+ 4
(d) Tashkent	+ 4	+ 5
(e) Tomsk	+ 5	+ 7
(f) Khabarovsk	+ 9	+10
UNITED STATES:		
(a) EASTERN ZONE: Connecticut. Delaware. Florida. Georgia, Maine, Maryland, Massachusetts. New Hampshire, New Jersey. New York. North Carolina. Ohio. Pennsylvania, Rhode Island, South Carolina. Vermont, Virginia. West Virginia	− 5	− 5
(b) CENTRAL ZONE: Alabama, Arkansas. Illinois. Indiana. Iowa, Kansas, Kentucky. Louisiana, Michigan. Minnesota. Mississippi. Missouri. Nebraska. North Dakota. Oklahoma, South Dakota. Tennessee. Texas. Wisconsin	− 6	− 6
(c) MOUNTAIN ZONE: Arizona. Colorado. Idaho. Montana. New Mexico. Utah. Wyoming	− 7	− 7
(d) PACIFIC ZONE: California. Nevada. Oregon. Washington State	− 8	− 8
URUGUAY	− 3½	− 3
VENEZUELA	− 4½	− 4½
WEST INDIES:		
(a) Bahamas	− 5	− 5
(b) Barbados	− 4	− 4
(c) Cuba	− 5	− 5
(d) Dominican Republic	− 5	− 5
(e) Haiti	− 5	− 5
(f) Jamaica	− 5	− 5
(g) Leeward Islands	− 4	− 4
(h) Martinique	− 4	− 4
(i) Nassau	− 5	− 5
(j) Puerto Rico	− 4	− 4
(k) St. Lucia	− 4	− 4
(l) St. Vincent	− 4	− 4
(m) Tobago	− 4	− 4
(n) Trinidad	− 4	− 4
(o) Turks Island	− 5	− 5
YUGOSLAVIA	+ 1	+ 1
ZANZIBAR	+ 2¾	+ 3

Courtesy of "London Calling" magazine of the British Broadcasting Corp.

Practical Radio Course
(*Continued from page 59*)

resonance curve to give us any desired compromise between selectivity and sideband response with the assurance that this compromise will hold unchanged for every station received. Furthermore, its constancy permits of judicious "faking" of the audio amplifier response to strengthen the high notes if we find that we cannot get the degree of selectivity we desire without undue cutting of sidebands in the i.f. tuned circuits.

5. It is possible to provide a choice of more than one over-all fidelity characteristic in a given receiver through the use of simple variable selectivity arrangements in the i.f. amplifier. This is especially important in high-fidelity AM receivers, communications type receivers, etc.

6. The i.f. fixed-tuned circuits are cheaper and occupy less space than would an equal number of variable-tuned signal-frequency circuits as there is no need for ganged variable tuning capacitors.

7. The absence of variable tuning capacitors reduces the possibility of widespread feedback occurring within the i.f. amplifier and makes preventive shielding of the circuits easier.

8. Since the total r.f. gain is obtained in amplifiers operating at two different frequencies, the possibility of over-all-feedback is reduced.

Image-Frequency Rejection

It will be remembered from previous discussions of the operation of the preselector that its main responsibility is to reject interfering signals of *image* frequency. Since the mixer will convert these to a frequency equal to the i.f. employed in the receiver, they will not be rejected by the tuned circuits of the i.f. amplifier. Consequently if they are to be rejected at all, the preselector, located ahead of the frequency converter, must do it.

Adjacent-Channel Selectivity

By adjacent-channel selectivity is meant the ability of the receiver to choose between the simultaneously received signals of the broadcasting stations operating on adjacent frequency channels. For American AM broadcasting stations, the usual frequency allocation of adjacent-channel stations is such that there is a 10 kc. separation between their carrier frequencies.

Let us consider the problem of selecting the signal of a 1000 kc. station from that of the adjacent-channel 1010 kc. station. The frequency difference between these two signals is 10 kc., or $10 \times 100/1000 = 1\%$. If a t.r.f. receiver were used for reception, this frequency difference would be maintained throughout the entire r.f. amplification system since both signals would progress through it unchanged in frequency. In order to obtain sufficient selectivity to select the desired signal from the interfering one, a cascaded series of t.r.f. amplifiers (all tunable) would have to be employed with the ultimate aim of achieving a cumulative resonance curve for the entire r.f. system that would be sharp enough to sufficiently attenuate the undesired signal 1% away in frequency so that it would not create annoying interference with the desired signal. This would necessitate the use of quite a number of tuned stages, each having its own variable tuning capacitor in the tuning gang. The resulting receiver would be quite bulky and costly.

If a superheterodyne receiver were used for the reception, it would have to meet the same selectivity requirement. The tuned circuits of the preselector provide some attenuation of adjacent-channel signals. However, the amount of adjacent-channel signal attenuation provided by the two tuned circuits in the usual 1-stage preselector would not be sufficient to completely eliminate interference from strong signals of such close frequencies. Fortunately, the very nature of the superheterodyne process makes a high degree of adjacent-channel selectivity inherent in the *i.f. amplifier,* and the amount required may be obtained very largely by proper design of its tuning circuits and without reference to any other part of the receiver. Let us see why this is so.

How I.F. Amplifier Provides Adjacent-Channel Selectivity

Let us assume that the fixed-tuned circuits in the intermediate amplifier of the superheterodyne receiver employed in the preceding discussion are peaked at the now-standard i.f. of 455 kc. In the preselector circuits of the receiver there is a difference of 1010—1000 = 10 kc. = only 1% between the frequencies of the desired 1000 kc. signal and the interfering 1010 kc. adjacent-channel signal. If the selectivity of the preselector is insufficient to prevent the undesired 1010 kc. carrier from getting through rather strongly to the mixer, *both* signals will be acted upon by the 1455 kc. oscillator signal and the mixer and will have their carriers converted into carriers of lower frequencies, as illustrated in Fig. 2. Both frequency-converted signals will be present in the input of the i.f. system. The carrier of the *desired* signal will have a frequency of 1455—1000 = 455 kc. That of the interfering signal will have a frequency of 1455—1010 = 445 kc. It is evident that the frequency separation is still 10 kc., but the *percentage difference* is now 10 × 100/455, or approximately 2.2%. Therefore, while the original frequency difference is only 1%, it is approximately 2.2% after the two signals have undergone frequency conversion and reached the intermediate amplifier. Consequently the relative adjacent-channel selectivity problem in this case is approximately 2.2 times simpler for the i.f. circuit than for the t.r.f. preselector circuit of equal selectivity. In comparison it will be seen that an improvement of 2.2/1 = 2.2 times has been obtained from a selectivity standpoint by heterodyning the 1000 kc. wanted signal to 455 kc., with respect to adjacent-channel selectivity. The adjacent-channel selectivity of the i.f. amplifier is often called the *arithmetical selectivity*.

Effect of Signal Frequency on Selectivity of I.F. Amplifier

To determine the effect of signal frequency upon the adjacent-channel selectivity of both the r.f. preselector and the i.f. amplifier assume now that signals of higher frequencies—1500 kc. for the desired signal and a 1510 kc. for the undesired adjacent-channel signal—are applied to this same receiver. The frequency difference between these two carriers is still 10 kc. The percentage difference, however, is now 10 × 100/1500 = 0.66%, which means that the relative adjacent-channel selectivity problem is more difficult for the preselector now than it was in the case of a 1000 kc. signal.

However, after these two signals have been "converted" to the lower frequencies by the action of the 1955 kc. oscillator signal and the mixer, their frequencies will be 1955—1500 = 455 kc. and 1955 — 1510 = 445 kc. respectively. The percentage difference between these two frequencies is still 2.2%. It is evident that while the adjacent-channel selectivity of the preselector decreases with increase of signal frequency, that of the i.f. amplifier remains constant over the whole of the tuning range of the receiver.

In practice the decrease in selectivity of the preselector as the signal frequency increases is modified somewhat by the fact that it is usually possible to obtain higher values of Q at high frequencies than at low, so that the selectivity does not fall off as rapidly as one might expect as the signal frequency is raised. Nevertheless the fact remains that the higher the operating frequency the lower the adjacent-channel selectivity of the preselector. It will be remembered that trouble due to adjacent-channel interference in the old t.r.f. receivers occurred mostly at the high-frequency end of the band!

As most of the adjacent-channel selectivity in practical superheterodynes is obtained in the i.f. amplifier, it is substantially independent of the signal frequency and, ignoring the effect of the preselector circuits, the rejection of an adjacent-channel interfering signal is just as good at one end of the tuning band as it is at the other. This is a definite advantage of the superheterodyne receiver. The second great advantage is that since the i.f. circuits employ fixed-tuning we can use as many as are necessary to provide adequate selectivity and gain without complicating the signal-tuning operation of the receiver or making it unduly expensive.

I.F. Peak	Freq. of wanted signal (after conversion)	Freq. of interfering signal (after conversion)	% Freq. difference between wanted and interfering signals (after conversion)
100 kc.	100 kc.	90 kc.	10%
130 kc.	130 kc.	120 kc.	7.7%
175 kc.	175 kc.	165 kc.	5.7%
260 kc.	260 kc.	250 kc.	3.9%
455 kc.	455 kc.	445 kc.	2.2%
600 kc.	600 kc.	590 kc.	1.66%

Chart shows the effect of i.f. peak value on the per-cent frequency difference between wanted and interfering signals. The greater this percentage difference in frequency the more easily the two signals will be separated and the unwanted signal attenuated in the i.f. tuning system of the superheterodyne receiver.

How I.F. Value Employed Affects Selectivity of I.F. Amplifier

While we are on the subject of adjacent-channel selectivity of the i.f. amplifier it will be well to investigate how it is affected by the value of i.f. employed in the receiver. This was an important consideration affecting the standardization of receiver i.f.'s by the RMA a few years ago.

In order to determine the effect of the i.f. value employed in the receiver upon the adjacent-channel selectivity of the i.f. amplifier it will only be necessary to calculate the per-cent frequency difference that results, after frequency conversion, in a receiver to which a wanted 1000 kc. signal and an interfering 1010 kc. signal are applied and which employs the following successive values of i.f.—100 kc., 130 kc., 175 kc., 260 kc., 455 kc., and 600 kc.[2] The results are tabulated above and illustrated graphically in Fig. 3. It is apparent that the lower the i.f. employed in the receiver the *greater* will be the arithmetical selectivity advantage, or the percentage frequency separation of wanted and interfering adjacent-channel signals after the frequency conversion has taken place. The greater this percentage difference in frequency the more easily the two signals will be separated and the unwanted signal attenuated in the i.f.

[2] These are some of the i.f. peaks that have been employed in AM broadcast-band superhet receivers during the past fifteen years—before the standardization of i.f. peaks by the RMA.

If this were the only factor involved, it would appear to be advantageous to employ as low a value of i.f. as possible in a superheterodyne. However, several other important conflicting considerations (for example that of image interference) enter into the selection of the i.f. to be employed and place a definite, practical limit on how low it may be made. We shall learn more about this in the next lesson of this series.

(To be continued)

1N34 Discriminator

(Continued from page 55)

plus equipment stocks. These are less expensive than the units described and have been found to work equally well. The wiring of these units is the same as for the 1N35 and 1N34.

Fig. 4 shows a Summerhays discriminator which differs from the more

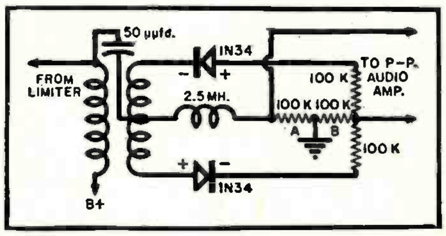

Fig. 4. Circuit diagram of Summerhays discriminator applied to push-pull grids. This arrangement delivers greater output than the Foster-Seeley circuit shown in Fig. 2. For single-ended operation output may be taken across A or B.

familiar Foster-Seely discriminator in that the two rectifiers are wired to provide rectification in opposite polarities. Two advantages of this type of discriminator are that it can be readily fed to a push-pull amplifier as shown in Fig. 4, and the output, whether single ended or push-pull exceeds that of the Foster-Seely. Another advantage is that where a center frequency indicator for tuning purposes is desired the Summerhays system delivers more current and therefore a less sensitive meter can be used without d.c. amplification. Amateurs should find this circuit and the others described in this paper very effective for inclusion in receivers for reception of amateur FM transmissions.

It should be mentioned in passing that the 1N34 functions equally well when used as a detector for AM, either in domestic or communications receivers.

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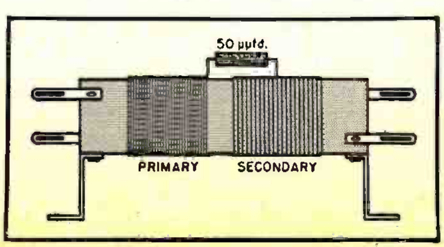
Fig. 5. Conversion of i.f. transformer to a discriminator transformer.



BIZ QUIZ

Test Your Sales Ability

One of a series of sales aptitude tests especially prepared for RADIO NEWS by Mr. George Speer, Director of Institute for Psychological Service, Illinois Institute of Technology.

1. Do you like to imagine how you'd change things, if you could? *(a) Seldom (b) Sometimes (c) Frequently*
2. When someone criticizes you, do you *(a) Feel hurt. (b) Think about it for awhile and then forget it. (c) Ignore it entirely.*
3. If you see an accident, do you *(a) Quickly take an active part in giving help (b) Offer to help (c) Watch others*
4. When you find that other people disagree with your opinions do you *(a) Become discouraged (b) Pay no attention (c) Try to prove that you are right*
5. When you attend a meeting do you usually *(a) Heckle the speaker (b) Ask questions of the speaker (c) Listen quietly to the speaker*
6. If you were able to travel, would you *(a) Take a conducted tour (b) Go with friends who help plan the trip (c) Prefer the adventure of traveling alone*
7. If you are suddenly called on to speak in public, do you find it *(a) Easy and enjoyable (b) Fairly easy but not enjoyable (c) Difficult and unpleasant*
8. Do your political or social beliefs tend to be *(a) Definitely radical (b) Progressive but not radical (c) Conservative*
9. When you attend a football or baseball game do you intentionally make remarks easily overheard by those around you? *(a) Frequently (b) Occasionally (c) Never*
10. Have you ever asked for contributions to a cause in which you were interested? *(a) Yes (b) No*
11. A fellow employee has told some stories about you which are uncomplimentary and unjustified, but not serious. Will you *(a) Confront him and demand an explanation (b) Feel badly, but decide not to do anything (c) Ignore it entirely*
12. When dealing with a very important person in the community do you feel self-conscious *(a) Greatly (b) A little (c) Not at all*
13. When you vacation do you prefer *(a) A quiet secluded place (b) A moderately active resort (c) A lively resort*
14. Have you ever pretended you were busy or in some other way avoided meeting or serving a customer? *(a) Never (b) Sometimes (c) Frequently*
15. If you feel a customer is being dictatorial and domineering do you *(a) Try to treat him the same way (b) Behave normally, but wish you didn't have to (c) Feel and behave normally*
16. Do you prefer *(a) Never or seldom to be alone (b) To be with others about half the time (c) To be by yourself a great deal*
17. When people watch you work do you *(a) Feel nervous (b) Pay no attention to them (c) Do your best work*
18. You have greeted very familiarly a customer whom you believed to be an acquaintance. When you discover he is a stranger to you are you embarrassed *(a) Very much (b) Somewhat (c) Not at all*
19. Do you prefer companions *(a) Of your own sex (b) Of both sexes (c) Of the opposite sex*
20. When making decisions do you *(a) Act on the spur of the moment frequently (b) Sometimes act quickly, but usually after thinking things over (c) Almost always think things over before acting*

(Answers on page 155)

All-Wave Receiver
(Continued from page 45)

coil table. If commercially wound coils are purchased, some alteration may be needed, as there may be evident in the operation of the set a persistent squeal on which variation of the regeneration control will have no effect. This is due to too much oscillation and can be remedied by removing one or more turns from the plate or tickler coil until, by trial and error, the squeal disappears. No more than 45 volts should be used as plate voltage. A single 1½ volt flashlight cell may be used for filament supply but its life will not be long at the .2 ampere drain for the filaments. For short periods of portable operation, however, the flashlight will be sufficient. A No. 6 dry cell will give much longer service. Only about .01 ampere is drawn from the "B" battery so that a small portable type will do. One additional tube socket may be seen towards the rear on the r.f. side in the photograph. This will indicate how the sockets are mounted to the masonite baseboard. However this socket is not used; an r.f. stage can be added later on if desired. If a metal chassis is used, all ground connections should be soldered directly to the chassis or panel at the nearest point. If a baseboard other than metal is used, a piece of tinned bus bar wire may be run the length of the board and all ground connections which cannot be made to the metal panel can be made to this bus bar. This bus bar can be seen in the bottom view of the set running approximately midway between front and rear. A hole must be put in the lower shield to permit the passage of the bus bar. Both the panel and the bus bar must be connected to the ground or B— post. Particular care should be taken in wiring in the tube sockets. All the miniature tubes use the same type of socket but the same pins are not used for the various tubes and it is fairly easy to make an error in wiring if one is not careful.

The operation of the set is similar to that of any regenerative receiver. Stations are indicated by a squeal or whistle during tuning. Backing off the regeneration control until just beyond the point of oscillation will permit a phone station to come in clearly.

Winding specifications for constructing various plug-in coils.

BAND (METERS)	L_2	L_1
Broadcast	100 t.*	25 t.*
200-80	54 t.*	16 t.*
80-40	23 t.*	8 t.*
40-20	10 t.*	6 t.*
20-10	6 t.**	4 t.*

All coils are wound in the same direction with No. 28 enameled or d.s.c. wire. The spacing between L_1 and L_2 is ⅛". Coil forms are 1¼" diam. and 2⅛" long with a 4-prong base.
* Closewound
** ⅛" between turns

Phone stations can also be received by tuning the receiver to zero beat with the incoming signal. For reception of code stations, the receiver can be left in an oscillating condition. Oscillation is indicated by a hissing sound in the speaker or the phones or by a click when the finger is touched to the stator plates of the tuning condenser. If there is no apparent click, the set is not oscillating.

Both the stability and the sensitivity of the set will be found to be good. The quality of voice signals compares favorably with commercial sets, if the volume is kept low. The speaker is not designed to carry too much audio output. Only a short antenna is required but one as long and as high as possible should be used for maximum results. A good ground is almost an essential. A connection to a waterpipe or to a bar of metal buried a couple of feet below the earth's surface will do well. The entire set, including tubes and miscellaneous components, can be built for about eight dollars.

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Spot Radio News

(Continued from page 22)

will have a fair opportunity to compete." The committee requested that a "most favored nation" clause be included in all agreements. Good exports mean jobs to "a large number" of U. S. workers, RMA pointed out, adding: "Because of our large industry and mass production, we in the United States are in a position to appropriate large sums of money for engineering and research and thus have for many years been world leaders in radio engineering and in the development and manufacture of radio transmitters, sets, parts and tubes. Because of the superiority of the American product, many people in foreign countries prefer American-made radio equipment. We enjoy a unique position and are desirous of retaining this leadership. . . . Involved in the reciprocal trade negotiations this spring are: Australia, Belgium, Brazil, Canada, Chile, China, Cuba, Czechoslovakia, France, India, Lebanon, Luxembourg, Netherlands, New Zealand, Norway, Union of South Africa, Russia, United Kingdom, and the colonies of all of these nations.

PRODUCTION in this country, untrammeled by OPA controls, continues to boom. Latest RMA concensus points toward a total of from 12,000,000 to 20,000,000 sets before year's end. Minimum estimates among RMA members average 13,400,000 sets; maximum, 18,000,000. . . . RMA also reports that television receiver production is increasing steadily, usually breaking a record each month. Radio receiving tube output is hitting new peaks. . . .

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Within the INDUSTRY

M. MARKOWITZ was recently named vice-president in charge of manufacturing by the board of directors of *Air King Radio Products Company, Inc.,* manufacturers of the *Air King* line of radios and radio-phonograph combinations.

Mr. Markowitz has been associated with the company for the past twenty years, during which time he served in many capacities with the *Air King* organization. His experience in the purchasing, fabrication of materials and mass production fields will be fully utilized in his new position.

* * *

FEDERAL TELEPHONE AND RADIO CORPORATION has announced that eighteen FM transmitters have been built and shipped by the company in recent months.

Stations soon to begin operating with this equipment represent 12 states bounded by New York and Minnesota on the north and Texas and Florida on the south. Most of these installations are of the 3 kw. type although some stations will go on the air with the company's 10 kw. units.

* * *

JOHN J. WILD, formerly associated with the *Television Equipment Sales Section* of *General Electric Company* as assistant sales manager, was recently named sales manager for the *Potter Instrument Company* of Flushing, New York.

Mr. Wild, who is a graduate of Georgia Tech, will be in charge of the merchandising of the company's line of electronic counting, timing, and industrial control equipment.

* * *

GEORGE T. DEANEY has been named purchasing agent of the *Weston Electrical Instrument Corporation* of Newark, New Jersey, succeeding A. R. Briggs, who recently retired after 45 years' service with the company.

Mr. Deaney joined the *Weston* organization in 1926 under its cooperative plan of industrial engineering training. He completed this training in 1928, the same year he received his B.S. in Electrical Engineering from Newark College of Engineering.

During his 18 years with the company, Mr. Deaney has worked as a time study engineer, department foreman, and cost estimator. His most recent position was that of department head in charge of mechanical engineering.

* * *

ELECTRONIC APPARATUS, INC. of New York has recently acquired the controlling interest in *Tuck Electronic Corporation* of Jersey City, N. J.

G. Emerson Pray, senior engineer and director of *Tuck Electronic Corporation,* was elected president of that company and also named director and vice-president of the parent company.

The new subsidiary of *Electronic Apparatus* will continue to maintain its operations at the Jersey City plant where the company manufactures, designs, and develops specialized industrial and electronic testing apparatus.

* * *

LOUIS S. KIMBALL has been recently named vice-president in charge of operations for the *Colonial Radio Corporation,* manufacturers of private brand radio receivers.

In his new position, Mr. Kimball will make his headquarters at the main plant, Buffalo, New York but will also have charge of the company's operations at the Bloomington, Illinois and Riverside, California factories.

Mr. Kimball has been associated with *Sylvania,* parent company of *Colonial,* since 1942 when he joined the organization as manager of the Fluorescent Fixture plant. He was later promoted to the post of general manager of the Fixture Division in 1945. He was connected with *General Motors'* Frigidaire Division for sixteen years prior to joining *Sylvania.*

* * *

WILLIAM F. COTTER has been appointed chief engineer of *Scott Radio Laboratories, Inc.* of Chicago.

Mr. Cotter has long been associated with the radio engineering field, having played an important role in the development of point-to-point duplex telephone, ship-to-shore telephone systems, police radio communications systems, and home receivers.

He has been associated with *Stromberg Carlson, American Bosch Magneto Company,* and *Federal Telephone and Telegraph Company* of Buffalo, New York. He is a member of several professional engineering societies and holds executive positions with the A.I.E.E., I.R.E. the Radio Manufacturers Association and the Radio Technical Planning Board.

Mr. Cotter succeeds Marvin Hobbs, former chief engineer with the company, who resigned to engage in consulting engineering on radio broadcast equipment.

* * *

DONALD T. McCOY will cover the Ohio sales territory for the *Belden Manufacturing Company* of Chicago, manufacturers of cable and wire.

Included in the lines that Mr. McCoy will handle are *Belden's* automotive, radio, arc welding, cable and neon sign equipment. Mr. McCoy is a recent graduate of the company's sales training and expansion program. He was discharged from the Army last April with the rank of 1st Lieutenant in the Corps of Engineers. His formal educational training was completed at Marmion Military Academy, Aurora, Illinois.

* * *

JACK E. SNYDER is the new manager of the export division of *Concord Radio Corporation* of Chicago. He will supervise the extension of the company's service to the radio and electronics industry throughout the world.

Mr. Snyder has been associated with *Concord* for the past sixteen years.

* * *

WILLIAM MAC MURTRIE has been appointed to the post of General Purchasing agent of the *Philco Corporation.*

He has been associated with the company since 1935 when he joined the purchasing department. In 1938 he was placed in charge of the Chicago office of the company's purchasing department and later became divisional purchasing agent for the automobile radio division with offices in Detroit.

His promotion to assistant general purchasing agent came three years ago, during which time he was a key figure in handling the production of airborne radar equipment for the Army and Navy.

* * *

PYRAMID ELECTRIC COMPANY of Jersey City, New Jersey, has recently acquired a 30,000 square foot, single story plant at Paterson, New Jersey, to handle increased production of dry electrolytics, as well as several types

ANSWERS TO BIZ QUIZ

1. a	6. c	11. a	16. a
2. c	7. a	12. c	17. c
3. a	8. b	13. c	18. c
4. c	9. a	14. a	19. c
5. b	10. a	15. c	20. a

ARE YOU A SALESMAN? Give yourself 5 points for each answer you had checked correctly. A score of 45 is average, and 75 or better is very good indeed.

of condensers which are expected to be added to the company's line in the near future.

The general offices of the company will remain at the main plant located in Jersey City, New Jersey.

* * *

WALTER E. HARVEY has joined *P. R. Mallory & Co., Inc.* of Indianapolis as manager of the Wholesale Division.

Mr. Harvey has been placed in charge of distribution and merchandising of the company's line of radio and electronic replacement parts.

He has been long associated with the wholesale jobbing trade, having been connected with *Thermoid Company,* manufacturers of automotive and industrial rubber products. He has also held executive posts in several national trade associations.

* * *

KINGS ELECTRONICS CO. of Brooklyn, New York has recently announced a new service to manufacturers of television equipment.

The company, manufacturers of television antennas, variable condensers, coaxial cable connectors, microphone plugs, and jacks, is making available the services of its television engineering staff to assist manufacturers with their special television and FM antenna requirements.

Companies who wish to avail themselves of this service are asked to contact J. H. Robinson, vice-president, *Kings Electronics Co.,* 372 Classon Avenue, Brooklyn 5, New York.

* * *

ALFRED T. JOHNS is the new production manager of *Lear, Incorporated's* Home Radio Division.

With seventeen years' in the radio industry, thirteen of which were with *Sparks Withington Company,* three with *International Detrola* and a year with *John Meck Industries,* Mr. Johns brings to his new position a wealth of experience in production methods.

* * *

KENNETH A. NORTON has been named chief of the newly established Frequency Utilization Research Section of the Central Radio Propagation Laboratory at the National Bureau of Standards.

Mr. Norton, who is an authority on radio wave propagation, rejoins the Bureau's staff from the War Department where he served during the war as a consultant on radio propagation to the Chief Signal Officer and as assistant director the Dr. W. E. Everitt's Operation Research Group.

He will direct the activities of this new section which was activated to investigate the utility, for specific applications, of various portions of the radio frequency spectrum. He has been associated with the Bureau of Standards intermittently since 1929, having been granted leaves of absence to serve with the FCC and the War Department.

-30-

Sound Recording
(Continued from page 92)

harmonics of a fundamental tone are generated at different intensity levels. This may be compared in a sense to higher resonant modes of a vibrating mechanical system and their general effect is to reduce fidelity of the original tone.

There is a definite phase effect existing between the sound wave and generated harmonics in the ear and the effect contributes to the distortion experienced in hearing. As may be expected, there are definite intensity limits between which speech and music are reproduced with perfect fidelity.

There are many factors affecting the quality of a tone. Among these are the harmonic content, pitch, and intensity. The *quality* of a tone is also called *timbre* and should be distinguished from *fidelity.* Timbre is a relative quality of sound while fidelity is a true measure of the accuracy with which a sound is reproduced. While much has been done in measuring timbre, the results are subjective. "Fullness," "richness," "brassy," "metallic," are some of the terms used in describing the timbre of a sound.

(To be continued)

What's New in Radio
(Continued from page 78)

50 db. below 1 volt dyne/ cm^2 open circuit.

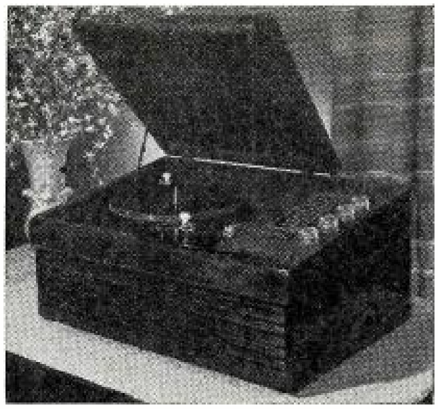
Designed in an attractive combination of black molded plastic and satin chrome finish, this high impedance unit can be used with any amplifier or recorder employing high impedance input. The microphone is supplied complete with an 8 foot cable, plug and removable base which allows conversion from a desk to hand mike at will.

The Brush Development Company, 3405 Perkins Avenue, Cleveland 14, Ohio will supply additional data to those who ask for it.

COMBINATION RADIO

Air King Products Company, Inc. has recently introduced its new table model radio-phonograph combination, "The Crown Princess," to the trade.

Designated as the Model 4704, this unit is styled with simple dignity which fits into any decorative scheme, modern or period. This model comes in satin walnut finish accented by an edge-lighted dial, and features an automatic record changer for ten and twelve inch records, a featherweight low-pressure tone arm, permanent



needle, crystal pickup, a.v.c., full range tone control and built-in aerial.

The company will gladly furnish information on this, and other units in the line to those writing *Air King Products Company, Inc.*, 1523 Sixty-third Street, Brooklyn 19, New York.

—30—

Transmitter-Exciter

(*Continued from page* 39)

value of fixed capacitance which must be shunted across the coil so as to cover the frequency range of 1750 to 2000 kilocycles. From this example we may derive the general relation, $C = \Delta C/(f_r^2 - 1)$ where ΔC is the variation in tuning capacity (maximum minus minimum capacity of tuning condenser) and f_r^2 is the square of the highest frequency divided by the square of the lowest frequency.

A popular misconception regarding e.c.o.'s is that the position of the cathode-tap affects the drift. While the cathode tap adjustment does have an effect on the frequency vs. supply voltage characteristic and may thereby cause chirpy keying, it does not affect the drift characteristic. This drift, usually evidenced by a gradual change in frequency toward lower frequency as the oscillator warms up, is almost entirely due to temperature, humidity, and other random variations affecting the physical characteristics of the oscillator components, principally the tuning condenser and coil form. In attacking drift, therefore, we must attempt to eliminate these variations. In ordinary amateur construction there is little control over humidity variations, but changes of the ambient temperature inside the oscillator compartment may be reduced to negligible proportions. Cyclic heating of the oscillator components does not produce exact reproduction of components because of the poor retrace characteristics of most of our insulating materials and for this reason it is more practical to eliminate temperature variations rather than attempt to stabilize the temperature of the oscillator compartment at some value which must necessarily be higher than the highest value of the ambient temperature.

Practically all the heat in the oscillator compartment has the tube as its source. Tube heating is made up of the heater and plate and screen grid dissipations. The 6F6, popular as an e.c.o., is a serious offender from the standpoint of heater dissipation since it has a .7 amp. heater which, even in the absence of plate dissipation, heats the envelope enough to make it uncomfortable to touch. One of the best e.c.o. tubes from the standpoint of reduced heat dissipation (and for several other reasons) is the 9001. Compared to the 6F6, the 9001 with its 150 ma. heater represents a 450% reduction in heat dissipation. In the transmitter described, the less expensive 6SJ7 was used as oscillator, operating the heater at three volts. At this voltage the heater current is considerably under 300 ma. and the reduction in heat, again compared to the 6F6, is over 500%. The tube envelope barely becomes warm to the touch.

Plate dissipation is the other major item to be reduced. The literature available on the subject emphasizes that low-power input to a self-controlled oscillator results in improved stability. However, low power to many amateurs means anything under five watts, which is enough to heat the oscillator compartment to a considerable extent. In the transmitter described herein, the combined plate and screen grid input is .09 watt, (90 volts at 1 ma.), or about 10% of the heater power dissipation. Needless to say, the heating is negligible. Tests have shown the oscillator to be re-

WHAT PRICE GOOD WILL?

WITHOUT his knowing it, every salesman is building something into the warp and woof of his life that is worth more than the dollars and cents he takes each year from his efforts.

The name of this something is good will.

Good will is another name for the number and intensity of the business friendships a salesman is able to build for himself—and keep.

A good many attempts to put a value on good will have been made, but the clearest was published in the newspapers a few years ago when a firm of investment bankers bought the automobile business of the Dodge Brothers.

The amount paid for that business was 170 million dollars—all cash. The physical assets of the Dodge concern amounted to little more than half that—100 million dollars. But here were hardheaded New York bankers paying 70 million dollars for what?

For good will. For two words—Dodge Brothers. And they considered it a very great bargain.

It was. For good will is a constant asset. Plants can burn down, physical assets can be dissipated, but if a man or a firm has good will, he has the only thing in business which has a constant and growing value.

Take care of your good will and your good will will take good care of you.

That sentence sounds as if repeater Gertrude Stein had written it, but it is good selling if not good language.

-30-

80 & 40 Meters

L_1, L_2 1750-2000 kc., 19 t. #26 d.c.c., diam. 1¼", winding length, ⅝". Sec. 5 t. #26 d.c.c. interwound at gnd. end of grid coil.

L_3 3500-4000 kc., 19 t. #22 d.c.c., diam. 1¼", winding length, ⅝".

L_4 80-40 meters, 19 t. #22 d.c.c., diam. 1½", winding length, ¾".

40 & 20 Meters

L_1, L_2 3500-4000 kc., 10½ t. #22 d.c.c., diam. 1¼", winding length, ⅝". Sec. 3 t. #22 d.c.c. interwound at gnd. end of grid coil.

L_3 7000-7300 kc., 14 t. #24 d.c.c., diam. 1¼", winding length, ⅝".

L_4 40-20 meters, 10 t. #22 d.c.c., diam. 1½", winding length, ¾".

Details for constructing coils for 20, 40, 80 meter operation.

markably stable, holding zero-beat with commercial stations at 7.5 mc. for hours at a time after a warm-up period only long enough to allow the tube heater to arrive at a stable temperature. Since the heater voltage is reduced, the warm-up time required to bring the tube to operating temperature is slightly longer than would be necessary with 6 volt operation but does not exceed one minute.

As a further commentary on the cathode-tap adjustment, tests showed no difference in performance from the value of feedback which would barely sustain oscillation to that value which caused squegging. The voltage regulator tube gives better than .5% regulation of the oscillator supply voltage because of the low oscillator current drain. Since the voltage is so well regulated, the cathode-tap has no chance to cause chirpy keying.

The oscillator is followed by a 6AG7 biased to class "A" operating conditions. The 6AG7 combines the high gain characteristics of the television series such as the 1852 with the high plate dissipation rating of the 6V6. Since it is well-screened, it affords additional isolation of the oscillator from the higher level stages. A 6L6, 6V6, or 6F6 may be used in the doubler stage with practically the same results. This stage is tuned to twice the e.c.o. frequency.

Careful attention to short leads and adequate bypassing will pay dividends in freedom from parasitic oscillations and spurious coupling between stages. Mica bypass condensers were found to be insufficient and were replaced with higher capacity (and cheaper) paper condensers which completely cured all parasitic troubles.

The 807 final amplifier stage has a combination of fixed and grid leak bias for oscillator keying. The 807 may also be keyed, and in this type of operation the fixed bias is not used, resulting in somewhat more output. Power input is approximately 43 watts with oscillator keying and 54 watts with final amplifier keying. A switch is provided in the 807 cathode lead to permit frequency setting of the e.c.o. without QRM to other stations. With a 140 μμfd. tank condenser both the 40 and 80 meter bands may be covered with one plate coil. The 807 operates as a frequency-doubler for 40 meter output but the output is almost as great as in straight-through operation. The tank coil socket is mounted on spacers above the chassis so that the leads to the coil will be out of the proximity of the 807 grid circuit. There is no reaction on the frequency as the 807 tank circuit is tuned through resonance.

The power supply is conventional, using condenser input to obtain approximately 500 volts for the 807. The total drain from the power supply with the 807 loaded is 170 ma. With a 12 μfd. input condenser the output is T9. The fact that the 807 plate and screen current does not flow through the filter choke actually aids the filtering since the choke is not saturated with d.c. Also, there is a phase difference in the ripple voltages applied to the 807 output and input circuits which tends to cancel the hum in the carrier. This transmitter was used quite successfully on phone with many complimentary reports.

—30—

20 Watt Modulator

(*Continued from page* 51)

versally applicable, as is, to cathode modulation. Output windings of the transformer shown will handle 200 ma. d.c.

For modulating "inflexible" u.h.f. rigs, the 500-ohm output of the modulator might be applied to the 500-ohm primary of a multimatch modulation transformer such as *Stancor* A-3834 or A-3866.

An individual builder may prefer to use another type of output transformer in the T_2 position to give a variety of output impedances. This is permissible. The plate-to-plate impedance of the primary will have to be 9000 ohms, and the secondary should be capable of carrying 200 milliamperes d.c.

The two relay contacts in series with the high-voltage center tap of power transformer T_3 may be connected to terminals of the transmit-receive relay in the transmitter. This will allow the modulator to be switched off automatically during reception periods without extinguishing the tube heaters. If relay control is not desired, the relay contacts may be omitted or may be connected together temporarily by means of a short jumper wire.

Mechanical Details and Wiring

The modulator is built on a 17" x 8" x 2" metal chassis. A 17" x 8" x 5" ventilated metal cover fits over the top of the unit and is secured to the left and right ends of the chassis by means of self-tapping screws. This cover was removed for the photographs, Figs. 1, 2, and 4.

All parts must be secured firmly to the chassis before wiring is started. 10-32 screws are used to mount the transformers and filter choke. Liberal use is made of lock washers.

In each of the first two amplifiers stages, it is imperative that all ground returns be run to *one* grounded lug. This common lug preferably should be located at a central point. This perhaps does not make the neatest appearing arrangement, but it is the most efficient electrical assembly of a high-gain audio stage. Such common ground connections in the various stages should be connected together by means of a length of heavy bus wire. The chassis must not be depended upon as a return conductor.

Leads between jack *J*, radio-frequency choke RFC_1, and the control grid terminal of the 6SJ7 socket must be enclosed in shield braid and the braid must be connected to chassis at each end of its length.

A tightly-twisted pair made of heavy hookup wire must be run between the heater terminals of the amplifier tube sockets and the 6.3-volt winding of transformer T_3. This line must be kept close to the chassis. One side of the heater line must be grounded to chassis at one point (preferably at the power transformer), but under no circumstances should the chassis itself be employed as one leg of the heater circuit.

In Figs. 2 and 4, the chassis receptacle for the 115-volt line plug may be seen along the rear lip of the chassis. This is a handy attachment, since it permits complete removal of the line cord-plug assembly. It is an added refinement, however, and may be omitted if cost is to be kept down or space conserved.

From left to right along the front lip of the chassis (See Fig. 1), are mounted the microphone jack (*J*), gain control (R_6), on-off line switch (S_1), and pilot light (*PL*). In Fig. 1, the microphone plug is shown inserted into the input jack. Each of these components is mounted as close as possible to the rest of the circuit with which it is associated.

The hole seen on top of the chassis between the third metal tube and the electrolytic capacitor, in Fig. 1, was intended originally for leads to a volume level meter on the front of the dust cover. After several tests, however, this meter was finally dispensed with.

In order to prevent core vibration, all assembly screws and nuts in the transformers and choke must be tightened carefully before these components are mounted on the chassis. It is not uncommon for these screws to loosen in shipment.

Before the final mounting is completed, the core of the filter choke must be set in the direction which results in the least hum pickup by the first amplifier stages. The correct direction must be determined experimentally by rotating the choke while listening to the hum in a speaker connected to the modulator output terminals. Thus, the entire modulator must have been wired and in working condition before this test can be made. The mounting of transformers and choke shown in Figs. 1 and 5 was found to be the best arrangement for components of the make and type specified. If an individual builder uses these same parts, he may follow the indicated layout to the letter.

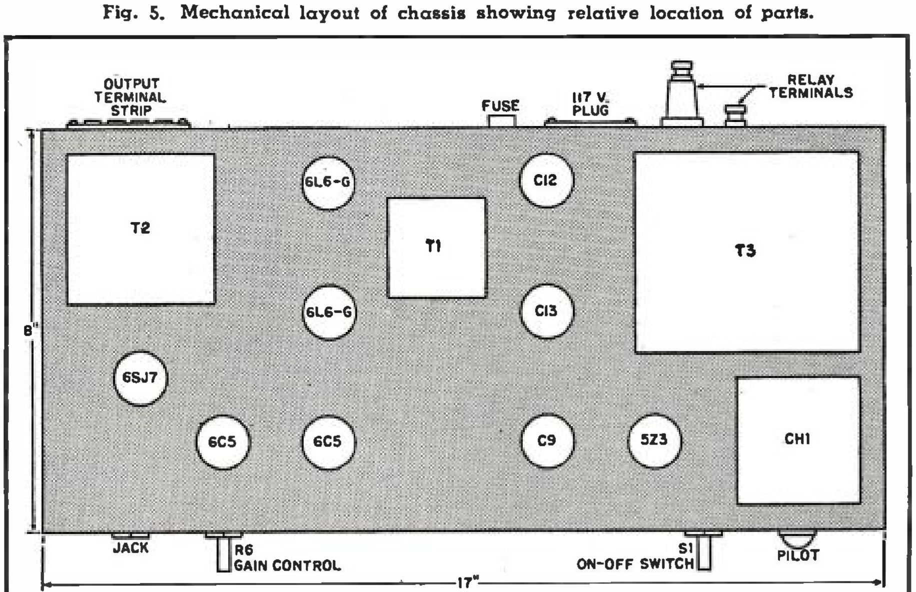
In wiring the modulator, long leads are to be avoided in all stages. Each component must be placed as close as physically possible to other components to which it is to be connected. Grid and plate leads must be kept far enough apart to prevent undesired feedback coupling.

Testing

Because of the straightforward nature of the modulator, no adjustments or elaborate tests are necessary to place the unit into operation.

After assembly and wiring have been completed and have passed inspection, the modulator may be

Fig. 5. Mechanical layout of chassis showing relative location of parts.



checked by connecting a speaker with 500-ohm input to the 500-ohm output terminals of the unit, and switching on the power. With the gain control "wide open," both hum and hiss should be negligible and there should be no whistles, squeals, or motor-boating. *Do not use headphones for this test.*

An audio-frequency signal of 1 millivolt or less fed into the input jack, *J*, from a low-distortion audio oscillator, should give a strong, clear signal in the speaker. Effectiveness of the gain control may be checked while this signal is passing through the amplifier by swinging potentiometer R_6 through its entire range. If blocking or plugging of the signal occur near the maximum volume setting of R_6, reduce the signal from the oscillator.

If d.c. voltage measurements are to be made at the socket terminals, use a voltmeter with very high input resistance, preferably an electronic type such as the *VoltOhmyst Jr.* or *Vomax.* Test meters with a sensitivity rating of 1000 ohms per volt or less will give erroneous readings.

Some advantages may be realized by matching the 6L6 tubes used in the output stage. A simple plate and screen current test usually will be sufficient and the easiest one for most amateurs to make, although a matching of transconductances would be much better. It is not imperative, however, that these tubes be matched.

—30—

3" Oscilloscope

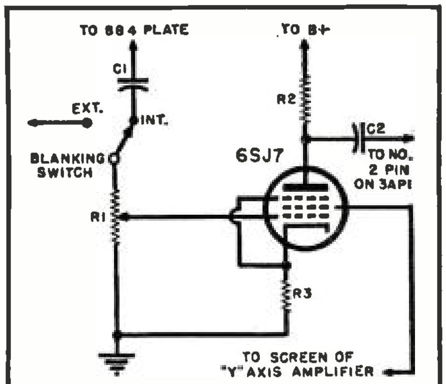
(*Continued from page 70*)

out of tubes and parts. The focus, intensity, and two centering posts are brought to the front panel through flexible insulated couplings, panel bushings and extension shafts. Be sure to insulate the resistors in the high voltage bleeder circuit properly. The circuit diagram is shown in Fig. 1.

The finished scope should be enclosed in a metal cabinet so that the unit will be electrostatically and magnetically shielded. The exact size and shape will depend on the size and shape of the chassis you use.

When the unit is finished, turn it on and you should observe a trace on the tube provided all the switches are turned to internal position, the sweep amplitude control is advanced, and the sweep frequency switch is set to any of the frequency ranges. Adjust the focus and intensity controls until the trace is sharp and bright enough to be easily observed. The trace or spot should not be left motionless when it is bright, as it will burn the screen.

Connect the *Y* axis input to the 60 cycle output on the front of the scope and adjust the controls until you become familiar with their operation. In some cases, it may be necessary to ground the scope to a water pipe by means of the ground binding post at the bottom of the front panel.



R_1—500,000 ohm pot.
R_2—91,000 ohm, ½ w. res.
R_3—820 ohm, ½ w. res.
C_1—100 μμfd. mica cond.
C_2—.1 μfd., 1000 v. cond.

Fig. 7. Circuit diagram of Z axis amplifier. This unit can be incorporated as an additional feature of cathode-ray oscilloscope.

Let us now measure an unknown a.c. voltage. The a.c. voltage brought out at the bottom of the front panel is from one of the 6.3 volt filament windings; although its r.m.s. value is 6.3 volts, its peak-to-peak value is 17.8 volts or, roughly, 18 volts. We can, by holding a ruler against the front of the C-R tube, adjust with the *Y* axis gain control this waveform to exactly one inch in height. By measuring the height of an unknown voltage with the ruler we can determine the value of an unknown voltage. Remember that the peak-to-peak value (distance from top of positive peak to bottom of negative peak) of a sine wave is 2.82 times the r.m.s. value. The *Y* axis amplitude control must not be touched after the calibration is made or the calibration will change. If the unknown voltage is greater than can be measured on the 3" tube with an 18 volt per inch sensitivity then set the 18 volts equal to ¼ inch, etc.

If we want to measure a d.c. voltage, then the jumper on the *Y* axis deflection plate at the back of the scope should be removed and a known d.c. voltage applied directly to the plates. The spot will move to a new position and remain there. The distance is measured and then the distance an unknown voltage moves the spot is measured and compared with the calibration distance. If a very large voltage is to be measured, a voltage divider of very high resistances should be placed across it. The resistance values should be accurately known. 5% carbon resistors will suffice in most instances if their wattages are not exceeded.

To find an unknown frequency, one has several choices. First, you can compare it with the frequency calibration of the internal sweep by turning the sweep knob to minimum and adjusting the sweep frequency knobs until one cycle appears on the screen. This is a rough frequency determination, but will suffice in some cases. To more accurately determine the frequency, compare it with a known frequency from the 60 cycle line frequency, an audio oscillator or a signal generator. If neither of the latter is available there are a few common sources of known frequency. The output from a full-wave rectifier is 120 cycles per second. WWV, the standard frequency station, broadcasts a 440 cycle note and a 4000 cycle note on exactly 5 megacycles, which can be picked up on all-wave superheterodynes.

The unknown frequency is introduced into the *Y* axis amplifier. The known frequency is applied to the *X* axis amplifier by switching the *X* axis switch to external and turning the sweep frequency switch to the off position.

The modulation envelope of a phone transmitter may be observed by applying some r.f. from a coupling coil placed in the field of the transmitter's tank coil directly onto the vertical deflection plates. Distortion in audio amplifiers is easily located and eliminated.

Receiver signal tracing is possible with the scope, and the location of noise and intermittents is also possible. Receiver alignment is best done with a scope, and requires an oscillator which has its frequency swept through an adjustable range. There are several sweep frequency signal generators available on the market, as are frequency modulated signal generators. These generators also generate a sweep which is applied to the *X* axis of the scope.

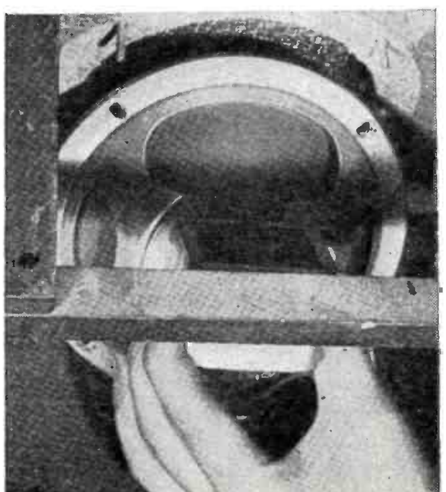
There are a host of other uses for your scope which you will discover as you use it. There is no substitute for this convenient window through which you can actually see what is going on in a circuit.

—30—

STUDS MAY DAMAGE SPEAKER CONE

RADIO speaker cones are often damaged by piercing the cone with the sharp end of the mounting studs when removing or replacing the speaker.

Grasp the speaker as shown and guide it carefully into place—keeping the mounting studs lined up with the holes in the speaker rim—to avoid damage to the cone. . . . . H. L.



Technical BOOKS

"THE PEOPLE LOOK AT RADIO" by Paul F. Lazarsfield and Harry Field. Published by *Chapel Hill, The University of North Carolina Press.* 151 pages. Price $2.50.

This book covers the results of a survey made by the University of Denver's National Opinion Research Center at the behest of the National Association of Broadcasters. The findings were later analyzed and interpreted by the Columbia University's Bureau of Applied Science. These results are incorporated in this report to the broadcasters from the American people.

Several surprising results were discovered in the course of this survey. If you are a "commercial hater" you are definitely in the minority. 62 percent of the people polled expressed their preference for radio programs *with* advertising; 35 per-cent wanted their program material without product plugs, while 3 per-cent had no opinion on the subject.

Many other interesting facts about the part radio plays in the instruction, education and entertainment of the public are included in this book.

* * *

"THE DECIBEL NOTATION" by V. V. L. Rao. Published by *Chemical Publishing Company,* Brooklyn, New York. 176 pages. Price $3.75.

Since the "decibel notation" was first used in 1924 in connection with telephone engineering there has been no text in the English language which made any attempt to explain the origin, development and applications of decibel notation until the appearance of Mr. Rao's book.

In covering his subject, the author has delved into the development of the logarithmic unit, zero levels and level signs, decibel meter and decibel graphs, sound levels and phon calculations.

Technical personnel in the radio and acoustics field should find this book of great assistance in their work. The many graphs and tables which are used extensively throughout the text material have many practical applications.

—30—

ERRATUM

It has been brought to our attention that on page 12 of the January issue in "Spot Radio News" we were guilty of giving away fourteen minutes of Station WQQW's time to free advertising messages. The sentence should read "No commercials will be permitted longer than one minute" says station policy. "At least fourteen minutes free of advertising will precede and fourteen minutes free of advertising will follow each commercial." Our apologies to Station WQQW.

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RADIO ENGINEERING

SLIDE Rule Short Cuts, with Positive location of the Decimal Point. Easier, Quicker AC-DC calculations. Nothing else like it. Second Edition —$1.50 postpaid. W. P. Miller, 536 "F" St., San Diego 1, Calif.

RADIO Engineering Broadcasting, Aviation and Police Radio, Servicing, Marine Operating and Electronics taught thoroughly. Expenses low. Write for catalog. Valparaiso Technical Institute, Dept. N, Valparaiso, Ind.

FOR SALE

MAGNETIC Wire Recorder: Magazine with 10,000 feet stainless steel wire, contains recording, reproducing and erasing heads with level-wind control, two spools with automatic brake and high speed rewind. Switches for warning, stop and overrun. Add your motor and amplifier and make 8000 cycle recorder. Brand new—made for Government and in original packages. Price, while they last, $15.00. Sent COD with $5.00 prepayment. Rotary Beam Antenna Motors: reversible, geared-head motor, can operate 200 lb. beam, 1½ and 3 R.P.M. torque 75 in. lbs. 12 volts D.C.—Operate from A.C. with transformer and dry disc rectifier. Relays and switches built-in. Made for Government, cost $115. Our Price, while they last, $5.50. Sent COD with $3.00 prepayment. Radioco, 1110 Marshall Bldg., Cleveland, Ohio.

SPEAKER Cones replaced, prompt service, satisfaction guaranteed, 3, 4, or 5 inch, $2.25; 6 inch, $2.75; 8 inch, $3.25; 10 inch, $4.50 up; 12 inch, $4.95 up. National Radio Distributors, 899 Southern Boulevard, New York City 59, N. Y.

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ONE complete No. 19—Mark II Tank—transmitting and receiving set. Or will trade for good radio test equipment or new bicycle parts. J. C. Stradley, 15 Rice St., Hamlet, N. C.

25 MODEL 1100-A Karadio medium frequency nine tube crystal controlled mobile radio receivers. Tuning range 2 to 3 megacycles. Complete with tubes and crystal for operation on 2726 kilocycles. In good condition. 3 Temco model 25A-IF, 25 watt output, mobile transmitters. Tuning range 2 to 3 megacycles. Tubes—6L6-Oscillator, 2/807-final, 6C5-amplifier, 6N7 driver, 2/6L6-modulators. Dynamotor power. Fair condition. For operation on 2726 kilocycles. 1 Kaar model PTL-22X, 22 watt output, mobile transmitter. Tuning range 2 to 3 megacycles. Tubes—HY-69-oscillator, HY-69-final, 2/HY-69-modulators. Dynamotor power. For operation on 2726 kilocycles. In excellent condition. 1 General radio model 775-A frequency monitor. Complete with tubes and crystal for monitoring 2726 kilocycles. New, in excellent condition. For sale by Southern Natural Gas Company, P.O. Box 2563, Birmingham, Ala., % Lucien C. Bomar.

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DUAL microammeter, 200 microamps each, 3¼" diameter Westinghouse, $3.50. 1-0-1 milliammeter, 2⅜" diameter, $2.00. Oil filled capacitors, .25 mfd, 4000 WVDC, 85c. 3" Cathode ray scope, radar indicator ID-93/APG-13A, 115v 400cps, complete with 11 tubes, new, $25.00. Write for list. Rubin Radio, Shrewsbury, N. J.

SX-28A HALLICRAFTER in A1 condition, $190. S. Palasek, 62 Main St., Port Washington, N. Y.

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JENSEN JHP-52 Speaker, Cabinet, Amplifier, practically new. Earl H. Swen, Gilby, N. D.

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A. 4-TUBE video amp. chassis—Contains valuable ceramic sockets, terminal strips, chokes, condensers, etc. Real buy for the amateur. $2.50. B. Complete well filtered DC power supply conservatively rated at 375V-140 mils—Features two CD 16 mfd.-600V. filter capacitors and separate 6.3V. filament supply. Uses two 6x5's—Connections are brought to terminal strips, less tubes, $5.95. C. Westinghouse Oil filled Condensers, 10 mike 600WV, rectangular can, $2.50. D. 5" P.M. Speaker, Magnet 2.15 ounce, Alnico #5, $1.59. Belmont Radio Supply, 1921 Belmont Ave., Chicago 13, Illinois.

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RIDER Manuals Wanted, 1 to 5. Write A. Lopes, 780 E. 214 St., New York City.

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FRENCH radio businessman, reliable, competent, first class references, wishes to represent American radio firm in France. Write to Louis Matigot, 50 North Drive, Huntington Station, N. Y.

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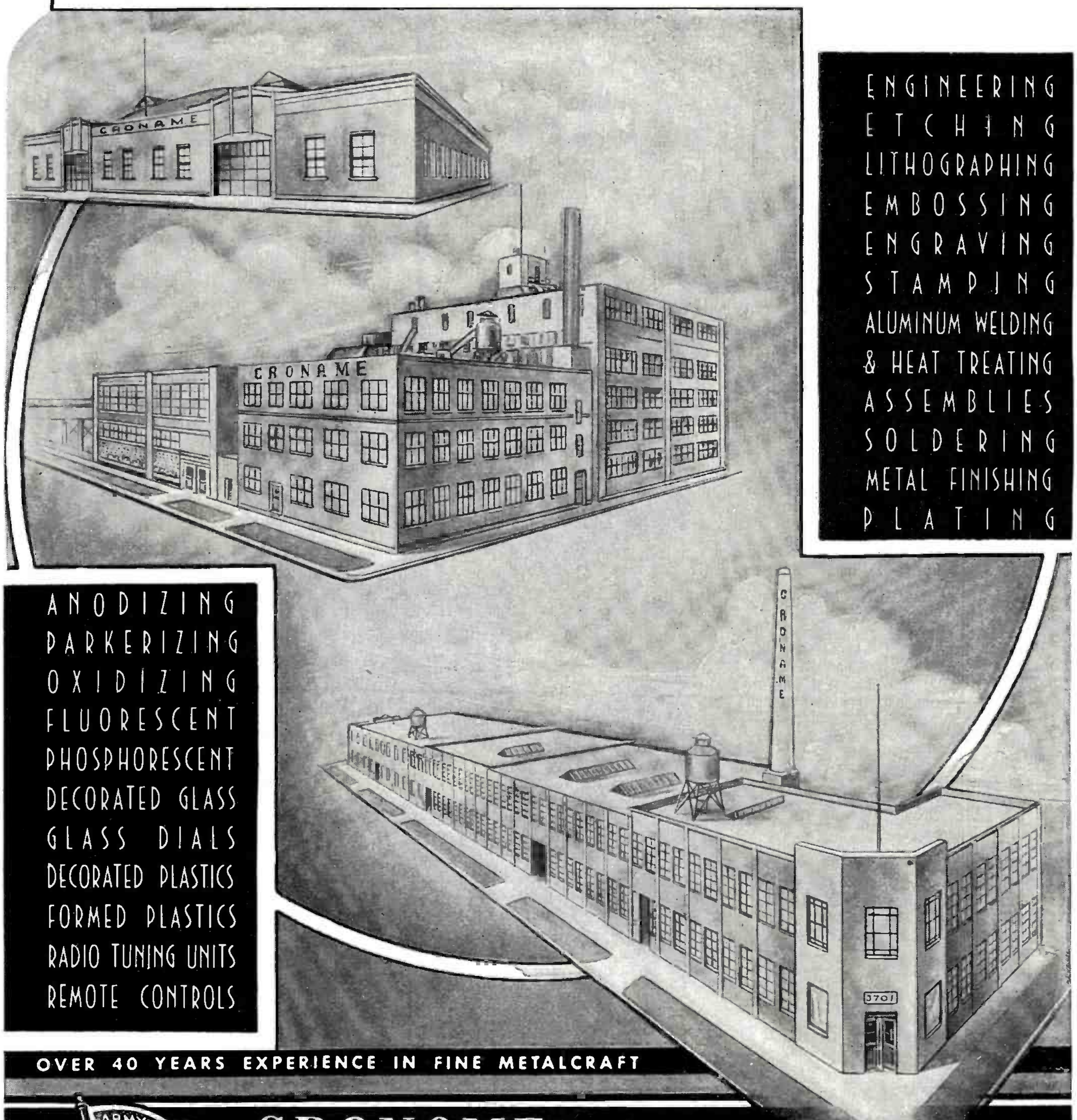

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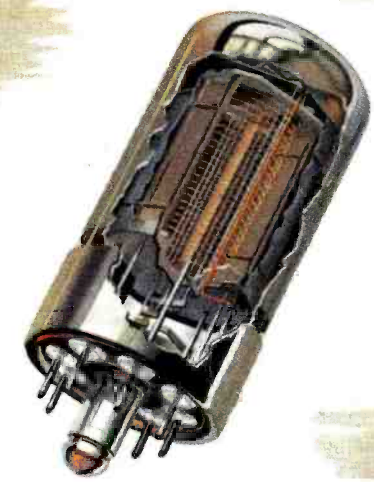

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