NEW STATION CALL LIST

RADIO NEWS

SEPTEMBER
25 Cents

Radio Fights Forest Fire

Radio Aloft
Portable Set Tester
Making a Dynamic Mike
56-Megacycle Magnetron Transmitter

[illegible]ERS. [illegible]ou [illegible]a[illegible]c[illegible]d [illegible]c[illegible]
[illegible]awls' [illegible]ngineers [illegible]roduced [illegible]t!

THE ULTIMATE IN TELEVISION

Rawls

Televisor

Most efficient televisor produced for home use. Equipped with Duraluminum lens disc 16″ diameter. Each of its 60 lenses accurately adjusted focally to produce clear, definite images on screen. Disc driven by heavy duty synchronous motor, with switch and framing device operated from front panel.

Short Wave

The Rawls Short Wave Unit in connection with the broadcast receiver has been especially designed for long distance short wave reception from 15 to 200 meters, Super Heterodyne Circuit incorporating 9 tubes in the combination. The use of the new multi mu and pentode tubes give exceptional tone and power. To switch from one short wave band to another, it is unnecessary to change coils—just the click of the panel switch and the change is made automatically.

Broadcast

A six-tube receiver, designed to give the ultimate in tone, selectivity and power. Uses the following tubes: two 235 Multi Mu, one 224A Detector, one 227 and one 247 Pentode output with 280 rectifier. The tone quality of the set is due to the accurate matching of all parts. Its eight-inch Dynamic speaker handles, without distortion, the tremendous output of the pentode tube. Designed especially for reception of the synchronized voice with television image.

Television

The television receiver is the most important receiver of the combination. Eight tubes T.R.F. circuit, using two 235 Multi Mu in RF circuit, one 224A Detector, one 224A, one 227 and two 245's in audio circuit, also with the 280 rectifier. Very careful attention has been given the audio amplifier and its frequency response is flat from 15 to 75,000 cycles, which is necessary to give clear, definite television images. Its two 245 tubes are so connected to supply the undistorted output and current necessary for proper operation of the Rawls crater point lamp.

To give the public the very latest in television our engineers have produced the "Ultimate in Television and Radio."—*Model TV85.* . . .

Pioneering in the television field, they were quick to grasp the need of a set *capable of producing a picture large enough for a group to sit by and enjoy.*

No longer is it necessary to peep into a small aperture—one person at a time. The TV85 projects a picture on a screen in the panel of set. Invite your friends—*any number of people can enjoy the program.*

In addition, it is now possible to get the *added thrill* of LISTENING TO AS WELL AS SEEING your favorite artist on the screen . . . and the TV85 is not only a television receiver . . . it is *also the latest in combination ALL WAVE RECEIVERS.* . . . Covering bands from 15 to 550 meters.

W. C. Rawls & Company RN
Bankers Trust Building
Norfolk, Virginia

Gentlemen: Please send me complete information about your dealer's franchise.

Name.....

Address.....

City.....State.....

Housed in a beautiful console cabinet that will fit the appointments of the most pretentious home. . . . *TRULY the last word in TELEVISION AND RADIO.* . . .

Think of the thrill of reaching out with just a turn of the dial to *that unknown, unexplored region of short waves* . . . just beyond the range of your present receiver. . . .

Distance means absolutely nothing . . . FOREIGN BROADCAST an exciting chase through the underworld of a distant city hot on the trail of a murderer, thief, reported clearly by the police department. You don't have to strain to listen . . . *signals come in as loud and clear as your local broadcast.*

Listen to AMATEUR STATIONS all over the world.

Hear the progress in the field of Aviation. Planes are timed and reported exactly the same as on the most modern railroad . . . Dallas, Texas, reports No. 622 overdue . . . quickly the entire country is on the qui vive searching for the missing plane.

It is positively thrilling . . . and don't forget all this time you are comfortably seated in your favorite chair surrounded by your family and friends . . . enjoyment for them all. . . .

Be up to date . . . order your Rawls TV85 today . . . costs no more than a good single purpose receiver, yet it provides *thrills that you've never experienced.*

LIST PRICE

$295.00

"Originators of Rawls Yellow Base Tubes"

Rawls Yellow Base Tubes

Dealers' franchises will be *valuable.* Write us of your qualifications for *exclusive contract.* If there is no dealer in your community handling the complete Rawls television set, write us direct.

W. C. RAWLS & COMPANY

R. N. BANKERS TRUST BUILDING • • NORFOLK, VIRGINIA

Announcing a New receiver

POSITIVELY *Guaranteed* TO RECEIVE REGULARLY, WITH LOUD SPEAKER VOLUME, FOREIGN STATIONS ✦ ✦ 10,000 MILES OR MORE DISTANT

THE SCOTT ALLWAVE DELUXE

Eleven new and sensational developments enable this receiver to completely shatter all previous known standards of radio performance

✦ ✦ ✦

No Plug-In Coils or Tapped Coils — New system actually MORE efficient than Plug-In Coils.

Single Dial tunes BOTH R. F. and oscillator circuits from 15 to 550 meters, perfectly and *automatically* WITHOUT TRIMMERS, by newly developed method protected by patents pending.

4/1000ths Microvolt Sensitivity — This truly tremendous power brings in stations 10,000 miles distant with volume of a local station.

New Selectivity Masters Every Channel — Laboratory curves prove DELUXE MODEL most selective receiver ever built. Absolute 10 KC separation at 200 times signal ratio.

New Class "A" Linear Amplifier — Gives perfectly uniform response to all frequencies from 30 to 8,000 cycles—Provides perfect reproduction and linear output at LOW as well as HIGH volume.

New Twin Speakers — Laboratory-matched to give richness and thrilling realism and to eliminate all trace of speaker distortion or blasting at high volume.

New Tonal Realism — The perfectly engineered combination of CLASS "A" Amplifier, laboratory-matched twin speakers — and receiver — gives to the tone of the SCOTT ALLWAVE DELUXE the fourth dimension lacking in all ordinary reproduction.

New Type Tubes Used in highly developed circuits secure amplification never before attained in a radio receiver.

Static Suppressor reduces atmospheric noises to minimum, permitting practical use of our extreme sensitivity on far distant stations.

100% Shielding — Makes possible full use of tremendous sensitivity without slightest trace of oscillation.

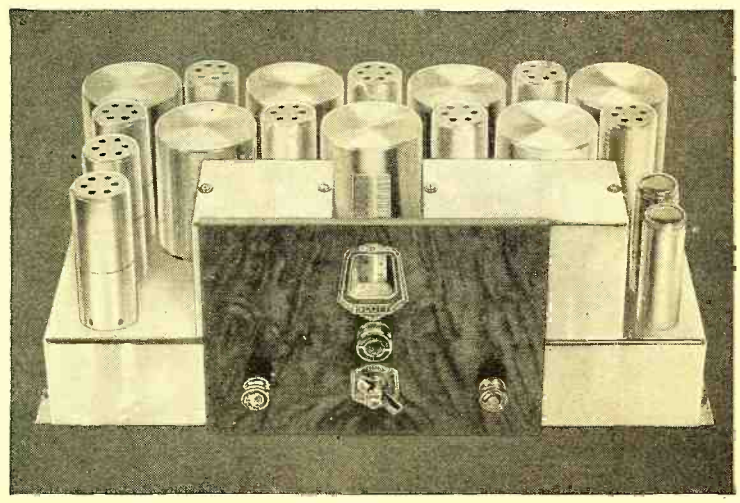
New Scott Slow Motion Drum Dial — No cords or cables to get out of adjustment—Positive drive without back lash.

Guaranteed Daily World Wide Reception in your own home—any day of the month—any month of the year.

✦ ✦ ✦

Send for Technical Details, Laboratory Information and Proof of the above statements. Use the coupon. Mail it today to

THE E. H. SCOTT RADIO LABORATORIES, INC.
4450 Ravenswood Avenue, Department RN-92, Chicago



Our Challenge to the Radio World

Our tests show the performance of no other receiver even approaches that of the new SCOTT ALLWAVE DELUXE—A fact confirmed by laboratory measurements made by *independent* testing laboratories. Here's our Challenge—

1. Over eight years ago a SCOTT SUPER EIGHT brought in 119 programs from 19 different broadcasting stations, all 6,000 miles or more distant, and had all reception fully verified — **Who Can Equal THIS Record?**

2. Over 16,000 detailed logs of foreign station reception have been received from owners of SCOTT SETS since January 1st, 1932 from 257 different foreign stations in 43 foreign countries (Canada and Mexico logs not counted). **Who Can Equal THIS Record?**

3. Every regular program from station VK2ME, Sydney, Australia, 9,500 miles distant, has been logged and reception recorded for twelve consecutive months on a SCOTT ALLWAVE RECEIVER located in Chicago. **Who Can Equal THIS Record?**

4. Finally—What manufacturer claiming "record breaking performance" is willing to place his receiver alongside the new SCOTT ALLWAVE DELUXE for a competitive test on distant stations from 15 to 550 meters—the results of this test to be published in THIS magazine—Reception results to be judged by three or more leading Radio Engineers or Radio Editors—After reception tests, both receivers to be subject to tone test—Results to be judged by three or more well known musical authorities. **Who Will Accept THIS Challenge?**

THE E. H. SCOTT RADIO LABORATORIES, INC.
4450 Ravenswood Ave., Dept. RN-92, Chicago
Send me full particulars of the new SCOTT ALLWAVE deluxe.

Name .....

Street .....

Town ..... *State* .....

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Technical Editor

William C. Dorf
Associate Editor

John M. Borst
Ass't Tech. Editor

RADIO NEWS

Howard S. Pearse
Associate Editor

Samuel Kaufman
Broadcast Editor

Jos. F. Odenbach
Art Editor

Edited by Laurence M. Cockaday

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(Cover Design by Morey)

DEPARTMENTS

Published Monthly by Teck Publications, Inc., *Washington and South Avenues, Dunellen, N. J.*

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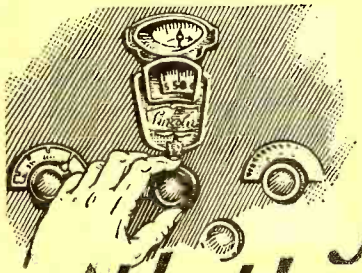


Tune the NEW way for World-Wide Reception with the LINCOLN DE·LUXE·SW·33

SILENT TUNING···

The weakest carrier wave is registered on the signal indicator and can be tuned with precision and perfect silence without disturbing atmospheric noises.

SIGNAL INDICATOR

A meter directly above the dial indicates, not only the weakest signal, but allows the operator to tune into a signal perfectly. Guess work is entirely eliminated. Comparative signal strength is indicated.

UNDISTORTED HIGH AMPLIFICATION·

Three stages of push pull with new system of twin-grid detection allows tremendous undistorted amplification of the high gain I. F. amplifier. The handling power of this system seems to be unlimited and tremendous volume on weak signals can be had if desired.

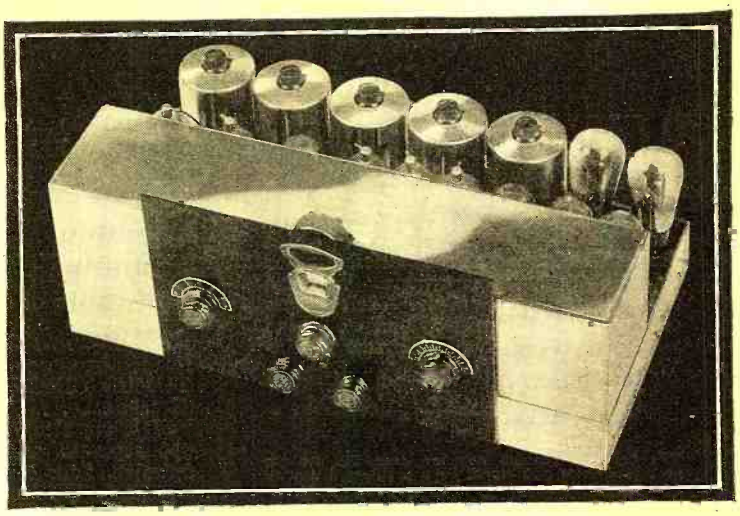
AUTOMATIC VOLUME CONTROL·····

There are two paramount advantages in good automatic volume level. First, in tuning from weak to strong signals; and secondly, in holding a steady volume level on fading stations which is so common in short wave reception. The effect of this new Lincoln feature is so efficient that a near-by stroke of lightning registers only a muffled sound in the speaker; it has the same effect on all sharp electrical interference.

NEW FIDELITY

Twin-grid detection preceded by push pull input I. F. transformers and followed by two stages of transformer coupled push pull stages, produces an undistorted register of a wide band of frequencies, giving a perfectly balanced output with realism hard to associate with radio.

All of the new reactions in the SW-33 model are what we all have wanted for years,—they are here for you today—thanks to Lincoln's foresight in radio possibilities.



THE NEW DEVELOPMENTS

have made the new DeLuxe SW-33 just about as ideal a receiver as one could hope to own. The use of five variable mu tubes controlled by the new twin grid second detector and followed by two transformer coupled push pull stages has opened the gates to new ideas of enjoyable distant reception.

The signal indicator locates carrier waves which are difficult to hear; many times the carrier is not being used or modulated as is the case in transatlantic phone. The signal indicator registers these silent carriers and enables you to be accurately tuned, ready for the voice to be heard.

WHEN THIS CARRIER IS TUNED, ATMOSPHERIC NOISES ARE REDUCED TO A MINIMUM, AUTOMATICALLY.

Distant stations can be tuned silently, and volume then brought up to desired strength (volume control does not affect sensitivity). Perfect volume level on short wave stations is another great asset in the new Lincoln. If you have ever tuned in a foreign short wave station, or even many of our short wave stations in the U.S.A., you will appreciate the great value of uniform volume level.

The performance of Lincoln equipment has been known the world over for years. Its use by Polar Expeditions, broadcasting stations, both domestic and abroad, U. S. Naval Station operators, and hundreds of super critical DX fans, has proved Lincoln's exceptional merit.

Complete equipment consists of chassis, power equipment, auditorium type speaker and complete set of laboratory tested tubes. Chassis is finished in highly polished nickel over copper and presents a handsome appearance. Precision laboratory construction is employed throughout, and every receiver is tested on distance before shipment.

Write for description of new developments and new sales plan which overcome the present defects in the present custom built radio merchandising.

LINCOLN
DeLuxe Receivers

LINCOLN RADIO CORPORATION
Dept. N-9, 329 So. Wood St., Chicago, Ill.
Please send information on ☐ A.C. ☐ D.C. receivers.

Name _____

Address _____

City _____ State _____

Print name and address plainly

Again Midwest Offers the Season's Greatest Radio Sensation!

All-Wave

Regular Broadcasts--Foreign Broadcasts-Police-Amateur-Ships at Sea—*All With One Dial!*

WHAT a radio! One complete 16-tube chassis with one DUAL-RATIO DIAL—new Super-Heterodyne circuit with a range of 15 to 500 METERS. . . . No plug-in coils—No Trimmers . . . and with the new STAT-OMIT tuning silencer you get in-between-station silence and perfect tuning without Neon lights, meters or buttons which were formerly necessary without this latest tuning circuit. . . . Large acoustically matched DUAL SPEAKERS. . . . New CLASS "B" PUSH-PUSH Super Power Amplifier with six times the power of ordinary tubes. . . . Full band AUTOMATIC VOLUME CONTROL. . . . COLORLITE Multi-Wave Band Selector giving instant choice of four distinct wave bands, regular broadcasts, foreign broadcasts, police and amateur. . . . FULL-FLOATING VARIABLE CONDENSER. . . . Complete Scientific Shielding. . . . Absolute tone fidelity. . . . Image Frequency Suppressor. . . . Fractional Microvolt Sensitivity. . . . 18 TUNED CIRCUITS. . . . NEW TYPE TUBES, 29, 56, 57, 58, 42, 46 and 82 tubes. . . . SUPER TRIODES, DUAL AND TRIPLE GRIDS, Two Full Wave Rectifiers including the new Mercury type. DUAL POWERED, two separate power transformers. A bigger, better, more powerful, more selective, finer toned radio than you've ever seen before . . . offered at an amazingly low price direct from the big Midwest factory. Midwest engineers have far outdistanced all past performances in perfecting this new set.

DEAL DIRECT with FACTORY! Save the Middlemen's Profits

Midwest methods of production effect large economies and give radio fans bigger and better radios for less money. And when you get this big, powerful Midwest 16-TUBE set you get ALL that the radio world can offer you—great range, perfect tone, amazing selectivity, tremendous reserve power, sensationally low cost of operation. Don't be satisfied with less than a Midwest 16-tube all-electric set. Broadcast listeners are coming to realize that a receiver covering only the regular broadcast waves is *only half a set.* This amazing new Midwest gives you regular, foreign, police and amateur broadcasts in one single dial set. No converter or any extra units required. Improvements in short-wave receivers and programs have made ordinary broadcast sets obsolete. In selecting a set, choose one that is not only good today but will be in step with tomorrow.

Complete Line of Beautiful New Consoles

The big new Midwest catalog shows gorgeous line of artistic consoles in the new six-leg designs. Mail the coupon or write us a postal. Get all the facts. Learn how you can save 30 percent to 50 percent on a big powerful radio by ordering direct from factory.

PAY As You PLAY!

Remember, you buy DIRECT FROM THE MAKERS. No middlemen's profits to pay. You get an absolute guarantee of satisfaction or money back. You try any Midwest 30 DAYS before you decide to keep it. Then, if you wish, you can pay for your set in easy monthly amounts that you'll scarcely miss. Besides, you can make easy EXTRA money as our USER AGENT. Coupon brings full details—mail it NOW!

TERMS *as low as* **$5.00 DOWN**

Mail the Coupon!

Investigate! Mail the coupon. Get the Midwest catalog. Learn the facts about Midwest 9, 12 and 16-tube ALL-WAVE sets. Learn about our sensationally low factory prices, easy payment plan and positive guarantee of satisfaction or money back. Save up to 50 percent on your new radio!

World-Wide Reception

Just a few excerpts from letters written by delighted Midwest owners. We have thousands of them on file. Mail coupon or write for new catalog and we'll send you ample PROOF of Midwest World-Wide reception.

Clarity! Selectivity Volume! Distance!

"To try and express our joy over the set we purchased from you would be a problem, but with the deepest sincerity we will defy anyone to pry it away from us.

"Clarity! Selectivity! Volume! Distance! Anything and everything one would care for in a radio. It surely is a beauty! Having visited your plant, I am at liberty to say I found it just like the radio, 'Ship-Shape'.

"May you enjoy many more years of success as I know you will with your 'direct from factory' prices."

P. G. Kurth, 2211 N. Booth Ave., Milwaukee, Wis.

France, England, Spain, Cuba, Hawaii

"We have always thought that our nine-tube radio was quite superior to most, but now that we have tried out the Midwest All-World, All-Wave, we are all for your set. There is nothing to equal its clear, life-like tone, selectivity and power to bring in distant stations as clearly as locals.

"Regarding the Short Wave, it comes way above our expectations. Police stations, testing stations, airports and amateur operators come in clearly at almost any time. We also get stations in France, England, Spain, Cuba and Hawaii."

D. M. Fish, R. F. D. No. 4, Ithaca, N. Y.

Germany, Italy, South America

"Have received the set and so far am very pleased with it. On broadcast it is exceptionally sharp. I live in the heart of the city with 42 broadcasting stations within 10 miles and the Midwest is surely giving results. KMOX comes in like a local.

"As for short waves, received Germany last Sunday afternoon. Italy has also been heard and several South American Stations."

E. Joyce, 756 Home St., Bronx, New York City.

Likes Midwest Automatic Tone Control

"Reception on the regular broadcast set, in my opinion, is very hard to equal and I dare say impossible to hear on any set costing twice the amount of the Midwest. It is very sensitive and so selective that barely a touch of the dial knob and you have another station coming in clear and without interference. The automatic tone control is great. I am now able to hold many stations which before would fade out right in the best part of the program. I have not done very much 'fishing' with the short wave as yet, although I have listened to Bound Brook, N. J., Schenectady and Australia and a few others."

Archie J. Goss, 6th South 3rd West, Brigham City, Utah.

W8XK—W3XAL—WIXAZ —W2XAF

"I am very much satisfied in every way with my Midwest radio. I heard Sydney, Sunday 3:00 A. M. Also W8XK, W3XAL, WIXAZ, W2XAF, in the evening. On the regular band have some 55 stations so far."

Aug. Balbi, 1427 Myra Ave., Los Angeles, Calif.

MIDWEST RADIO CORP.

16-Tube Only $39.95

Completely Assembled with Large DUAL SPEAKERS

Save UP TO 50%

30 DAYS FREE TRIAL

New 1933 Features

New Class "B" Push-Push Power Amplifier. . . . Stat-Omit Tuning Silencer. . . . Color-Lite Tuning. . . . Full band automatic Volume Control. . . . Triplex Duo-Diode Detection. . . . Dual-Ratio Single Dial. . . . No Trimmers, No Plug-in Coils, No tuning meter or Neon light required. . . . Fractional Microvolt Sensitivity. . . . Dual Powered (2 separate Power Transformers). . . . Absolute Tone (30 to 5200 cycles). . . . 18 Tuned Circuits. . . . New Mercury Rectifier. . . . Full-Floating Variable Condenser. . . . Low Operating Cost. The new Midwest 16-tube set actually uses less current than previous sets of 8 and 10 tubes. . . . Uses the new type tubes, 29, 56, 57, 58, 42, 46, 82. . . .

Remember, every Midwest set is backed by a positive guarantee of satisfaction or your money back. 30 DAYS' FREE TRIAL in your own home makes you the sole judge. Midwest, now in its twelfth successful year, offers bigger, better, more powerful, more sensitive radios at lower prices than ever before. The coupon or a postal card brings you big new catalog and complete information. Mail it NOW!

Every Improvement That Makes for Better Reception

BATTERY RADIOS

Using the New AIR CELL BATTERY

Two sensational values: a 6-tube super-het for standard-wave reception and a 9-tube ALL-WAVE, both using the new AIR CELL "A" battery that never needs recharging. Low factory prices. Coupon brings details. Mail it NOW!

Nothing has been overlooked and nothing important omitted in the new Midwest 9, 12 and 16-tube ALL-WAVE A.C. sets. You'll be amazed and delighted with the volume, the ease of control, the amazing clarity of reproduction and the absence of frying and cracking noises. Such radio reception has never before been known. Don't buy a set of any kind until you get the big new Midwest catalog. Mail the coupon now. Learn how you can save 30 percent to 50 percent direct from the factory—and buy on easy terms to suit your convenience.

Get All the Facts NOW

RUSH THIS COUPON FOR AMAZING FREE TRIAL OFFER AND BIG BEAUTIFUL CATALOG

USER AGENTS
Big money in spare time. Check here for details. ☐

Midwest Radio Corp., Cincinnati, Ohio.
Dept. 97, Cincinnati, Ohio.
Gentlemen: Please rush my copy of your big, beautiful, new catalog and complete details about the powerful, new 9, 12, and 16-Tube ALL-WAVE super-heterodyne outfits. This is not an order, and I am not obligated.

Name .....
Street .....
Town ..... State .....

Dept. 97, CINCINNATI, OHIO

The Editor–to *You*

EXPERIMENTERS and technicians will be interested in a new use for the Magnetron tube—the tube with two plates but minus a grid. This issue contains a comprehensive article telling how it may be used as an oscillator (together with a powerful field coil) on 56 megacycles, to form what may be the most powerful type of ultra-short-wave transmitter. At any rate the tube, in this new use, opens up an entirely unique field of experimentation for the transmitting amateur. The editor believes that here again the amateur experimenter and technician may pioneer a new development in opening up the ultra-short-wave bands to practical usage.

* * *

And speaking of amateurs, we are printing on this page a picture of the youngest of all the world's 30,000 or more licensed radio amateur experimenters. He is Alan T. Margo of Porterville, Pa., age 9½ years. Following the example of his father, who was a "ham" back in 1910, young Alan has just passed the Government radio operator's license which he secured from the Federal Radio Commission. His station, a single-tube, 5-watt outfit, is now on the air with the call letters W6FZA. We hope our readers will listen for him.

* * *

The youngest amateur up to the time the Margo license was granted was Charles Beard of Ashville, N. C., age 10, who operates W4ZM.

* * *

Only a little older than young Mr. Beard is Henry Lee Carter, Jr., of Rochester, New York. The most elderly licensed amateur is Dr. George W. Kirk, of Curtiss, Ohio, operating W8ARJ, so we are told.

* * *

While speaking of amateur operators, we might also say that professional operators are reading RADIO NEWS in increasing numbers and we have in this issue a new department (promised last month) for professional radio operators under the title "QRD". It will be found to be chatty and, it is hoped, timely and helpful to this great fraternity.

* * *

Is it possible to subdivide the electron? This is a question that is being asked by some scientists who have been making new experiments along this line. On page 145 is an interesting article by Dr. Irving J. Saxl entitled "Weighing the Electron." It shows some startling results found in these experiments and discusses the possibilities of the Sub-electron.

* * *

Would you like to own a modern and efficient dynamic microphone for your own experiments or for your own public-address system? You may do it if you will follow the instructions given in the article on Building Your Own Dynamic Microphone, appearing in this issue.

* * *

The editors are often asked the question, "Just who are the readers of RADIO NEWS?" It might be interesting to individual readers to know the present result of a series of tests that have been made on our circulation—both news-stand and subscription. The tests were made in the following way: questionnaire coupons were sent to a representative number of subscribers, picked at random, to be filled out by them. Letters from readers for a period of six

months coming to the Technical Information department, the Export Radio department, the Free Booklet department and coupons running in the magazine with questionnaire material to be filled out by the reader, have been indexed as to the various kinds of readers and their preferences for articles. The result, at present, compiled from thousands of individual readers' answers is as follows: Radio Engineers form 9% of the total readers of RADIO NEWS, Technicians and Laboratory Workers are an additional 15%, Servicemen readers are 54%, Dealers are 16% and Amateurs and Students in high schools and colleges are 6%.

* * *

The preferences, for articles of various kinds, of this group of readers runs as follows: Articles telling of new developments in radio technique and application, including television, short-waves, photo electric uses, new laboratory procedure, new testing and measuring instruments, 45%. For information concerning service work, including actual service data, descriptions of new parts and accessories for replacement work, use of set testers, analyzers, resistance measuring devices, tube checkers, tube data, etc., and regular business procedure for the serviceman, 44%. About 11% of the readers expressed a special preference for articles describing new designs of receivers, new circuits and hook-ups, etc. Over 50% of the total number of readers answering expressed a desire for articles dealing with experimental subjects. And 89% checked their interest in educational articles, for increasing their knowledge of radio in order to better their positions in the radio industry. The editors believe these results are significant of the progress recently made by the magazine and of its increasing importance in the radio field.

* * *

Coming over the editor's desk this month are many interesting letters from readers, a few excerpts from which follow below:

"I noted in your last editorial column about the man in England who wishes to correspond with radio fans in this country. I would like to do so myself but do not wish to give up my back numbers which I use for references."—F. W. Anderson, Jamesville, Wis.

* * *

"I have built the Set Tester De-Luxe from RADIO NEWS and have just completed a series of tests on it calculated to show up any faults the instrument might possess. Without exception, in every one of these tests the tester showed a performance that would equal a much more expensive instrument."—Kenneth L. Rosencrance, Marion, Ind.

* * *

"I am opening a service shop and must say I need RADIO NEWS. Have taken it for three years and saved every number."—Floyd Roberts, Kearney, Nebr.

* * *

"I have been getting your magazine at news-stands for several years and of course I have been often told 'we are all sold out, and have had to chase all over town for my copy. So it gives me great pleasure to be at last a regular subscriber to RADIO NEWS."—Joseph O'Connor, Springfield, Mass.

* * *

"For the past few years I have been reading RADIO NEWS. It is one of the few radio books worth reading. I often use it for reference work."—Norman K. Freemann, Beechhurst, L. I.

* * *

The Editor invites our readers to correspond further with him on any matters of reader interest.

Hugo Gernsback

* One of a series

Are you sick of Radio Noises ?

Motors, refrigerators and other electrical apparatus often spoil radio reception. This man-made static can be stopped. Let a Tobe Radio Noise Specialist diagnose and cure the trouble. Our specialist in noise elimination will call, make an examination and quote a reasonable fee. No obligation. All radio set manufacturers approve Tobe Service. Write or phone.

TOBE DEUTSCHMANN CORPORATION
136 Liberty St., New York City

RADIO NOISES CAN BE STOPPED

Telephone: REctor 2-9193

Of course you are —and so are all your Customers

But what are you doing about it?

You can stop radio noises by using Filterettes—the accepted remedy for Radio Interference.
Authorized Service Stations receive full benefit from consumer advertising like that reproduced on this page.*
Territories are still open. Wire or write for your franchise today.

*Two of a series of nine ads which appeared in the Newark (N. J.) Evening News, during the month of June.

* Two of a series

Does ol' Man-made Static Spoil your Radio ?

IF elevators, motors, electric refrigerators and other electrical apparatus interfere with your radio enjoyment, call a Tobe Noise Control Specialist to investigate the cause of the trouble. No obligation. Write or phone.

All radio set manufacturers approve Tobe Service

We Stop Radio Interference

TOBE DEUTSCHMANN CORPORATION
136 LIBERTY STREET, NEW YORK CITY
Telephone: REctor 2-9193

The TOBE "FILTERIZER"

The Tobe "FILTERIZER", now available, attached to any make radio, makes the receiver as "FREE from MAN-MADE STATIC" as the so-called "NOISELESS" radio. Cash in on the demand for Noiseless reception. Write for details.

TOBE DEUTSCHMANN CORPORATION
Filterette Division
CANTON, MASSACHUSETTS

Acknowledged Authority on Radio Interferance—Makers of FILTERETTES, the Accepted Remedy

When the Erstwhile Friend of Man Turns Enemy

Fire in the forests is a cataclysm so awful and so hard to escape that all of the living kingdoms are affected by it. The plant kingdom, attached as it is to mother earth, finds no escape except as is afforded by man's ingenuity in stopping the progress of the flames. Bacteria and insects are destroyed, it is true, but their mobile abilities soon cause replacement. Animals and man, equipped as they are with instinct and intelligence, fear woods fires as a common enemy and often flee side by side. Radio is now giving man new tools and new speed in fighting fire in its first stages, while it is still small, to prevent widespread conflagrations.

Radio News

VOLUME XIV September, 1932 NUMBER 3

RADIO FIGHTS FOREST FIRE

The forest Ranger up to this time had to rely upon primitive communication methods in fighting great fires in our National forests. He has hit the trail to carry word of a conflagration either by horse or afoot. But now radio comes to the rescue with two portable transmitter-receivers that contact headquarters within a few seconds bringing necessary help and equipment in short order

By George A. Duthie*

PORTABLE radio receiver-transmitters for emergency communication in the national forests is a recent achievement of the U. S. Forest Service. It is an achievement hailed with enthusiasm by forest officers. Since the day when the radio telephone was announced forest rangers have dreamed daydreams of the time when a ranger, on leaving for a trip to the back country, would slip a radiophone into his pack, along with his grub, and be able to report back to headquarters from the deep woods or from beyond the high ranges. "An impractical, futile dream," said experts who were appealed to for help to solve the problem. But the ranger "amateurs," unfettered by knowledge of radio engineering that recognized this futility, substituted enthusiasm for learning, and trial-and-error experiments for fundamental research, to achieve the impossible. The dream has now come true. Its final achievement was marked by a recent order for the construction of 105 portable and 27 semi-portable radio sets of a special Forest Service design. It is the first step toward equipping the field force with this long-sought solution for its emergency communication problems. It is the culmination of 14 years of research on radio transmitter-receiver sets that can be carried about in the forests and set up at will for temporary emergency service.

Although both sets are portable radio transmitter-receivers, the smaller instrument is referred to as the "portable" because it is so light that it can be carried about in a ranger's back-pack. It weighs only 10¾ pounds, including batteries and antenna, and is literally a hand radio set which the forester can carry right along with him as he works (See Figure 1). For the sake of lightness the phone transmitter is dispensed with and the instrument transmits code only—but it receives voice! The larger set is called "semi-portable" to distinguish it from the portable. It is a radiophone (receiving and transmitting) handling voice as well as code. It weighs about 60 pounds and may readily be transported any place where a pack-horse can go.

Forest Service Photos

THE RANGER'S PORTABLE

Figure 1. Special forest service radio pack, weight ten pounds, range ten miles

In the forests the communication problem is present on almost every job. Whether it is fire patrol or fire suppression, building roads or trails, cruising timber, rescuing lost persons or inspecting range, there is always need for communication. The work is spread over thousands of square miles of rough timbered territory and the efficiency and speed with which it is done is directly affected by the efficiency of the communication system in quite the same way that field operation of an army depends upon its communication service. Between points of permanent activity, such as ranger headquarters and lookout stations, telephone lines have already been built. There are 40,000 miles of government-owned lines in the forests, and approximately 100,000 miles of commercial and private lines, all of which are available for official use and yet less than 20 percent. of the territory lies within convenient reach of a telephone line. There are 200,000 square miles of territory without communication ser-

*Forest Service, U. S. Department of Agriculture.

SET-UP AT FIELD HEADQUARTERS

Figure 3. This semi-portable radiophone can be carried by motor or pack horse and set-up in a safe location near the fire to contact rangers on the fire line

vice except by messenger or, temporarily, by stringing insulated emergency wire.

The use of the latter type of communication has been confined principally to large fires where it has rendered valuable aid, but it is not satisfactory because it is slow, expensive and generally inadequate. A crew of men will toil for days to reach the fire camp with an emergency line and the pressing need for it is sometimes past before it is completed. It is costly because it is difficult to lay down and maintain, and frequently the wire is not worth the cost of salvage after the emergency is over. It is inadequate because it furnishes connections only to the supply base. A wire line cannot be maintained to the rapidly changing fire front where sweating crews are waging a real battle. It is here that the communication need is most acute, for the fire fighters may be frantically calling for help but their message will speed no faster than a runner can travel. The work of the various crews attacking the fire on several sectors must be correlated, but the officer in charge can receive his reports and send out instructions only by a messenger who may take an hour (or many hours) to reach his objective.

Minutes Count at a Fire

The radio solves this problem, for it will move right along with the crews. It takes but a few minutes to set up the instruments and its message reports the situation to headquarters at the instant—not the situation as it was an hour or five or ten hours ago. I have timed a forest officer who, without hurry, unpacked a portable set, hung up his antenna between two trees, and established communication with a distant station in twelve minutes. In fire suppression work minutes count and that is why the radiophone is regarded as an achievement of great importance in forest protection. The patrolman or the "smoke chaser" hunting incipient fires or the crew boss on the fire line may now carry his communication with him and contact headquarters at will (See Figure 2).

How often do small fires become raging conflagrations during the interval while reenforcements are being summoned? Perhaps a margin of thirty minutes in arrival time would have been sufficient to stop the fire in its first run. The portable set will give the forest officers the benefit of that margin.

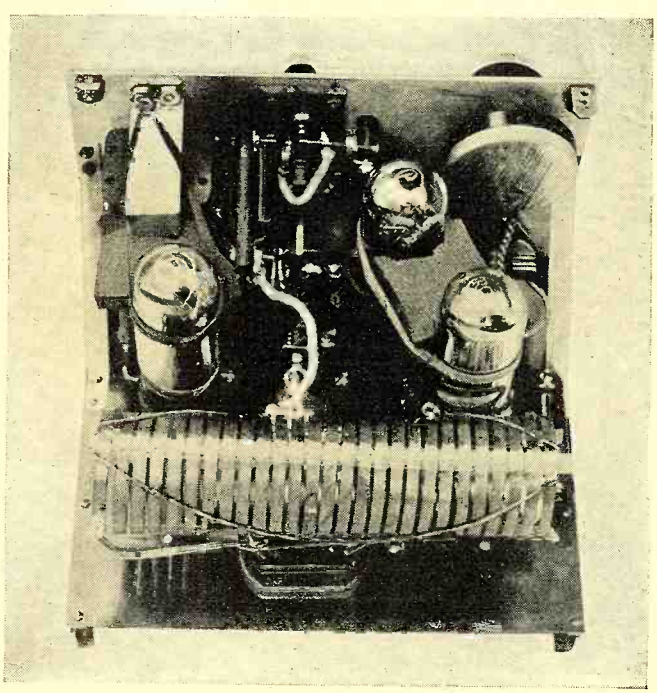
Radio will not, however, replace the telephone lines for regular service between permanent stations. It will supplement the wire system and provide temporary emergency communication for 80 percent. of the forest territory that is out-of-reach of the wire lines. The equipment designed by the Forest Service for its work consists of two short-wave sets; a 3-tube portable for the patrolman's pack, light, compact and sturdy, which transmits code and receives voice; and a 6-tube semi-portable set which can be readily transported by pack horse or automobile and which transmits and receives either code or voice.

The outstanding features of the portable set are its light weight; its compactness; its simple, rugged construction; and its low cost. These four features, together with dependable service under the peculiar atmospheric conditions encountered in forests, comprise the essential requirements that the set had to meet before it could be adopted. Its power plant consists of a single 140-volt B battery and an A battery of two flashlight cells which have a life of seven hours. The power of the transmitter is too small to be measured, but its C.W. range is from 10 to 15 miles—which is enough for its purpose. Exclusive of B battery and antenna, the entire equipment is contained in an aluminum box 6 by 8 by 9 inches. It weighs but a trifle more than 10 pounds and can be fabricated for $50.

Semi-portable Ranger Set

The semi-portable radiophone (See Figure 3) weighs 60 pounds and has a range of 10 miles for voice and 20 miles for code. Its power consists of two 200-volt B batteries and an A battery of three No. 6 dry-cells. It is constructed with the same rugged simplicity as the portable set. While it is too heavy for a man to pack far over mountain trails, it will stand packing on a horse or by automobile over rough roads.

The scheme of use for the two sets is to place the semi-portable at the lookout station, the fire camp or construction camp or any other field job when the short period of occupancy of the camp and the distance from a telephone line renders wire communication unavailable. The portables will be carried by the field-going men who are traveling on foot or by saddle horse. At the lookout station, the radiophone will act as central station to which the "smoke chasers," who are dispatched to investigate smokes, will report back with the portable C.W. sets. On large fires, the crew bosses and patrolmen will carry the portables on the fire line for reporting to the central camp where a dispatcher will be constantly on the air with a semi-portable radiophone. A contemplated development for camp set-up is an amplified receiver which will pick up the signals from the field sets and make them audible without keeping the dispatcher with his ears glued to the headphones.



INSIDE THE PORTABLE

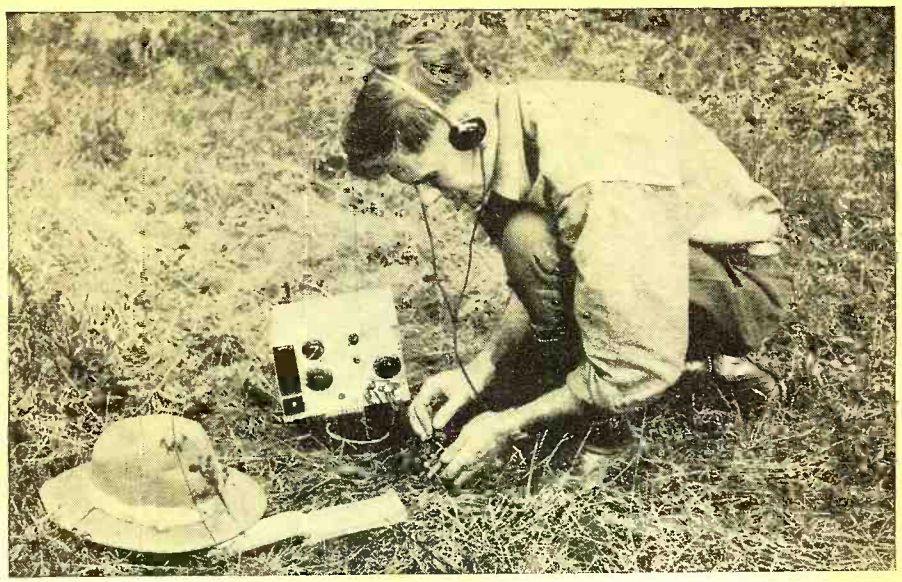
Figure 6. This inner view shows the details of the c.w. transmitter-receiver illustrating compact arrangement

The history of the development of this equipment, like that of most new equipment, has been one of long research, many discouragements, threatened abandonment and a slow breaking down of the main obstacles and final success in a climax of feverish enthusiasm. The first attempt to use radio in forest work was made immediately following the World War with long-wave equipment. It was a complete failure but it served to discover some of the special problems of radio transmission peculiar to the conditions in the forests. These problems, for some years, appeared to be insurmountable obstacles to the adaptation of radio to forest communication.

The chief obstacles were: 1. The absorption of radio energy by the green timber, which to overcome would, it seemed, require much more power than could be provided in a portable set. 2. The shadow effects of rough topography. Under high mountains there might be "dead spots" from which low-power radio signals could not emerge. 3. The deadening effect of static and fading in the mountainous country, an effect that varies for different wavelengths and for different periods of the day. 4. The difficulty of erecting long antennas in the forest where the thicket of undergrowth and swaying branches of trees would interfere. 5. The mechanical difficulty of constructing a set with a combination of extremely light weight and the sturdy construction which is necessary to withstand the hazards of transportation in a wilderness country. 6. Simplicity of design which will obviate delicate adjustments and tuning so that the apparatus can be operated by inexperienced and unskilled men.

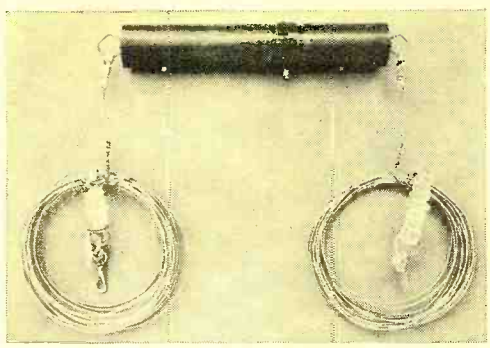
It would be a simple matter to build radio sets that would overcome any one of these obstacles, but to successfully meet all of them in combination presented a discouraging, yes even hopeless, problem for many years.

Following the failure of the first attempt to use radio, nothing more was done for several years save that some of the more radio-minded members of the service kept the idea simmering until in 1927, Dwight L. Beatty, an inspector, made some interesting demonstrations with a small short-wave "bread-board" set which resulted in his detachment from other duties and his full-time assignment to the radio problem.



SMOKE CHASER WITH PORTABLE SET

Figure 2. This ranger is recording back to field headquarters an incipient fire by means of the portable set for field use

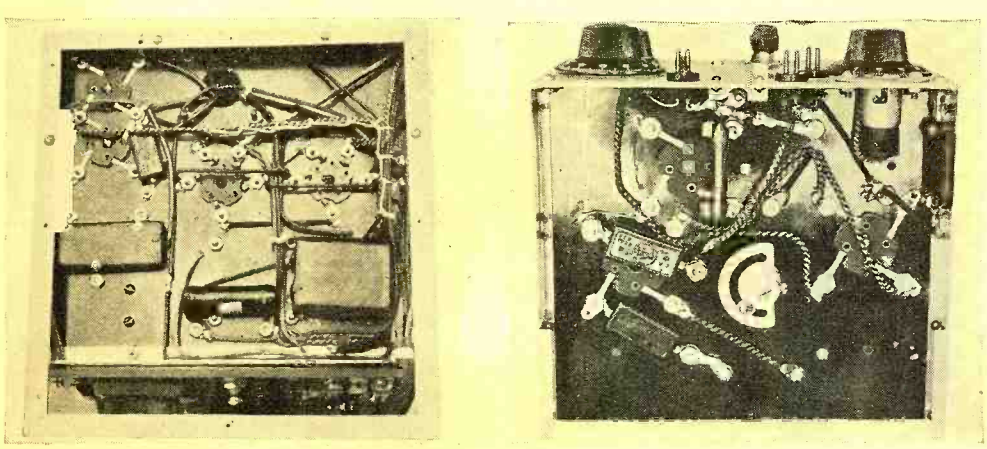


THE POWER-FEED ANTENNA

Figure 4. This antenna was developed for the special use of the forest service radiophone

Beatty first canvassed the field of commercial sets, especially airplane radio, but found nothing that would meet the forest requirements. Radio engineers and experts were interviewed, but they offered no suggestions more than to say that the problem opened up a field of research in which they could see little opportunity for fruitful work. It became obvious, therefore, that if radio-in-the-woods was to become possible, it must come through amateur experimentation.

So Beatty set to work. At the outset, his purpose was to discover the effect of absorption of radio energy by green timber and the nature of the interference encountered in the shadow of rough topography. He found that the loss in signal strength, in timber as compared to an open setting, ranged as high as 35 percent. He also discovered that the shadow effect and fading in the mountains varied in wide limits for different wavelengths and that these variations changed during different periods of the day. For example, a 91-meter signal at noon might be completely smothered but after 4 o'clock it picked up in volume while from the same station a 55-meter signal which was strong, throughout the day, faded away at night. He found also that some types of equipment were more sensitive to these effects than others, which led him into extensive tests of different combinations of parts and hook-ups. He worked diligently for three years, endlessly building sets, testing them under field conditions, tearing them down, rearranging and reconstructing, always searching for improved equipment that would improve efficiency and better provide the specified qualities of lightness, compactness, strong construction, efficiency of performance under forest conditions, simple design and low cost. Only standard parts were used so that there is nothing new about the equipment except its design and assembly. In each alteration of design greater sim- (*Continued on page* 174)



BOTTOM VIEW OF THE TWO RANGER UNITS

Figure 5a, at left, shows the underneath views of the sub-panel of the semi-portable transmitter-receiver. Figure 5b, at right, shows the same view of the portable unit which may be carried on the ranger's back

RADIO ALOFT!

IN PRIVATE AND TRANSPORT FLYING

Modern airport and 'plane radio equipment not only provides an operations communication medium, but also a guide for blind flying and landing under weather conditions which would otherwise offer an unsurmountable hazard to 'planes, pilots and passengers

[*By* John B. Brennan, Jr.]

PICTURE yourself on a plane, one of those big tri-motored affairs, which has just taken off from the Newark Airport, bound for Cleveland. Although you may not have known it, the pilot, previous to the take-of, scanned the weather dispatches at the Operations Office and found that he would have good weather along the major portion of his course but on arriving in the vicinity of Cleveland he might expect haze and fog.

Once up in the air his co-pilot, who is also the radio operator, has donned the headphones, switched on the radio receiver and has tuned it in to the signals being transmitted by the radio range beacons, of which, on his course, there are three; one at New Brunswick, New Jersey, one at Bellefonte, Pennsylvania, and the other at Cleveland, Ohio, all on direct route.

In clear weather it is not necessary to depend on the radio range beacons for an indication of the true course since visual searchlight beacons and markers on the ground at these searchlight points are situated along the course every ten miles. Therefore, having satisfied himself that the radio receiver is functioning properly the co-pilot tunes it to another wavelength so that he may listen to the many radio ground stations located along the path of his course and to the major aeronautical ground stations located at the scheduled stopping points along his route and which are a part of the vast radio chain system operated by the airways organization which employs him.

Thus, speeding along at some ninety to one hundred and ten miles an hour, the plane in which you are comfortably seated is always in constant communication with some radio station on the ground and your pilots are being advised periodically of flying conditions ahead of them, i.e., visibility, height of ceiling, force and direction of the wind and so forth.

Then, too, the co-pilot keeps the ground stations posted on the progress of the flight of your plane and every fifteen minutes he switches on his radio transmitter and reports his position along the course.

As you near Cleveland the threatened foggy weather has materialized and you fly into a blanket of fog so thick that it is difficult to see the tips of the monstrous wings of the plane. Spotting a position on the ground is out of the question under these conditions and it is here that the radio range beacons come into play.

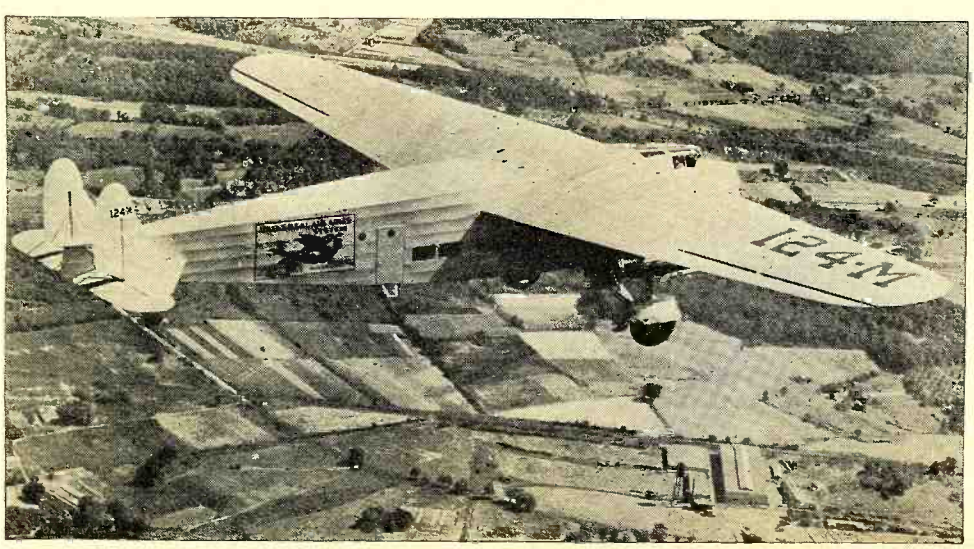
Tuning to the beacon wavelength the operator listens for the characteristic signal, a long dash, which will tell him that he is on his correct course. If the plane is bearing to one side of the beacon path of signals then he will hear a dot and a dash while if on the other side he hears a dash and a dot. It is when the dot dash and the dash dot converge into one long dash that the pilot knows that he is bearing along the true course.

Intermediate marker radio beacons advise him that he is nearing Cleveland and through a hole in the misty blanket he comes down to pick out familiar landmarks on the ground. By this time the visual beacons are sending out their friendly flashes of piercing light and after picking up the boundary lights at the Cleveland Airport he circles the field and comes in for a perfect three-point landing.

Now lets change the scene and see what has been happening at the Cleveland ground station while the plane is approaching it through its blanket of fog. In the first place, before the plane reached the fog area the radio dispatcher at Cleveland Airport advised the pilot of the plane when he might expect to meet up with this impenetrable blanket. Because the pilot has been advising him of his position as he progressed along the route, the dispatcher knows exactly where the plane is. By means of little pins with the numbers of the various planes aloft the dispatcher marks off their position on a large map of the several air routes which converge at his airport.

In addition to his job of keeping the planes advised of the weather they are flying into the dispatcher handles the routine messages concerning the taking off and arrival of planes at his and other airports.

Thus you have been given a small picture of the radio drama being enacted daily at the hundreds of airports which dot the country and the countless planes which fly the air routes.



Today the country is literally webbed with these air routes. A glance at Figure 1 will show that there are two transcontinental routes, one extending by way of New York to Chicago, Omaha, Salt Lake City and thence westward across the Rockies to Oakland, California. Another, starting at New York takes a more southerly route after leaving Chicago and terminates at Los Angeles, going by way of Kansas City; Amarillo, Texas; Albuquerque, New Mexico, and Kingman, Arizona. On the West Coast a regularly established air route has terminals at Seattle and San Diego, with intermediate stops at such places as Portland, San Francisco and Los

Angeles in either direction.

On the East Coast one route goes to Buffalo by way of Albany, another goes to Boston by way of Hartford while still another goes to the Central and South American countries by way of Washington; Charleston, South Carolina; Jacksonville and Miami, Florida, and Havana, Cuba.

Beacon Stations

On December first, 1930, there were forty radio range beacon stations in operation with an additional nine due to be completed and in operation by January first, 1931. These stations are of the aural type, sending out the characteristic dot dash, dash dot signal. They are shown in Figure 2. According to information made available by the U. S. Department of Commerce there were to be twenty-one radio range beacon stations of the visual type in operation by June of 1931, with forty-one others of this type projected for installation and operation in the then near future.

THE VOICE AND EARS OF TRANSPORT 'PLANES

The relief pilot functions as radio operator, receiving weather reports, beacon signals and landing instructions. By means of his transmitter he keeps ground stations informed of the 'plane's position and carries on communications incidental to operations

Aeronautical radio apparatus may be divided roughly into two classes, i.e., the equipment used on the plane and the equipment used on the ground. In both cases these classes may be further subdivided into the transmitting and receiving equipment used at both terminals of the two-way communication system.

Aviation Radio Equipment

For use in transport airplanes there has been developed a radio transmitter which is both light in weight and compact. Known as the Western Electric 10A radio transmitter, it has a carrier of fifty watts and is arranged for substantially complete voice modulation. It covers the range from 1,500 to 6,000 kilocycles.

The operating frequency selected is maintained to within plus or minus .025% of the assigned value by means of a quality-crystal controlled oscillator. This accuracy is maintained even at extremes of flying weather by virtue of the fact that the quartz crystal is temperature controlled by a thermostat of the mercury-column, contact making type. Space in the transmitter is provided for two of these frequency controls.

The crystal-controlled oscillator employs a tube of the five-watt variety which generates oscillations at a frequency which is one-half of that actually radiated by the antenna. Coupled to the output of the oscillator is a second five-watt tube which acts as a frequency doubler. This stage in turn is coupled to the modulating power amplifier which consists of a fifty-watt tube, Rice neutralized. The modulation system consists of three fifty-watt tubes connected in parallel, whose grid circuits are energized by a special type of microphone transformer.

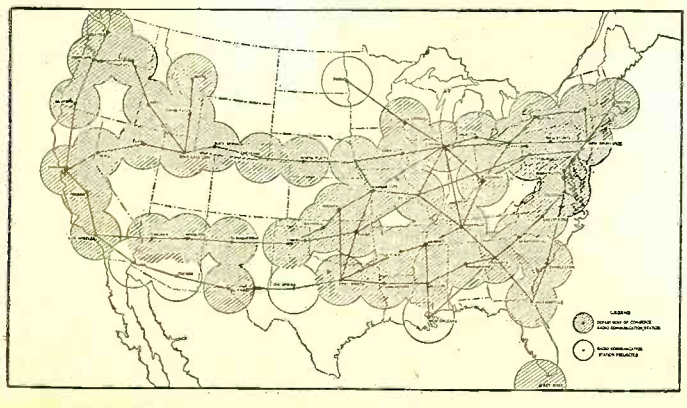
Power for the transmitter may be supplied from either a dynamotor which is run from the ship's storage battery or from a special wind-driven generator. The twelve-volt ship's battery supplies filament excitation while the dynamotor or generator supplies 400 milliamperes at 1050 volts for plate and grid bias supply. Connection from the transmitter to the power supply is made by means of a specially designed plug provided with locking pins and a lock ring.

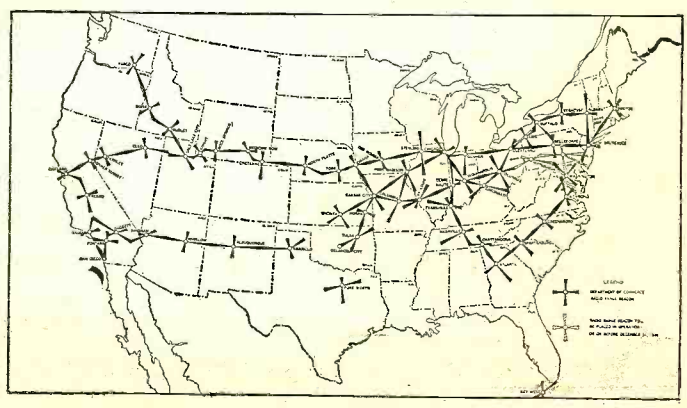
Wavelengths for Aviation

The transmission of signals to aircraft is in the case of transport service accomplished at the short wavelengths, say in the neighborhood of fifty meters, while for itinerant aircraft transmission from the ground to the plane takes place between 200 and 450 meters. Airport transmitters are assigned the frequency of 278 kc. while weather report stations usually transmit on frequencies lying in the range from 240 to 350 kc. Thus, to cover this wide range of wavelengths two separate Western Electric receivers have (*Continued on page* 175)

GOVERNMENT AIR RADIO SERVICES

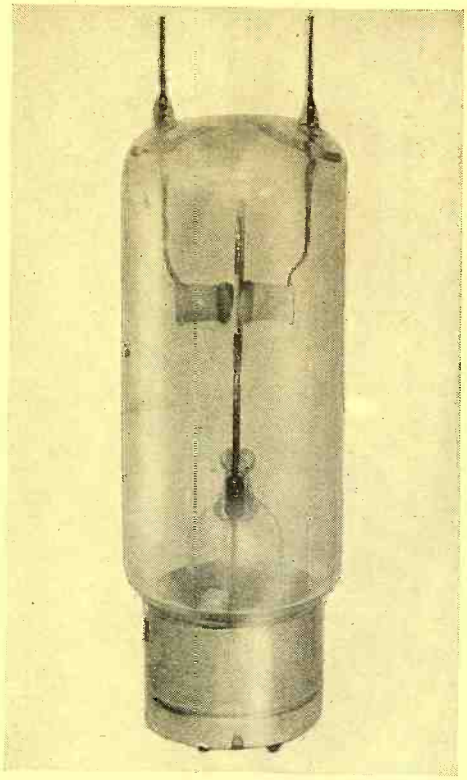
Figure 1, left. The areas enclosed within circles denote coverage by U. S. Department of Commerce transmitters which broadcast, at least hourly, weather reports, and other information for flyers. Unshaded areas denote stations either under construction or proposed. Figure 2, right, radio beacon transmitters are distributed at short intervals along the more important airways, as indicated on this map





HOW TO CONSTRUCT MAGNETRON

Here it is, something new in radio! A new employing the gridless double plate tube in a Gill-Morill method. This article, a feature of short wave field, will be invaluable to the



THE MAGNETRON

Figure 1. The tube which with its field coil offers new fields of experimentation on the ultra-short waves

By James

THE American amateur was the first to make practical use of the 200-meter band, and the first to develop the utility of still shorter and vastly more important communication channels. A new field of research, the ultra-short waves, now challenges his ingenuity, and we are sincere in our belief that here again the "ham" will make a genuine contribution to ultra-high-frequency technique. The magnetron, in particular, offers fertile possibilities, and its application to commercial enterprise may be, to our way of thinking, materially accelerated by its exploitation and development in the amateur ranks. This article finds dual justification in the effort to stimulate such experimentation, and in presenting a practical 56-megacycle magnetron transmitter.

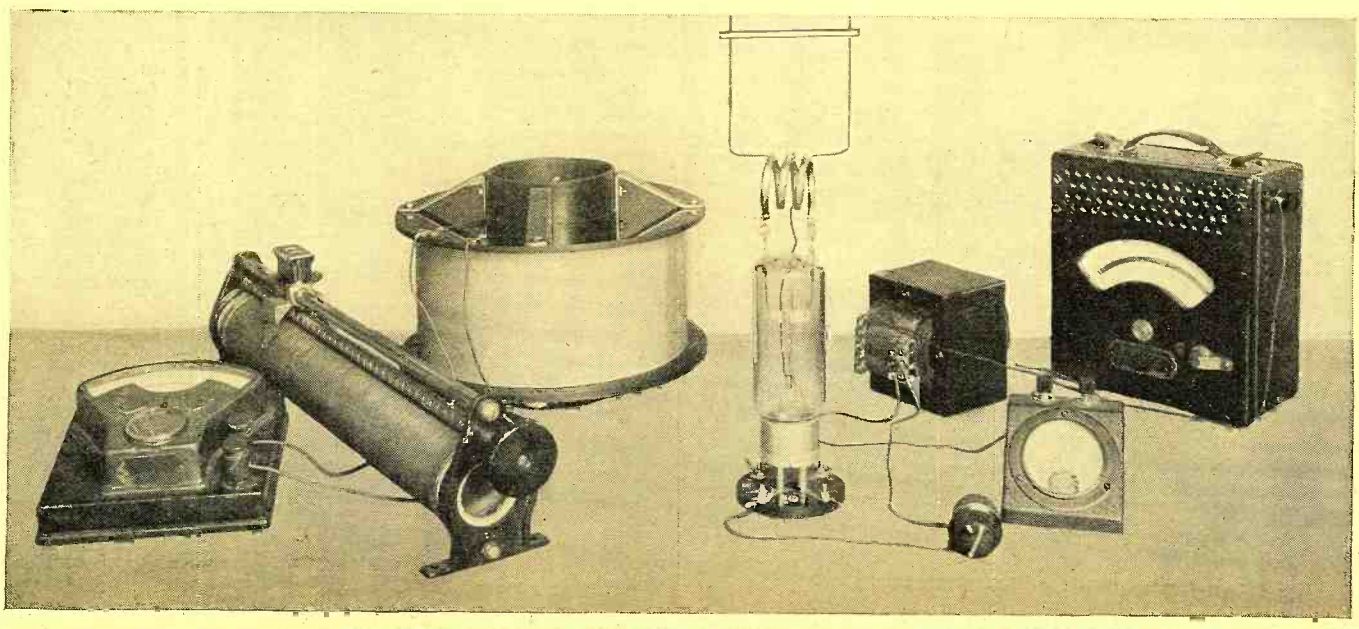
As we pointed out in the original article of this series, there exist a variety of methods whereby ultra-short-wave energy can be set in motion. However, the necessity for efficiency (reasonably high-power output for practical input powers) and stability places a definite limitation on the systems serviceable for useful communication. The magnetron, today, offers the most economical method for generating quasi-optical power. As it is an electronic device, its functioning is perhaps best understood by indicating its similarity to more conventional systems. It is not particularly difficult to design the usual sort of tube oscillators for wavelengths between 5 and 10 meters, and by the utilization of their harmonics to extend this range to a still lower minimum. However, as might be imagined, the stability of such systems leaves much to be desired, and the power output is generally inadequate.

Also, as may be readily understood, maximum frequency limitations are necessarily imposed by considerations of the capacity and inductance by which resonance is determined. An additional complication, the fact that as the frequency is still further raised the period approaches the times required for the electrons to complete their inter-electrode cycle, imposes further limitations—at the same time offering a solution to the problem. It was found that, under proper conditions, oscillations could be sustained the frequency of which was dependent on the geometry of the tube or on the potentials applied to the elements, rather than upon the LC characteristics of the circuit. Such systems have been described categorically as Barkhausen-Kurz circuits in deference to their two most-prominent investigators. It is logical and true that such arrangements are capable of delivering higher powers, at very short wavelengths, than those with which we have become familiar on the conventional short waves. It was also discovered that the power output could be increased by resonating the circuit to the natural electronic frequency, and such transmitters have

* The National Co.

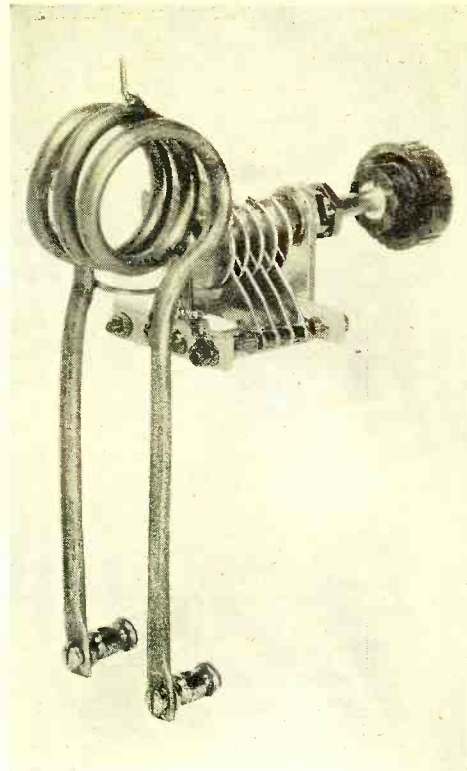
SET-UP OF THE NEW TRANSMITTER FOR 1½ METERS

Figure 2. This illustration shows the essentials of the magnetron oscillator system. The field coil, rear center, has been removed from around the tube for clarity. The particular arrangement shown is for a frequency range corresponding to approximately 1½ meters. The plate supply circuit is not shown



A 56 MEGACYCLE TRANSMITTER

oscillator principle for the ultra-short waves manner comparable in many respects to the the RADIO NEWS *series on opening up the ultra-technician and earnest experimental amateur*



THE HIGH C TUNER

Figure 10. This is the tuned circuit for resonating the new magnetron oscillator tube as explained in the text

Millen*

come to be known as Gill-Morill circuits and are comparable in many respects with the magnetron system.

The magnetron is not a new tube. It has been with us for well over a decade, and was originally designed as a tube in which electron control was effected by magnetic influence rather than electrostaically. In other words, the grid of the tube was a magnetic coil, and, peculiarly enough, the magnetron was first used as a radio-frequency amplifier and oscillator in the neighborhood of 8000 meters!

The magnetron used in ultra-short-wave work varies from its prototype in several essentials. The magnetic coil no longer functions as a grid (in the control sense), but its effect is similar to that of a "bias." By increasing the magnetization current, the space current can be cut off—corresponding to an increase in negative bias in a conventional triode circuit. At optimum magnetic bias, the space current is reduced while space charges build up within the tube. Connected with a suitable circuit, a negative-resistance characteristic permits these charges to dissipate and reaccumulate, producing a cycle the time constant of which is partly determined by the spacing of the elements, the intensity of the magnetic field and the potentials applied. Subsequent experiments have shown that, as in the Gill-Morill circuits, the efficiency of the magnetron is greatly increased when the circuit resonance approaches the natural electronic period.

The magnetron used in the experiments and transmitter to be described is the GE-239, and is shown in Figure 1. The anode is split into two semi-cylindrical sections mounted coaxially with the heavy tungsten filament. It is an air-cooled tube, used principally as an oscillator. The lowest operable wavelength is .75 meters, and at 1 meter, with a plate potential of 1500 volts, has a plate impedance of 5000 ohms. The maximum operating anode potentials are 1500 volts d.c. and 2000 volts r.m.s. a.c. The maximum d.c. anode current is .075 ampere, and the maximum plate dissipation 60 watts. The inter-electrode capacities are anode-to-anode (filament grounded) .5 mmfd.; anode-to-filament (other anode grounded) .7 mmfd. The tungsten filament draws 5 amperes at 5 volts.

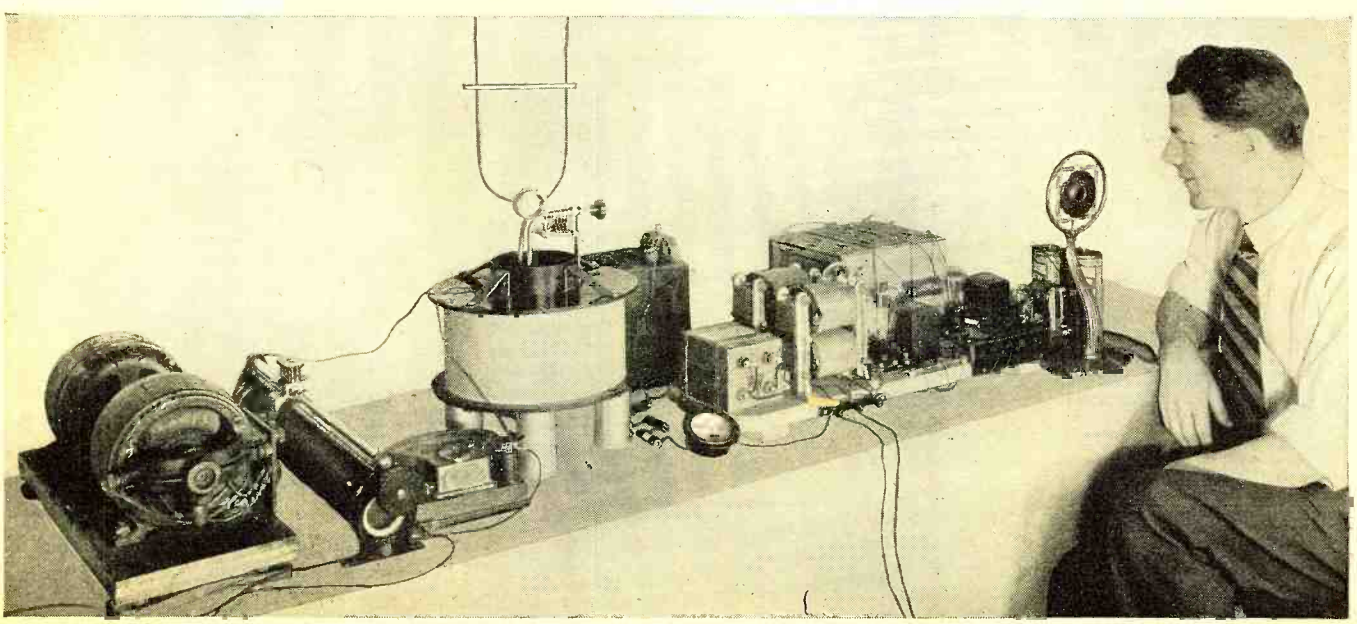
The mechanical characteristics of the tube are indicated in the photographs. The anodes are connected from the top, and the base plugs into a standard 50-watt socket. The overall length is 10 inches; diameter 2¼ inches.

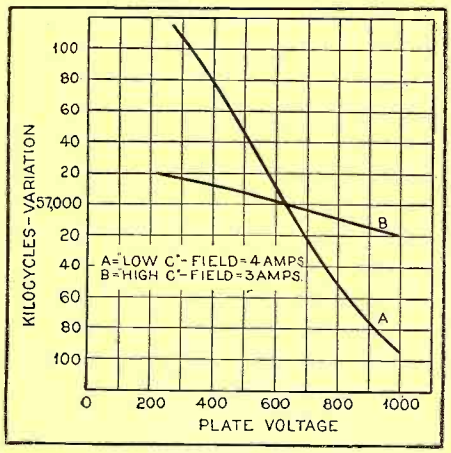
The output of this tube, in both power and stability (when properly operated) is definitely superior to other arrangements, its output at .75 meter being vastly better than that available with the B-K G-M circuits.

Figure 2 shows the experimental layout from which the various data accompanying this article were secured. The circuit, as may be observed from Figure 3, is simplicity itself.

COMPLETE 5 METER AMATEUR PHONE TRANSMITTER

Figure 8. Robert McCoy of the Jackson Research Laboratories shown operating the station. The high C tuned circuit may be seen just above the field coil which is in correct position surrounding the coil. Speech amplifier equipment is at the right energized by a storage battery and B batteries. The motor generator supplies the field coil energy



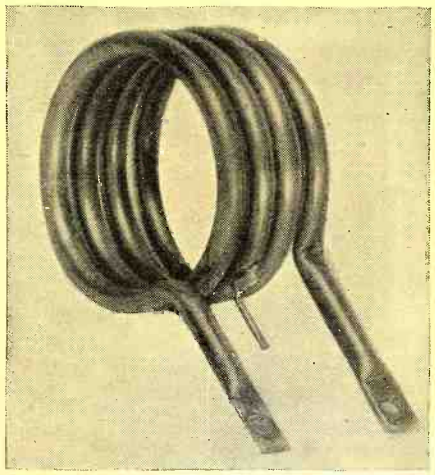


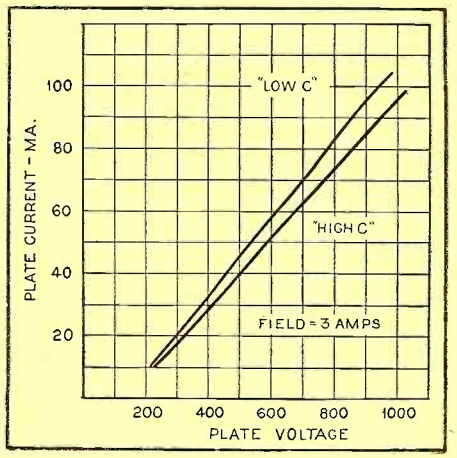
FREQUENCY VARIATION

Figure 4. Curves showing increased stability by using high C circuit

LOW C COIL

Figure 9. This is the tapped four turn low C coil used in the original experiments





MODULATION DATA

Figure 7. Linear relation of plate voltage-plate current adapts the magnetron readily to modulation

It consists of the tube between the anodes of which is connected the center-tapped coil. (As will be described, this coil was changed in the course of the experiments, and an exterior capacity shunted across it. The simple inductor is shown in Figure 9 and the coil plus the tuning condenser, are shown in Figure 10.) The field coil has been removed from its place around the magnetron for the sake of clarity.

The oscillating frequency is largely determined by the inductance and the capacity of the circuit. For the highest frequency (400 megacycles), the inductance of the anode leads and the capacity between them is sufficient. In this case the external anode leads are short-circuited with a copper bar or ribbon) about one inch from the glass, and the high voltage is connected to a tap at the center of the bar.

The Field Coil

The field coil is wound with 70 pounds of number 14 enameled wire, on a form having an inside diameter of 5 inches. The length of winding is 5 inches, 74 turns to the layer, with a total number of 2665 turns. Each layer is separated with paper insulation .015-inch thick. The coil is excited with a potential of 100 volts through a suitable reristor, providing a maximum current of 5.8 amperes and a maximum continuous field strength of 830 gauss with a dissipation of 580 watts. The outside diameter of the coil is 11 inches. The variable series resistor should be capable of carrying the maximum excitation current and should have a resistance of at least 17 ohms.

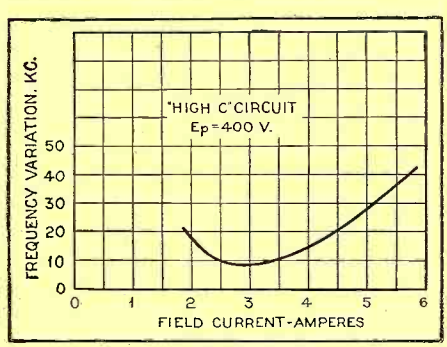
The effect of the magnetic field on the operating characteristics of the magnetron is, as we have already suggested, somewhat similar to that of a bias of the grid of a triode oscillator. At low values of field, below 2½ amperes, corresponding to a small bias, the plates heat excessively; the plate current is high and the efficiency is low. As the field is strengthened, the circuit becomes more stable, operating with greatly improved efficiency and output. The current in this region varies from 3 to 5 amperes. Plate-current "cut-off" can be obtained with an excitation current of about 7 amperes.

In general, the requirements of the oscillatory circuit, in respect to efficiency, stability, etc., are similar to those of the dynatron oscillator, although, of course, the frequency range is much greater.

As the filament is tungsten, it is possible to operate it over a wide range of voltages without encountering the trouble experienced with thoriated filaments. It was found, however, that for best stability the filament should be operated near its rated voltage—though a 10 or 15 per cent. variation has a relatively small effect.

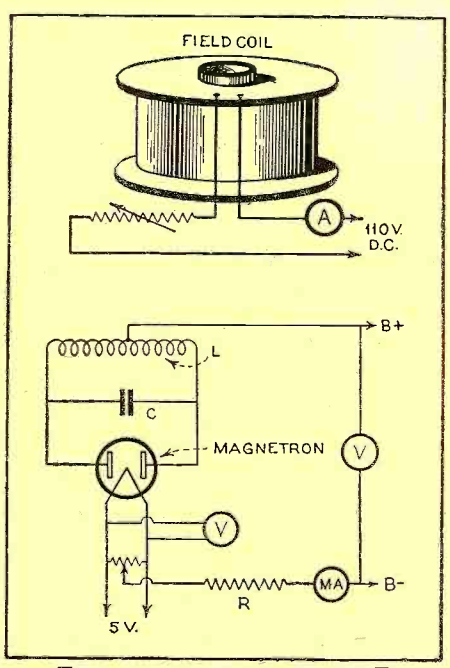
The first tests, while altogether satisfactory in respect to output, left a great deal to be desired from the standpoint of stability. Curve A, of Figure 4, illustrates the manner in which frequency varied as the plate voltage was changed. In this original experiment the tuned circuit consisted of 4 turns of ¼-inch copper tubing, 2 inches in diameter, mounted directly on the anode leads, the tuning capacity being the inter-electrode capacity of the tube (about .5 mmfd.) and the distributed capacity of the coil and leads. The frequency was approximately 56 mc. The circuit and operating conditions under which this test was made probably represented the most unfavorable, with respect to frequency stability, that would be encountered in practice.

The total change in frequency, i.e., about 200 kc., seems rather appalling to one familiar with the operation of low-frequency apparatus. As a matter of fact it is not much worse than that encountered in a (*Continued on page* 182)



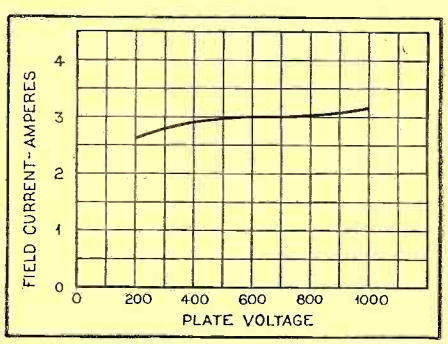
CHOOSING PROPER CURRENT

Figure 5. Showing relation of field-current ripple and frequency variation with the high C circuit



THE MAGNETRON CIRCUIT

Figure 3. The data supplied in this article was obtained from a transmitter using this simple circuit. The top diagram shows field coil hook-up



OBTAINING MINIMUM VARIATION

Figure 6. This is a field current, plate-voltage curve for getting the least frequency variation

AN INTERESTING EXPERIMENT IN

Weighing the Electron

AND WHAT IT MAY MEAN

By Dr. Irving J. Saxl

IN all our modern electronic technique, including radio technique, television, acoustics and in all other basic sciences connected with electricity we are making use and apply constantly the electronic theory and its fundamental unit, the electron.

We have considered the electron to be the smallest entity of matter, having one single, definite electric charge and include it in our formula, whether we are now building radio tubes, X-ray tubes, motor-generators or whether we are making intricate electrical measurements. We might say almost, that all modern scientific investigation in the basic sciences, and a good deal of all practical developments, are connected in some way or other with the electron.

We are living in a century of electrification. New electrical machines, appliances and instruments are still being given to humanity at high speed—and all of them go back, in their last root, to our knowledge of the electrical phenomena and its basis: the electron.

But what do we actually *know* about this tiniest entity of the universe? It is the commonest thing in the cosmos, there is no atom of matter in which there is not at least one electron, and yet, what is it in reality, this most important, minutest quantity of the microcosmos?

The theory that a material body is composed of tiny "building-stones," which cannot be divided, is not new. The Greek philosopher, Democritos, had written of it already and even in the Hindu philosophy, first signs of this idea appear in a general way.

Today there are a number of units which we cannot subdivide chemically. We call them elements. From Faradays experiments on electrolysis it was found what amounts of a certain material can be electrolytically deposited within a certain time. It is now possible to determine the number of molecules of which the deposited substances are composed by using the laws which have been given us by Loschmidt, making it possible to determine, mathematically, the number of the molecules contained in each cubic centimeter. Using this number, called "Loschmidt's Number," and using the data taken from Faradays' laws it has been possible *to determine the average charge of a single ion.* It was found to be in the order of 10^{-10} electrostatic units.

Around the year 1900, Townsend, J. J. Thomson and A. H. Wilson carried on further determinations of average values which also gave an electric charge of about 10^{-10} for the monovalent ion.

Of course, as far as electronics technique is concerned, the single electron does not seem to be today of industrial importance. What is important is the effect of a vast number of electrically-charged bodies which, after all, make important for practical use only the *average* value. For going deeper into the matter, however, it *is* important to know more about the individual happenings within a physically defined body.

If we have a carload of potatoes, can we say the size of the potato is this and that? Is it not probable that, if we observe a large-enough number we will find small ones and large ones . . . and that the small ones might be almost any size smaller than the larger ones? Can we take the "average potato" and say: this is THE size of the potato?

Can we, therefor, state positively that there is no smaller charge in the world? We have subdivided the molecules and we have subdivided the atoms which, as the name expresses, "cannot be subdivided any further." Is the electron, on the knowledge of which we base so much of our present-day physical knowledge, is it really the last bit of matter? Or is it just one step farther into the unknown depths of the universe?

It was Dr. Felix Ehrenhaft, Professor of Physics at the University of Vienna, who wrote in 1909: "Smallest entities of electricity are, as far as can be predicted, to be expected upon particles of smallest capacity," and, "These particles, however, have to be large enough to make them just individually perceptible optically, as it is necessary to investigate each one separately." *

For determining the size, the weight of these particles, the relation between their electrical charge and constituting matter, the important entity $\frac{e}{m}$, we naturally cannot apply a chemists balance. Even the finest balances for Pregls micro-analysis are crude in comparison with the values which have to be determined for this purpose. Other ways have to be found for bringing about this determination.

HE MADE THE EXPERIMENT

Figure 1. Dr. Felix Ehrenhaft, Professor of Physics at the University of Vienna

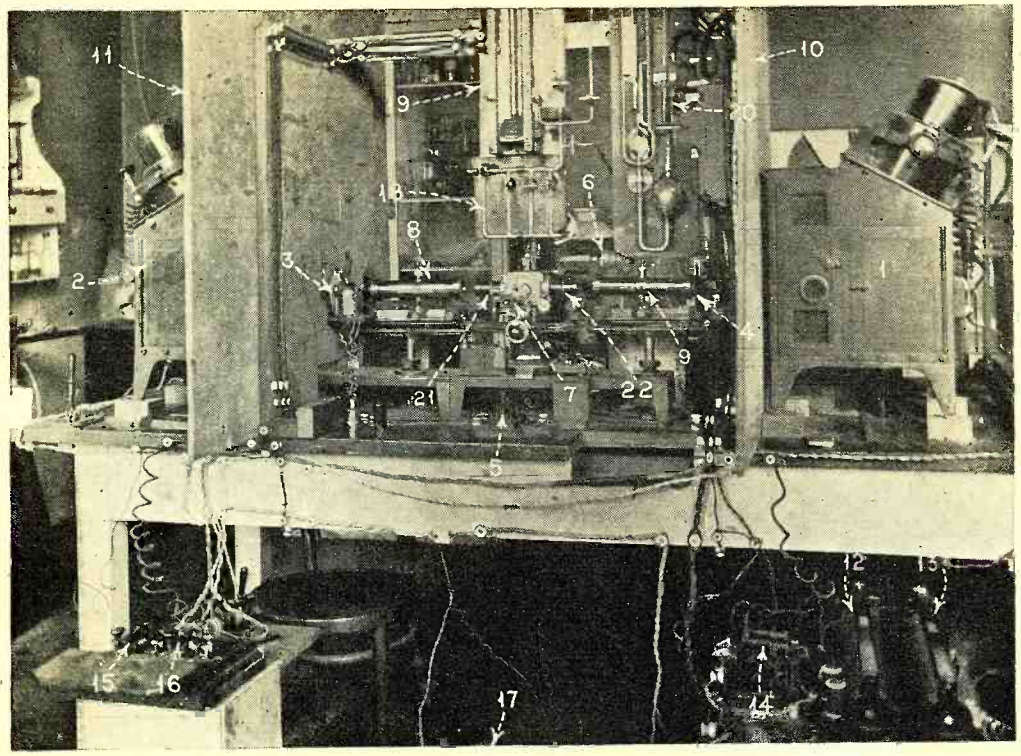
However, a condenser balance has been developed making possible the incredible exact weighing of body-particles smaller than the tiniest dust particles which we see dancing in an intensive ray of sunlight if we look normally upon this projecting ray.

The test particles which are to be investigated are brought into the field of an electric condenser. They are strongly illuminated from the sides and are viewed through a microscope. By putting electric charges across the condenser plates it is then possible to move these particles up and down between the plates by electrostatic attraction and repulsion.

From these movements of the particles in the condenser, the exact time of which is determined, it is possible to calculate both the weight and the charge of the body as described in greater detail at the end of this article.

Acting upon his idea, Ehrenhaft tried to take into consideration for his experiments, particles of well-defined form and chemical characteristics. He therefore worked with small globes of gold, platinum, silver, mercury, etc. The spherical form of his particles he was able to show by microphotographs in white light. For fully resolving still smaller bodies, the author has helped perfect for him the application of ultra-violet-microphotography, following early designs of Prof. A. Koehler. † A microscope using these principles has been manufactured by Zeiss and used in this country for the optical analysis of alloys.

For making visible these very small particles, Ehrenhaft constructed a special tiny condenser. It consists principally of two round plates of brass or iron of about ¼ inch in diameter and spaced about 1 millimeter apart. These condenser plates form the walls of a very small air chamber (see Figure 2 which shows a schematical cross-section through



THE SET-UP FOR WEIGHING THE ELECTRON

Figure 3. This is a front view of the observer's table in the Ehrenhaft experiment. Observation takes place through the microscope, Number 7, the illumination of the tests particles being normally made at right angles by the powerful projectors, Nos. 1 and 2

the condenser that was used in all the tests on the particles).

The two cylindrical pieces, D_1 and D_2, of which the condenser is made, are screwed in from the upper and from the lower ends. By means of the screws, S_1 and S_2, it is possible to correct their distance precisely. O is the front lense of the microscopic objective through which the particle is viewed. The illumination takes place, normally, upon the cross-section of the condenser and upon the axis of the observing microscope, as shown in the closeup of the front of Ehrenhaft's apparatus in Figure 3. The observation is made between the condenser plates D which are embodied in a housing of bakelite. T_1 and T_2 are the terminals into which the contacts of the electric conductors are screwed securely. The gas, which is chemically and physically purified and in which the test particles are suspended, is brought into the viewing condenser by means of the stopcock A.

The Set-up Employed

Figure 3 shows the front view of the apparatus at the eyepiece of which one observer is to sit. 1 and 2 are the illuminating arcs. These are high-intensity, self-regulating, direct-current arc lights burning with about 30 amperes. It is necessary to use 2 separate sources of illumination as during the long duration of the observations one pair of carbons may burn out. A second pair of carbons is therefore always ready for use in the other projector so that it can be put into use immediately and make possible a continuous observation. In addition, these two light sources put against each other in an angle of 180 degrees are necessary also for another reason:

Most particles brought into the path of this highly intensive light react in a specific way upon the irradiation. Dependent whether they are light-positive or light-negative they *move to the light source or run away from the source of light.* (This effect, called *Photophoresis* and probably in definite relation to the photo-electric principles involved in photocells, was discovered by Ehrenhaft.)

By using two separate lighting units, diammetrically opposed to each other, it is possible, simply by illuminating from the opposite direction, to push a particle back into the center of the observation field. This change in illumination is done with the aid of the electro-magnetic shutters, 3 and 4, which are operated from a double-pole switch, 5.

The particles, which have been formed in the desiccator, 6, are brought through glass tubing into the condenser. The microscope, 7, is the device through which the particles in the condenser are observed. The actual illumination takes place from the left and the right. For eliminating the effect of infra-red heat rays, the light, after coming from the projectors and the shutters, passes through two filters containing a solution in the horizontal cylinders 8 and 9. The light beam is concentrated into the condenser field with the aid of two microscopic objectives, 21 and 22, so that an extremely intensive "dark-field" illumination is secured. For avoiding any indirect heat-radiation, the two projectors are placed behind the asbestos walls 10 and 11.

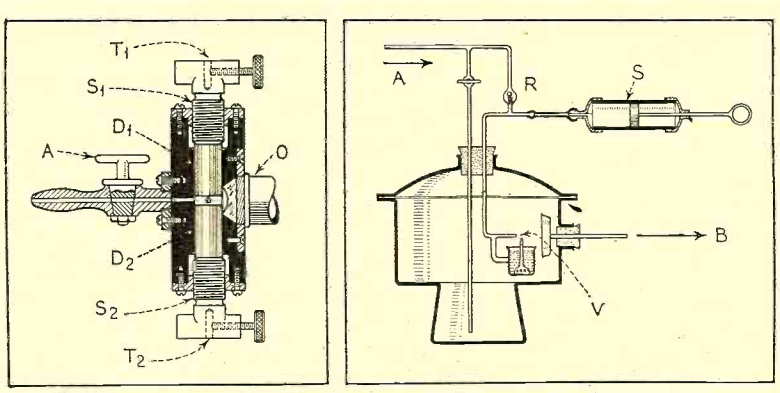
Time Recording Important

The amount of voltage applied across the condenser plates can be regulated by the rheostats 12 and 13. The switch, 14, makes it possible to change, instantaneously, the polarity between the two plates. With a foot switch, 17, this voltage is put onto the condenser plates.

The telegraph keys, 15 and 16, at the left lower side of the picture, operate automatic stop-watches electromagnetically. These watches can be read down to one-fiftieth of a second. They record the time of ascent and descent of a particle within the condenser, the path of which is viewed upon a grid in the observing microscope 7. This path is not a straight line, up and down, but moving in different curves. The particle dances about following the Brownian movement; a twinkling spot upon a dark background in the observing microscope.

The exhaust gauges, 18, consist of a series of small capillary tubes through which the exhaust gas has to pass and by means of which it is possible to regulate the speed of the exhaust procedure. On the manometer, 19, the air pressure in the electric condenser can be read (through a little telescope which is on the assistants desk). 20 is a McLeod, an instrument with which pressure (of a fraction of one millimeter) can be read down to microns.

The observer looks



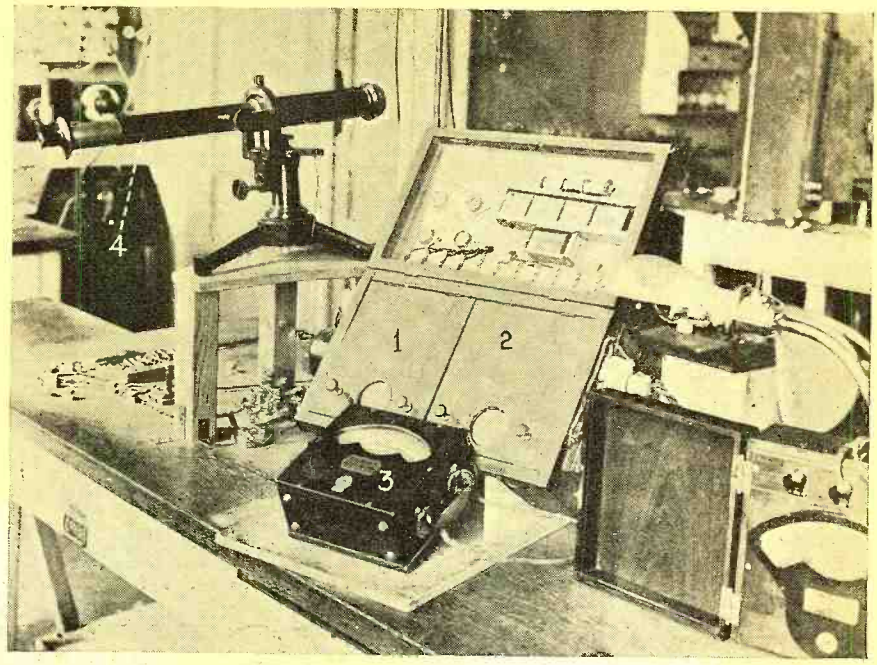
SPECIAL CONDENSER AND VAPORIZER EMPLOYED

Figure 2. Left, shows a cross-sectional diagram of the condenser in which the movement of the particles was analyzed. Figure 5, right, contains a cross-sectional sketch of the vaporizer employed for producing the particles to be "shot" into the condenser

into the eyepiece of the microscope so as not to loose the path of his particle. He is kept very busily engaged in regulating the voltages which change sometimes, especially if an accidental radioactive material has been in the neighborhood of the condenser or other effects have taken place as to liberate electric charges, for instance, by irradiation with ultraviolet light. The observer has furthermore to start and stop the procedure, to regulate the exhaust, to work the light switches so that he cannot afford the time to make actual recordings. Mechanical recording has therefore been applied for these intricate investigations, under the control of an assistant.

Figure 4 shows the assistant's table. It is placed behind the observer's seat, as at the assistant's table lights are necessary. Meanwhile the entire room is kept dark so that the observations will not be effected by any outside light. In Figure 4, 1 and 2 are the electro-magnetically-controlled stop-watches.

The actual voltage put across the condenser plates and regulated by a shunt, is read on the precision voltmeter 3. The air pressure in the condenser is read over a system of reflecting mirrors with the small telescope 4.



THE ASSISTANT'S RECORDING TABLE

Figure 4. In these intricate investigations the incorporation of an assistant for recording is imperative. The assistant records time upon the accurate electrically-operated stop watches, notes the applied voltages, gas pressures and makes other important records

Producing the Particles

The test particles were produced by three different methods: No. 1. The first method was to build an electric arc between two pieces of metal. This arc smelts off minute drops of the metal to be used as particles. They evaporate from the electrodes and coagulate in the colder atmosphere which surrounds the electrodes in the form of balls of the dimension 10^{-4} to 10^{-5} cm. No. 2. The second method employs bodies which can be evaporated and these are brought into a small container of glass or quartz and heated with a small flame (Mercury, Sulphur, Selenium, etc.) to liberate a steam which condenses in the form of small balls. No. 3. Figure 5 shows the third method of producing balls of a heavy fluid as e.g. Barium-Mercury-Iodine, Mercury, etc. These small balls will always be geometrical spheres of great accuracy where the capillary powers are larger than the forces which bring about the "drop" form. A vaporizer V in which specially purified gases are sucked through the opening with the aid of a syringe-like pump, S, distributes small particles of the fluid in which it is immersed.

The specific weight of this fluid is known and therefore also the specific weight of the particles. These fall very slowly, due to their submicroscopic size. They are contained in the gas current and are transported together, with it, through the funnel, B, into the condenser field.

There the particle is irradiated strongly from the side, as stated above, and it is seen in the microscope as a luminant point upon a dark field. It is possible to read the distance through which the particle falls freely in the air-condenser chamber, upon a grating which is inserted into the eyepiece. If the particle carries an electrical charge and if the plates of the condenser are charged electrically, it is possible to move the particle upward by electrostatic power! It is also possible to measure here by its speed!

The particle is allowed to fall again after switching off the electrical field so that it moves downward under the influence of gravitation. This procedure is repeated long enough so as to receive satisfactory averages of the ascent and descent of each particle tested.

If a sphere falls in a space filled with gas, its speed of fall does not get larger into the infinite. The friction of the sphere in the air works against gravitation and after a certain time, the friction gets so large that the ball moves with a constant speed. With a submicroscopic sphere as used in Ehrenhaft's experiments, this constancy is reached after a very short time.

Investigations have shown that the velocity of such a particle is proportionate, within certain limits, to the power acting upon it. Stating v for velocity and P for power, we get the equation:

$$v = P . B \qquad (1)$$

where B is a factor of proportion. Its physical meaning is the velocity under the influence of the power which is unity. B may be called the *mobility* of the particle.

For a free-falling body of spherical form we have, therefor, the equation:

$$v_f = \frac{4a^3}{3} \pi \sigma g . B \qquad (2)$$

where v_f is the velocity of the fall, a is the radius, σ is the density and g is the gravitational acceleration.

If the particle is pulled upward again under the influence of the electrical forces put unto the condenser and has the velocity v_s, then we can say:

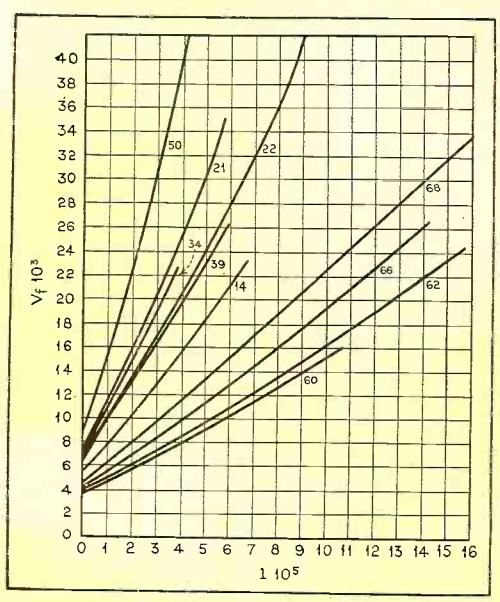
$$v_s = (e.E - \frac{4a^3}{3} \pi \sigma g) . B \qquad (3$$

where e is the electrical charge of the particle and E is the field intensity in the small condenser.

From equation (2) can be computed the radius of the particle:

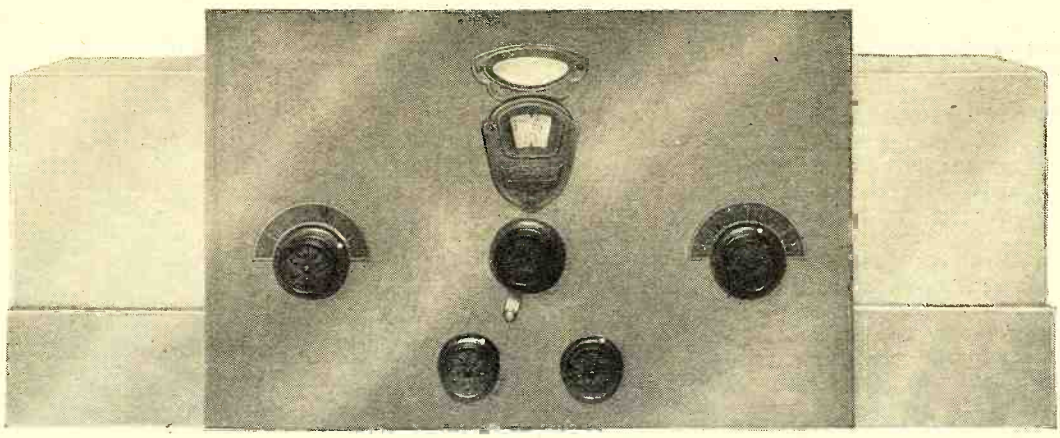
$$a = \sqrt[3]{\frac{3 v_f}{4 \pi \sigma g . B}} \qquad (4)$$

It is necessary to know, from other sources, the value of B, of the mobility of the particle. This known, it is possible to determine the electric charge of the particle, by simply inserting the value for a, from the equation (*Continued on page* 183)



HOW GAS PRESSURE AFFECTS FALL

Figure 6. Diagram showing graphically the dependency of the speed of fall of particles from the average three-mean-path of the gas as produced at different pressures from experimental data of Dr. Max Reiss



THE CONTROL PANEL

Figure 2. The window just above the tuning dial discloses the visual tuning meter, a material aid in tuning to obtain exact resonance and best quality of reproduction

An Outstanding DX SUPER *for Long and Short Waves*

By William C. Dorf

FIDELITY of reproduction, sensitivity and selectivity are of course looked for today in a new receiver by the modern listener but with the rapid modern development in tubes and circuit design, the discerning fan expects far more than just these three features. More than likely, for instance, he will want to have an all-wave receiver so that when the spirit moves him he can tune in on the foreign broadcasts, the amateur bands, the police bands and other interesting reception available throughout the short-wave spectrum. He will probably also give thought to such modern developments as automatic volume control, band switching arrangements, low noise level and simplicity of operation.

For such a person the new Lincoln DeLuxe SW-33 receiver is by all means worthy of consideration. It offers a surprising number of strictly up-to-date features, including some that forecast developments which will undoubtedly be more or less generally adopted during the next year or so by many other manufacturers of receivers.

This receiver is not one of the mass production type but is a laboratory designed and laboratory built set which enables it to enjoy the advantages of high precision both in construction and on the test bench. The article this month will be concerned primarily with the outstanding practical and technical features of the receiver while the article next month will provide some information on the results obtained with this receiver under test by the RADIO NEWS staff.

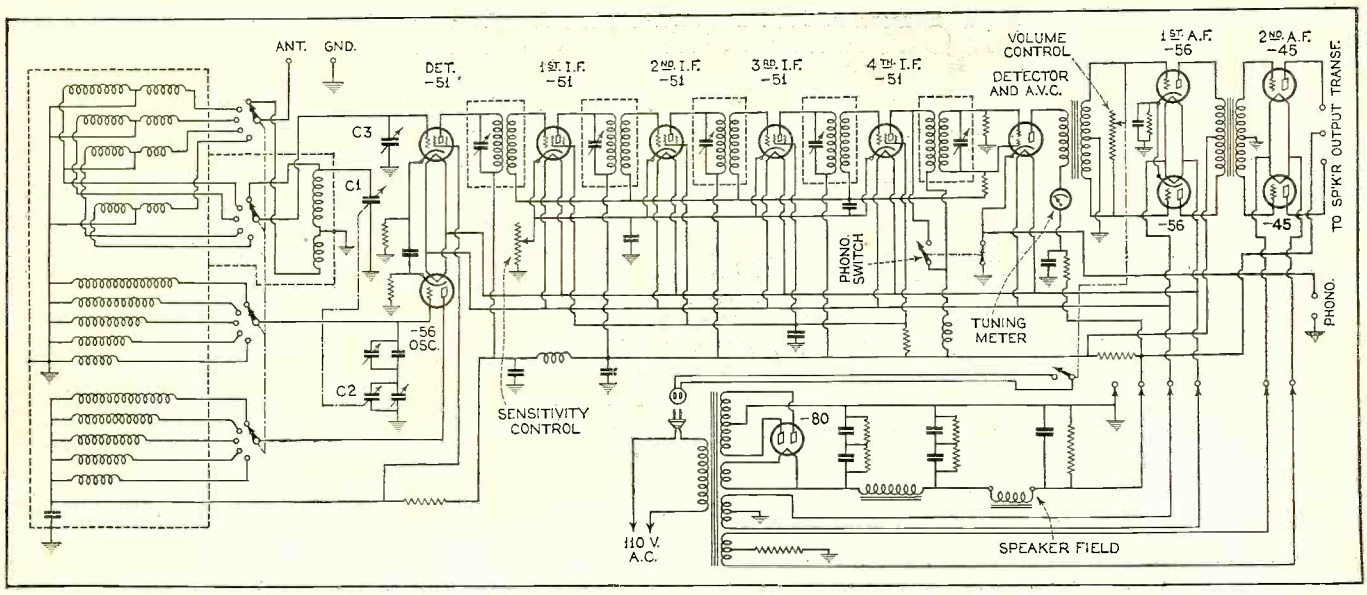
The receiver employs twelve tubes in all. The first detector is followed by four tuned intermediate-frequency stages and all of these employ type –51 variable-mu tubes. The oscillator employs a type –56 tube while the new Wunderlich tube used as the second detector also functions as an automatic volume control. The audio channel employs two stages, both of the push-pull type. The first stage, transformer coupled to the detector, employs two type –56 tubes. Their output is transformer coupled to the pair of –45's which serve in the power output stage. The rectifier is one of the –80 type and feeds into a two-stage filter with the speaker field serving as one of the chokes. The main deviation from conventionality in the filter system is the inclusion of shunt resistors across the filter condensers. These represent a type of bleeder circuit which is helpful in maintaining good voltage regulation and likewise in the prevention of overloading of the rectifier and the condensers.

The coils employed in the tuned circuits are wound on individual forms to eliminate the dead-end losses which would be encountered were tapped coils to be employed. The coils for each band are selected by means of a multiple switch which is controlled by the upper left hand knob on the front panel (Figure 2). These coils, together with the band-changing switch are indicated at the left hand end of the schematic diagram, Figure 1. As will be noted, inductive coupling is used in the antenna input circuit for all wave bands.

For the broadcast band, the input tuning condenser and the oscillator condenser are ganged to provide single control and are operated by the central knob located just beneath the dial window on the front panel. The input tuning condenser, C1, when the band selector switch is set for the broadcast band, is shunted by a smaller variable condenser, C3. This is controlled by the upper right hand knob on the front panel and serves as a trimmer condenser for broadcast tuning. When operating on the four short-wave bands, C1 is automatically cut out of the circuit and all of the input tuning is accomplished by means of C3, only the oscillator condenser, C2, being controlled by the main tuning knob for these wavelengths. Thus on the broadcast band, the receiver is substantially single control, although allowing for more precise adjustment by including the control knob of C3 on the front panel. For short-waves the receiver is actually two control but its operation is simplified by the fact that the setting of C3 is not critical.

The intermediate-frequency amplifier employs four stages, as stated before. These are inductively coupled with the primary of each coupling transformer tuned by means of a midget condenser mounted directly on the individual shield can which encloses each coupling unit. The secondaries are untuned except in the case of the coupling unit between the fourth i.f. tube and the detector. In this unit the primary is untuned but the secondary, which serves as the input for the detector, is of the tuned type.

This receiver is one of the first to adopt the new Wunderlich tube in the detector circuit. This tube not only serves as an excellent detector but provides a simplified method for automatic volume control. In the plate circuit is included a visual tuning meter. Not only does this meter simplify the tuning process by providing visual indication of exact resonance when tuning in stations; it also makes the process of lining up the intermediate-frequency stages extremely simple. In most receivers an output meter, a screw driver and a considerable amount of patience are required in lining up intermediate stages and even then it is frequently almost impossi-



THE SCHEMATIC CIRCUIT DIAGRAM

Figure 1. Four stages of transformer-coupled, plate-tuned i.f. are employed, feeding into a Wunderlich tube which combines the function of second detector and automatic volume control

ble to line them up exactly because of the detuning effect encountered in inserting the screw driver within the shields which enclose the transformers. In this receiver adjustment is made by means of the small Bakelite knobs mounted on top of the i.f. transformer cans.

The lining-up process consists simply in tuning in a station (preferably a distant one) and then adjusting the i.f. tuning controls until the visual tuning meter shows the maximum deflection. This entire operation can be accomplished in a minute or two and is absolutely precise. To insure keeping the intermediate frequency at the desired value, a guide line indicating the approximately correct setting for the i.f. tuning condensers is inscribed on the top of each can.

There are other features of the circuit but they need not be discussed here as they are self-evident to anyone making a careful study of the schematic circuit diagram in Figure 1.

The automatic volume control is not included simply as a talking point, but actually does provide automatic control to a highly effective degree. The manual control of the audio volume level is obtained by means of a variable resistance across the secondary of the first audio-frequency transformer. Once this control has been set for the desired loudspeaker level all stations which would normally be heard above this level are cut down, thus all local stations can be received at a very close approximation to the same volume level, and distant stations as well, provided they are not too far distant.

Sensitivity control and manual volume control are entirely distinct. The sensitivity control, which is the lower left hand knob on the front panel, varies the bias supplied to the grids of the four i.f. tubes. Actually this control serves a dual purpose. By regulating sensitivity it also varies the amount of noise picked up. Thus in a relatively noisy location, the sensitivity control can be adjusted to a point just above the noise level. When this has been done then all stations, local and distant, will be received without local background noise. For one who has operated a receiver employing automatic volume control, the advantage of this arrangement will be readily appreciated. If it were not for this possibility of noise suppression, the noise level when tuning between stations might be most annoying inasmuch as the automatic volume control feature is operative only when a station is tuned in, and in the absence of a signal permits the receiver sensitivity to go up to maximum, with high noise level at such times.

The advantages of the visual tuning meter require little stressing. With such a powerful and selective receiver as this one, the best tone quality is obtained only when the receiver is tuned exactly to the desired station. If the dial setting is a hair's breath above or below its exact setting, quality may be seriously affected. For one with sufficient experience it is possible to closely approximate the correct setting by ear. However, the visual meter makes this process a much more simple one and insures exact tuning adjustment for the best quality of reproduction.

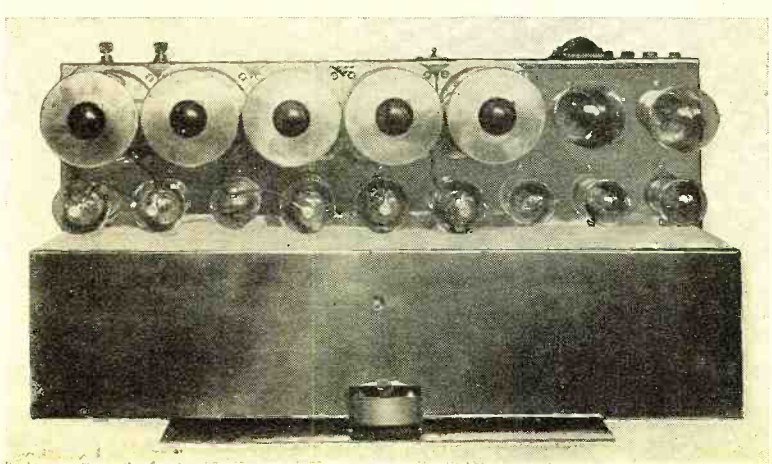
A simple yet extremely important aid in short-wave tuning, is the gear-shift vernier arrangement on the main tuning dial. This takes the form of a small lever, projecting out underneath the main tuning control. With this lever thrown to one side, the reduction ratio of the tuning control is approximately the same as that normally employed in broadcast receivers. But by throwing this lever to the left, this ratio is greatly increased, becoming 53 to 1. In other words, with the lever in this position a quarter of a revolution of the tuning knob changes the tuning less than one degree on the 100 degree dial. This arrangement is particularly helpful in tuning the critical short-wave stations to exact resonance and also in finding short-wave stations. Especially on the lower wavelengths under 30 meters, it is all too easy to skip over a station completely if a receiver provides a tuning control ratio of only ten to one or thereabouts.

As to the physical construction, the reader can be largely left to judge for himself from the photographs shown

(Cont'd on page 187)

THE TOP OF CHASSIS

Figure 3. All coils and condensers are completely enclosed in shields, each i.f. coupling unit in its individual can (at the rear). A knob on the top of each can permits exact alignment of the i.f. amplifier without tools or meters other than the tuning meter on the front panel



COMPLETE CONSTRUCTIONAL DETAILS ON A

Dynamic Microphone

This type of microphone is the latest to win popular acclaim because of its excellent reproduction quality, quietness and stability. The model described here can be constructed at a very slight cost

By Paul S. Zolnier *and* Julius E. Selliken

Part One

IN view of the extensive existing interest in the relatively new dynamic microphone, the following description of one which can readily be constructed by any experimenter should prove helpful. Not only does this microphone, a model of which is pictured on these pages, show an excellent frequency characteristic but it also offers a good degree of sensitivity and—what is of paramount importance to most of us—it is surprisingly inexpensive to make. For one who owns one of the old Magnavox horn type loudspeakers, the total cost will not exceed a few cents. If the junk box does not include a Magnavox unit, perhaps a friend's will.

Two Types Known

There are two kinds of dynamic microphones; the ribbon type and the moving coil type. The last-named is a true generator in that, instead of merely varying an applied voltage as is the case with the carbon microphone, it actually generates an e.m.f. to be applied to the following amplifier. This occurs due to the action of the sound-actuated voice coil moving back and forth in a strong magnetic field produced by the field coil and concentrated in the annular space between the central pole-piece and the top-plate.

The dynamic microphone has no inherent noise-background, such as the carbon-hiss of the carbon type, nor is it affected by sudden changes in temperature or climatic conditions. Moreover, it is not so easily damaged by misuse, and low impedance leads from microphone to amplifier are possible, with resultant low noise pickup from extraneous sources.

The uses of this microphone are varied in that it can be used for amateur radio purposes, public address and call systems, or for general experimentation in the home laboratory.

For the construction of the model described here assemble the list of necessary materials shown at the end of this article.

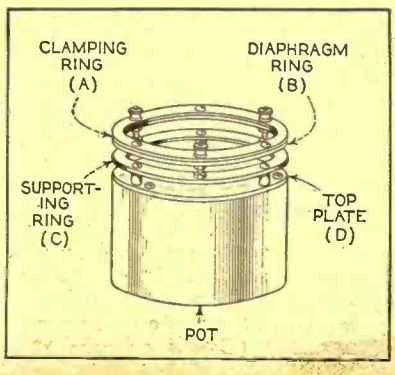
Three brass rings, as shown in Figure 1, are required; outside diameter 3¾ inches and inside diameter 3 inches. These are cut from the brass sheet by scroll saw, circle cutter, lathe or by a machinist. The three rings are drilled the same, alternating 3/16 inch holes with No. 28 holes; six holes in each ring, evenly spaced on the mean diameter. Remove all rough edges with a half-round file. Next place the supporting ring (C) so that it is centered on the top plate (D) and mark through the smaller holes. Punch, drill with a No. 35 drill and tap the top plate for 6/32 machine screws.

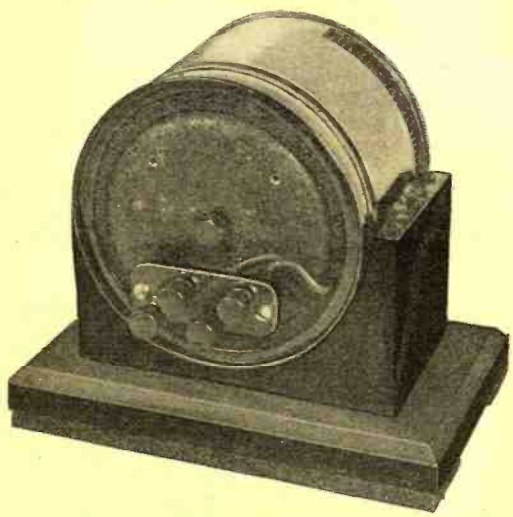
Fasten the three ¾ inch 6/32 machine screws through the 3/16 inch holes of the supporting ring, using hexagon nuts. Put into position the top plate screws. Fasten the supporting ring to the top plate with the ½ inch 6/32 machine number screws, inserting the three brass pillars. The supporting ring will keep the top plate screws in place until the proper time for fastening them. Place one 6/32 hexagon nut (adjusting) on each of the upright screws. Fasten the clamping ring to the diaphragm ring by using three ¼ inch 6/32 machine screws RH through the No. 28 holes.

The Diaphragm

The paper for the diaphragm must be rather stiff, a suitable variety being the bond paper used for business stationery, having a hard smooth surface (not glazed). It is very important to bear in mind the necessity of keeping to a minimum the weight of all the parts making up the complete diaphragm and voice coil assembly, since the frequency-response range of the completed microphone depends very largely upon the weight of the diaphragm assembly, due to the fact that it must move in accordance with, and be actuated by, the feeble voice pulsations.

On the diaphragm paper draw three concentric circles, as in Figure 2. Using a pair of dividers, go over the second circle hard enough to indent the surface without cutting or tearing the paper. Draw a chord on the outside diameter 1 3/16 inches long. From the ends draw radii AO and BO to the center. Parallel to, and ⅛ inch from radius BO, draw another line DC to form a cementing flap. Cut out the diaphragm on the 3-inch circle. Then make a cut from A to O, and from C to D. Cut out the ¾-inch circle using a pair of embroidery or manicure scissors. Put a thin coat of collodion on the flap and bring the line AO to coincide with line BO. Hold in position until the collodion has set. With the scissors make small radial cuts from the outside circumference to the second circle, spaced about ⅜ inch around the circumference, as shown





A REAR VIEW

Here is shown the method of mounting, with a layer of sponge rubber between "mike" and can, to absorb shocks and vibration

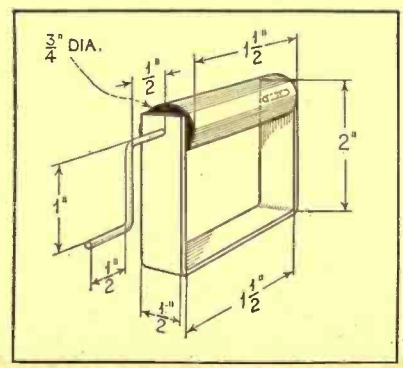
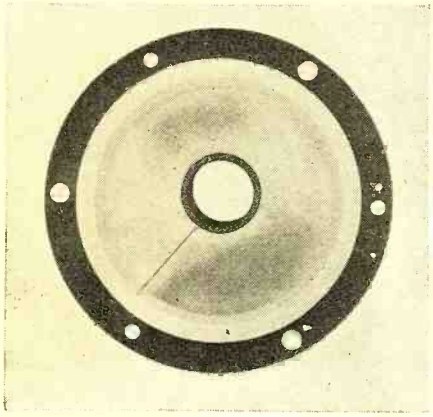
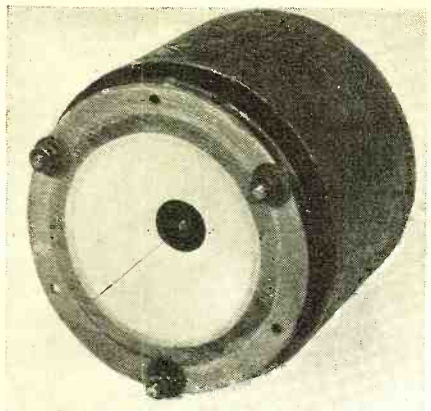


Figure 1 (left), details of ring assembly. Figure 3 (right), the jig for coil winding. The voice coil is difficult to wind by hand but the operation is simplified by this jig



UNDER SIDE OF DIAPHRAGM

This gives a clear idea of the construction. The dark inside circle is the voice coil attached to the center opening in the diaphragm



THE MICROPHONE UNIT

The diaphragm and voice coil assembly is shown here, mounted in position. This shows how the diaphragm is flexibly supported by the silk cloth

in the Figure 2, and bend up the flaps slightly. This prepares the cone edge for fastening to its flexible support.

Suspending the Cone

The support used for suspending the diaphragm or cone is georgette crepe silk, easily obtainable at any dry goods store; light weight material being preferable. Place the silk over one of the brass rings and after stretching tightly across the diameter hold in place with one hand while cementing the silk at both ends to the flat surface of the ring. After it has dried repeat this procedure at right angles to the first stretch, and continue until the silk has been stretched tightly and evenly all around the ring. Then draw the silk around under the ring, cement it to the under side and cut away the excess silk with a razor blade when the collodion has dried.

Place the silk covered ring, face down, on a flat surface. Apply a thin coating of collodion to the flat edge of the paper cone, place it in the center of the silk and press down on the edges. It might be well to place a slight weight on the cone so that it rests evenly on the silk. When the collodion has set cut away the silk covering the cone center, using a razor blade.

Preparing the Voice Coil

Before winding the voice coil, which is the most difficult operation and the one requiring the most skill, it will be a good idea to construct a simple coil-winding jig, as shown in Figure 3. Bend a 5½-inch strip of brass into a U shape with the middle section 1½ inches long, and drill a No. 28 hole in each of the two arms of the U on the center-line ¼ inch from the ends. The winding spindle is of metal ¾ inch round and 1½ inch long. Both ends are drilled and tapped in the exact center for 6/32 machine screws. Into one end thread a short machine screw and cut it off leaving a ⅛-inch stud. Into the other end is screwed the crank for turning the spindle. This may be a 2-inch 6/32 machine screw bent to the required shape. Before the jig is assembled bend in the sides of the U slightly to insure a very snug fit between the U and the spindle. The bottom of the U is fastened in a bench vise with the crank on the right side.

To prepare the spindle for coil winding, wrap it with button thread for a distance of about 1 inch and wrap over this a 12-inch length of waxed tissue paper (lunch paper) about ¾ inch wide. Fasten the ends of the thread and paper with collodion. The winding is started by making a few overlapping turns to hold the wire securely in place. Wind, closely and evenly, one layer of wire ¼ inch long. With a camel hair brush apply some of the thin collodion to the coil and smooth it with the fingertips. The same procedure is followed with the succeeding five layers making a total of six layers to be wound. Great care must be exercised to get the wire wound closely, evenly and without bumps or kinks.

When the final coat of collodion has dried remove the winding spindle from the jig and unwind the thread. Remove the waxed paper, and if desired, a thin coating of collodion may be applied to the inside of the coil for additional strength.

Attaching Voice Coil

Apply a ridge of collodion or Dupont cement all around the edge of the ¾-inch hole of the diaphragm. Place the voice coil (keeping its leads at the end away from the diaphragm) on the diaphragm taking care that it is centered with respect to the ¾-inch hole. Place a small weight on the voice coil to press it down evenly until the collodion sets. This weight must not be heavy enough to disrupt the even layers of the coil or injure the diaphragm.

Ordinary Dupont household cement cannot be used for cementing together the several layers of the voice coil, but can be used for cementing the completed coil onto the paper cone diaphragm. Collodion of a thin consistency suitable for the voice coil is easily made by dissolving small pieces of clear celluloid in acetone. Care must be used with this highly inflammable mixture.

List of Materials

1 model R-3 Magnavox horn type loudspeaker unit (six volt field winding)
1 Sheet of 1/16-inch brass, 4 inches by 12 inches
1 Piece of georgette crepe silk 6 inches square
3¾ inch rh 6/32 machine screws
9 6/32 hexagon nuts
1¼ inch rh 6/32 machine screws
3½ inch rh 6/32 machine screws
3 5/16 inch round pillars ¼ inch high with holes to clear 6/32 machine screws
1 Sheet light bond letter paper
1 Audio transformer or Ford coil secondary (to provide the voice coil wire)
1 Sheet waxed tissue paper (lunch paper)
1 Spool button thread
1 Small bottle of Acetone
Pieces of clear celluloid to make collodion cement
1 Brass strip 5½ inches by ½ inch by 1/16 inch
1 Metal or wood winding spindle ¾ inch diameter, 1½ inches long

(*Continued on page* 185)

CHARACTERISTICS AND CIRCUIT DATA FOR

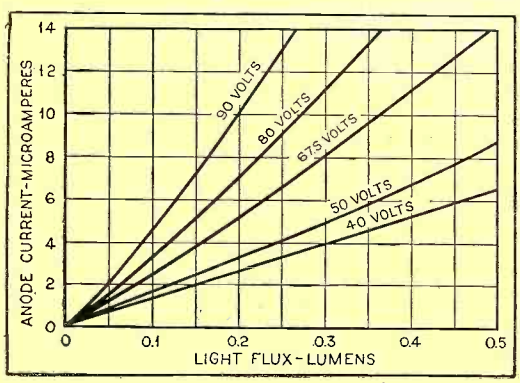
A NEW PHOTOTUBE

This new phototube, of unusual sensitivity, should interest experimenters, television engineers and those working in the sound moving picture field

By
J. van Lienden

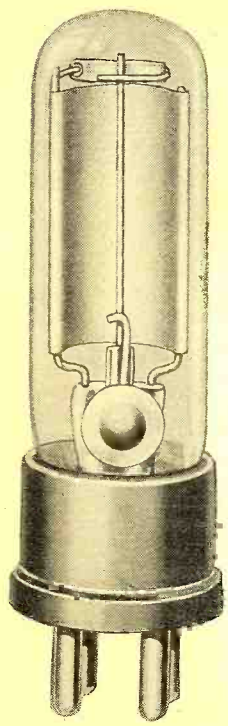
A NEW, sensitive gas-filled phototube, known as type 868 has been made available by R.C.A. and Cunningham. This photo-electric cell is especially adaptable to sound moving pictures in the home to television, and to experiments with light because of its excellent response in the red and infra-red region.

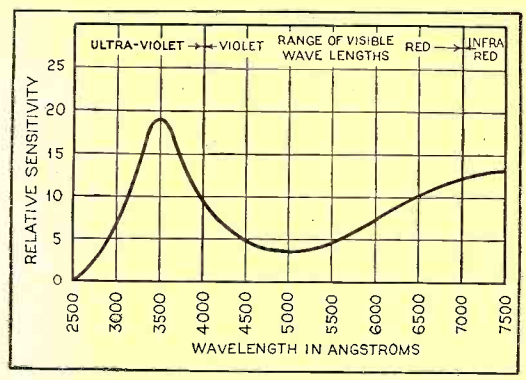
The 868-type phototube is of the central-anode type. The cathode, consisting of a semi-cylindrical metal sheet, has a sensitized surface —a thin film of caesium—which emits electrons when exposed to light- heat- or ultra-violet rays. In the center of this cathode is placed the anode, which attracts the liberated electrons. A small amount of gas is used to increase the sensitivity.



LIGHT-CURRENT CHARACTERISTICS

Figure 1. The current in the phototube, type 868, varies nearly proportional to the quantity of light falling on the cathode





COLOR SENSITIVITY CHARACTERISTICS

Figure 2. How the sensitivity varies with the wavelength. The measurements were made with a constant energy falling on the cell

The current flowing through the tube is dependent on the applied voltage and on the light falling on the tube. In Figure 1, the current, in micro-amperes, has been plotted against luminous flux for different anode voltages. It is seen that the lines are nearly straight, which means that the current is nearly proportional to the light falling on the cathode of the tube.

In Figure 2, a graph is shown which illustrates how the tube responds to light of different wavelengths. The greatest sensitivity is in the ultra-violet and the infra-red regions. This characteristic should make the tube useful for signalling with infra-red (invisible light or for burglar alarms employing such a light source).

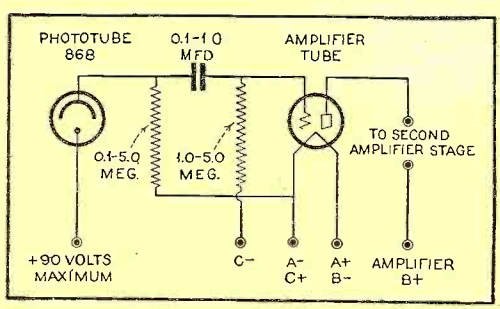
Circuit Connections

In general it is necessary to amplify the current impulses delivered by the tube. This can be done with a triode connected as in Figure 3. The maximum anode-voltage allowable is only ninety volts, but it is recommended to work with a lower potential whenever possible. The tube should be so employed as to prevent any large amount of luminous flux to fall on it which would cause a current of more than 20 micro-amperes to flow. Even when the tube is not connected in a socket, the exposure of the cathode to direct sunlight or any other really powerful source of radiant energy may result in permanent injury to the tube.

The load impedance can be any value between .1 and 5 megohms. The best value to use depends on the service for which the tube is intended. Maximum sensitivity is obtained with a load of 5 megohms, but this is at a sacrifice of some of the quality. A resistance of 1 megohm is satisfactory from the viewpoint of both sensitivity and fidelity.

The tube is fitted with the standard 4-pin base such as is used on triodes. The small prong, which is the plate prong on a triode, is the anode of the phototube. The large prong, diagonally across, connects to the cathode. The tube may be mounted in any position.

Connecting leads from the phototube to the input circuit of the amplifier should be as short as possible in order to minimize noise.



TYPICAL CIRCUIT

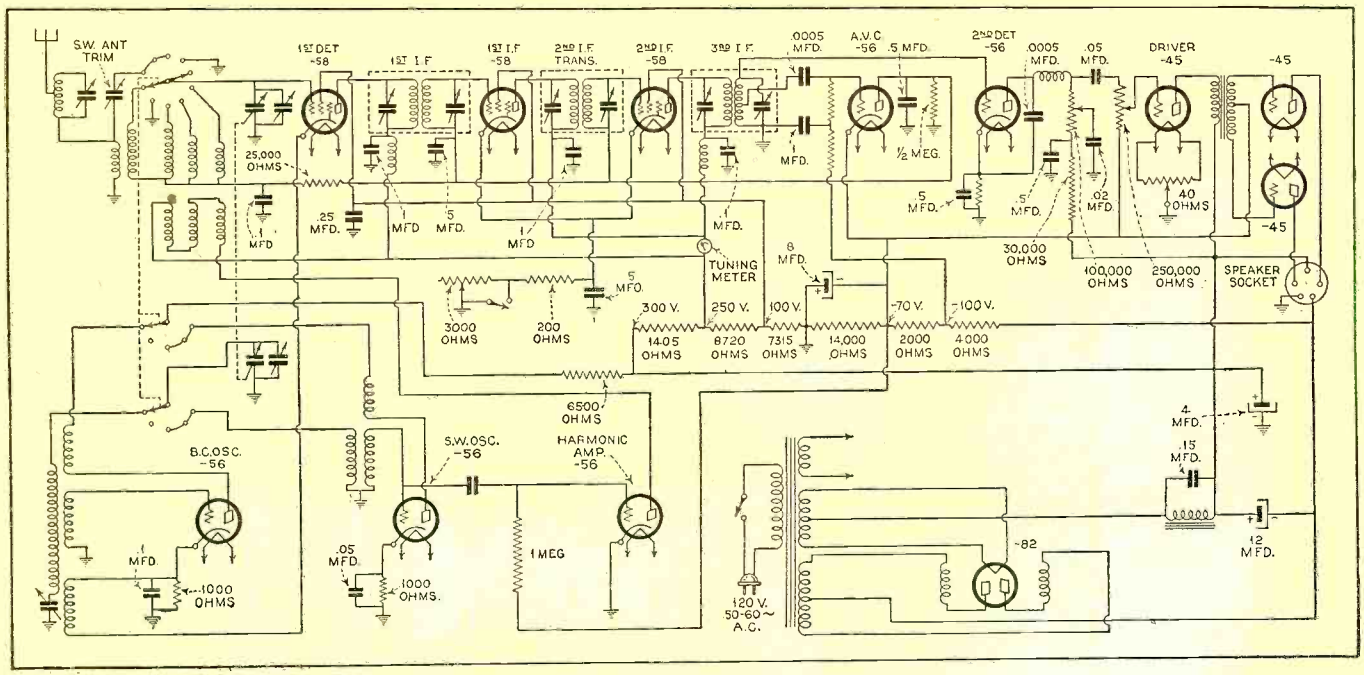
Figure 3. Schematic diagram for the reproduction of speech or music by means of the type 688 phototube. When necessary, other stages of resistance-coupling can be added

TABLE I

ANODE SUPPLY VOLTAGE	90 VOLTS MAXIMUM
ANODE CURRENT	20 MICRO-AMPERES, MAXIMUM
STATIC SENSITIVITY	4.5 MICRO-AMPERES PER LUMEN
DYNAMIC SENSITIVITY (1000 CYCLES)	40 " " " "
DYNAMIC SENSITIVITY (5000 CYCLES)	38 " " " "
GAS AMPLIFICATION FACTOR	NOT OVER 7
LOAD CIRCUIT RESISTANCE	.1 TO 5 MEGOHMS
MAXIMUM OVERALL LENGTH	4⅛ INCHES
MAXIMUM DIAMETER	1⅜ "
BULB	T-8
BASE	SMALL 4-PIN

In table 1 are listed the characteristics of the 868 type phototube. In this table sensitivity values are given for conditions where a Mazda projection lamp, operated at a filament temperature of 2870 degrees Kelvin, was used as the light source. A 1-megohm load-resistance is used in the test circuit.

The gas amplification-factor is given (*Continued on page* 176)



THE SCHEMATIC CIRCUIT DIAGRAM

Figure 3. The new features of the circuit are explained in detail in the text

Improved Design for a
UNIVERSAL SUPER

This new receiver offers automatic volume control, a unique noise suppression circuit, true "Class A" power amplification and a dual oscillator system with a harmonic amplifier which simplifies band switching

By McMurdo Silver*

IN the April, 1932, issue of RADIO NEWS the writer described the totally new system of short-wave reception embodied in the Silver-Marshall 727SW receiver. At the present writing some thousands of these receivers are in service substantially all over the world, and reports on their performance seem to more than justify the prophecy that they would prove to be extremely satisfactory short-wave receivers.

Substantially no complaints have been received except on one subject—the occasional forcing through of a local broadcast station at its regular broadcast-band dial setting on one or two short wave bands, occasioned by the sometimes inadequate rejectivity of the short-wave antenna circuit and the fact that in the system, not only was the desired harmonic of the single oscillator available on the short-waves, but its fundamental as well.

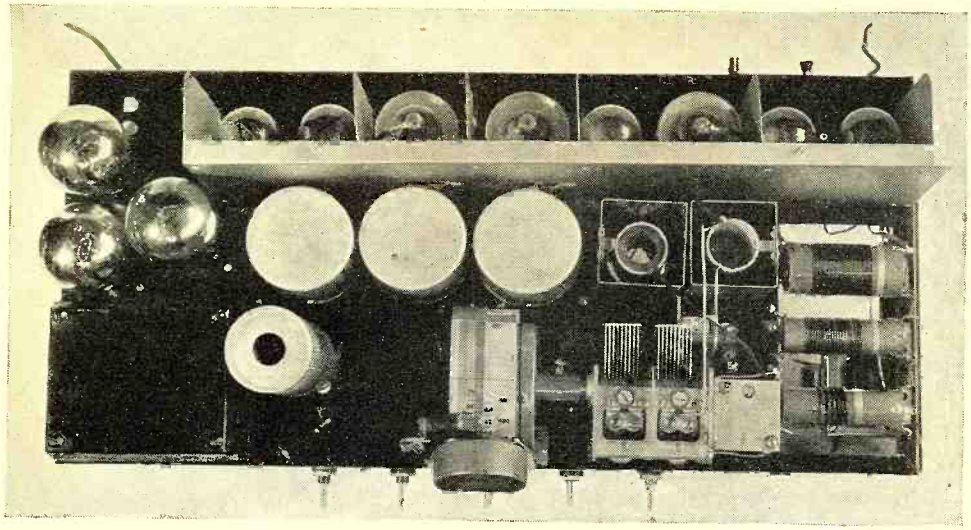
With the recent introduction of new tubes, and the development of the new audio system described in the July and August issues of RADIO NEWS, it was felt desirable to develop a new design which would not only take advantage of these new improvements, but at the same time eliminate any possible unfavorable performance aspects of the 727SW.

The new receiver is known as the 728SW model and, first shown at the Chicago Trade Show, differs essentially from the 727SW in having twelve tubes, the two extra tubes being a separate short-wave oscillator and a driver audio stage. It is illustrated in Figures 1 and 2, with its circuit diagram in Figure 3. No performance curves appear herewith, since those in the August, 1932, issue apply directly to the 728SW.

Examining Figure 1, the simplicity of the complete assembly can be seen at a glance, as well as the symetry of the controls, which left to right are manual volume control and on-off switch, tone control, suppressor switch, short-wave antenna trimmer, four position wave change switch and (above the noise suppressor switch) the single tuning control. The visual tuning meter is just above the calibrated dial, which is divided into four sections for the four ranges of 550 to 1500 kc., 1.5 to 4.3, 3.4 to 9.2 and 9.2 to 22.7 megacycles respectively from right to left, and corresponding to the four positions of the wave-change switch. These ranges are seen to overlap to give full coverage from 550 to 22,700 kilocycles, which includes all U. S. and all foreign short-wave broadcasting. The dial calibration is accurate to one division or 10 kc. on the broadcast band, and is equally accurate on the three short-wave bands; that is, the mechanical error, if any, on the short-wave bands will be exactly equal in terms of mechanical movement of the dial.

Figure 2 shows the chassis from the top, with the r.f. tube shield and coil housing removed. At the center is the tuning dial, with the visual tuning meter, and to its right the two-gang tuning condenser with the low-frequency broadcast oscillator trimmer mounted on its right end and accessible for adjustment through a hole in the top of the shield can, as are the two trimmers for the gang condenser. Behind the gang condenser is the broadcast oscillator coil, with (at its right) the broadcast antenna coil. Both of these coils are individually shielded, as is a the short-wave oscillator coil which is beneath the chassis. The three short-wave antenna coils are at the extreme right, with their harmonic generator pickup coils seen as the narrow white windings at the right end of each coil form. The three round cans at the middle center are the 465 kc. i.f. transformers, their trimmers (six in all) being accessible from beneath the chassis. At the lower left is the shielded power transformer, so wound that its high voltage secondaries, which might radiate the r.f. disturbances developed by the

*President, Silver-Marshall, Inc.



TOP VIEW OF CHASSIS

Figure 2. Here the shielding has been partly removed to show tubes (top) and coils (right)

-82 mercury rectifier tube, are nearest to the can and shielded by the grounded low voltage heater windings. The -82 rectifier is shielded as shown at the right of the power transformer. The tubes from right to left are: -56, short-wave harmonic generator; -56, short-wave oscillator; -58, vario-mu first detector; -56, broadcast oscillator; two -58 i.f. amplifiers (individually shielded by tube cans removed in Figure 2 for clarity); -56, a.v.c. tube; -56, second or audio detector; -45, audio-driver stage; two -45's in the push-pull "Class A Prime" output stage; and the -82 rectifier. The antenna lead, ground binding post and noise suppressor adjustment shaft can all be seen on the rear of the chassis at the upper right of Figure 2.

Antenna Trap Circuit

The circuit diagram of Figure 3 really tells the most interesting part of the story, and is worthy of careful examination. Starting at the left, the antenna is seen connected to a trap circuit. This trap is tuned to 465 kc., and is intended to prevent any possibility of commercial code stations on the east or west coast which may operate on 462 kc. getting through to the i.f. amplifier, which would cause trouble by heterodyning broadcast stations after conversion to the 465 kc. intermediate frequency. This is not an essential feature, since the possibility of such troubles is rather remote, yet it serves to indicate the care that has been taken with every feature of the design of this receiver.

The antenna trap feeds into the oversize primary for the broadcast band first detector input coil, which is tuned by one section of the gang condenser. When the gang switch is thrown to any other of its three short-wave positions, one of the three short-wave antenna coils is picked up and tuned by one section of the gang condenser, trimming for each short-wave band being done by the short-wave antenna series condenser. This arrangement holds the short-wave circuits in step, and makes finding short-wave stations quite easy, since the antenna series condenser is actually a true trimmer, and not a major tuning control. It will be noticed that the wave-change switch gang has one dead position between the broadcast and short-wave positions, this being to obviate any possible capacity effects between these circuits. The first detector is a -58 vario-mu tube to prevent any possibility of cross modulation on channels adjacent to powerful local stations, and to aid in volume control, its control grid bias being varied by the a.v.c. tube over and above its maximum fixed bias, which is that of the -56 broadcast oscillator tube, these tubes being commonly self-biased.

The -56 broadcast oscillator is at the lower left of Figure 3, and is of the conventional S-M tank tuned or Meissner type. Its tank circuit is tuned by one section of the gang condenser, seen to the right of the lower switch sections, the variable condenser below the tank coil being the low-frequency trimmer. The range of this oscillator is the broadcast band plus the intermediate frequency, or 1015 kc. to 1965 kc.

Dual Oscillator System

The short-wave oscillator employs a separate coil and tube, since this makes for greater economy than would the additional switching that would be required if only one oscillator circuit were used. It also obviates any possibility of broadcast band stations riding them on the short-wave bands, since when the short-wave oscillator is in use the broadcast oscillator is in-operative, and vice versa. The short-wave oscillator is tuned by the second section of the gang condenser, and has a range of approximately 1965 to 4800 kc., from which it is seen that it alone cannot heterodyne signals in the broadcast band to the intermediate amplification frequency, hence can in no way contribute to the forcing through of broadcast stations on the short-wave bands. This oscillator is coupled to the first detector through a -56 tube, which is operated at 250 volts plate and 70 volts negative grid bias as a distortion amplifier, or harmonic generator. The utilized frequencies generated by the harmonic generator, which is fed by the short-wave oscillator, are the latter's fundamental frequency and its second and fifth harmonics—all more than strong enough to do a perfect heterodyning job, as is proven by fact that even the fifth harmonic can overload (*Continued on page* 187)

THE COMPLETE RECEIVER

Figure 1. Complete shielding is provided. The dial is accurately calibrated in kilocycles for each of the four bands and a visual resonance meter is shown over the dial

HINTS ON DESIGN AND INSTALLATION OF AUTOMOBILE RADIO

The rather complex electrical system of the modern automobile offers many problems for the auto radio installation man. The following pointers on noise elimination, based on the author's extensive experience in this field, should prove unusually helpful

By **M. J. Sheedy**

Part Two

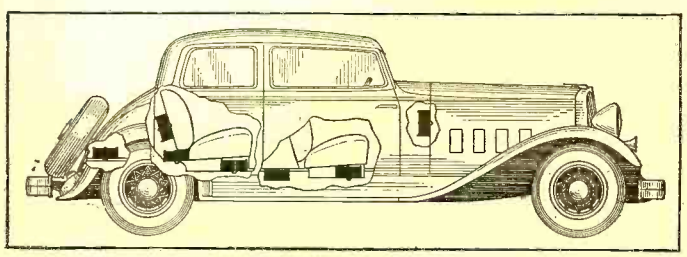
IN making a radio installation in an automobile it is always well to look over the car wiring and make certain it is in good order, also that the breaker points are clean and have a flat surface, and that the generator brushes and commutator are in good condition.

Shielding the spark plug wires is not recommended. It is expensive and the results obtained do not warrant it. Tight shielding adds considerable capacity to the system. This capacity must be charged and consequently absorbs energy from the coil. This will be noticeable by hard starting. In cars equipped with a magneto this rule does not apply.

Shielding H. T. Wiring

Rubber covered high tension wires should never be shielded as corona trouble and leakage will soon be experienced if tight shielding is used. Where it is necessary to shield a high tension wire, varnished cambric covered wire should be used. This wire can also be had with metal shielding already on it.

If the ignition coil or coils are mounted on the car side of the dash, they should be removed and remounted under the hood. Always keep the hood down when listening for spark noise in a receiver. The hood acts as a shield to confine the radiation. If a top antenna is used, it is a good idea to by-pass the wire to the dome and tonneau lights. This will be necessary if the switch is on the ground side. Another wrinkle is to lengthen the distributor rotor, so as to shorten the gap.



Courtesy P. R. Mallory

AUTO B ELIMINATOR INSTALLATION

The relatively small size of the new automobile B eliminators facilitates installation. This view shows seven available locations on a typical car

Quite often a noisy condition can be traced to poor suppressors. While a collection of suppressors of various makes, when tested, may show a nearly uniformed d.c. resistance, yet their a.c. resistance may vary greatly. This is caused by either the quality or nature of the material, or the kind of binder used in it's composition. The simplest and best way to test them is to notice the color of the spark. The whiter the spark the more efficient the suppressor. The more blue in the spark, the more a.c. there is present.

If a motor does not idle properly with suppressors, it may often be remedied by shortening the gap in the spark plugs. The effect of the suppressor on the plugs is like increased compression.

The installation and service of auto radio equipment can be most efficiently handled by automotive electric shops, with the services of a good radio man. Large service stations of this type, having drive-in facilities, can supply service for a number of dealers, and are also in a position to make direct sales to their car service customers. Customers sent in for radio work are also good prospects for car service work.

Very few dealers have the facilities to properly do the work and frequently work an injustice on the customer when they try it. Curb-stone installations are rarely satisfactory. A few manufacturers discourage their dealers from attempting it by only guaranteeing the equipment when it is installed by an authorized service station.

This policy reacts to the dealer's advantage. It relieves him of the installation problem, and assures the customer of specialized and intelligent service and gives the dealer greater confidence to make sales. Poor installations have spoiled more sales than poor receivers.

Every radio dealer, car dealer, and automotive service station can sell auto radios. It is an excellent sales item for the radio dealer in the spring and summer months, when the sale of household receivers is slow.

Auto radio is gradually taking a prominent place in the radio industry. Practically all the leading manufacturers are now marketing receivers for this purpose. Although auto radio was originally introduced for pleasure cars, it's field is rapidly expanding, and there are unlimited opportunities for this business.

The thousands of buses in use throughout the country in themselves constitute a sizable market. Anyone who has ridden any distance by bus, can appreciate this. A little entertainment or current news flashes go a long way to break the monotony of an otherwise tedious ride. Very little effort has been made, however, to sell this market. We will admit that the general run of equipment has not been up to standard for this type of service. With the introduction of superhetrodyne receivers, special tubes, greater output with less current drain, and dynomotors for plate current supply, this business can now be gone after with greater confidence. Buses equipped with radio are given preference by the public and are also in demand for private charter.

Taxicabs constitute another prospective market. Such installations can be arranged so that the set can only be used when a fare is in the car. Much more headway has been made in Europe along this line than in this country.

If a radio is appropriate in an automobile, it certainly is at home in a motor boat. Household receivers are not adaptable to this use and do not give consistent service when used aboard ship. Automobile receivers are better able to stand the rigors of this type of service. The one drawback is that while present-day radios are fine for speed boats, and runabouts, they are not quite adaptable for the small cruisers, due to the mounting arrangements and types of control used. The small cruiser constitutes the greatest market.

Motor-Boat Radio

There is an opportunity for some enterprising manufacturer to market a set to fill this need. Such receivers should be similar in type to the present-day midgets, but built to withstand the corrosive effects of salt air and dampness. Provision should also be made for additional speakers. Motorboat builders and dealers are waiting for such a receiver. The radio mariner in coastal waters can set up a loop antenna with such a receiver and have an excellent direction finder.

Auto radio has made more (*Continued from page* 185)

"Professional" Receiver

FOR AMATEURS AND SHORT-WAVE FANS

This, the concluding article on this new receiver, provides further information on design features and tells something of the results obtained by the author in his tests under a variety of reception conditions

Part Two

By Gordon Fraser

IN the initial article, which appeared last month, the extreme sensitivity and selectivity of the Hammarlund Comet "Pro" receiver, and its unusual system of band-spread tuning, were discussed in considerable detail. The present article will be devoted mainly to a consideration of the circuit design, and will disclose some of the reasons for its outstanding effectiveness in the reception of amateur and short-wave broadcast signals, as well as all other types of transmission carried on in the range between 15 and 200 meters.

The circuit diagram is shown in Figure 3 and the top and bottom views of the chassis in Figure 7 and 8, respectively. A detailed circuit of the input and oscillator tuning system was given in Figure 2 last month, with a detailed explanation of its operation.

A study of Figure 3 will show that the receiver employs eight tubes, including a -24A for the first detector, two -35's for the intermediate-frequency stages, a -24A for the second detector, -27's for the oscillator, the c.w. beat-frequency oscillator and the audio stages, and a type -80 rectifier. The wavelength and oscillator coils, marked respectively "W. L." and "OSC." on the diagram are coils of the plug-in type, four pairs of which are used to continuously cover all portions of the 15 to 200 meter band.

The main wavelength and oscillator tuning condensers provide a capacity of 138 mmfd. each in the tank circuits. Each of these is shunted by two other condensers of 15 and 26 mmfd. capacity. These two smaller condensers in the oscillator circuit are ganged with the two in the detector circuit while the two larger tank condensers are individually controlled. Thus coarse tuning is accomplished with the two controls while fine tuning utilizes the vernier shunt condensers with their single control, making the receiver single control once it has been tuned (by means of the tank condensers) to the approximate wave desired. While the four sections of the vernier condensers are ganged, all four are used only when the higher wave coils are plugged in, the action of plugging in these coils closing the circuit to the 26 mmfd. condensers automatically and thus providing a vernier capacity of 41 mmfd. in each circuit. When using the low wave coils only the 15 mmfd. condensers are left in to serve as verniers.

The advantage of this tuning arrangement is at once apparent. First, in that it spreads the stations out nicely on the dial; second, because it provides the advantage of single control when single control is most needed, i.e., when actually tuning in the desired station.

The single control vernier tuning has another advantage which is not so obvious but nevertheless certain. This is found in the fact that while using the ganged vernier control, there can be no complications from image-frequency interference as both circuits are tuned in step.

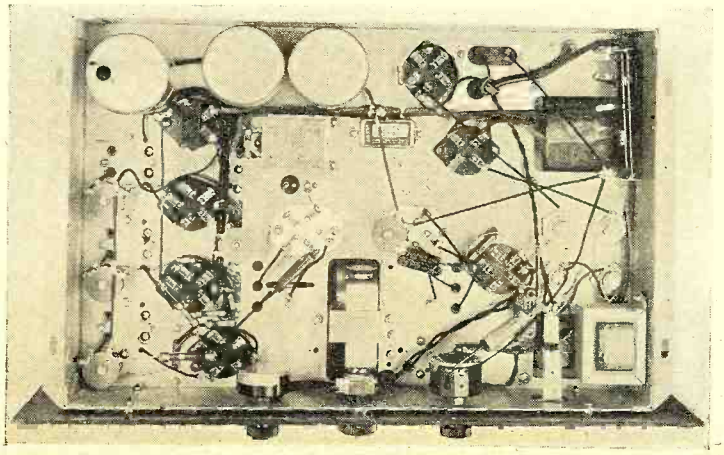
The first detector circuit is of the grid-bias type. Coupling between it and the oscillator is provided solely through the physical relationship of the two coils, there being no separate pick-up coil or capacity coupling between the two circuits.

The intermediate-frequency amplifier is really the heart of this receiver and its design does much to account for both the sensitivity and selectivity demonstrated in operation. This amplifier employs two stages, with two tuned circuits between tubes. Thus there are 6 tuned circuits provided between the first and second detectors, the condensers in each of these tuned circuits being of the adjustable type to permit the intermediate amplifier to be lined up precisely. The i.f. coils are Litz wound and every precaution is taken to provide absolutely minimum high-frequency resistance. It is because of the high degree of amplification obtained in this i.f. amplifier and the excellent selectivity it provides, that r.f. amplification ahead of the first detector has been found quite unnecessary. Nor are pre-selector circuits necessary.

This does not mean, however, that entire dependence for efficiency has been placed on the i.f. amplifier. The tuned circuits of both the oscillator and the detector input have been held to a minimum r.f. resistance. The coils, for instance, are wound on Isolanite type plug-in forms and both the tuning condensers and sockets are insulated with the same material.

THE "PRO" CHASSIS, TOP AND BOTTOM VIEWS

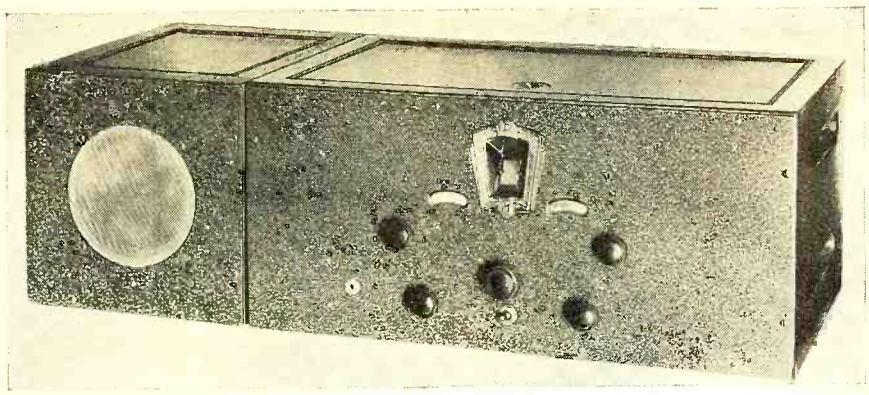
Figure 7, Left. Here the two "tank" condensers can be seen with their individual tuning dials and directly behind them, operated by the drum dial, are the ganged vernier condensers which constitute the band-spread system. Note how the power supply equipment is isolated at the right to eliminate hum transfer. Figure 8, Right. All is ship-shape, with short leads and careful layout to provide absolute stability. The i.f. tuning condenser adjustment screws are distinguishable just to the left of the line of tube sockets



At first glance it may seem strange that Litz wire is not used in winding these plug-in coils. Various experiments have shown that at frequencies over 1500 kc. (200 meters) Litz offers little advantage and in fact the ordinary types of Litz wire are likely to be less efficient than solid wire.

C.W. Beat Oscillator

The second detector is also one of the grid bias type and capable of handling a high input without overloading. The output circuit of this tube is particularly interesting in that it employs a two stage r.f. filter, the purpose of which is to confine the r.f. currents so that they cannot get into the audio circuit, where they would—and in all too many short-wave receivers actually do—cause untold trouble. This second detector is resistance-coupled to the single audio tube.



THE RECEIVER WITH AMPLIFIER UNIT

While the receiver is intended primarily for headphone reception, a magnetic speaker can be used on most stations. Where high power reproduction is desired a separate power speaker is available, as shown here with the receiver

The beat-frequency oscillator, VT7, is coupled to the second detector by means of an extremely small capacity and is in the circuit only when its switch is thrown to the "on" position. The tube itself is, of course, in the circuit at all times but when this switch is opened the plate voltage is removed, stopping oscillation. This oscillator circuit is tuned by an adjustable condenser, which allows it to be brought into exact resonance with the intermediate frequency. Once adjusted this tuning element requires no further attention.

To an amateur who has heretofore had a separate regeneration control dial to provide a heterodyne for c.w. reception, this oscillator system will prove a revelation inasmuch as it requires no adjustment whatsoever yet provides as near perfect c.w. reception as could be desired. Not only is this oscillator useful in c.w. reception but it also provides an easy means of tuning in extremely distant and weak broadcast signals. For this purpose, the oscillator switch is thrown to the "on" position and the receiver tuned in the usual way. When the carrier of a distant station is heterodyned, the receiver is tuned to zero beat. The oscillator is then cut off and the operator will find the receiver tuned exactly to the desired broadcast station. This is particularly helpful because even though the desired station may have faded out almost completely at the moment, the greater sensitivity of the receiver when used for heterodyne reception will permit tuning in the station which might otherwise be easily skipped over, particularly if the fading is bad.

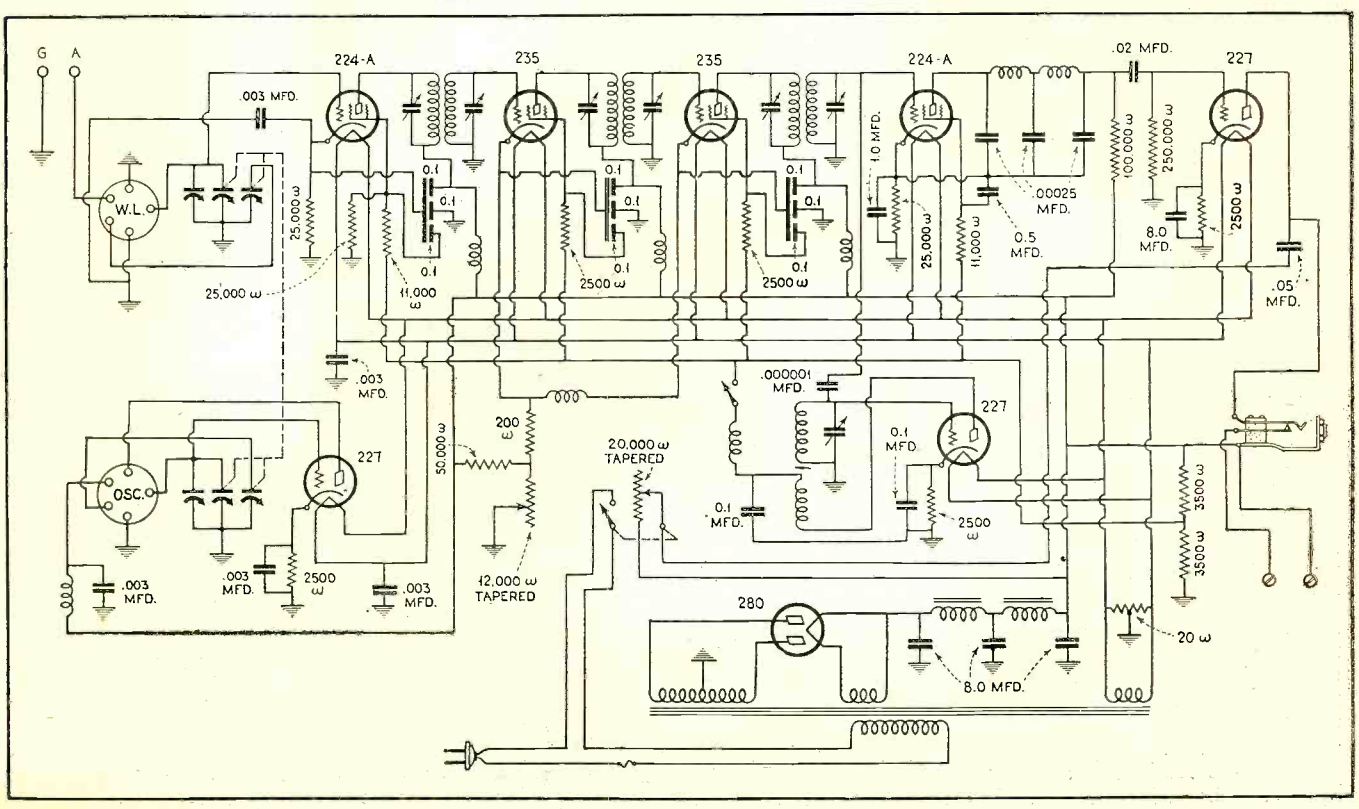
The output of the audio tube is available either at the single circuit jack which is mounted on the front panel of the receiver or at the output terminals provided inside the receiver. The set has ample power under most conditions to operate a magnetic type speaker. If desired a speaker of this type may be connected to the output terminals, where it is automatically cut out when 'phones are plugged into the headphone jack. When so used, no speaker coupling transformer is necessary. When greater volume is required, it can be obtained by means of a separate unit consisting of a push-pull stage, which employs a pair of –45's, a dynamic speaker and its own power supply. This unit is enclosed in a cabinet to match the receiver cabinet and is shown in one of the accompanying illustrations.

Head-phones for DX

There is much to be said in favor of this output arrangement. It permits the amateur or D.X. fan to listen in at all hours without disturbing the family. Furthermore, any seasoned listener knows that the loudspeaker cannot compare with headphones when listening to extremely weak signals.

The power supply has been included in the receiver and is of a conventional type. It will be noted (*Continued on page* 170)

FIGURE 3. THE SCHEMATIC CIRCUIT DIAGRAM



The Handy-Pack A. C.—D. C.

SET ANALYZER MULTIMETER

A surprisingly compact instrument which provides for all a.c. and d.c. measurements encountered in testing receivers, including six prong, Wunderlich and Triple-Twin tubes

By **T. J. Goldman**

WITH the introduction of the six-prong tube base and the numerous other new tube types, radio set analyzers have become more or less obsolete. In addition, there are many radio servicemen who do not possess good testing equipment due to the great expense involved and are trying to get along with inadequate equipment. It is our purpose to present an analyzer which will accommodate all of the latest types of tubes, which will cost very little, and which can be put into the toolbag. This instrument will also be a useful adjunct to any laboratory, as its accuracy depends only on the accuracy of the parts used and on the accuracy of calibrations.

The heart of the kit is the 0-1 d.c. milliammeter and the miniature copper-oxide rectifier. No a.c. meter is used, a.c. voltages being converted by the rectifier just mentioned, which partly accounts for the small size. The reader is doubtless familiar with the meter, possibly has one; however, a word about the rectifier will not be amiss.

This rectifier consists of a set of four copper-oxide plates arranged in the conventional Wheatstone bridge circuit. As may be seen in the photograph, Figure 1, it is very small in size. Its maximum current carrying capacity is 15 milliamperes. The output of the bridge is flat up to 4000 cycles input, with a gradual falling off of one-half of one per cent. per 1000 cycles thereafter. The error due to temperature change is so slight as to be negligible at ordinary room temperatures. All series resistances and shunts must be placed in the external circuit as the rectifier will be damaged if subjected to high voltages or heavy currents.

When using the meter on d.c. it is necessary to take the bridge out of circuit, as it becomes an undesirable shunt. This shunt effect varies at different points on the scale, as the resistance of the rectifier depends on the current density. For example, when using the copper-oxide rectifier with a 0-500 microammeter, it is only necessary to use a double-pole double-throw toggle switch to change from d.c. to a.c., leaving it across the meter. As the current density is so low, the shunt effect of the rectifier is almost unnoticeable, in spite of the high resistance of the meter. The output of the rectifier is

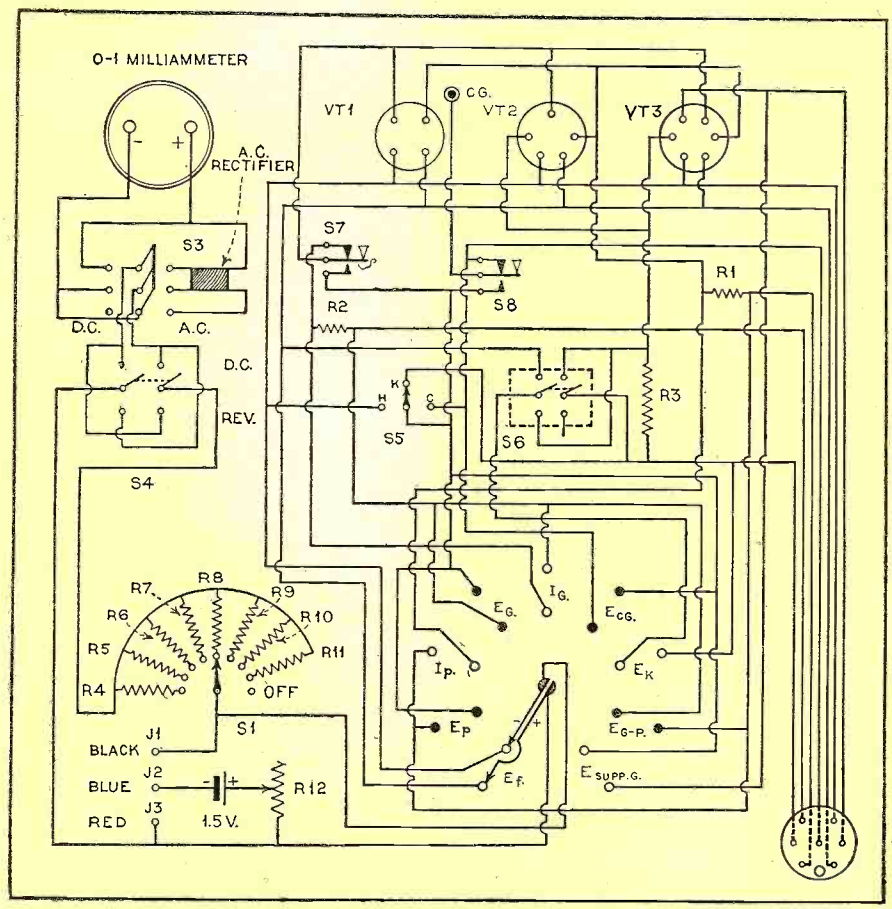


FIGURE 5. THE COMPLETE CIRCUIT DIAGRAM

the average value of the a.c. input, but may be calibrated in RMS values. The d.c. output is approximately eighty-six per cent. of the a.c. input, hence the a.c. scale may be roughly calibrated as one and one-sixth the d.c. scale for the same series resistors. In the endeavor to keep expense down, no attempt is made to have the a.c. and d.c. readings alike at full scale, although it would be a simple matter to accomplish it. The copper-oxide rectifier is mounted on the triple-pole double-throw switch, just below the meter.

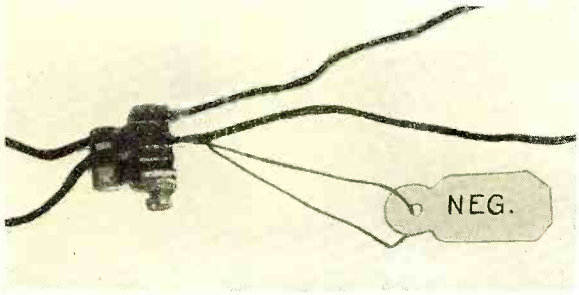
The first step in the construction of the analyzer is to obtain a suitable case. Almost any small box will do, although we would not advise anything smaller than the dimensions given in Figure 4. In fact, if the builder has not had much experience in this sort of construction, he had best increase the size a little. The case illustrated is built of three-eighth inch oak cut as follows: 2 pieces 2¼ inches by 8¾ inches, 2 pieces 7 inches by 8 inches, 2 pieces 2¼ inches by 7 inches, 2 pieces 1¼ inches by 8¾ inches, 1 piece 2¼ inches by 8 inches, which is placed 4⅞ inches from the front. After the

pieces are squared up, put them together with brass screws, using glue on the joints; then sandpaper it. A handle, latch, rubber feet, and hinges are necessary, of course. Use eight rubber feet, four on the back and four on the bottom. It is best to use slip hinges so that the cover may be taken off when the instrument is being used. To finish, apply two coats of a good mahogany varnish.

Cut a piece of bakelite or hard rubber to 4⅞ inches by 8 inches. No measurements will be given for the drilling of the panel, as they depend on the available material. Four small metal brackets should be screwed to the case near the corners to support the panel. Holes corresponding to the positions of the brackets should be drilled in the panel. If the brackets cannot be tapped to receive screws solder nuts to them.

A 1¼ inch hole must be drilled in the end of the case at about the center to accommodate the cable connector. It will be necessary to place a small piece of bakelite or wood between the plate and the side of the box to keep the pins from projecting. Notch the top of the hole in both the side and the extra piece for the guide pin to fit into. The annalyzer plug cable should then be soldered to the cable connector as indicated in Figure 3.

When everything has been mounted, with an eye to easy manipulation and short leads, cut and bend two pieces of ¼-inch brass strip to the shape shown in Figure 2, for the battery holder. The size will depend on the size of flashlight battery used. Mount this holder on any dead screw coming to the rear of the panel. The screw-head which makes contact with the positive pole must be insulated with fibre washers to prevent shorting the battery.



THE MINIATURE RECTIFIER

Figure 1. This tiny rectifier, smaller than a ten-cent piece, converts the d.c. milliammeter for a.c. measurements

The Switches

Before doing any soldering, study the wiring diagram to understand perfectly the operation of the instrument. The nine point bi-polar switch places the combination meter across different parts of the tube circuit; voltage and current ranges being controlled by the eight point single pole switch. All voltages are measured at 1000 ohms per volt. This is enough in all but very high resistance circuits, as for instance, resistance coupled circuits using high mu tubes, or in any case where a grid to ground circuit is completed through a high resistance.

Current is measured by measuring the voltage drop it produces across a 100-ohm resistance (R_1, R_2 and R_3). By Ohm's Law, one milliampere passing through such a resistance produces a voltage drop of one-tenth volt. Therefore we measure this voltage drop and multiply by ten to find the current.

This is satisfactory for the higher current ranges. However, using this idea on low voltage ranges is not so good, as the meter shunts out too much current. Therefore we must make the one hundred ohm resistance a shunt for the meter and series multiplier resistor. Thus we put 170 ohms in series with the meter, shunted by 100 ohms for a three ma. range and 770 ohms in series with the meter for a nine ma. range. The total resistance of the meter and series resistor is two hundred and eight hundred ohms respectively. Two hundred ohms shunts one-half of the current passing through the one hundred ohm resistance, so that a full scale reading of the meter indicates a total of three ma. All resistances used in the analyzer must be of the precision type. One-watt sizes will do for the voltage multipliers, but larger sizes must be used for the current shunts.

In the endeavor to keep size down, specially altered carbon resistances are used for voltage multipliers (from 3000 ohms up) and small wire-wound resistances are used for the 100, 170 and 770 ohm strips. To alter the carbon resistances, and make the wire-wound strips, it is necessary to use a Wheatstone bridge, or a very accurate and easy reading d.c. microammeter. It is also necessary to use the carbon resistances specified. To make the high resistances, select one having a slightly lower value than that needed (for example 2500 ohms for the 3000 ohm resis.). Insulate the jaws of a small vise with friction tape, insert the resistor with the edge projecting. Arrange the resistance measuring set-up using a high enough voltage to give you nearly a full scale swing (if you use a meter) and start to file away a little of the carbon. The more carbon you file away, the higher the resistance of the unit.

Preparing the Resistors

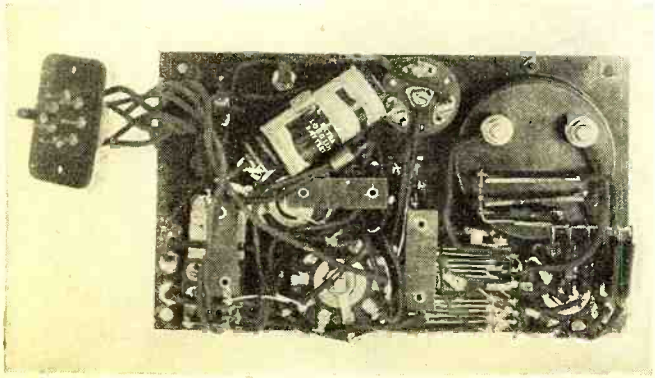
For the wire-wound resistantances, determine the resistance per foot of the wire, calculate the number of feet needed and then cut it off a little longer. Measure the resistance, and, if too high, cut off more of the wire. Repeat until the right value has been reached. Wind on a fibre strip, and fasten with rivet-lugs, as most resistance-wire cannot be soldered. If you decide to use the manufactured substitutes, increase the size of the case and panel accordingly.

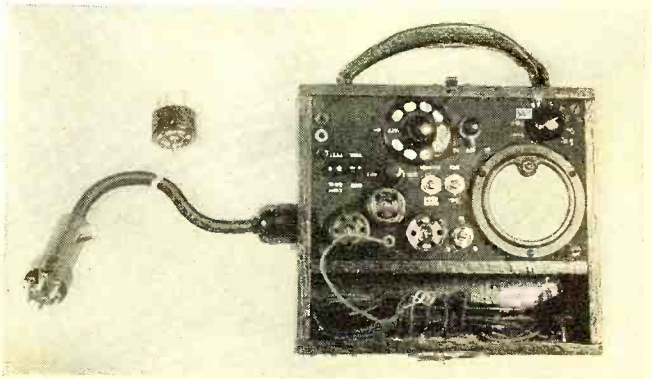
The single-pole triple-throw toggle switch, S5, varies the reference point for voltage measurements to cathode in different types of tubes; for example to K for the usual heater tubes, to F for audio pentodes, and to the overhead cap for the Wunderlich tube. Ordinarily it may be left in the K position as the six to four adaptor connects K to filament. When the resistor in the cathode circuit is not being used it is shorted out by one section of the double-pole double-throw toggle switch, S6, as it may add an undesirable additional bias to the tube under test if it is of the heater type.

The "tube test" (S7 and S8) simply removes all bias from the tube, which usually results in an increase in plate current. As this increase is considerable in power tubes, it is well to keep the button down for only a short time. You can get an idea as to how good tubes (*Continued on page* 186)

THE ANALYZER

Only 8¾ inches long, 7 inches deep and 3¾ inches high, over all, the instrument is readily portable, yet will do everything required of a larger unit. The carefully planned arrangement facilitates wiring and avoids overcrowding





CRUISING THE SHORT-WAVES WITH THE

Latest All-Wave Super

Last month the author described the results of broadcast reception tests using this new receiver. This month he discusses its effectiveness on the short waves, based on tests in four locations around New York City

Part Two

[*By* S. Gordon Taylor]

THIS, the second of a series on the new Scott DeLuxe all-wave superheterodyne will describe some of the results obtained when using this receiver on wavelengths below 200 meters. Last month something was told of its operation on the broadcast band—how in two successive attempts, a week apart, stations were easily tuned in on every broadcast channel but one and in addition some half-dozen foreign stations operating in the 200-550 meter band.

As the short-wave tests were intended to show typical results from this receiver, it was decided to set up the receiver in several different locations rather than to depend entirely on one location. No attempt was made in any of these tests to pick out especially propitious days or hours (even if such could have been determined in advance), or especially favorable locations. The tests were made at the author's summer place in Connecticut and at another staff member's camp in the woods about ten miles inland from the Hudson and a few miles north of the New York-New Jersey boundary, and at a friend's summer place in West Nyack, a suburb roughly twenty miles outside of New York City. These three locations and one in New York City were decided upon for the tests, as they provide fairly wide geographical distribution and a variety of conditions, but still are suburbs of New York City and therefore easily accessible.

The hours selected for the tests were those which were most convenient and the tests extended over relatively short intervals.

The test in New York City was conducted in an apartment house located on a triangular corner with a trolley line curving around two sides of the building and the third exposed side fronting on a street where automobile traffic is exceptionally heavy. These latter details are pertinent, as all sensitive short-wave receivers are susceptible to interference from automobile ignition. Automobiles bound up the hill are stopped by a traffic light at the bottom and start from a dead standstill; they take the hill in low and second gear causing more than the ordinary amount of ignition interference. The trolley line is likewise extremely noisy.

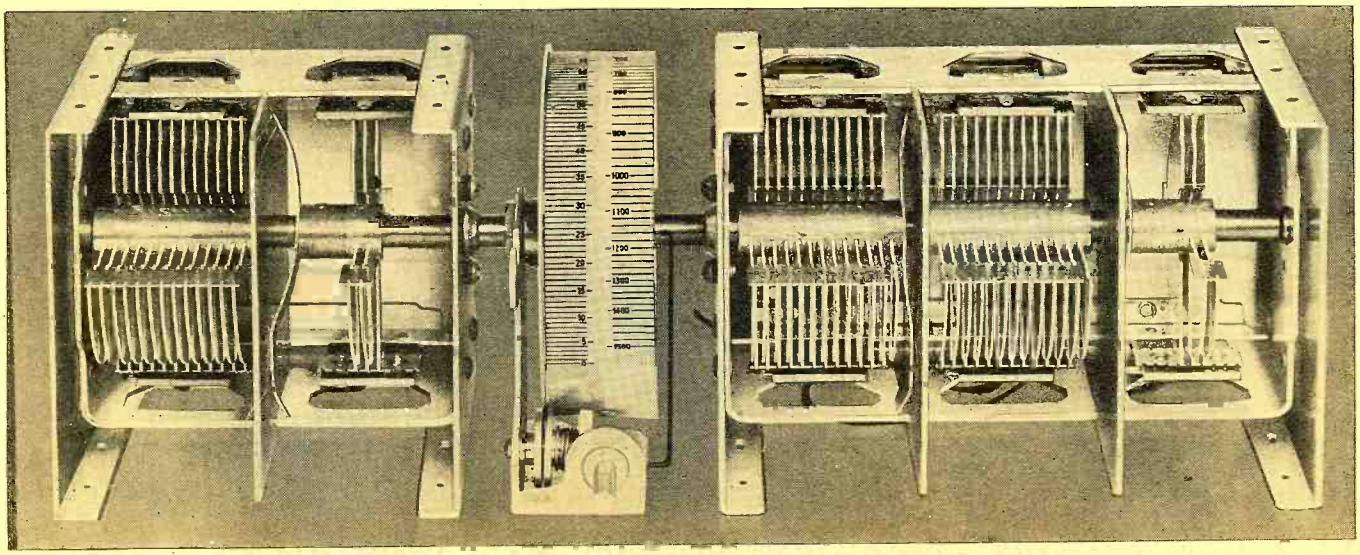
A single-wire antenna, approximately fifty feet long, with a lead-in taken off one end and running approximately 60 feet down the side of the building and through the apartment to the location of the receiver, was employed. Under these conditions the down lead provided about at much pick-up as the flat top, but, unfortunately picked up more noise than signal, thus contributing to the relatively high, local noise-level found here.

In spite of this condition, the test produced signals from all of the more commonly heard European stations, many of the American short-wave stations and the Cuban and South American short-wave broadcasters. The potential volume level on these stations must have been high because, due to the high local noise, the volume control could never be turned more than part way, yet these various stations were received on the loudspeaker. Under these conditions the volume was at times quite low but at other times filled the apartment, always keeping the background noise at a relatively low level. A location such as this one is, of course, far worse than average. It is probably as bad as will be found anywhere around New York City with the possible exception of some of the down-town business districts. The main consideration is that even in this extremely unfavorable location, reception was accomplished up to several thousand miles.

The second test was conducted in West Nyack. Here the receiver was installed on a screened porch. The house is set in a clearing of approximately two acres, surrounded by heavy underbrush and numerous trees. The antenna was a single wire, approximately 100 feet long and its average height, making allowance for the sag, was about 13 to 14 feet. The lead-in was only about 6 feet in length and the ground lead to a cold water pipe about 15 feet. The West Nyack tests were conducted during part of one day, beginning about 1.00 p.m. and continued off and on until about 7.00 p.m. Along about 5 o'clock a heavy storm came up, accompanied by thunder and lightning, and lasted

THE GANG-TUNING UNIT

All tuning elements are mounted on a single shaft which is controlled by the single tuning knob operating through an ingenius friction drive reducing gear



about one-half hour. After this the atmospherics continued.

All of the usual foreign stations operating during the afternoon were tuned in and it was quite obvious that reception conditions in this location *were* favorable. During the afternoon the Eiffel Tower station in Paris, for instance, was consistently received with little fading, except over long periods. During the periods when the signals were coming through the strongest, the owner of the house was able to understand the French speech from a point 300 feet away from the house (and the loudspeaker). During the fading periods, the signal was still strong enough to provide "living-room volume" without turning the sensitivity control up to a point which made the noise level troublesome.

Rome and Points East

Switching to 12RO, Rome, the listener walked away from the receiver until he reached the point where he estimated the Italian speech would be understandable to anyone familiar with the language. This proved to be 150 feet from the loudspeaker. Earlier in the afternoon, EAQ, Madrid, was received with approximately the same volume as 12RO. This latter station was particularly consistent, with almost no fading. In addition to these foreign short-wave broadcast stations, a number of foreign commercial telephone stations were heard, including a German station, the call of which was not given but which came in with unusual strength.

The next test was arranged at the camp mentioned earlier in this article. Here the antenna, strung between two trees, had an average height of 25 feet. The camp is located in a clearing of about 100 feet by 50 feet and is surrounded by an almost impenetrable forest growth—such a location as one would expect to find in the Maine woods but certainly not within commuting distance of New York. Even in the clearing there were several trees which made it necessary to put the antenna up with its nearest end about 50 feet from the cabin. The antenna and lead-in, together, were approximately 150 feet long, the lead-in being of insulated wire which in several places came in contact with the foliage of trees.

Here the reception conditions were found almost the same as those of West Nyack but the tests did not get under way until after most of the European stations had signed off. However, EAQ at Madrid was still on the air and just below it on the dial was LSN of Buenos Aires. Both of these stations came in well enough to really enjoy the programs. Running in our usual luck, the tests were interrupted by another thunder storm. The result was that local broadcast signals were badly broken up by static and the programs from Buenos Aires and Madrid were actually more enjoyable than were those on the broadcast band! On the short wavelengths, static was almost absent and the signal level was so far above the noise level that more than comfortable volume was obtained before approaching the noise level.

SHORT-WAVE TUNING GUIDE

This station finder shows at a glance the dial setting for any short-wave station whose wavelength is known. The front disc is revolved until the desired wavelength appears at the opening. The arrow then points to the correct dial setting

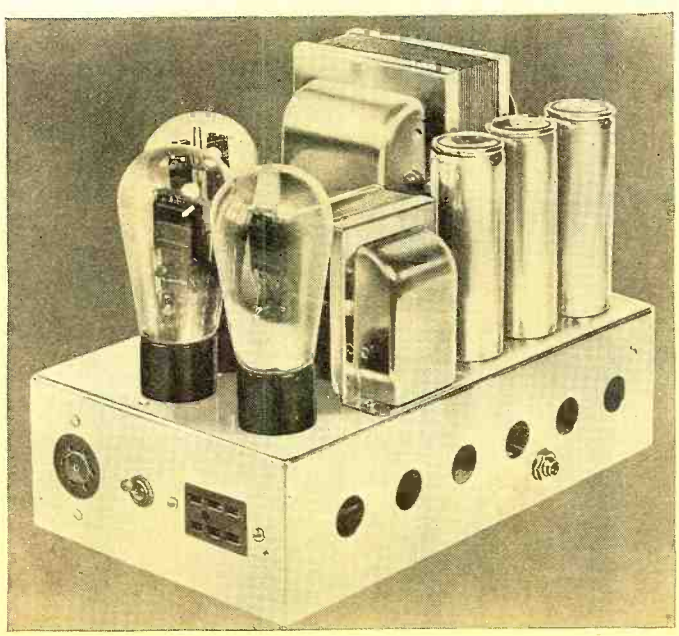
The final tests were made at Fairfield Beach, Connecticut, which borders Long Island Sound, and is 50 miles (by road) from New York City. The antenna employed was a mediocre affair, approximately 70 feet long, varying between 12 to 15 feet in height. The lead-in was approximately 20 feet long. Tests in this location were tried at various hours of the day—hours which were found convenient, in between swimming, golf and other summer time sports. It was at this location that the only late-at-night tests were made. In general the signal level was lower than at either of the other suburban locations. But the signal- above-noise level was higher than in the New York City location because of the lower noise level encountered.

Australian Reception

The usual run of European stations, as mentioned in connection with the preceeding tests, were found but reception was less consistent in this location than in the other suburban locations. Some afternoons the European stations were received with fine volume; on other days they were not satisfactory. They could be heard any day, of course, but their field strength above the noise varied greatly from day-to-day and from hour-to-hour. At one time, when a home recorder was not available, both the Paris and Rome stations were coming in with plenty of volume to permit making excellent records. During the next test, with a recorder available the output volume was entirely inadequate for recording purposes. At another time some records were made using one of the Acratest professional type portable recording units. Reception at that time was far from its best but records were nevertheless obtained on both the Paris and Rome stations. This recorder, incidentally, proved capable of making excellent records. It includes an unusually constant drive, the power being applied at the outer edge of the heavy turn table where the strong leverage applied is not affected by the drag of the cutter. The turn-table is accurately balanced to eliminate wobble. The recording head is moved across the record by a positive screw thread drive, cutting and recording the aluminum records at the same time. The quality of both speech and music, as recorded by this equipment is really good, representing a reasonably close approach to commercial records.

THE POWER-AMPLIFIER UNIT

This unit, designed and finished to match the receiver chassis, provides all operating power for receiver and twin speakers. It includes the push-pull power output stage



From the foregoing, it appears that this Connecticut location is far from being an ideal one for this type of reception but this only tends to emphasize the excellent qualities of the Scott receiver, proven in one outstanding bit of reception. This took place while tuning around at random shortly after 2:00 a.m. on Sunday morning, May 22nd, during the only test carried on in the early morning hours. When tuning slightly above 30 meters, a carrier was encountered and a moment later an announcement was made in English. It was neither the King's English nor the so-called American English. A moment later the station was announced as VK3ME, Sydney, Australia, the an-

(*Continued on page* 177)

Mathematics in Radio

Calculus and Its Application in Radio

By **J. E. Smith***

Part Eighteen

WE are learning that the study of Calculus is not as difficult as it first appeared to be and that it is essential to the understanding of advanced electrical theory and practice.

The practical engineer generally asks himself to what extent the use of Calculus will enable him to advance more rapidly in his work. This is more effectively answered by the fact that a knowledge of this subject, when once appreciated, induces a confidence in one's self that is invaluable.

In order to appreciate more fully the practical applications of Calculus to Radio, let us develop in more detail some of the relations in Radio theory which are already known. The study of such a subject only requires a correlation of known facts.

We have stated previously that the differential calculus deals with the rate of change of one variable with respect to another. Let us investigate the simple sine wave of Fig. 1, in order to bring out a little more thoroughly the relationship involving the "rate of change." We have here a sine wave function of "e" or "i" which varies with the value of θ. But going a step further, the rate of change of the sine wave at any instant can be expressed in another way. Thus, with reference to Fig. 2 (a), a line PT has been drawn tangent to the sine wave at point A. The slope of such a line is defined as the ratio of O to a. This ratio is approximately equal to 1. Consider Fig. 2 (b), and at point B, it is noticed that the slope of the line is determined from the ratio of approximately 11 divisions to 37 divisions which is about 1/3. Now, if the line PT is drawn tangent to the curve where it goes through the zero axis at point 0 as shown in Fig. 3, it is apparent that its slope is greater than for points A and B. It is seen to be in the ratio of about 25 to 17, or approximately 1.5.

The slope of the line drawn tangent to the curve at any point determines the rate of change of the wave. From the above analyses, the rate of change at 0 is greater than at A. In like manner, the rate of change at A is greater than at B, and for a point on the curve which is its maximum, such as E max in Fig. 1, the slope must be zero. Thus, the rate of change is maximum at zero (o) and minimum at the top of the wave (E max).

The use of calculus will show this result immediately. Let the wave of Fig. 1 be expressed as follows:

$$(I) \quad e = E \max \sin \theta$$

But it was shown in the last article that the value of the derivative at any point on the curve is equal to the slope of the line drawn tangent to the curve at that point.

Let us take the derivative of (I) with respect to θ:

$$(II) \quad \frac{de}{d\theta} = \frac{d\,(E \max \sin \theta)}{d\theta}$$

This is of the form $\frac{d}{dx}(cv)$, the solution of which has been shown to be equal to $c\frac{dv}{dx}$. Here, E max equals C and v equals sin θ.

Equation (II) becomes:

$$(III) \quad \frac{de}{d\theta} = E \max \cos \theta$$

Plotting III in Fig. 4, it is noticed that calculus has determined immediately the rate of change at any instant of the sine wave. It is also in agreement with the above analyses, as it is noticed that the rate of change is maximum when the sine wave passes through zero and is at minimum when the crest of the wave has been reached. This analysis is a very important one, and further use will be made of it in later discussions.

Reactive Electromotive Force Drop with Inductance

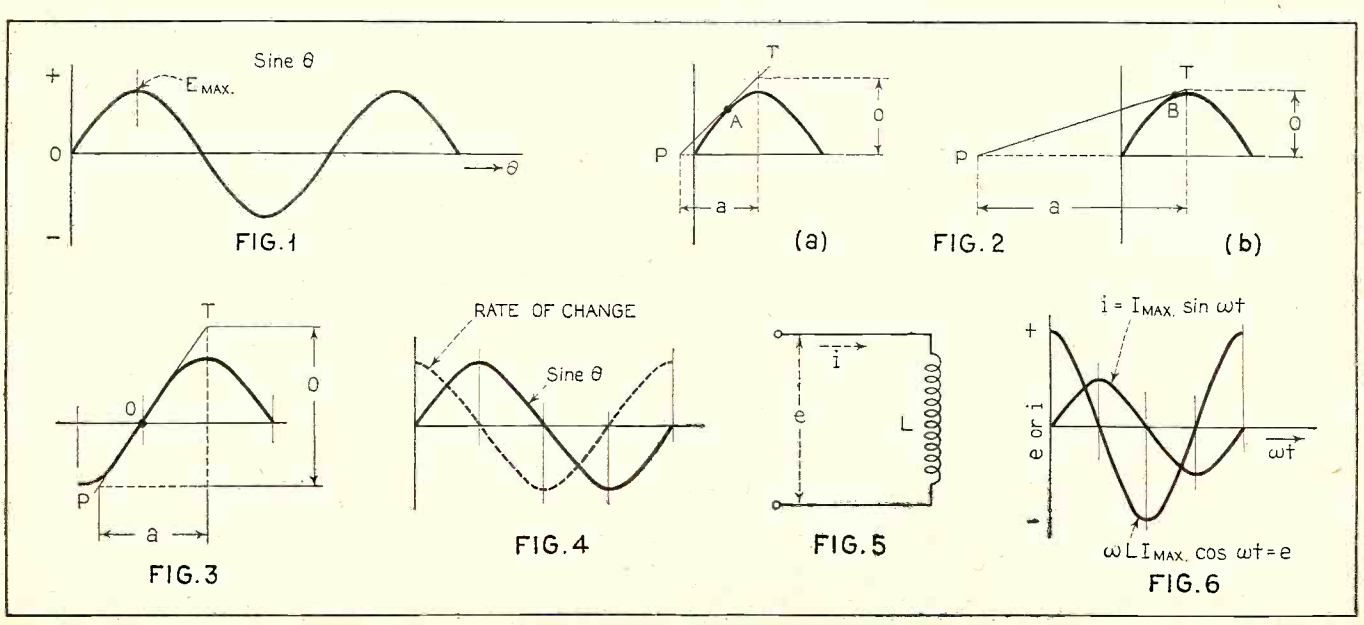
Let us consider how the use of calculus shows the relation of the current with respect to the voltage in an inductive circuit.

We think of the inductance of a circuit as being associated with the surrounding magnetic flux and also with the current flowing through the circuit. In considering the inductive circuit of Fig. 5, we recall that there is a magnetic flux around the coil due to the current i. The self-inductance of this circuit is simply equal to the ratio of the total magnetic flux φ to the current i. This is expressed as:

$$(I) \quad L = \frac{\phi}{i}$$

(II) Therefore, $\phi = L\,i$

(*Continued on page* 185)



* President, National Radio Institute.

Broadcasting Stations in the U. S.

By Frequency, Wavelength and Call Letters *

550 KC., 545.1 Meters
KFDY, KFUO, KFYR, KOAC, KSD, WGR, WKRC

560 KC., 535.4 Meters
KFDM, KLZ, KTAB, WFI, WIBO, WLIT, WNOX, WPCC, WQAM

570 KC., 526.0 Meters
KGKO, KMTR, KXA, WEAO, WKBN, WMAC, WMCA, WNAX, WNYC, WSYR, WWNC

580 KC., 516.9 Meters—*Canadian shared*
KGFX, KSAC, WIBW, WOBU, WSAZ

590 KC., 508.2 Meters
KHQ, WCAJ, WEEI, WKZO, WOW

600 KC., 499.7 Meters—*Canadian shared*
KFSD, WCAC, WCAO, WICC, WMT, WOAN, WREC

610 KC., 491.6 Meters
KFRC, WDAF, WFAN, WIP, WJAY

620 KC., 483.6 Meters
KGW, KTAR, WFLA, WLBZ, WSUN, WTMJ

630 KC., 475.9 Meters—*Canadian shared*
KFRU, WGBF, WMAL, WOS

640 KC., 468.5 Meters
KFI, WAIU, WOI

650 KC., 461.3 Meters
KPCB, WSM

660 KC., 454.3 Meters
WAAW, WEAF

670 KC., 447.5 Meters
WMAQ

680 KC., 440.9 Meters
KFEQ, KPO, WPTF

690 KC., 434.5 Meters—*Canadian exclusive*

700 KC., 428.3 Meters
WLW

710 KC., 422.3 Meters
KMPC, WOR

720 KC., 416.4 Meters
WGN, WLIB

730 KC., 410.7 Meters—*Canadian exclusive*

740 KC., 405.2 Meters
KMMJ, WSB

750 KC., 399.8 Meters
WJR

760 KC., 394.5 Meters
KVI, WEW, WJZ

770 KC., 389.4 Meters
KFAB, WBBM, WJBT

780 KC., 384.4 Meters—*Canadian shared*
KELW, KTM, WEAN, WMC, WPOR, WTAR

790 KC., 379.5 Meters
KGO, WGY

800 KC., 374.8 Meters
WBAP, WFAA

810 KC., 370.2 Meters
WCCO, WPCH

820 KC., 365.6 Meters
WHAS

830 KC., 361.2 Meters
KOA, WEEU, WHDH, WRUF

840 KC., 356.9 Meters—*Canadian exclusive*

850 KC., 352.7 Meters
KWKH, WWL

860 KC., 348.6 Meters
KMO, WABC, WBOQ, WHB

870 KC., 344.6 Meters
WBCN, WENR, WLS

880 KC., 340.7 Meters—*Canadian shared*
KFKA, KLX, KPOF, WCOC, WGBI, WQAN, WSUI

890 KC., 336.9 Meters—*Canadian shared*
KARK, KFNF, KUSD, WGST, WILL, WJAR, WKAQ, WMMN

900 KC., 331.1 Meters
KGBU, KHJ, KSEI, WBEN, WJAX, WKY, WLBL

910 KC., 329.5 Meters—*Canadian exclusive*

920 KC., 325.9 Meters
KFEL, KFXF, KOMO, KPRC, WAAF, WBSO, WWJ

930 KC., 322.4 Meters—*Canadian shared*
KFWI, KGBZ, KMA, KROW, WBRC, WDBJ, WIBG

940 KC., 319 Meters
KGU, KOIN, WAAT, WCSH, WDAY, WFIW, WHA

950 KC., 315.6 Meters
KFWB, KGHL, KMBC, WRC

960 KC., 312.3 Meters—*Canadian exclusive*

970 KC., 309.1 Meters
KJR, WCFL

980 KC., 305.9 Meters
KDKA

990 KC., 302.8 Meters
WBZ, WBZA

1000 KC., 299.8 Meters
KFVD, WGEO, WHO, WOC

1010 KC., 296.9 Meters—*Canadian shared*
KGGF, KQW, WHN, WIS, WNAD, WPAP, WQAO, WRNY

1020 KC., 293.9 Meters
KFKX, KYW, WRAX

1030 KC., 291.1 Meters—*Canadian exclusive*

1040 KC., 288.3 Meters
KRLD, KTHS, WKAR, WMAK

1050 KC., 285.5 Meters
KFBI, KFKB, KNX

1060 KC., 282.8 Meters
KWJJ, WBAL, WJAG, WTIC

1070 KC., 280.2 Meters
KJBS, WCAZ, WDZ, WTAM

1080 KC., 277.6 Meters
WBT, WCBD, WMBI

1090 KC., 275.1 Meters
KMOX

1100 KC., 272.6 Meters
KGDM, WLWL, WPG

1110 KC., 270.1 Meters
KSOO, WRVA

1120 KC., 267.7 Meters—*Canadian shared*
KFIO, KMCS, KRKD, KRSC, KSFG, KTRH, WDBO, WDEL, WHAD, WISN, WTAW

1130 KC., 265.3 Meters
KSL, WJJD, WOV

1140 KC., 263.0 Meters
KVOO, WAPI

1150 KC., 260.7 Meters
WHAM

1160 KC., 258.5 Meters
WOWO, WWVA

1170 KC., 256.3 Meters
WCAU

1180 KC., 254.1 Meters
KEX, KOB, WDGY, WHDI, WINS, WMAZ

1190 KC., 252.0 Meters
WOAI

1200 KC., 249.9 Meters
KBTM, KERN, KFJB, KFWF, KGCU, KGDE, KGDY, KGEK, KGEW, KGFJ, KGHI, KGY, KMLB, KVOS, KWG, WABI, WABZ, WBBZ, WBHS, WCAT, WCAX, WCLO, WCOD, WEPS, WFAM, WFBC, WFBE, WHBC, WHBY, WIBX, WIL, WJBC, WJBL, WJBW, WKJC, WLAP, WLBG, WNBO, WNBW, WNBX, WORC, WRBL, WWAE

1210 KC., 247.8 Meters—*Canadian shared*
KDFN, KDLR, KGCR, KGMP, KGNO, KFOR, KFVS, KFXM, KMJ, KPPC, KWEA, WALR, WBAX, WBBL, WCBS, WCOH, WCRW, WEBQ, WEDC, WGBB, WGCM, WHBF, WHBU, WIBU, WIBI, WJBU, WJBY, WJW, WLCI, WMBG, WMRJ, WOCL, WOMT, WPAW, WPRO, WQDX, WRBQ, WSBC, WSEN, WSIX, WSOC, WTAX

1220 KC., 245.6 Meters
KFKU, KTW, KWSC, WCAD, WCAE, WDAE, WREN

1230 KC., 243.8 Meters
KFQD, KGGM, KYA, WBIS, WFBM, WNAC, WPSC, WSBT

1240 KC., 241.8 Meters
KLPM, KTAT, WACO, WXYZ

1250 KC., 239.9 Meters
KFMX, KFOX, WAAM, WCAL, WDSU, WGCP, WGMS, WLB, WODA, WRHM

1260 KC., 238.0 Meters
KOIL, KRGV, KVOA, KWWG, WLBW, WTOC

1270 KC., 236.1 Meters
KGCA, KOL, KVOR, KWLC, WASH, WEAI, WFBR, WJDX, WOOD

1280 KC., 234.2 Meters
KFBB, WCAM, WCAP, WDOD, WIBA, WISJ, WOAX, WRR

1290 KC., 232.4 Meters
KDYL, KFUL, KLCN, KTSA, WEBC, WJAS, WNBZ

1300 KC., 230.6 Meters
KFAC, KFH, KFJR, KGEF, KTBR, WBBR, WHAP, WHAZ, WEVD, WIOD, WMBF, WOQ

1310 KC., 228.9 Meters
KCRJ, KFBK, KFGQ, KFIU, KFJY, KFPL, KFPM, KFUP, KFXJ, KFXR, KGBX, KGCX, KGEZ, KGFW, KIT, KMED, KRMD, KTLC, KTSL, KTSM, KWCR, KXRO, WBEO, WBOW, WBRE, WCLS, WDAH, WEBR, WEXL, WFBG, WFDF, WFDV, WGAL, WGH, WHAT, WJAC, WJAK, WKAV, WKBB, WKBC, WKBS, WLBC, WMBO, WNBH, WOI, WRAW, WROL, WSAJ, WSJS, WTEL, WTJS, WTSL

1320 KC., 227.1 Meters
KGHF, KGIQ, KGMB, KID, KTFI, WADC, WSMB

1330 KC., 225.4 Meters
KGB, KSCJ, WDRC, WSAI, WTAQ

1340 KC., 223.7 Meters
KFPW, KFPY, WCOA, WSPD

1350 KC., 222.1 Meters
KIDO, KWK, WAWZ, WBNX, WCDA, WEHC, WMSG

1360 KC., 220.4 Meters
KGER, KGIR, WCSC, WFBL, WGES, WJKS, WQBC

1370 KC., 218.8 Meters
KCRC, KFBL, KFJI, KFJM, KFJZ, KFLX, KGAR, KGDA, KGFG, KGFL, KGKL, KMAC, KONO, KOOS, KRE, KUJ, KVL, KWKC, WBGF, WBTM, WCBM, WDAS, WGL, WHBD, WHBQ, WHDF, WIBM, WJBK, WJTL, WLEY, WLVA, WMBR, WPFB, WQDM, WRAK, WRAM, WRDO, WRJN, WSVS

1380 KC., 217.3 Meters
KOH, KQV, KSO, WKBH, WSMK

1390 KC., 215.7 Meters
KLRA, KOY, KUOA, WHK

1400 KC., 214.2 Meters
KLO, KOCW, WBAA, WBBC, WCGU, WCMA, WFOX, WKBF, WLTH

1410 KC., 212.6 Meters
KFLV, KGRS, WAAB, WBCM, WDAG, WHBL, WHIS, WODX, WRBX, WSFA

1420 KC., 211.9 Meters
KABC, KBPS, KCMC, KFIZ, KFQU, KFQW, KFXD, KFXY, KFYO, KGFF, KGGC, KGIW, KGIX, KGKX, KGVO, KICK, KORE, KXL, KXYZ, WAGM, WDEV, WDIX, WEDH, WEHS, WELL, WFDW, WHDL, WHFC, WIAS, WILM, WJBO, WJMS, WKBI, WLBF, WMBC, WMBH, WPAD, WSPA, WTBO

1430 KC., 209.7 Meters
KECA, KGNF, WBAK, WCAH, WFEA, WGBC, WHP, WNBR

1440 KC., 208.2 Meters
KLS, WABO, WBIG, WCBA, WHEC, WMBD, WOKO, WSAN, WTAD

1450 KC., 206.8 Meters
KTBS, WBMS, WGAR, WHOM, WKBO, WNJ, WSAR, WTFI

1460 KC., 205.4 Meters
KSTP, WJSV

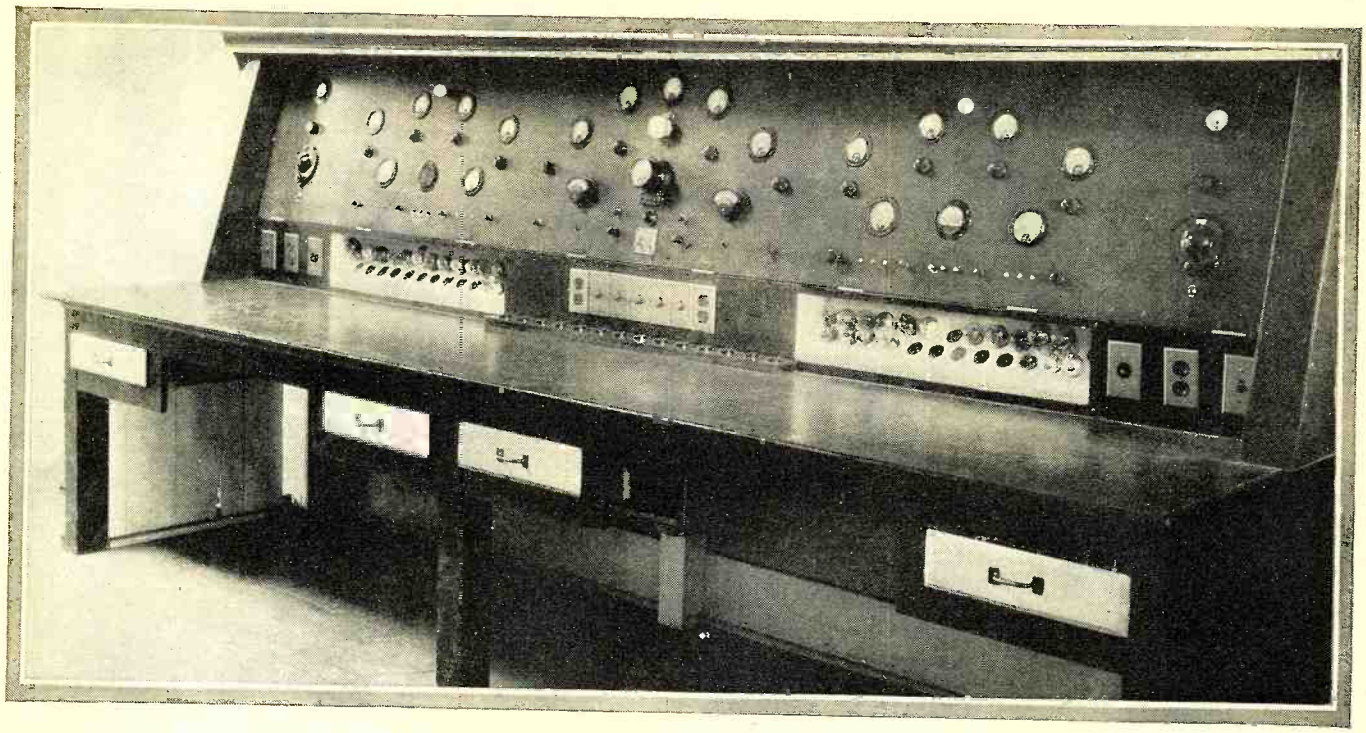
1470 KC., 204.0 Meters
KGA, WLAC, WTNT

1480 KC., 202.6 Meters
KFJF, WKBW

1490 KC., 201.6 Meters
WCHI, WCKY

1500 KC., 199.9 Meters
KDB, KGFI, KGFK, KGIZ, KGKB, KGKY, KNOW, KPTM, KPQ, KREG, KUT, KXO, WCLB, WKBV, WKBZ, WLBX, WLOE, WMBA, WMBJ, WMBQ, WMIL, WMPC, WNBF, WOPI, WPEN, WRDW, WSYB, WWRL, WWSW

*Next month's issue will contain an alphabetically arranged station call list giving call letters, location, frequency and power.



The Service Bench

Service Equipment—Modernizing Set Analyzers, Output Meter, A Tube "Short" Tester, Service Shops and Ideas, Test Speakers, The Service Salesman, Rural Advertising, Service Rates, Service Notes—Majestic, Crosley, Stromberg-Carlson

Conducted by
Zeh Bouck

AS this appears, the political campaign is starting on the home stretch. Public interest, particularly in its radio presentation, is unprecedented, and the serviceman is in a position to cash in on it. Aside from the service work which can be expected from intelligent advertising and publicity associated with politics as a radio feature, the public address field is a promising source of potential income. Local political organizations, newspapers, civic clubs, schools and auditoriums are logical markets for both rental and sale of P. A. installations. A wide-awake serviceman in a town of 20,000 is in the best position to take advantage of these possibilities.

THE Jewell Model 199 tube and set tester was probably the most popular of its kind until its utility was curtailed with the advent of the screen grid tube. However, the manufacturer immediately advised owners of this device that it could be modified by the factory to take care of the new tubes at a nominal cost. Thousands of servicemen took advantage of this offer, and the Jewell 199 is still widely used on all but pentode tests. Mr. C. Washburn, Jr., radio and electrical engineer of Jacksonville, Florida, describes, in the following article, several simple changes, which, in addition to effecting further improvements for ordinary screen grid-tests, makes it possible to employ this analyzer on pentode tubes. While the subsequent notes apply directly only to the factory rebuilt 199 analyzer, the considerations advanced suggest fundamental changes required in making similar adaptations in other tube testers.

"There are seven wires in the tester cable. Referring to the inverted sketch in Figure 1, you will find two wires (black) attached to terminals 5 and 6 and leading through to a single prong on the plug. We can use one of these, namely number 5, to take the place of the extra wire to the control grid. Unsolder the leads from terminal number 1, and solder them to number 2. That leaves the number 1 terminal clear. Take the lead which was formerly used for the separate control grid lead, and, from the end having the plug, cut off about six inches of wire, so that the plug (which plugged into the jack on the tester marked 'long lead') has a 6-inch length of wire still soldered to it. Pull this wire through the hole in the panel (originally for the mounting screw nearest the jack marked 'long lead') and solder the end of the wire to terminal number 1. Leave enough of this lead above the panel so that the plug can be inserted in the jack marked 'long lead'.

"Unscrew both screws in the cable plug, and slide the handle back along the cable so that the wire which is connected to terminal No. 6 in the tester can be cut loose from the filament prong. (Caution should be observed to cut the right one—the small black wire.) Pull a piece of flexible hookup wire through the handle along with the cable, solder the end to the black wire which was cut, and tape carefully. Pull the handle back to the base and replace the screws. We now have the upper end of the hookup wire extending from the top of the handle. Fasten a cap to the handle, near the top (to which a control grid clip in the set can be clipped) and solder the hookup wire to this cap. This enables us to test screen grid and variable mu tubes by plugging the lead coming out of the panel into the 'long-lead' jack, and the short lead, from the 'short-lead' jack to the cap of the tube in the tester socket as before; but now, of course, we have no extra lead from the set to the analyzer, and the control grid lead in the set clips onto the cap on the handle of the plug.

"For the pentodes, I use a S.P.D.T. snap-switch, with oxidized finish. The principle involved is that in the Jewell all readings for 5-prong tubes are made to cathode, and the type 47 tube does not have a cathode but uses the cathode prong for the screen voltage. In order to be able to read all voltages from the filament for pentode tests, this switch transfers the common cathode lead for other tubes to the filament for pentodes. (By common lead, I refer to the common connection for all meter ranges.) This lead will be recognized as a piece of bus-bar running diagonally across the d.-c. switch block and indicated in Figure 1. The flexible wire from the end of this bus-bar to the negative binding post on the panel and thence to the cathode, is unsoldered from the binding-post and run to the center terminal on the switch. One side of the switch is wired to the binding-post, while the other side is connected to the filament connection at the top of the a.-c. switch block and which leads to terminal No. 2. The switch is mounted on the panel at the top of the a.-c. switch block, as close to it as possible, so that it lines up with the left hand row of push-buttons. The letter C is scratched on the panel on one side of the switch, and the letter F on the other—cor-

responding to cathode and filament. With the switch on the F side all pentode voltages can be read with the exception of the screen potential. To obtain the screen voltage, press the 300 plate-voltage button with the switch on the normal or C side. This gives the voltage from plate to screen, which may be negative (if the screen potential is higher than the plate) in which case the reverse button will have to be pressed. Switch to the F side to read the true plate voltage,

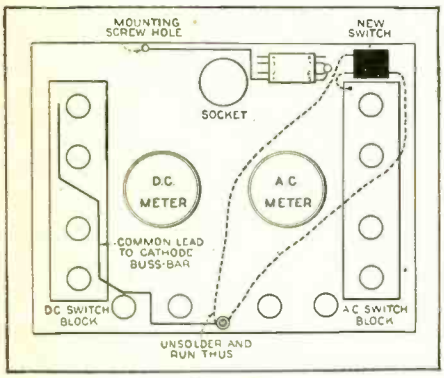


FIGURE 1

and the algebraic sum of these two voltages will be the screen potential.

"Thus all pentode readings can be made without the use of any adapters (with the exception, of course, of the screen current, which is unnecessary, anyway)."

A Simple Output Meter

An output meter is a far more accurate instrument than the human ear in determining maximum response in radio service adjustments. It is to the serviceman what the stethoscope is to the physician, and the economy with which it can be constructed leaves little justification for not using it.

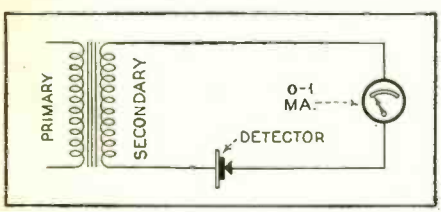


FIGURE 2

Mr. A. G. Murphy, of the Hilltop Radio Service, Columbus, Ohio, reminds us of the simple arrangement shown in Figure 2. A Jewell 0 to 1 milliammeter is connected in series with a fixed carborundum detector and the secondary of a 4 to 1 audio-frequency amplifying transformer. The primary is connected across the plates of push-pull output tubes, or from plate to high-voltage source (in parallel with the output) in the case of a single power tube.

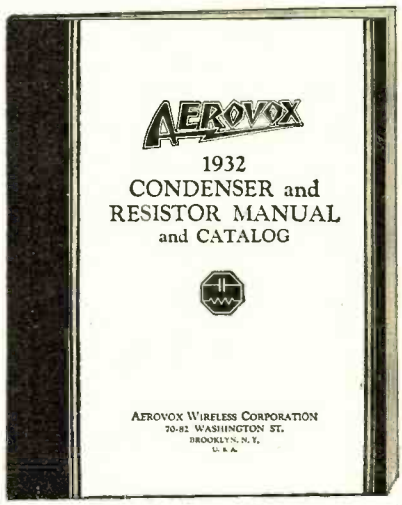
Hilltop Radio Service (by the way) has a neat and attractive letterhead, shown in Figure 3. This can be easily duplicated by any

FIGURE 3

job printer. An antenna "cut"—varied slightly for the sake of individuality—is inexpensive. The words "Hilltop Radio Service" are in *Cooper black*, and the remainder of the type are variations of *Gothic*.

A Simple Tube Short Tester

Mr. Albert W. Bast of Milwaukee, Wisconsin, finds the circuits we have published for locating tube-element shorts needlessly complicated, and suggests the arrangement shown in Figure 4. The only special equipment required is the transformer with four 6-volt and two 2.5-volt secondaries. Such a transformer can be readily made up by winding the secondaries over the primary, or on the other leg of the core of any stand-



Data Book on Condensers and Resistors for the Serviceman

RADIO NEWS takes pleasure in offering, free of charge, through the courtesy of the Aerovox Corporation, this 48-page Condenser and Resistor Manual and Catalog. In addition to complete data and specifications, including installation and voltage rating specifications of condensers, current-carrying capacities of resistors, and physical dimensions, electrical characteristics of various standard types of condensers and resistors. This book contains tables and formulas for solving condenser and resistor problems, besides a useful reactance-frequency chart with direction for its us. The very complete specifications will be appreciated by servicemen, as they eliminate costly uncertainty in replacement work.

Simply address your request, stating your position or interest in radio, to RADIO NEWS, Dept. A-C, 222 West 39th Street, New York City.

ard replacement power or filament-lighting transformer. Most power transformers have two 2.5-volt windings, so it will only be necessary to eliminate the high-voltage secondary and wind the four 6-volt secondaries.

Sockets numbers 1 and 2 are for cold tests, and 3 and 4 for heated-filament tests. One 2.5-volt winding supplies filament current to the last-named sockets and the other lights the pilot lamp and furnishes current for testing dial lights and preheating sockets when desired. The four signal lights are covered with Graybar Electric No. 4D red-lamp caps and the pilot light with a number 4F green-lamp cap.

The circuit is self-explanatory, and the various lamp combinations signal tube shorts as follows:

Lights Nos.	*Location of Short*
1	Cathode to filament
1 and 2	Grid to filament
1, 2 and 3	Control grid to filament
1, 2, 3 and 4	Plate to filament
2	Grid to cathode
2 and 3	Control grid to cathode
2, 3 and 4	Plate to cathode
3	Control grid to screen grid

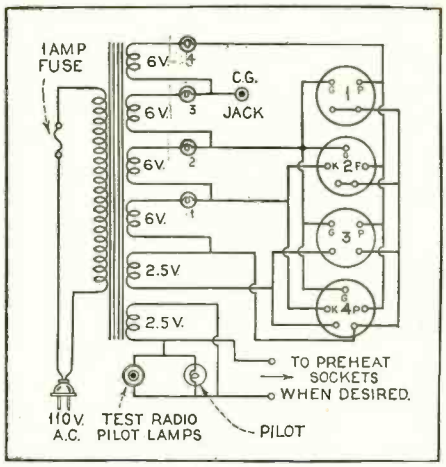


FIGURE 4

3 and 4	Plate to grid
4	Plate to control grid (unusual)

THIS MONTH'S SERVICE SHOPS

One of the neatest and most elaborate service benches that have come to our attention is the equipment maintained by the Radio Service and Supply Company, 403 East Pikes Peak Avenue, Colorado Springs, Colo., whose motto is "Service only—only the best." In describing it (shown on preceding page) Manager E. O. Reinhardt writes:

"The panel contains 24 Jewell, Hickok and Weston meters. On each side of the panel is a complete set of tested tubes, with additional spaces for the tubes removed from receivers. Tube testing, preheating and set-analyzing sockets are located in the center of the bench, just below the main switching panel. The meters are grouped in three main sections—the set-analyzer group at the left; in the center, tube-testing, line-voltage, 'A' and 'B' voltage meters; at the right is a vacuum-tube voltmeter and an additional set analyzer. The panel contains a completely interchangeable layout for testing resistance, capacity and practically any other kind of work. Compressed air is piped to the bench for cleaning between

(*Continued on page* 189)

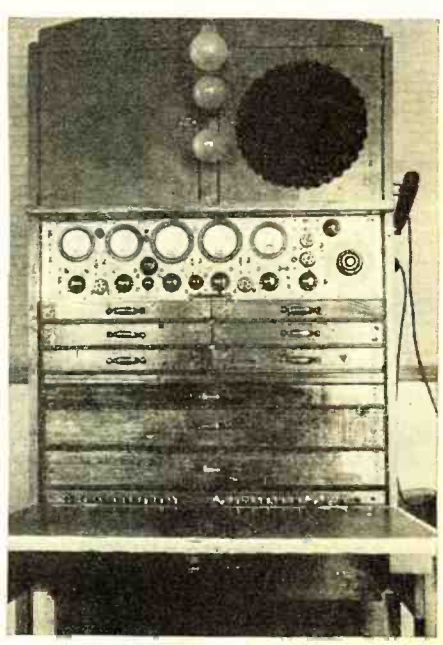
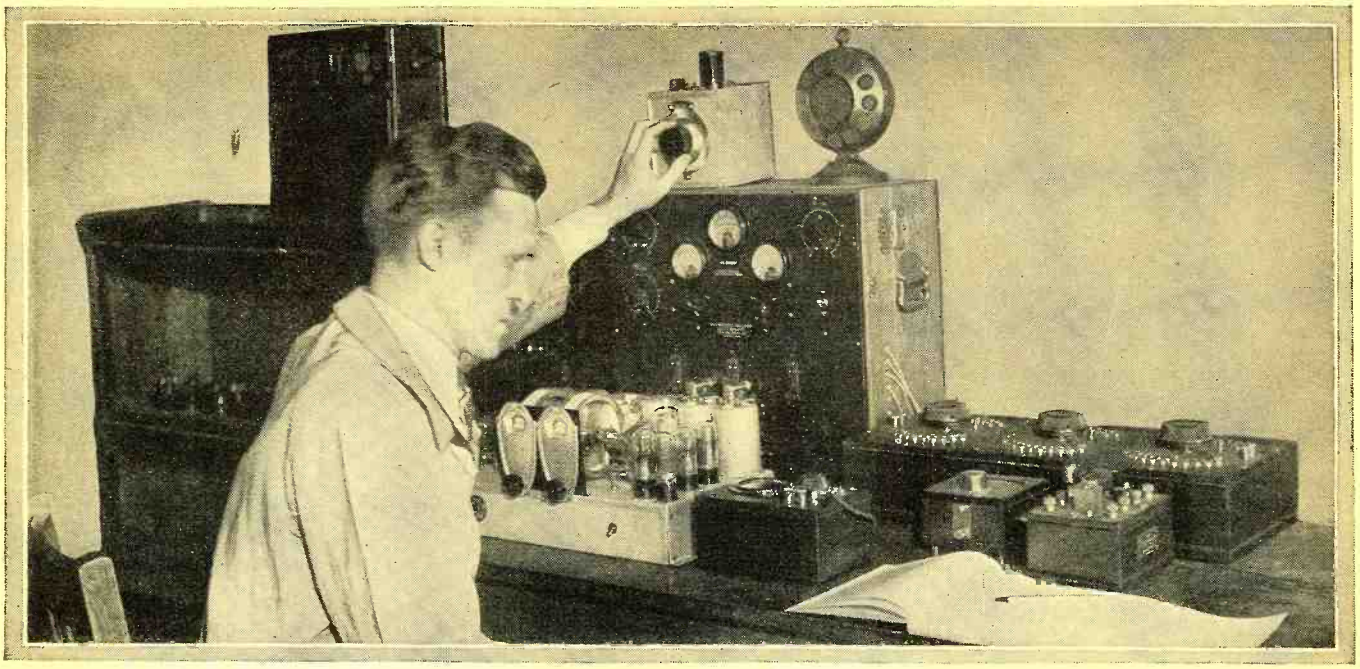


FIGURE 5



With the Experimenters

Simple Home-made Time Delay Thermo-Relays for the Experimenter, Data on Electrolytic Condensers for Amateur Transmitters, Universal A.C. Dynatron Oscillator, Making Meters Easy to Read, Pentode Adapters for 2-Volt Receivers, Connectors for Storage Batteries, Making an Effective Indoor Antenna

Conducted by

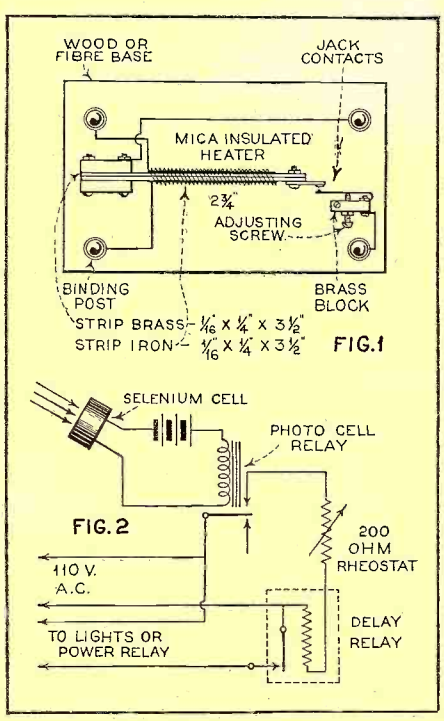
S. Gordon Taylor

Simple Time Delay Thermo-Relays

TIME delay relays are handy instruments to have around a laboratory, but their excessive cost usually prohibits their use by the amateur experimenter. The author experimented with several types, including the copper ring-magnetic lag relay used by the telephone company and the induction disk type used by power companies. The latter type was described in the February number of RADIO NEWS for the current year. Although this relay is probably the best type for definite timing delay, it is rather complicated and delicate. In a great many cases, such definite delay is not necessary as, for instance, in photo-cell installations for opening garage doors or turning on lights when the sun goes down. However, some device should be incorporated in such installations to insure against the accidental operation of the equipment by a transient impulse. If a delay device is connected in the circuit, the light reaching the photo cell must change in value for some length of time, thus the shadow of a bird flying overhead, or a momentary reflection of light from some bright object will not operate the power relay. This delay need not be accurate, and any value from 40 to 60 seconds will be entirely satisfactory.

A simple thermo-relay as described here will not only meet the requirements, but is easily constructed by the experimenter from scrap materials. The working parts of the relay are shown in Figure 1.

The thermostat strip consists of a compound strip of two metals riveted together, one of brass and the other of sheet iron. Around this strip is wound the heater element, being insulated from the strip itself with a sheet of mica from an old fixed condenser. The end of the bi-metallic strip has bolted onto it a contact from an old filament jack. The other contact from this jack is fastened to a block of brass which carries an adjusting screw. The size of these contacts depend on the current to be broken, but a filament type jack usually has at least two heavy contacts on it which will carry one ampere safely. When a current flows through the heater wire, heat is produced which causes the metals of the thermostat strip to expand. Since the brass expands more than the iron, the strip will bend, the concave side being the iron side. This will make the contacts on the end of the strip providing the movable contact has shifted its position sufficiently. The use of this relay in a delay circuit for switching on lights whenever the natural daylight falls below a certain value is shown in Figure 2.



TIME DELAY SWITCH

Using 36 turns of nichrome wire from a 30 ohm rheostat with about 5 volts available under rheostat control, closure was obtained with the following results:

¾ amp.	10 to 120 secs.
1 amp.	5 to 10 secs.
1½ amp.	1 to 7 secs.

Using 200 turns from an old air-cooled Electrad resistor, closure was obtained in from 1 to 120 seconds with as low as 100 mills for the longer time values at a voltage of about 110 volts a.c. The time of closing depends on the number of turns with which the heater element is wound, the current used, and the distance the contacts must travel from the cold position.

C. BRADNER BROWN,
Kansas City, Mo.

Electrolytic Condensers for "Ham" Transmitters

For the past two years electrolytic condensers have found an increasingly important place in amateur radio work, and splendid results have been obtained by users fully acquainted not only with electrolytic condenser technique but also with the operating voltages dealt with. Hence a few notes at this time may prove well worth while.

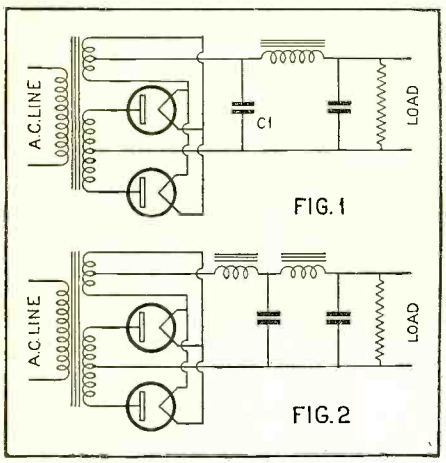


FIG. 1

FIG. 2

A condenser in order to be suitable for amateur transmitter filters should be capable of withstanding the existing operating voltages without any sputtering or similar troublesome phenomena. Since for the present the available electrolytic condensers are limited to a working voltage of 500, it is obvious that two or more units must be wired in series to stand the necessary working voltage. Also, in series operation of condensers having equal capacity the effective capacity is represented by the capacity of a single unit divided by the number of units in series. Thus with three 500-volt, 15 mfd., units wired in series to operate in a 1,500-volt rectifier circuit, the total capacity is one-third of 15 mfd. or 5 mfd.

Difficulty experienced with condensers of any type when employed by amateurs may be traced to lack of knowledge regarding actual working conditions as well as the limitations of the condensers. For this reason the user should make sure that he knows definitely the *peak or surge voltages* that obtain in the filter circuit, and that these extreme voltages are fully matched by the working voltages specified by the makers of the condensers employed.

There are two classes of rectifying circuits in common use, shown in the accompanying diagrams. Figure 1 illustrates the circuit most commonly used by amateurs, since this type of circuit will deliver the maximum voltage for the same load and transformer voltage. The use of such a circuit, especially with the now universally used mercury-vapor rectifiers, places an enormous overload on the rectifiers and condenser C1. The untrained constructor usually blames both tube and condenser manufacturers, not realizing that the condensers may be operating at a voltage much higher than the meter usually associated with such equipment would indicate.

The circuit shown in Figure 2 will greatly increase the life of the apparatus and, at the same time, will provide much better regulation. Its only drawbacks are the slightly higher transformer voltage and the additional choke required.

For the present, the standard 500-volt electrolytic condenser units are the largest available. If the recently improved and refined units are employed within their rated working voltage, they should give absolutely satisfactory service. The main point is to use a sufficient number of units in series, properly wired with regard to polarity, if anything employing one additional unit in series so as to come somewhat below the maximum working voltage of each unit. Such a safety factor pays by way of utmost reliability as well as longest service life.

RECOMMENDED USE OF ELECTROLYTIC CONDENSERS

Maximum d.c. Volts	Number of Series Units 500-volt Type	Capacity Using 8 mfd. Units
600- 800	2	4.0
850-1200	3	2.6
1250-1600	4	2.0
1700-2000	5	1.6
2100-2500	6	1.3

The low cost of electrolytic condenser capacity makes it possible to employ a liberal amount of capacity in the filter circuit of the rectifier end of the amateur transmitter, thereby securing the smooth output so desirable for radio telephone work. In time this application may lead to special electrolytic units designed for higher operating voltages, but for the present the standard units already available are highly economical.

WILLIAM MASON BAILEY,
Chief Engineer,
Dubilier Condenser Corp.

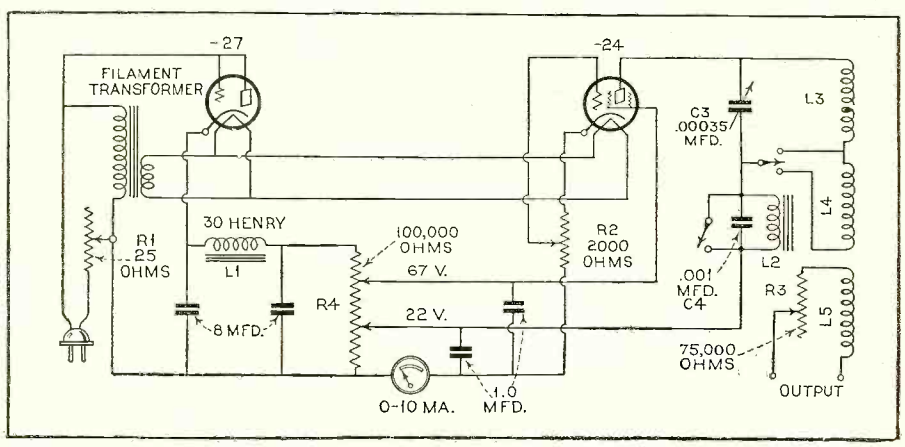
A Universal A.C. Dynatron Oscillator

Many servicemen and service shops, while aware of the need of accurate and stable test oscillators, are using obsolete battery-operated models. It was with the idea of modernizing my own test equipment that the accompanying circuit was developed. The parts were mounted in a heavy aluminum can, and the whole works incorporated in a portable test set. No difficulty should be encountered in its construction, and the device has limitless possibilities.

Any frequency, audio or radio, may be had by using the proper coils and condensers in the plate circuit. The constants shown will cover the broadcast and intermediate bands, *and modulate either at the chosen audio frequency*. The various inductances used are as follows: L1—30 henry choke; L2—primary of audio transformer; L3—broadcast coil; L4—4.5 millihenry lattice-wound coil mounted in end of L3; L5—3 or 4 turns on end of L3.

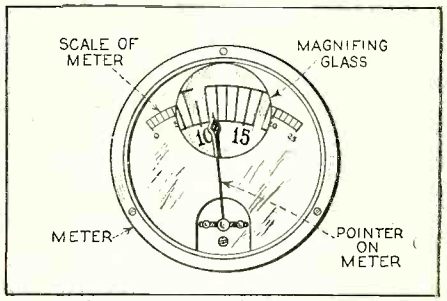
When the oscillator has been calibrated at a given current, as indicated by the meter, ma., the frequency will remain constant at that current drain regardless of varying line voltage or ageing of the tubes. For extreme accuracy as a frequency meter the coupling resistor R3 should be at a minimum setting. No attempt should be made to use a series resistor instead of the voltage-divider system for providing the reduced voltage for the plate circuit.

KENNETH SLOAN,
Phoenix, Arizona.



Easy Reading Meters

Recently when I was making some calculations using Readrite meters which have small scales, I wanted to enlarge the scale so I could obtain a much more accurate reading. I was able to enlarge the scale by placing an ordinary magnifying glass, that I took off a flashlight, on the meter as the drawing illustrates.



I now keep one of these magnifying glasses in my service kit and I would not want to be without it when I use my Readrite meters.

WM. NAKEN,
Chicago, Ill.

2-Volt Pentode Adapter

I operate a radio sales and service shop in a small country town and specialize in battery type radios. Since the arrival of the 2-volt tubes I am frequently asked whether the 5-volt tubes can be replaced by this more economical type.

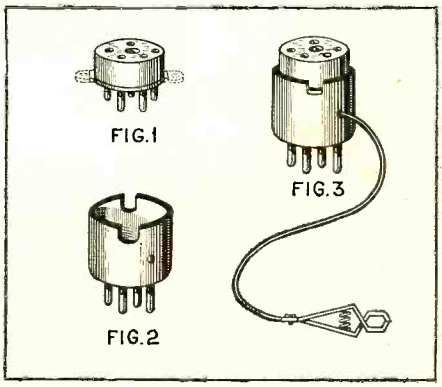


FIG. 1

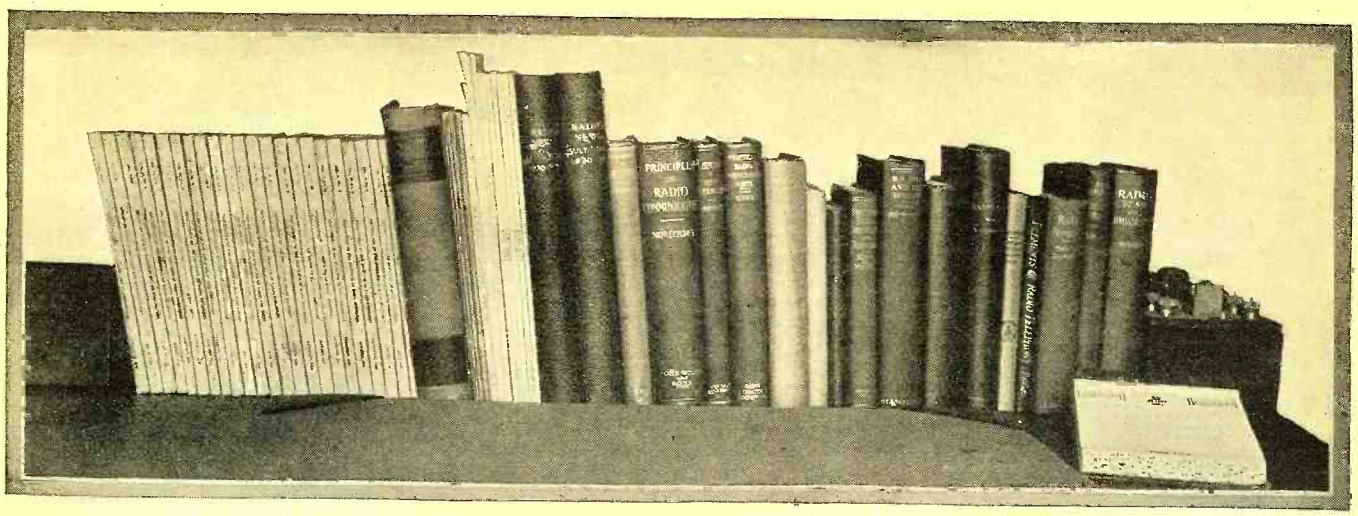
FIG. 3

FIG. 2

I have found that in most cases it was not only possible but that vastly improved selectivity and sensitivity resulted.

There was, however, one objection. The tone quality and volume suffered when compared to that originally produced by radios using the –12A or –71A tubes, except in cases where the output was push-pull. There the –31's were satisfactory. The –33 pentode was the tube for the job but unfortunately it had five prongs. Of course a five-

(*Continued on page* 188)



Radio Science Abstracts

Radio engineers, laboratory and research workers will find this department helpful in reviewing important current radio literature, books, Institute and Club proceedings and free technical booklets

Conducted by
Joseph Calcaterra

First Principles of Television, by A. Dinsdale; John Wiley & Sons. Complete textbooks on television have been few. New developments are coming so fast that many books of a few years ago are no longer up to date. Mr. Dinsdale's book treats the entire field, including the latest advances, in simple language that can be understood by the serviceman or experimenter.

Before going into a discussion of the various systems, a few chapters are devoted to the elementary principles of optics and the photo-electric cell. Then some of the earliest attempts are described. A complete description is given of the systems originated by Jenkins, Baird and the Bell Laboratories. The chapters on the Baird system include the treatment of such associated apparatus as the phonovisor and the nocto-visor.

Individual problems of television are then dealt with, separately, in chapters on synchronism, image, structure and transmission channels.

In the concluding chapters on the present state of the art in Germany, England and the United States, the cathode-ray scanning systems of Zworykin and Farnsworth are considered in detail. This is the first time we have seen the Farnsworth system explained.

The book is published in England and it employs British technical terms that may seem a little strange to the American reader.

As a proof of the author's attempt to make the book as up-to-date as possible, he includes a description of Sanabria's system in the preface; these demonstrations being held while the book was going to press.

ABC of Television, by Raymond F. Yates; Norman W. Henley Publishing Co. A book covering the subject from the view-point of the home-builder and experimenter. The greatest value of the work is in the instructions for the building of television apparatus; even the construction of selenium cells is described and a method of depositing sodium, electrolytically, through the glass bulb of a photocell.

In the first chapters the earliest experiments of those workers who succeeded in telegraphing pictures are described. The parts of the television apparatus are then discussed in different chapters including: amplifiers, photo-cells, neon lamps, scanning and synchronizing.

The text is so clearly written that the average reader should have no difficulty in understanding the major problems involved in television.

Review of Papers Published in the June, 1932, Issue of the Proceedings of the Institute of Radio Engineers

The Transmission and Reception of Ultra-Short Waves That Are Modulated by Several Modulated High Frequencies, by Manfred von Ardenne. This paper gives the results of an extended study made by the author in solving the problems involved in obtaining technically reliable transmission and reception of ultra-short waves, modulated with several high frequencies.

The Precision Frequency Measuring System of R.C.A. Communications, Inc., by H. O. Peterson and A. M. Braaten, Proc. The system now in use in Riverhead, N. Y., consisting of a primary standard of frequency and a means for comparing transmitter frequencies with this standard, together with the additional apparatus necessary for accurately checking the standard, is described in this paper. The method used makes possible an accuracy of measurement to plus or minus 59 cycles at 20,000 kc. and to 0.2 cycles at broadcast frequencies.

A New Circuit for the Production of Ultra-Short-Wave Oscillations, by H. N. Kozanowski. This paper describes a circuit by means of which outputs of 5 watts can be obtained in the 60-cm. region. The increasing importance of radio waves of less than one meter, especially for directional or beam transmission and the economies possible in transmission at these ultra-short wavelengths makes this paper an important contribution to ultra-short-wave literature.

Equivalent Electrical Networks, by Nathan Howitt, Proc. This paper shows how to obtain, by a matrix multiplication, network equivalent at all frequencies to a given network, as well as the networks with the least number of elements.

The Application of Permeability Tuning to Broadcast Receivers, by R. H. Langley, Proc. of the Radio Club of America, April, 1932. This paper describes in detail a new system of tuning by a method which produces simultaneous and proportional variation of inductance and resistance and thereby provides uniform performance over the broadcast or any other range, with a degree of mechanical and electrical simplicity quite beyond anything so far suggested.

Review of Three Papers From the May, 1932, Journal of the Institute of Radio Servicemen

Automobile Radio "B" Eliminators, by Paul E. Gerst. A discussion of the desirable characteristics required in automobile radio "B" eliminators, the various types now available and their advantages and disadvantages, from both electrical and mechanical standpoints.

Radio Receiver Measurements, by George H. Scheer, Jr. In recent years the necessity of accurate measurements of receiver characteristics has been recognized more and more as an important step in the development of better receivers. This paper gives complete information on the making and interpretation of receiver measurements.

The Design and Performance of Electro-Dynamic Loudspeakers, by Benj. Olney, Jour. of the Inst. of Radio Service Men, May, 1932. This paper discusses the important factors, such as sound radiation from diaphragms, the necessity of an adequate

baffle, cabinet characteristics, interaction between loudspeaker and tubes, which affect the magnetic, electrical and mechanical design and performance of loudspeakers.

Review of Two Papers Published in the April, 1932, Journal of the Royal Society of Arts

Geophysical Methods of Prospecting, by A. B. Broughton Edge. An article on the various ways of locating ores, including: magnetic, gravimetric, electrical and seismic methods. The principles are explained and the necessary instruments described.

Light-sensitive Cells in the Service of Man, by F. H. Constable. A simple account of the various types of light-sensitive cells, their manufacture and applications. There are graphs on the variation of daylight with the seasons and on the behaviour of selenium cells exposed to outdoor conditions.

Review of Two Articles Published in the April, 1932, Journal of the Acoustical Society of America

Loudness and Intensity Relations, by Lloyd B. Ham and John S. Parkinson. Tests with many subjects show that persons of normal hearing can make judgments on the relative loudness of tones, with fair consistency. The judgment always indicates a ratio rather than an additive function. A new scale of noise measurement is proposed.

Comments on the Theory of Horns, by William M. Hall. In order to get a mathematical solution for the behaviour of sound within horns, simplifications are made. If no cognizance is taken of the effect of these simplifications, incorrect conclusions may be drawn from the results obtained. The author discusses the assumptions and approximations usually made.

Review of Contemporary Periodical Literature

An Improved Audio-Frequency Generator, by E. G. Lapham, Bureau of Standards Research Paper No. 367 (available from Supt. of Documents, Washington, D. C., for 10 cents). This paper describes the construction of an audio-frequency generator for use in making radio-frequency measurements. The output is continuously variable from 50 to 1500 cycles-per-second. It is constant to better than 0.1 cycle-per-second over the entire range.

Licenses Under the Amplifier Patents. Electronics, May, 1932. An analysis of the patents controlled by various companies in different fields showing the procedure which must be gone through to obtain licenses to use patented circuits in articles for different applications.

A New Cathode-Ray Oscillograph Tube, by G. F. Metcalf. Electronics, May, 1932. Characteristics, ratings and complete description of a new cathode-ray oscillograph tube, which makes possible the production of images that can be viewed by a group of persons in full daylight and are sufficiently brilliant to be photographed, are given in this article.

Improved Fidelity of Two-Speaker Radio Receivers, by Hugh S. Knowles. Electronics, May, 1932. This paper brings out the improvement in frequency response, transient response, overload characteristics and increased energy efficiency obtainable in multi-speaker installations using speakers of the proper characteristics, and points out the factors which must be taken into consideration to obtain best results.

Distance Range of Radio Waves. Bureau of Standards. A chart showing the distance and skip distance range in kilometers of radio waves of 10 to 30,000 kc. for day and night during summer and winter months.

The Padding Condenser, by B. F. McNamee. Electronics, May, 1932. This article describes a graphical method for solving single-dial "super" problems involving the determination of the proper values of padding condenser, and minimum capacity and inductance of the oscillator circuit.

Automatic Voltage Regulation, by Kasson Howe. Electronics, May, 1932. A complete description and explanation of the principles governing the operation of the Ward Leonard transformer-type voltage regulator, which provides a constant voltage to a load in spite of line-voltage and frequency variations, is given in this article.

The A, B and C of Amplifier Classifications, by George Grammer, QST, June, 1932. This interesting article explains, in easily-understood language, the essential differences in operation of Class A, B and C amplifiers together with data on the purposes to which the different types of amplifiers are best suited.

Design of Lens Scanning Systems for Television, by Ivan Bloch, Radio Engineering, June, 1932. This article discusses in considerable detail the theory and practice involved in the design of the optical elements of lens scanning systems, taking up, mathevolved in the design of the optical elements overlap requirements, focal lengths of lens, aperture of the crater-lamp anode, pitch of the disc spiral, distortion, etc.

Testing Radio Receivers on the Assembly Line, by Arthur E. Thiessen. Radio Engineering, June, 1932. One of the simplest routine methods for aligning and testing the overall sensitivity and performance of radio receivers in production by the use of standard-signal generators, is given in this article.

Free Technical Booklet Service

Through the courtesy of a group of radio manufacturers, RADIO NEWS now offers its readers this new Technical Booklet Service. By means of this service readers of RADIO NEWS will be able to obtain quickly and absolutely free of charge many interesting, instructive and valuable booklets and other literature which formerly required considerable time, effort and postage to collect.

To obtain any of the booklets listed in the following section, simply write the numbers of the books you desire on the coupon appearing at the end of this department. Be sure to print your name and address plainly and mail coupon to the Radio News Technical Booklet Service. Stocks of these booklets and catalogs are kept on hand and will be sent you promptly as long as the supply lasts. Do not send for any material in which you are not actually interested in order to avoid waste of needless postage

Review of Technical Booklets Available

18. *A Baptism of Fire.* This interesting 16-page illustrated booklet describes, in non-technical language, the materials and processes used in making Centralab fixed resistors. It gives many useful and little-known facts on the research work, facilities and skill required to manufacture these small but highly important members of the resistor family.

19. *Making Auto Radio Sets All-Electric with the Genemotor.* This circular gives complete specifications and description on the Carter genemotor which is designed to eliminate "B" batteries in connection with automobile, aviation, farm and other similar sets. A dynamotor unit operating from the storage battery, and consuming less current than a parking light is employed.

20. *Resistor Booklet No. 110.* This useful folder gives circuits which show how resistance units can be used to make multi-range voltmeters and ohmmeters, wheatstone bridges and capacity bridges. A chart indicates the proper resistance required with milliammeters of different ranges to convert them into voltmeters of any required range. A table listing standard values of Shallcross Super Akra-Ohm resistors is also included.

21. *Exact Duplicate Replacement Transformers.* This 6-page folder gives complete information, with receiver name and model numbers, on a complete line of Stancor replacement power transformers, chokes, audio transformers and output transformers made by the Standard Transformer Corp. The units listed are exact duplicates, electrically and mechanically, of the originally-installed transformers used in the many popular sets now in use.

22. *Resistor Stock List No. 8.* A 6-page folder giving complete specifications and listing the complete line of fixed, semi-variable, meter-multiplier, transmitting, voltage-divider and power-pack resistors, non-inductive resistors, slide-wire, rheostat-potentiometers and power rheostats which are carried in stock at all times by the Ohmite Mfg. Co. All resistors are of the vitreous enamelled type.

23. *Replacement Resistor Bulletin No. 10.* This 2-page folder gives a complete list of Ohmite "Red Devil" replacement resistor units designed to withstand high temperatures and also gives complete listings and data on a new type of vitreous-enamel, semi-variable resistors that are ideally suited for use as replacement voltage dividers.

24. *Service Kit Booklet.* This piece of literature explains how it is possible for any serviceman or dealer to obtain, without charge, a Sylvania service kit, 17 inches long, 7 inches wide and 10 inches deep, built of 3-ply veneer, covered with black leatherette and provided with decorative brass fittings, lock, key, kit for small parts, tool tray, literature rack and space for 20 assorted tubes.

1. *1932 Condenser Catalog.* A 12-page booklet giving complete details, specifications and list prices on Micamold dry electrolytic, paper, mica and replacement condensers, automobile ignition suppressors and carbon resistors.

2. A 4-page folder which gives complete specifications and list prices on the Hammarlund line of broadcast, short-wave, transmitting and midget variable condensers,

equalizing, trimming and padding adjustable condensers, sockets, coils, shields, chokes and flexible couplings.

3. *15 to 550-Meter "Comet" Superheterodyne.* A folder giving complete details of an efficient all-wave receiver, especially designed to cover the short-wave and regular broadcast channels up to 550 meters.

4. *14 to 200-Meter "Pro" Comet Superheterodyne.* A custom-built high-frequency superheterodyne receiver, designed especially for professional operators and advanced amateurs, is described in this folder. The receiver is designed for the reception of both code and voice signals and is especially suited for laboratory, newspaper, police, airport and steamship use.

5. *1932 Radio Catalog.* Complete specifications and list prices on the entire line of volume controls, voltage dividers, vitreous resistors, Truvolt adjustable resistors, public-address equipment, amplifiers, replacement controls and resistors are contained in this 10-page book. It also contains a chart of replacement controls and circuits and an important announcement on the Resistor Replacement Handbook.

6. *Line Voltage Control Folder.* This folder gives complete description of the characteristics and uses of the automatic regulator and explains why all leading radio manufacturers recommend its use to prevent radio trouble. A chart showing the proper unit for all the popular receivers now in use is also given.

7. *"Rich Rewards in Radio."* This 64-page book is filled with valuable and interesting information on the growth of radio and the opportunities existing in the fields of radio manufacturing, radio servicing, broadcasting, talking pictures, television, public-address systems and commercial station operation on land and sea, for men who are trained to fill the many jobs created by the radio and allied industries. The book also contains detailed information on the complete home-study courses in radio and allied subjects offered by the National Radio Institute.

8. *"Trouble Shooting in D.C., A.C. and Battery Sets.* This is a free sample lesson available to RADIO NEWS readers through the courtesy of the National Radio Institute. It contains valuable information on how to overcome hum and noises of all kinds, fading signals, broad tuning, howls and oscillations, poor distance reception, distorted or muffled signals, etc.

9. *Resistance Catalog.* A handy folder giving complete specifications and list prices of metallized and precision wire-wound resistors, motor radio suppressor kits, handy servicemen's resistor kits, etc.

10. *Information on the Suppression of Motor Radio Noises.* This interesting and useful folder, published by the International Resistance Company, shows how to overcome motor-generator, ignition, coil, interrupter and spark-plug noises in automobile radio installations.

11. *1932 Condenser Catalog.* This 4-page folder gives complete specifications and list prices on the line of both high and low-voltage paper condensers for by-pass and filter use in transmitting and receiving equipment. Units for both original and replacement use are listed.

12. *Certified Tube Plan Booklet for Servicemen and Dealers.* This booklet explains in detail a special plan of the Triad Mfg. Co. which makes it possible for servicemen and dealers who maintain a service department to obtain certified Triad tubes direct from the factory at discounts which enable them to make tube replacements at attractive profits. Distribution of this folder is restricted exclusively to servicemen and dealers who maintain a service department.

13. *Descriptive Folder for No. 108 Oil-Damped Phonovox.* Describes a phonograph record-reproducing unit designed to meet every requirement of broadcasting stations, talking-picture houses and homes.

14. *Descriptive Folder for No. 120 and No. 160 Phonovox.* Contains complete operating notes on both of the popular-priced electric phonograph reproducers.

15. *Booklet for the No. 171 Recordovox and Control Box.* Detailed descriptions, specifications, installation and operating notes on a versatile combination instrument for both making and reproducing records electrically through standard radio receivers.

17. *1932 Radio Instrument Catalogue WJ.* A 20-page book on radio measuring and testing instruments, containing specifications on the complete lines of both the Weston and Jewell organizations that is without doubt the most complete of its kind. A copy should be in the hands of every engineer, serviceman, purchasing agent, teacher or anyone in the industry who uses or specifies measuring and testing instruments.

August, 1932
RADIO NEWS Free Technical Booklet Service
222 West 39th Street
New York, N. Y.

Gentlemen: Please send me, without charge, the booklets or folders I have filled in below:

Numbers.....
.....

☐ Radio Engineer
☐ Serviceman
☐ Experimenter
☐ Laboratory Technician
☐ Dealer
☐ Jobber
☐ Manufacturer's Executive
☐ Professional or Amateur Set Builder
☐ Licensed Amateur
☐ Station Operator
☐
☐

I am a ☐ subscriber ☐ newstand reader.

Name.....
Address.....
City.....State.....

Professional Receiver

(*Continued from page* 157)

that the filter is of the two stage type employing three condensers of eight microfarad capacity each. This provides unusually effective filtering with the result that there is no noticeable hum in the headphones.

A tone control is provided on the front panel. This consists of a variable resistance and a .05 mfd. condenser connected between the resistance and the plate of the audio tube. This tone control is primarily intended to suppress undesirable noise of the high audio-frequency type. This is accomplished by decreasing the resistance, which allows the higher frequencies to be bypassed to ground.

The entire receiver is mounted on a metal chassis, as shown in Figures 7 and 8, which provides extensive shielding. The i.f. coupling coils are all completely enclosed in individual shields, as are also the tubes in the detector circuits, the intermediate stages and the beat-frequency oscillator. The power supply is well isolated at one end of the chassis, another factor in keeping the hum level down to negligible limits. The front panel is of heavy gauge metal, crystalline finished. Access to the screw adjustment on the i.f. condensers is provided under the chassis as is also the adjustment for the beat-frequency oscillator.

The receiver is enclosed within a heavy wood cabinet having hand holes at either end. These offer a convenient means for handling the receiver and at the same time provide ample ventilation for the receiver while in operation. The style and heavy construction of this cabinet and the front panel give the receiver a decidedly professional appearance yet at the same time its style is such as to fit in with home surroundings should one desire to install it in the living room or elsewhere in the house.

Since writing last month's article, an opportunity has been found to carry on further reception tests with this receiver. Operating it twenty-five miles outside of New York City, as well as in the city, stations from more or less all of the world were brought in with excellent volume and many of them with quality comparable in every way to that ordinarily expected from local broadcast stations operating on the higher wavelengths. Paris, Rome, Madrid and Buenos Aires stations, for instance, were all brought in with sufficient volume to operate a magnetic speaker directly from the output of the single audio tube. Using the separate amplifier and speaker these foreign stations mentioned were brought in with far more volume than could be comfortably used in the home.

During these tests the selectivity of the receiver was found to be such as to more than meet the demands of most short-wave reception. In certain bands, notably in the police and amateur telephone bands, all interstation interference could not, of course, be eliminated for the simple reason that it is physically impossible to separate all stations therein because many of them are working within a fraction of a kilocycle of others. It was a noticeable fact, however, that in a great many cases it was possible to understand 'phone conversation in spite of powerful heterodyne resulting from stations operating practically on top of the desired stations.

Coming back to the question of sensitivity again, during the tests conducted by the author, there was no way of determining the maximum sensitivity of the receiver. All of the short-wave stations tried (that were known to be on the air and receivable at the time) were successfully brought in. Inasmuch as the tests were conducted during the afternoon and early evening, there was no opportunity to bring in the Australians and other stations on the other side of the world. However, judging from the extremely powerful reception from stations up to 6000 miles away, such stations as Buenos Aires, Rome and Germany, there can be little question but that programs from the other side of the earth could readily have been brought in were the tests conducted during the hours between midnight and dawn.

Amateur 'phone stations from all over the United States were heard without any diffi-

(*Continued on page* 171)

What's New in Radio

A department devoted to the description of the latest developments in radio equipment. Radio servicemen, experimenters, dealers and set builders will find these items of service in conducting their work

By The Technical Staff

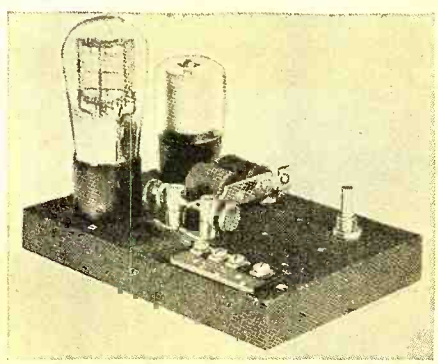
Unique Radio Receiver

Description—A midget radio receiver employing new type vacuum tubes which measure only ¾ of an inch in diameter, and a loud speaker of new design. The speaker is mounted on the bottom of the cabinet and it utilizes a piezo crystal that actuates a patented diaphragm which extends over the entire inner surface of the cabinet. Rochelle salts form the base for the crystal unit. The complete receiver which includes an electric clock measures only 11 inches by 7 inches by 7 inches.

Maker—Radio Products Corp., 548 South 11th St., Newark, N. J.

Photo-Electric Cell Kit

Description—A complete photo-electric cell kit comprising the metal chassis ready for assembly, a sensitive photo-electric cell, a relay, a pentode type amplifier tube, a potentiometer and the necessary resistances, wire, sockets and etc. Each kit is accompanied by a book of instructions for assembly, also drawings with instructive data on six different photo-electric cell control devices. There are numerous interesting experiments made possible by this photo-cell unit, such for instance, as opening garage doors at the flash of your headlamps, turning on parking lights of the automobile when the sun goes down, and systems for protection against burglary, and for the detection of fire or smoke.



Maker—Herman A. De Vry, Inc., 55 East Wacker Drive, Chicago, Ill.

Professional Receiver

(*Continued from page* 170)

culty whatsoever except that resulting from extremely crowded conditions in these bands which is, of course, unavoidable. Amateur c.w. signals as well as c.w. and i.c.w. signals of commercial stations throughout the world were brought in without difficulty both day and night.

On the whole, the "Pro" is an unusual short-wave receiver. The author, in his tests, has found it so far superior to the average run of short-wave amateur and broadcast receivers that there is no comparison. Its surprising combination of sensitivity, selectivity, tone quality and low noise level, will at least match these qualities in the very best of other receivers the author has tried. Coupling these outstanding merits with the fact that the receiver is equally well adapted to the purposes of the amateur and the s.w. broadcast listener, and its unique band-spread tuning system, it is hard to imagine a finer combination for any type of short-wave work.

Resistor Assortment

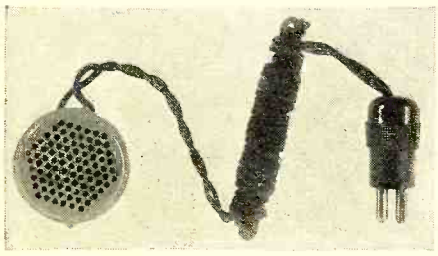
Description—A handy resistor replacement kit comprising twenty-five 1-watt carbon type resistors in assorted values. Each kit is accompanied by a resistor paralleling chart, the R.M.A. color code selector and a resistor replacement guide. This resistor paralleling chart is a convenient diagram for connecting the resistors in parallel to provide an infinite variety of resistant ranges thereby meeting numerous resistor replacement requirements. The R.M.A. color code selector consists of three color celluloid discs so arranged that they can be revolved to indicate the color combinations and corresponding value of any standard resistor

marked according to the R.M.A. color code. A card is furnished with each kit, entitling the purchaser to the new replacement resistor guide (now in the course of preparation), which is to include the latest 1932 radio receivers.

Maker—Continental Carbon, Inc., 13900 Lorain St., Cleveland, Ohio.

A Tiny Microphone

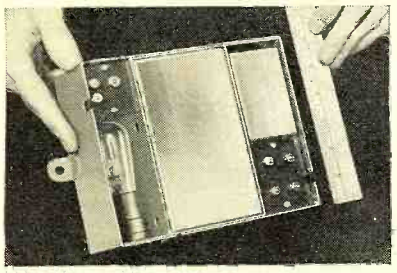
Description—A new microphone unit named the "Micromike" especially designed for public address systems and home recording application. In diameter it is approximately the size of a half-dollar piece. It is complete with a clasp mounted on the rear case of the microphone for convenient fastening to one's clothing, for instance to a coat lapel. This design permits the user freedom of movement and also an unobstructed view of the audience. The microphone employs a gold plated stretched alloy diaphragm, selected carbon and precision made parts. It is provided with fifteen feet of thin flexible extension cord, terminating in a connector plug. A volume control of small size called the "Mikontrol" is available for connection between microphone and the amplifier.



Maker—Radio Receptor Co., Inc., 106 Seventh Ave., New York City.

Automobile "B" Battery Eliminator Kit

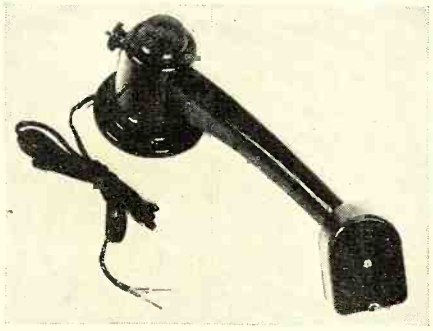
Description—A new "B" power supply kit for automobile radio installation that can be installed by the serviceman or motor car radio enthusiast. It utilizes an automatic load delay circuit for insuring long life to the mercury vapor rectifier tube and the interruptor. The eliminator can be controlled from the receiver by the use of the automatic relay included in the kit. The output of the unit, rated 180 volts at 35 milliamperes current, is adjustable to meet different receiver requirements. The eliminator measures 7⅜ inches by 6 inches by 2¾ inches.



Maker—Electronic Laboratories, Inc., 122 W. New York St., Indianapolis, Ind.

Phonograph Pick-up

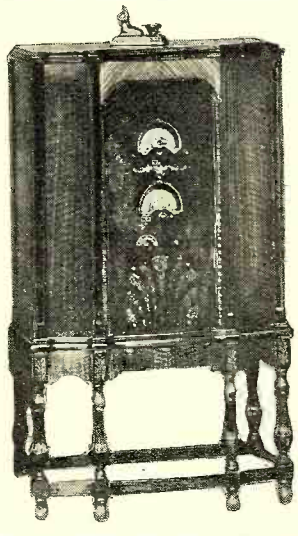
Description—A new type of magnetic phonograph pick-up unit complete with built-in volume control. The pick-up head is so constructed and mounted so as to follow the grooves of the record with minimum resistance. Two outstanding features of this pick-up unit are the swivel head, permitting the needle to be easily and quickly changed, and an arrangement whereby the supporting arm to the pick-up head can be lowered or raised while the pick-up is in operation, for the most efficient pressure. The supporting base of the unit is provided with three screw holes so it can be mounted permanently in the phonograph cabinet.



Maker—The Winchester Co., 36 East 22nd Street, New York City.

Console All-Wave Receiver

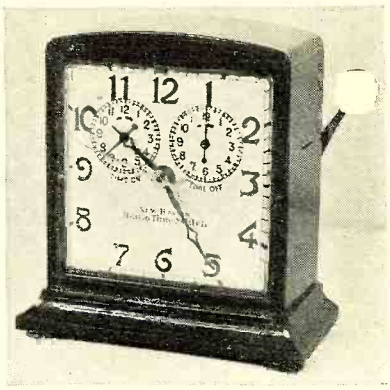
Description—The Sparton model 16-AW multi-wave 12-tube superheterodyne receiver has a wavelength range of 11.5 to 550 meters. Two separate tuning controls and a band selector switching arrangement are utilized for simplicity of operation and to eliminate the nuisance of changing coils. The upper set of controls on the instrument panel are used for the broadcast range of 200 to 550 meters and the lower set of controls are for the short wavelengths from 11.5 to 200 meters. The same volume control and tone control are employed for both receivers. The band selector switch is located at the extreme lower left-hand corner of the control panel. The 12 tubes used in the circuit are as follows: four –27 type, three –35 type, two –24A type, two –47 pentode type and one –80 rectifier. The receiver is provided with automatic volume control, tone and static control and a phonograph pick-up jack.



Maker—The Sparks-Withington Co., Jackson, Michigan.

Radio Time Switch

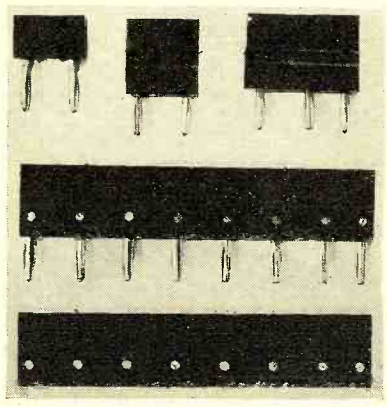
Description—A combination electric clock and double time switch equipped with a self-starting, sub-synchronous Westinghouse motor. It can automatically start and stop, at predetermined times, numerous electrical appliances. It is especially useful as an automatic radio receiver control. The electric line plug of the receiver or the electrical appliance is inserted in an outlet mounted on the back case of the clock. When the red flag lever is visible from the front, the clock is set for automatic switching. If the lever is in the neutral position, the electrical apparatus can be manually operated without interfering with the timekeeping qualities of the clock.



Maker—The New Haven Clock Co., New Haven, Conn.

Multi-plug Connectors and Receptacles

Description—Here is a line of multi-plugs and extension receptacles that should have popular appeal to the radio serviceman and experimenter. The eight-connector type plug shown here measures 1⅞ inches by 5¾ inches by ⅜ inch thick. This unit and the extension receptacle are adaptable to multiple connections on condenser-microphone equipment and numerous other laboratory applications. The three-unit plug shown on top is a polarity plug measuring 1 15/16 inches by 1⅞ inch by ½ inch. This company also announces a complete line of test prods, plug connectors and receptacles to meet many forms of laboratory testing and radio servicing work.



Maker—International Air Research Laboratories, 4808 47th Street, Woodside, Long Island, N. Y.

?QRD?

A column devoted to the commercial operator and his activities

Conducted by GY

HELLO, fellows, and how's everybody? I went up to the boss the other day and I says to him and then he says to me, "All right, go ahead," and so here I am pounding out this stuff to get the dope to and from you "ops," via this column.

Got the "Joe Pot" perking? Good. Now get an earful of this. You all remember JW, who was on that iron tugboat "Ma"? Well, I bunked into him the other day, and after chinnin' about this and that, he tells me he's gonna be a cop. Now feature that! Yeh, wouldn't that take the hysterisis right outa your armature? Can you imagine that long-legged drink o' water wearing white gloves and saying "No, madam, you can't cross this street against the lights"? I'll tell you true, I think he's just going in to get even, that's all!

Which reminds me of old Joe Tierney. Remember him on the monster *Utah* back in 25? Well, we were strolling along in front of the Balboa Clubhouse in Panama, talking Navy politics and such, not bothering anybody, when one of the ship's planes passed overhead, flying low. Just then Joe got smacked on the head with an apple core. Boys, he got red-headed and how! He looked up, shook his fist at the plane and shouted at it, "I'll get even with you." Yeh; now he's with the Airways down in Overland, Missouri, helping those planes out plenty with weather reports and everything else. Incidentally, he's always happy to hear from the old gang and writes a swell letter himself. Just send it to the above address: Chief-in-Charge, Mr. J. Tierney.

Not being able to get the boss to believe that gag about my grandmother dying (How'd you guess it? You're right!), I ambled up to the V.W.O.A. to get an earful of the dirt going on. There were more sparks hopping around than you ever did see. XA, DE, RT, LS, etc. and etc., were there chewing the fat, fast and furious. They were all hot and bothered about the coming International Radio Convention RTC which is to be held in Madrid the latter part of 1932. There's a lot of dope about them wanting to cut down the rating for qualification for license and the number of Ops to be used on vessels. To quote from the *Commercial Worker* of Canada, "The object of these moves is to dispense with the services of competent full-time radio operators on the great majority of cargo vessels, and combine the position with that of mate, mess-boy or some other position aboard ship, in conjunction with an auto-alarm device." Well, mateys, don't worry about it, as every one is cheering that Mr. T. J. O'Donnell, Secretary of the I.F.R.T. (International Federation of Radio Telegraphers), will have his legs under that conference table when the fireworks begin in Madrid. After what he did for us at the Washington Conference back in '27, when he made the high standard for Ops, he certainly will do his best to straighten out this matter to the advantage of each and every one of us brass-pounders.

"Imagine my embarrassment" the other day when an old shipmate of mine asked me "What happened to Robinson, who was up at NPO in '28?" And all I could do was "hem, haw and splutter." Come on, there, Robbie, old boy, old boy, drop us a line and tell us about yourself like you used to. Where are you at?—and what you doing? Remember that old Cantina in Bangbong where the beer was cold and the sun was hot and the music was "canned"? Let's hear from you. Drop me a line to this column, in care of this mag. And while I'm on the subject, all of you guys get together and part loose with some dope on what is going on around you, what's new and who got shot, if any.

RADIO NEWS is sure putting out the real dope, and when a dumkopf like me can understand it, there must be a system to handing it out. I'm one of those kind of guys who for a year and a half couldn't figure out why an armature turned over in one direction and didn't lock when the juice was put across the poles. Y'know, just one of those guys! One recent article in R. N. I'm referring to is the "Beat-Frequency Oscillator." If one of those Bellevue boys had shot that at me, I'd have challenged him to a duel. But this clear, concise and very explicit dope on the building of it and the reasons for it by Donald Lewis sure showed me what it was all about and will do the same for you if you take a look-see.

And then there's the Radio Physics course and the Math dope used in Radio and the use of Graphs and Charts and a raft of other stuff, especially the dope on clearing up much of the static going on in your head and around you. Shipmates, the way radio is going lately, it sure takes an engineer to get the real substance of it all, but with the clarity with which these articles are written there is no doubt but that you all will be able to get a clear idea of everything.

Well, as old Robbie would say, "This sure has been a long-mid-watch and the hay looks pretty tempting to me," but before I go, here's the last laugh I heard from one of our friends:

It is told of a radio operator, while on shore leave at some Eastern port, was arraigned in court for assault and battery on one of his shipmates while the two were partaking of some potent swamp juice in one of the numerous speakeasies.

"What is your name, occupation and what are the charges against you?" demanded the stern-looking judge.

"Sparks, Radio Operator, charged with battery," replied the brass-pounder without even as much as blinking an eye.

"Put him in a dry-cell," was the court's reply.

So toodleloo and cheerio, gang, and be good. Keep your ship on top side and don't flood the air with two much QRN. Don't you guys forget the address of this column—send in all the dope and any information you want to have. Anything you want, from the solution of a cross-word puzzle to the reasons why radio-frequency oscillations occur in the antenna and not in the ground, will be put through the "mill" for you. If anyboy has some new ideas that might aid some of the bunch in their practical work, please send them in so that through this column we lowly brass-pounders can take advantage of it. So GE and 73's.—GY.

Removal Notice

The Racon Electric Co., Inc., have moved to larger and better quarters at 52 East 19th Street, New York City.

Radio Fights Forest Fires

(*Continued from page* 139)

plicity was sought. Every dispensable part was eliminated to reduce weight.

By the summer of 1930, Beatty had developed two sets: a semi-portable radiophone weighing approximately 80 pounds (including batteries and antenna) and a portable set weighing less than 20 pounds. The antennas employed with both types were the same. It was a counterpoise system consisting of an antenna wire stretched approximately 15 feet from the ground between two light masts and a counterpoise wire at 3½ feet, stretched parallel to the antenna wire. The length of the system varied from 73 to 90 meters, according to the frequency in use.

Both sets were given extensive field tests in 1930 in the Columbia forest in southern Washington. Seven of the portables were placed in service with road and trail crews and fire patrolmen, and were used throughout the summer. Two of them were used at the Dog Mountain fire, where a large number of messages were exchanged during the course of the fire. Although these sets were used by men inexperienced in radio and without training in the use of code, the records of the use of the seven instruments showed better than 94 percent. successful performance. The 6 percent. failures were due, almost entirely, to weather conditions.

In spite of this good record there were still many problems to be worked out before the equipment could be voted a success under all conditions. The bugbear of absorption and shadows had been largely overcome, but the equipment was too heavy and the aerial too cumbersome. Therefore, when Beatty dropped the work in early 1931 there was grave danger that it would be discontinued. It was rescued from the discard by F. V. Horton, assistant regional forester of Portland, who put A. Gael Simson in charge of the work.

Simson was employed in forest research but he was an amateur radio enthusiast, having served as a radio operator in the Navy during the World War. He was given two assistants, Harold K. Lawson, a young logging engineer who was employed on timber sales work and road building, and W. F. Squibb, a student of electrical engineering at Washington State College, who accepted short-term summer employment as a ranger guard. All of these men are amateur radio fans. They took up the job where Beatty left it and tackled the unsolved problems with that intense enthusiasm that only an amateur knows. Three months after they started work, I happened in at headquarters one Sunday morning and finding the whole crew hard at work I remarked to Simson: "Your assistants seem to be pretty much interested in their job." "To a fault," he replied tersely, "Lawson, there, is a logging engineer. He thinks the right time to begin the day is 7 a.m., but Squib is a student; he likes to work at night and is ready to call it a day about midnight, and between the two they work me a mighty long shift." So the testing, experimenting, and rebuilding went on, almost feverishly, throughout the summer. Both sets shriveled in size and weight and increased in reliable performance. Perhaps the most outstanding improvement, however, was in the antenna.

The counterpoise system was unsatisfactory because it is clumsy and unhandy to erect. The two wires must be taut, parallel and reasonably level. On rough ground or in dense undergrowth, finding a suitable place to erect it frequently presented a serious problem. An opening may be readily found where a single antenna wire can be stretched where it is quite imposible to find one where two wires could be stretched 12 feet apart in the clear. It was, therefore, decided to make a special effort to develop a single-wire system and the result is a power-feed antenna of very simple design (See Figure 4). The length of the antenna is made to correspond to the frequency of the transmitter. A loading coil, fitted with a terminal attachment for the feeder wire, is inserted at the correct point to give the best results. This point has been found to be about 14 percent. "off-center." The coil reduced the length of the antenna to about 70 feet, which greatly simplifies its erection. Since the point of attachment of the feeder wire is definitely fixed by the terminal post on the coil, no particular care in erecting the power-feed antenna is necessary, excepting to be sure it is in-the-clear of branches or other interference. It has the additional advantage of being several pounds lighter than the counterpoise system, which is an important contribution to the success of the project.

The innumerable field tests of the past year have brought a great deal of new information about the selection of a site for the set-up. It was found, for instance, that a shift of 200 yards from the base of an overshadowing ridge may increase the strength of the signals as much as two points in a scale of ten, of which seven points represent the normal degree of loudness that the receiving operator desires from a headphone clamped to his ears. Another subject of inquiry was how readily inexperienced men could be expected to become proficient in the use of the C.W. portable set. Many of the men who may have occasion to use it will be temporary laborers, for whom no preliminary training in sending code is possible. It is really remarkable how quickly untrained men, who may never before have seen a telegraph key used, can pick up the use of the code. A monitor is built into the receiver which permits the operator to hear his own signals. This steadies his sending and provides a constant check on its quality. With a surprisingly small amount of practice he can send intelligible code signals with the tiny telegraph key. As a final demonstration test, a young laborer employed on trail construction was given about 30 minutes coaching and was instructed to send a dictated message. In 46 minutes he set up the radio, coded the message, sent it to a distant station, had it repeated back to him by voice, and packed up the radio ready for transportation. This demonstration silenced all doubts whether the rank and file of officers and temporary employees would or would not be able to use the C.W. sets without long preliminary training.

If light weight is the first essential, sturdy construction is a second requisite of almost equal importance. The vibrations, knocks, and jolts of transportation by truck, packhorse or man-pack would quickly disable the delicate meters which are usually considered indispensable in a radio transmitter. All delicate parts and fragile wiring had to be eliminated to insure dependable performance of the equipment when it racehes the field. It was found possible to dispense with all meters (except a small voltmeter which can be successfully cushioned in sponge rubber). The simple arrangement of the parts, to reduce wiring and strength of all connections, were worked out with great care (See Figure 5), and the tubes are set in spring sockets and cushioned with sponge rubber (See Figure 6) so that they need not be removed during transportation. Both sets have been subjected to every kind of stress they may

meet with in field use and have stood up under the roughest kind of treatment.

Finally the designers decided to give the semi-portable radiophone an accident test, just to see how much it would stand and where failure might first be expected. Four of the six tubes were tied to their sockets with rubber, the remaining tubes were left free. The set was then dropped 14 feet to the ground! The jolt caused the two free tubes to jump from their sockets and to break. The broken glass was shaken out of the set, the two broken tubes replaced and it was put "on-the-air" without further adjustment and a conversation carried on with a station 60 miles away. The sets have certainly been built for rough going!

The experimental stage is now completed. Every conceivable test for weaknesses that might develop has been made and as weak points have developed changes were made to remedy them. Radio is now ready for the field, the forests, and a thousand ranger officers are reaching for it. Approximately 150 sets will be available this year, and these will be issued to a few forests where the need for them seems most urgent and where good opportunity exists for exacting field tryouts. It is to be expected that some failures may develop, for the sets will be used in every kind of climatic situation from the humid forests of northern Washington to dry deserts of Arizona and California, from sea level to the timberline country of the Continental Divide, in heat and cold and from mountain top to the bottom of deep canyons. Some situations may be found where special equipment or change of design will be necessary, but the versatility they have already displayed in experimental tests gives confidence in their adaptability to almost any situation. Long before sufficient equipment to supply all of the forests can be had, there will be opportunity to discover any peculiar situations where special adaptations will be necessary.

A problem which can be foreseen, but upon which no work has as yet been done, is regulation of traffic in the channels assigned to the Forest Service. When 147 forests are equipped with radiophones and each forest has several central-camp stations receiving reports from several individuals using portable sets, it can be foreseen that, without regulation, there might be chaos. The very-low power and range of the instruments will help to hold this situation in check to some extent, but some additional regulation will doubtless be necessary so that all the men will not try to talk at once.

Radio Aloft

(*Continued from page* 141)

been developed. Essentially, both receivers look alike in outward and internal appearance excepting that one is designed for use at frequencies between 1500 to 6000 kc. while the other works between the frequencies of 230 to 500 kc. The short-wave receiver employs three stages of screen-grid radio-frequency amplification, a space-charge detector and one stage of audio-frequency amplification. The long-wave receiver employs one less r.f. stage and one more a.f. stage. They are designed to work with headphones . . . not loud speakers.

Power for these receivers is also obtained from a dynamotor as in the case of the transmitter, the plate potential being 200 volts and the filament voltage being obtained directly from the 12-volt storage battery.

Both the transmitter and the two receivers are mounted on trays which are constructed in such a manner as to provide a high degree of shock absorption, thus guarding against unduly severe mechanical strain due to vibration and landing shocks.

Usually both the transmitting and receiv-

ing equipment are located in some unused portion of the plane's fuselage and therefore a remote-control tuning apparatus is provided in the pilot's cockpit.

For itinerant aircraft a low-powered transmitter (Figure 3) has been developed to meet the especial requirements of this branch of the flying service. This transmitter, in design is much like that intended for the use of the transport planes, the difference being that instead of having a fifty-watt carrier this one has only a ten-watt output. The transmitter consists of a quartz crystal oscillator, a modulating amplifier and one stage of audio-frequency amplification. The ten-watt output is substantially completely modulated and the tuning range of the transmitter is from 3000 kc. to 6500 kc.

In the transmitter is contained an antenna transfer relay by means of which the antenna may be connected to either the transmitter or the receiver. Power for the operation of this transmitter is obtained from a dynamotor driven from the ship's 12-volt storage battery. It delivers 525 volts d.c.

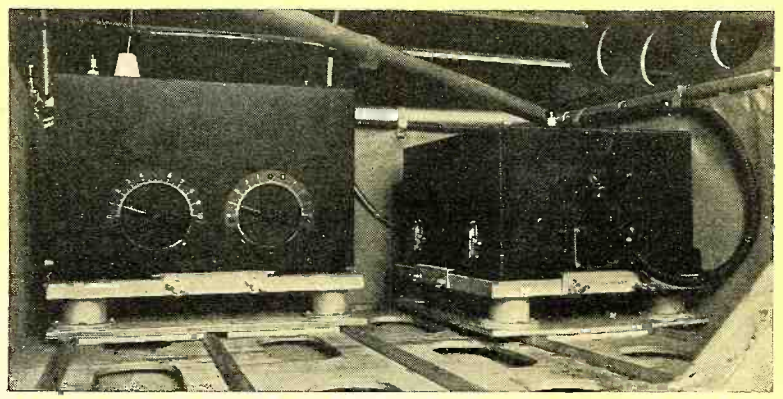
As is to be expected, the ground station which is used to communicate with planes operating in the transport service over the established chain airways is more elaborate and more powerful than the plane equipment.

The ground transmitter produces a carrier power of 400 watts which as in the case of the plane transmitter is substantially completely voice modulated. It is so designed that it may be adjusted for operation on any frequency between 1500 and 6000 kilocycles.

This transmitter comprises the following units: a crystal-controlled oscillator, a frequency doubler, a modulating amplifier an audio-frequency amplifier and a power amplifier. In the oscillator and frequency-doubler stages five-watt tubes are employed, while in the modulating amplifier stage a fifty-watt tube is used. The radio-frequency power amplifier employs a single 1000-watt (1kw.) radiation cooled tube which operates at a plate potential of 2500 volts. The audio amplifier system is similar to the plane unit in that it uses three fifty-watt tubes connected in parallel and operated by a special design of microphone.

The rectifier system works from a 220-volt three-phase 50 or 60 cycle line and supplies potentials on the order of 2500, 1000, 200, and 55 volts d.c. and 10 volts a.c. Rectification is obtained by means of seven low voltage mercury vapor rectifier tubes.

At airports which are not on the regular chain airways and where there is the desire to provide radio communication facilities to itinerant aircraft the ground station is not nearly so elaborate. The Federal Radio Commission has stipulated that such ground stations operate on a frequency of 278 kc., and that their carrier output be restricted to 15 watts. Actually the transmitter described here is rated at ten watts output. It consists of a crystal-controlled oscillator, a modulating power amplifier, a speech power amplifier, a full-wave rectifier, filament supply and all the necessary control circuits.



RADIO EQUIPMENT FOR PRIVATE AIRCRAFT

Figure 3. Here are shown the Western Electric transmitter (left) and receiver installed in a plane, ready for operation. Usually located in an out-of-the-way corner, the receiver is tuned by remote control from the pilot's position. The remote control cable is shown here, attached to the front of the receiver

The purpose of such a transmitter is to provide communication to pilots on planes in the vicinity of or nearing the airport so equipped. It is not intended for long range communication.

The maps which accompany this paper will serve to illustrate that fact that a pilot, whether he be of the itinerant or transport class and whose plane is equipped with the prescribed radio apparatus, need never be out of touch with the ground, regardless of whether he start out on a flight to a neighboring town or a more pretentious trans-continental flight.

Every day flying becomes increasingly safer because radio provides the long arm of communication as no other agency can, to keep the pilot informed of flying conditions ahead, landing facilities at unfamiliar airports and the other thousand and one things which only pilots want to know when they are out of touch with the rest of civilization.

A New Phototube

(*Continued from page* 152)

as the ratio of sensitivity at rated voltage to the sensitivity at a voltage sufficiently low to prevent ionization from taking place. In Figure 2, the wavelength of the visible spectrum has been given in Angstroms, the customary unit for the wavelength of light. It is equal to one-hundred-millionth of a centimeter, 10^{-8} cm.; this is equal to 39.37 x 10^{-10} inches.

In Figure 3 the light flux is expressed in lumens. An explanation of these units of light has already been given in the article on selenium cells in the June, 1932, issue of RADIO NEWS. The lumen is a unit defined as the quantity of light emitted in unit solid angle by a point source of unit brilliancy. If an area of one square foot is uniformly illuminated at one foot candle, the amount of light falling on it equals one lumen.

All-Wave Super

(*Continued from page* 161)

nouncer stating that the program being broadcast was one of an experimental nature, and giving the time as 4:07, Sunday afternoon, at Sydney. This announcement was followed by a number of selections by a military band. The announcer came on again, practically duplicating the previous announcement.

Reception from Australia is uncommon at this early hour in the morning. Ordinarily one hardly expects to receive signals from the other side of the world before 5 or 6 a.m., E. S. T. The reception on this station very closely approached the best foreign reception obtained in this location, in spite of the fact that atmospheric conditions were not good. Earlier there had been another thunder storm; static extending down below 25 meters. The result was that this Australian reception occasionally suffered from static interference but aside from this, the signal-to-noise ratio was very satisfactory and both the music and the announcements were clear and distinct. Not a single word of the announcement was missed. During this reception loudspeaker reproduction was used exclusively, as in all of the tests.

Little mention has been made of reception other than that from foreign broadcast stations with which short-wave readers are most familiar. In addition to these, any number of others, both foreign and domestic, were tuned in—not only broadcast stations but amateur, commercial, air service and police stations as well. But for comparative purposes, the tests were concerned primarily with the European stations because of their regularity on the air.

From the foregoing description of the short-wave tests, it is obvious that no attempt was made to provide especially favorable conditions of either location, time or antenna equipment. The effort, throughout, was to provide conditions under which the average reader ordinarily works, to show him what sort of results he could expect from the new set. The owner of such a receiver could probably better the results described. He could erect a permanent antenna, best suited to his conditions, of greater height than the temporary ones employed in the RADIO NEWS tests. He could experiment with different grounds. Also he would have all the advantages of a permanent location under known conditions. During most of the tests, the receiver was simply piled into a car and taken to the proposed test location. Once there, it was set up and put into operation in a few minutes. At no time during the tests were any adjustments made in the receiver. Throughout it remained exactly as received from the factory. The Arcturus tubes, with which these receivers are equipped, were never removed from their sockets, even during transportation—and the receiver was carried a total distance of several hundred miles in all.

Before concluding this article, a word should be included concerning the simplicity of short-wave operation provided by this receiver. There is one (and only one) tuning control. This tunes all circuits simultaneously! In spite of the lack of trimmers or auxilliary controls of any kind, the tracking of the circuits was absolutely accurate, whether working in the broadcast or the various short-wave bands. This feat is accomplished electrically, rather than mechanically, and the method employed will be discussed in the final article, next month. A single tuning control, a single volume (sensitivity) control and a single switch for band changing, constitute the complete control equipment; an arrangement which certainly takes the complications out of short-wave tuning.

Backstage in

Personal interviews with broadcast artists and executives

By

Samuel Kaufman

RAY PERKINS

RAY PERKINS, one of radio's most versatile entertainers, recently launched a new NBC series of novelty programs heard Tuesdays and Thursdays under the sponsorship of the Barbasol Company. His programs consist of songs, music and humorous chatter. He is supported by Peter van Steeden's Orchestra. Song-writer, singer, pianist and comedian, Perkins has often been referred to as the "one-man radio show." Half of the songs he sings on the air are his own and many of them have not been published. Since he first started to entertain at the age of six, Perkins has written musical shows, appeared in vaudeville, made pictures in Hollywood and worked for a magazine, in addition to his successful radio ventures. This program brings Perkins under the same sponsorship as Singin' Sam, of the CBS, and the Old Singin' Master of the NBC.

BEN BERNIE

BEN BERNIE—the CBS "Old Maestro"—was born Benjamin Ancel, the son of a blacksmith who lived in the shadow of Brooklyn Bridge. Young Benjamin took to music at an early age and at fifteen, it is said was an instructor at a New York music school. His next step was to the duties of violin demonstrator in a New York department store. Given to wisecracks, even at that early date, Ben always amused onlookers. A theatrical magnate happened along one day and Ben found himself in vaudeville as one-half of the team of Bernie and Klass. Ben's act was designed along musical lines until he teamed with Phil Baker. The Bernie-Baker vaudeville team went in for comedy, the pay checks increased and the act became an accepted hit. Although the team split up several years ago, Bernie and Baker remain steadfast friends—each one now a star in his own right. Ben was seized with the idea of a novelty band with the conductor doing something besides waving a baton. The idea clicked from the start and Bernie found himself and his band vaudeville headliners. He was booked at the Roosevelt Hotel in New York for five years. London and Hollywood successes followed before the band began a long Chicago booking. His broadcasts from the Windy City over coast-to-coast Columbia hook-ups have brought him added laurels.

DESPITE America's broadcasting supremacy, the field of radio drama has been badly neglected by domestic stations. The B.B.C., we discovered on our recent London visit, gives far more time and care to this important division of broadcasting than does either of the two American networks. But, of late, we have noticed some increased efforts on the part of NBC and CBS to advance radio drama. The NBC's Radio Guild, under the direction of Vernon Radcliffe, has made some worthy efforts, although many programs have been devoted to adaptations of stage plays rather than the presentation of original radio scripts. The CBS recently inaugurated a series of half-hour experimental dramas, under the direction of Don Clark, continuity chief. The series, according to Mr. Clark, was designed to prove that mature radio drama can be produced to hold and intrigue an audience for half an hour.

V. RADCLIFFE

AT eighteen, Sylvia Froos, CBS blues singer, finds herself a network star. Sylvia, a native New Yorker, won attention to her songs and mimicry when she was but a child. She made her vaudeville debut as "Baby Sylvia" at the age of eight. In the following decade she filled vaudeville engagements throughout the United States as well as parts of Mexico and Canada. She made a number of talking picture shorts and was featured with Chic Sale in the road company of "Gay Paree." In her present rôle of blues singer she was first heard on the CBS in March when she was featured with Louis Silvers' Orchestra.

Broadcasting

Chatty bits of news on what is happening before the microphone

SYLVIA FROOS

WHISPERING JACK SMITH, the singer who was a big hit in the early days of broadcasting, is back on the air over an NBC hook-up as the star of a new series heard Monday, Wednesday and Thursday nights. Smith's songs are presented in the same informal manner that won him his large following several years ago. Singing popular songs in his unique style, Smith filled numerous vaudeville, radio and phonograph engagements in the United States before his departure on an extensive European tour. During the past few years he appeared in most large European cities and was featured in several London musical shows. In his new series, Smith is presented in a group of solo selections with occasional accompaniment by the Hummingbirds, a female trio consisting of Margaret Speaks, soprano; Katherine Cavalli, mezzo-soprano, and Dorothy Greeley, contralto. The instrumental background is furnished by Arnold Johnson and his orchestra.

JACK SMITH

H. WARDEN WILSON, radio impersonator heard over the NBC, entered broadcasting as an engineer and became a microphone star by chance. He used to imitate the voices of noted air personalities as a prank, little expecting to turn his pastime into a lucrative radio act. Once his talents were realized he was put on the air and scored from the start. Wilson was born twenty-nine years ago in Trenton, New Jersey. He attended Jersey schools, played on scholastic football and baseball teams and spent summers working about seashore concessions. He joined a dance orchestra as drummer and played dance and theatre engagements intermittently for five years. He also appeared in several Broadway shows. His interest in radio dates back to the crystal detector days when he operated a spark transmitter listed as 2WV. Radio remained his chief interest and in 1923 he entered the Moore School of Electrical Engineering in the University of Pennsylvania. He completed the course in 1929, having dropped out of school one year to work with the Bell Telephone Company of Pennsylvania. Shortly after graduation he joined the NBC engineering staff. He took up mimicry for fun. While testing studio equipment, Wilson, at the microphone, began imitating famous radio personalities. His impersonations attracted the attention of program officials and, in 1930, the engineer made his net work debut as a performer. After several trials on sustaining spots, his efforts won him some choice sponsored assignments which earned wide recognition.

WARD WILSON

LOWELL THOMAS, noted author, traveler and news broadcaster, has signed a long time contract with his new sponsors, the Sun Oil Company, which presents him daily over the NBC. The author of a score of books and a lecturer who has appeared in practically all English-speaking parts of the world, Thomas was widely known as a reporter and traveler before he entered radio in 1930. He was born in a Colorado mining town and while still in his early twenties led two expeditions into the Arctic. Since then his explorations have included extensive tours into Malaya, Upper Burma and Central Asia. Thomas was the man who gave the world its first account of Colonel T. E. Lawrence, the mystery man of Arabia. He was one of the first correspondents to enter Germany after the signing of the armistice. On the new sponsored program series, Thomas comments on news events in much the same manner as on his old Literary Digest series.

Some Latest

A description of the outstanding acoustics and electronics as they are Office. This information will be found engineers, set designers and production as well as describing the

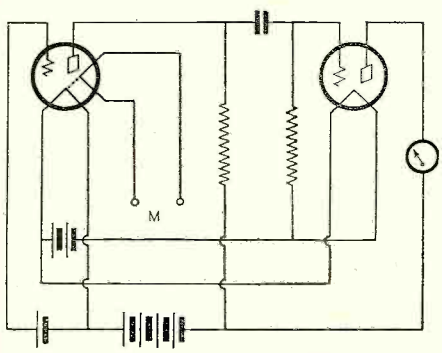
By Ben. J.

1,852,710. ANTENNA COUPLING SYSTEM. LOUIS ALAN HAZELTINE, Oakland, Calif., assignor to Hazeltine Corporation, a Corporation of Delaware. Filed Nov. 4, 1930. Serial No. 493,370. 6 Claims.

1. A high-frequency coupling circuit tunable throughout a frequency range and adapted primarily for coupling a capacity type antenna to the input of a thermionic tube, comprising, a tunable secondary circuit having coupled thereto a primary circuit including inductance sufficient to resonate with a certain antenna capacity at a frequency fixed at about the lowest frequency of said tunable range, and shunt resistance associated with said primary circuit sufficiently high in maximum magnitude to have an inappreciable effect upon the operation of said coupling circuit when connected to an antenna having said certain capacity, said magnitude being sufficiently low to prevent serious detuning for a given frequency adjustment of said tunable secondary circuit when said primary circuit is connected to an antenna of less than said certain capacity.

1,852,850. HOT WIRE MEASURING-INSTRUMENT. SIEGMUND LOEWE, Berlin, Germany. Filed Jan. 20, 1930, Serial No. 422,211, and in Germany Jan. 22, 1929. 9 Claims.

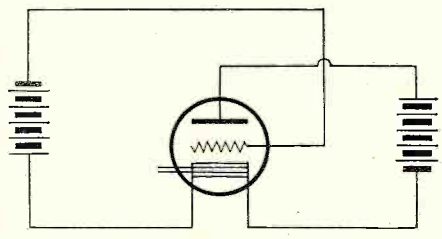
1. A measuring instrument with a hot



wire and a system with several electrodes and means to influence the relative position of the electrodes by the hot wire.

1,853,281. THERMIONIC TUBE AND CIRCUITS FOR THE SAME. FREDERICK S. MCCULLOUGH, Edgewood, Pa. Filed Jan. 5, 1926. Serial No. 79,353. 4 Claims.

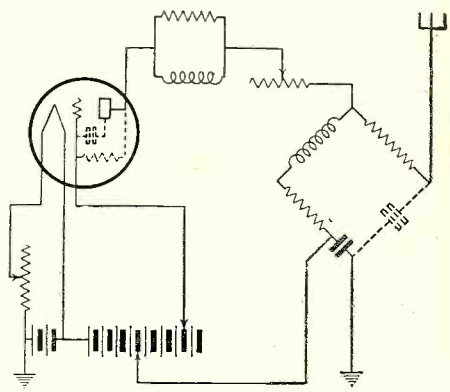
1. In an electric circuit, a thermionic tube



having a plate, a grid and an elongated cathode of the indirectly heated type, a source of current having its positive pole connected to the plate and its negative pole connected to one end of the cathode, and a second source of direct current having its positive pole connected to the opposite end of said cathode and its negative pole connected to the grid.

1,853,604. RESISTANCE-TUNED CIRCUIT. SEWALL CABOT, Brookline, Mass. Filed May 28, 1929. Serial No. 366,689. 11 Claims.

6. An electric circuit maximally respon-



sive or self-oscillatory at a definite predetermined frequency comprising a serially-connected inductance, capacity and variable resistance, and resistances of opposite sign connected, respectively, in shunt to said inductance and capacity, each of said resistances being approximately equal to the square root of the ratio of said inductance to said capacity.

1,853,929. ELECTRIC WAVE FILTER. FRANCIS X. RETTENMEYER, Woodside, N. Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a Corporation of New York. Original application filed Nov. 21, 1925, Serial No. 70,529. Patent No. 1,804,952, dated May 12, 1931. Divided and this application filed Mar. 2, 1931, Serial No. 519,408. 4 Claims.

1. In a three-phase wave transmitting system, a broad band wave filter comprising equal reactive impedances connected in series in each phase and equal reactive impedances connected between the phases, said impedances being substantially free from resistance and having values such that the structure freely transmits a wave lying within a preassigned band of frequencies and attenuates waves lying outside of said frequency band.

1,854,025. METHOD AND APPARATUS FOR GENERATING AND DETECTING IMPULSES. REGINALD A. FESSENDEN, Chestnut Hill, Mass., assignor to Submarine Signal Company, Portland, Me., a Corporation of Maine. Original application filed Mar. 23, 1918, Serial No.

* Patent Attorney, Washington, D. C.

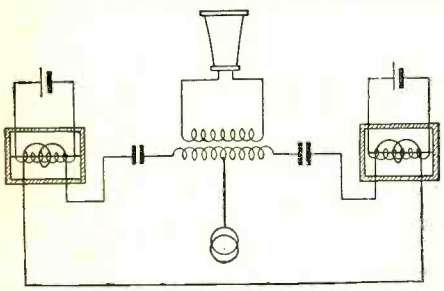
Radio Patents

patented inventions on radio, television, granted by the United States Patent a handy radio reference for inventors, men in establishing the dates of record, important radio inventions

Chromy*

224,288, Patent No. 1,501,105, dated July 15, 1924. Divided and this application filed May 21, 1924. Serial No. 714,899. 8 Claims.

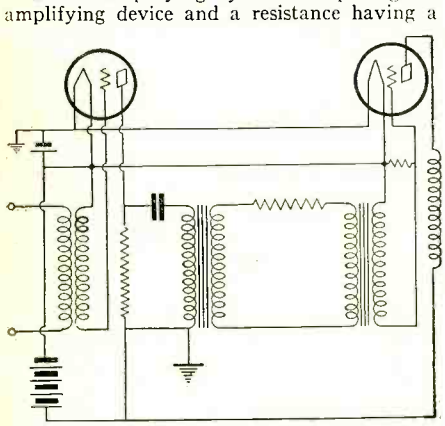
1. A circuit for transmitting electrical impulses in accordance with mechanical variations comprising a normally balanced electrical circuit, means for impressing upon the balanced sections of said circuit alternating current of a suitable frequency, means for unbalancing said circuit by varying the permeability of a magnetic core forming a part of one balanced section by the mechanical



forces exerted on said core, and means associated with said circuit for transmitting said electrical impulse.

1,854,294. REGULATOR FOR AMPLIFIERS. OLLIVIER MARIE GUSTAVE DE L'HARPE, Paris, France, assignor to Societe Francaise Radio Electrique, Paris, France. Filed Jan. 15, 1926, Serial No. 81,399, and in France July 22, 1925. 10 Claims.

1. An amplifying system comprising an amplifying device and a resistance having a

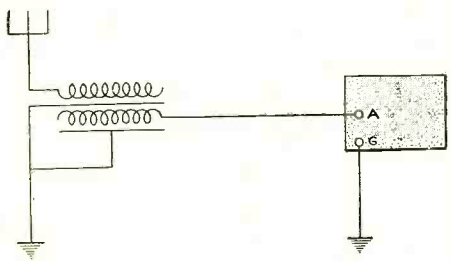


positive temperature co-efficient connected therewith, said resistances being so connected with the device that it varies the amplification factor of the alternating current component in inverse ratio to the applied energy and additional means to prevent the direct current component from flowing through said resistance.

1,854,448. RADIO SIGNALING. LOUIS COHEN, Washington, D. C. Filed Sept. 17, 1928. Serial No. 306,577. 6 Claims.

(Granted under the act of Mar. 3, 1883, as amended Apr. 30, 1928; 370 O. G. 757).

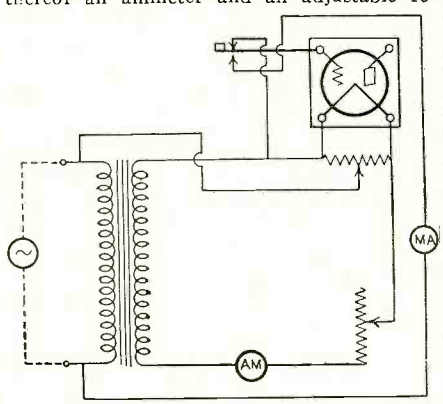
1. In a system for the reception of radio signals, comprising an antenna, and two adjustable wave conductors in inductive relation to each other, one of said wave conductors being connected to said antenna, and the other of said wave conductors being connected to a receiving circuit system provided



with means for detection and amplification, and means for adjusting each of said wave conductors to a quarter wave length of the signals desired to be received.

1,854,900. VACUUM TUBE TESTER. WILLIAM NELSON GOODWIN, Jr., Newark, N. J., assignor to Weston Electrical Instrument Corporation, Newark, N. J., a Corporation of New Jersey. Filed Feb. 8, 1928. Serial No. 252,871. 1 Claim.

In tube testing apparatus, a tube socket having a resistor connected between the filament terminals thereof, a switch for alternatively connecting the grid terminal to the plate or a filament terminal, a transformer, circuit connections from the transformer windings to the plate terminal of the socket and to a point in said resistor corresponding in potential to the electrical midpoint of the filament, respectively, an electrical indicating instrument included in said circuit connections, and means including as series elements thereof an ammeter and an adjustable re-



sistance for energizing the filament circuit from said transformer.

1,855,901. PROCESS FOR INTRODUCING MERCURY INTO DISCHARGE TUBES AND APPARATUS THEREFOR. MAX BAREISS, Watertown, Mass.,

(*Continued on page* 184)

A Magnetron Transmitter

(*Continued from page* 144)

self-excited push-pull oscillator operating on the same ultra-high frequency. Such as oscillator, however, cannot be considered satisfactory. An investigation (with the idea of improving stability) was therefore begun, and while it is not fully completed, it represents definite steps in the right direction.

Stabilizing the Circuits

Each portion of the magnetron circuit has a relationship to frequency stability. Variations in the magnetic field were very bothersome, so it was deemed advisable first to investigate this. It was discovered that when a certain magnetic field strength was employed, variations in the field current had a minimum effect on frequency change. The optimum field current, from this point of view, was about 4 amperes. This is important since the field-supply filtering is something of a problem, due to the high current required. In these tests a motor-generator furnished the field power and when the correct adjustment was attained, a monitoring test disclosed the fact that such disturbances as commutator ripple and minor line-voltage variations were no longer of major importance. The magnetron was not operating quite at its maximum efficiency at this field setting, but the drop in efficiency was small enough to be considered important in the light of the improved stability obtained.

The frequency variation, with change in plate voltage, was still the same, however, so the "low C" circuit was abandoned in the hope that a certain amount of tuning capacity would be beneficial. The magnetron operates most efficiently into an oscillatory circuit of high impedance, making a "high C" circuit theoretically undesirable. Nevertheless a tuned circuit was constructed employing a coil of 3 turns of ¼-inch copper tubing 1½ inches in diameter, tuned with a condenser of about 20 mmfd. capacity. Since the inter-electrode capacity of the tube is only about .5 mmfd., this additional capacity effected a considerable improvement in stability, without serious loss in efficiency.

The operation of the circuit, as a whole, was quite different from the original tests. Changes in field current, plate and filament voltages caused only a relatively small variation in frequency. The curves in Figure 4 show the contrast between the "low" and "high C" circuits.

A definite value of field current which minimized the effects of commutator ripple, etc., was found as before, but was considerably lower in value, being approximately 3 amperes instead of 4 amperes (Figure 5). It is interesting to note that the optimum operating value of field current, with regard to frequency instability caused by field variation, is approximately the same at all plate voltages, as is shown in Figure 6. As before, better output was obtained with the field current reduced slightly from that value giving most stable operation. The choice of field current will therefore depend somewhat on operating conditions. If a well-filtered supply is available, efficiency and output are the deciding factors. Where the field supply is subject to variation, stability is the predominant consideration.

The value of R is not critical as far as efficiency or frequency vs. plate-voltage variations are concerned. However, it was found that by the correct adjustment of R, frequency variations due to field strength changes could be still further reduced materially. The actual value varies between 100 and 400 ohms and depends on the plate voltage—higher resistance being required for higher potentials. Some energy is necessarily dissipated in this resistor, but this loss is relatively unimportant in view of the main goal of a stable circuit. Also, some compensation of this loss is achieved through an improved anode circuit efficiency.

A d.c. Filament Source Preferred

After a fair degree of stability had been attained, as indicated in curve B, Figure 4, another source of trouble became evident. This was vibration of the filament structure of the tube, due to the filament current, which was alternating current, reacting in a "motor" effect with the strong d.c. field. When the filament was light by d.c., this trouble was eliminated.

Modulating the Circuit

Referring to the curves in Figure 7, it is immediately seen that the relation between the plate current and plate voltage is essentially linear, and the circuit, therefore, lends itself admirably to modulation. From the slope of the curve, the effective plate impedance is found to be about 9000 ohms, which, while somewhat higher than that commonly encountered in the usual transmitting tubes of similar power, should present no serious difficulty from the standpoint of obtaining a satisfactory impedance relationship in the modulator output circuit.

Photograph, Figure 8, shows the complete set-up of the magnetron, with its attendant apparatus, including modulation and speech equipment. The modulator consists of two type –50 tubes in push-pull, connected through a suitable transformer to the oscillator plate circuit. Since the magnetron was operating with an input of about 35 watts at 650 volts, a fair percentage of modulation was obtained with the two –50's operating at the same plate potential. In any case the modulation should not exceed 70% if reasonably good fidelity is desired. The speech equipment and amplifier circuits are quite conventional.

The radiating system was a simple vertical, half-wave, copper-rod antenna approximately 8 feet long, and fed by means of a balanced transmission line.

Transmitting Tests

Field tests were made up to distances of about 5 miles, the signal being checked in comparison with that of a conventional modulated oscillator. Two types of receivers were used, one being a super-regenerator, and the other the latest type of ultra-high-frequency superheterodyne described in RADIO NEWS for August. It was, of course, impossible to check the effects of frequency modulation of the super-regenerator since the receiver itself is subject to a degree of frequency modulation from the suppressor frequency that is comparable with that of the worst transmitter. Due to this fact, only slight differences between the transmitters were apparent on the first receiver (the signal from the magnetron was appreciably sharper, but the tone quality was not noticeably better.)

On the other hand, when using the superheterodyne, the magnetron was found to give a clear-cut signal of good quality, in contrast to a decidedly broad and wobbly signal of low intelligibility from the modulated oscillator.

The tests definitely checked the various circuit requirements that laboratory experi-

(*Continued on page* 183)

Weighing the Electron

(*Continued from page* 147)

(4), and the value for E (which we can read directly on the voltmeter) in the equation (3).

The mobility B has, therefore, to be found in some other way if we want to determine the radius and the electric charge of our particle. Stokes, the English mathematician, calculated for the resistance W—which is reciprocal to the value of the mobility B—which is impressed upon a sphere during its motion through a fluid:

$$\frac{1}{B} = W = 6\pi\mu a \qquad (5)$$

It is assumed hereby that the fluid sticks continuously to the surface of the sphere.

For a sphere, however, which moves in a gas instead of a fluid and with reasonable speed, too, it may not be correct to suppose that the medium will stick to the surface. Aeromechanics and hydromechanics have shown that this case practically never happens. The so-called "laminar"-movement takes place only under theoretical conditions, assuming an almost infinitely small movement of an unelastic body in a fluid of small hydraulic mobility. Practically in all cases eddies and whirls appear which disturb markedly Stokes' law. Experience teaches against the theory that the gas glides along the surface of the exposed body and, in addition, the formation of whirls takes place for gases which are so dense that the average free-mean-path of their molecules is small against the radius of the sphere (that means sufficiently smaller than 10^{-5} cm.).

It has been necessary, therefore, to correct Stokes' law. Following the calculations of Stokes-Cunningham, this formula reads:

$$B = \frac{1}{6\pi\mu a\left(1 + A\frac{l}{a}\right)} \qquad (6)$$

Where l is the average free-mean-path of the gaseous molecules and A is a constant (which gives a value for the gliding and is supposed, following the theoretical calculations, to be near unity).

Will experiments at different gas pressures, especially in compressed gases, be able to solve this problem? Investigations at different pressures under one atmosphere have been already made. Figure 6 shows a diagram of measurements which have been taken for each individual particle at different pressures by Dr. Max Reiss. From these experiments which have been made between 1 atmosphere down to about 50 mm. pressure, it seems that some particles have a smaller density than the molecular material. On the other hand, particles have been found, which indicate much smaller values for the supposedly standard electric charge of an electron! It has apparently been possible to measure single electrical *charges as low as* 1.10^{-10} *electrostatic* units, that is *less than one-fourth of the values* found by other investigators.

For giving an idea about the incredible small forces with which we have to deal and which we have to control experimentally, in these intricate investigations, it may be mentioned that the forces which act upon the particle are of the dimensions of 10^{-10} dyne. This corresponds to an attraction with which two containers of about one quart of water each act upon each other over a distance of about 2 miles!

If the particles with which he operated were small enough, Ehrenhaft's measurements on individual particles showed values for the separate electronic charge which went far below the quantum charge which is required by the theory. From other methods the value of the electronic charge was determined to be about $4{,}77.10^{-10}$ electrostatic units. Dr. Robert A. Millikan in Pasadena, who described the condenser method at about the same time as Ehrenhaft ‡, and who was awarded the Nobel prize, found this larger charge.

In addition to having found smaller charges than the elementary quantum, Ehrenhaft states that it is not directly possible to consider the electric charges, he found, as simple multiples of the elementary charge. These conditions of being able to build simple *multiples*, quanta, would be a necessary requirement, if one of the cornerstones of modern physics should be a true natural law: the quantum theory of Max Planck which has proven so valuable a tool for many investigations.

According to Ehrenhaft, it would be necessary to determine the value of the unit of negative electricity much lower than $4{,}7.10^{-10}$ electrostatic units . . . *provided that there is existing any atom of electricity at all.*

In practice we continue, today, to use the electron *as such* in our calculations and our engineering. But will we, under these circumstances, consider the electron as a *truly existing standard entity* . . . in the scientific world of tomorrow?

* Wiener Akadem. Anz. number 7, March fourth, 1909.

† Ehrenhaft & Wasser, Philosophical Magazine, Vol. 11, 1926.

‡ R. A. Millikan: Physical Review XXIX, p. 260, December, 1909, F. Ehrenhaft: Anzeiger d. Wiener Akademie d. Wissenschaften, March fourth, 1909.

Magnetron Transmitter

(*Continued from page* 182)

ments had indicated to be desirable. Of the two transmitters, each employing similar modulating equipment, the magnetron gave a much stronger signal due, of course, to the higher degree of efficiency. Increased power at these frequencies does not result in a corresponding extension of range, since the behavior of the signal tends to comply with optical laws. However, the stronger signal was found to be much more effective in location subject to local interference.

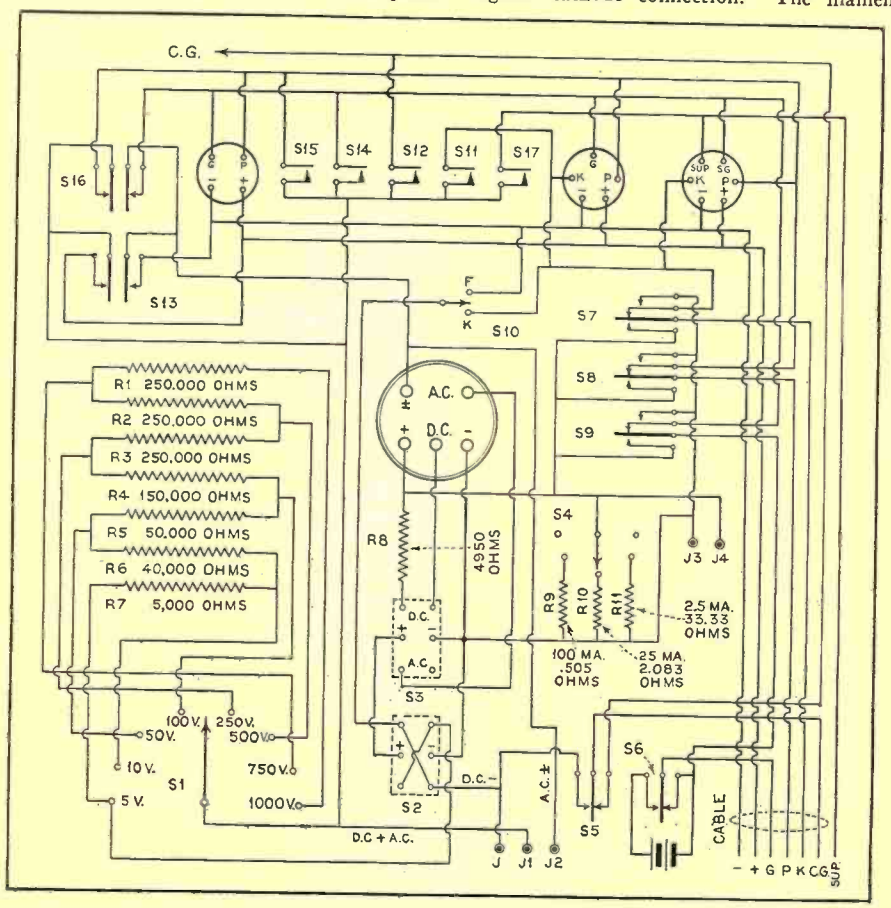
The possibility of modulating the r.f. output of the circuit by supplying the modulating power to the field coil will doubtless occur to many experimenters. However, aside from the difficulty of controlling the high excitation current with any depth of audio-frequency variation, field circuit modulation might be undesirable due to the excessive change in radio-frequency with field current change. Also, the r.f. output does not vary uniformly with the field, except over rather small limits and when using a somewhat restricted range of plate voltages.

Higher Frequency Possibilities

The tests described above were confined to the neighborhood of 56 megacycles. A vast amount of experimentation still remains before the possibilities of the magnetron are fully realized on frequencies above 300 megacycles (below 1 meter). Work in this region, which is not being used at present for any practical purpose, affords a highly interesting and unusually fertile field for the experimenter, and the magnetron, at the present time, is the tube best suited for this phase of exploration.

The Sprayberry Analyzer and Six Prong Tubes

The Sprayberry Analyzer, described in the July issue, was developed before the announcement of the new six prong tubes. However, few changes are necessary to incorporate facilities for testing these tubes and the revised circuit is shown herewith. An Alden six hole socket and six prong test plug are required. Also another Yaxley type 2001 switch (shown as S17). These parts are in addition to the other parts appearing in the regular parts lists.



Measurements are made as described for the other tubes. To get the suppressor voltage switch S17 must be depressed. Tubes which will be used in the six hole socket are the –57 and –58 types.

The –46 and –56 tube is placed in the five hole sockets and measurements made in the usual manner. Different voltage values will be applied to these new tubes and until they become more or less standardized it is recommended that you use the high current and voltage scales.

In regard to the mercury vapor rectifier or –82 type tube, measurements are made on it exactly as if the tube were –80. Measurements may also be made on the –95 or triple-twin tube. Remember when making measurements with this tube, which fits in an ordinary five hole socket, that the ordinary grid terminal becomes the input plate, the output plate is the regular plate, and that the input cathode corresponds to the regular cathode connection. The filament connections are as for any other five prong type tube.

When making measurements on any of these new tubes, if the meter tends to read reverse simply turn switch S2 and the meter will read up scale.

A Correction

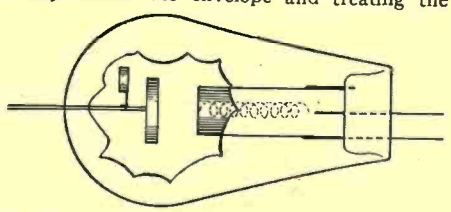
In the original diagram of this set analyzer the connection between the d.c. negative terminal of the meter and the center point of S2 should have been shown connecting to the lead between the center point of S3 and J3, instead of jumping over it. This correction has been made in the diagram shown herewith.

Radio Patents

(*Continued from page* 181)

and ERICH WIEGAND, Berlin-Waldmannslust, Germany, assignors to General Electric Company, a Corporation of New York. Filed June 9, 1930, Serial No. 459,862, and in Germany Aug. 21, 1929. 10 Claims.

1. The method of introducing mercury into the envelope of an electric discharge device which consists in forming a body containing mercury as a solid compound capable of being reduced, inserting the solid body within the envelope and treating the



body to cause a reduction of the compound whereby mercury is evolved.

Automobile Radio

(*Continued from page* 155)

progress from an engineering standpoint in the last eighteen months, than in the previous three years of its history. This is largely due to the co-operation of the accessory manufacturers in designing special tubes, batteries, generators, condensers, etc.

In selling or installing radio sets in cars or boats one should not overlook the advantages offered by the auto B eliminators, a number of which have been placed on the market within the past few months. Equipped with one of these units, the auto radio is as trouble free as the home receiver. The A battery, of course, requires no special attention so far as radio is concerned, as that is of necessity kept in proper operating condition at all times anyway. The extra drain imposed on it by the radio is slight, but even this can be compensated for by increasing the charging rate at the car generator.

The use of a B eliminator, depending on the car storage battery for its supply source, not only eliminates the B battery replacement nuisance, but most of these eliminators require less than half the space required for B batteries of the same total voltage. One can be mounted in any spare space in or beneath the car.

In this connection it is well to make sure before buying any particular make of eliminator, that it will work with the receiver which is to be used. Tests have shown that some of the eliminators on the market are noisy with certain receivers but quite satisfactory with others. Other eliminators, on the other hand, work satisfactorily with any receiver. Some auto receiver manufacturers have tested various eliminators and are therefore in a position to recommend the most satisfactory eliminators for use with their equipment. On the whole, there is now some excellent auto radio equipment on the market and it is worth looking into. What was yesterday's luxury is fast becoming tomorrow's necessity.

Mathematics in Radio

(*Continued from page* 162)

If the current in Fig. 5 is changing at every instant as would be the case with an alternating current, the magnitude of the magnetic flux around the coil would likewise change. This changing magnetic flux induces an e.m.f. in the coil, and the magnitude of this induced e.m.f. "e" at any instant is equal to the rate of change of the magnetic flux with respect to time (t). This is expressed as:

$$(III) \quad e = \frac{d\varphi}{dt}$$

The above relation can be used to advantage in connection with equation (II) in order to show the relation of the current in an inductive circuit with respect to the impressed voltage. Equation (III) tells us that we can take the derivative of equation (II) with respect to (t). Thus:

$$(IV) \quad \frac{d\varphi}{dt} = \frac{d}{dt}(L\,i)$$

Here, L is a constant, and (IV) is of the form $\frac{d}{dx}(cv)$, the solution of which is $c\frac{dv}{dx}$. Then (III) becomes:

$$(V) \quad e = L\frac{di}{dt}$$

The instantaneous value of the current i is expressed by the following equation:

$$(VI) \quad i = I \max \sin \theta = I \max \sin \omega t$$

Now, equation (V) tells us that we can take the derivative of equation (VI) with respect to "t". Thus:

$$(VII) \quad \frac{di}{dt} = \frac{d}{dt}(I \max \sin \omega t)$$

Here, I max is a constant, and (VII) is of the form $\frac{d}{dx}(cv)$. The various steps of differentiating are as follows:

$$\frac{d}{dt}(I \max \sin \omega t) = I \max \frac{d}{dt}(\sin \omega t)$$

$$= I \max \cos \omega t \frac{d}{dt}(\omega t)$$

$$= \omega\, I \,\mathrm{Max} \cos \omega t.$$

The solution of (V) thus becomes:

$$(VIII) \quad e = \omega L I \max \cos \omega t$$

This last formula, which has been easily obtained by the use of differential calculus gives us all the information that is necessary in order to show the relation of the current in the circuit of Fig. 5, with respect to the impressed voltage. From equation VIII, we recognize the reactance formula for inductance, that is,

$$xL = 2\pi fL = \omega L.$$

Plotting the instantaneous value of the current and the value of the voltage e, as obtained in equation VIII, the graph, Fig. 6, immediately informs us that the current in an inductive circuit lags behind the impressed voltage by 90°.

Dynamic "Mike"

(*Continued from page* 151)

1 2 inch 6/32 machine screw for crank
1 6/32 machine screw (head removed)
1 Hard rubber terminal strip, 2⅝ inches by 1 inch by 3/16 inch

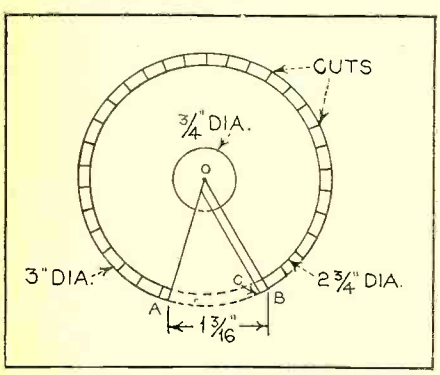


FIGURE 2. CONE SPECIFICATIONS

4 Binding posts
2 Metal pillars 5/16 inch diameter, ¼ inch long, with holes to clear 8/32 machine screws
2 ⅝ inch 8/32 machine screws
4 Soldering lugs

Next month the description and constructional details of the dynamic microphone will be concluded—THE EDITORS.

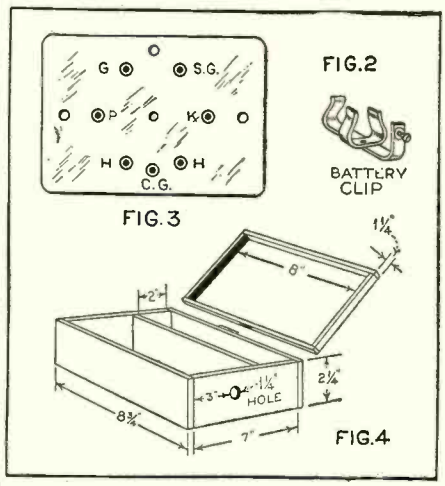
A. C.—D. C. Set Analyzer

(*Continued from page* 159)

should test by trying it on some which are known to be OK.

When wiring be sure to make all leads as short as possible. Cabling the wires is unnecessary as there are so few. Make all soldered connections clean, using enough solder to make a good joint but not enough to make a sloppy one.

After the analyzer has been wired, use the voltmeter on a low voltage battery to make sure that there are no shorts. Then use it a few times on your own receiver to get the "hang" of it. Keep the meter switch at "OFF" except when actually making a measurement, to avoid striking the needle against the side of the meter. When measuring the voltage of the second plate of a type -80 rectifier, screen grid voltage, and occasionally the filament voltage on d.c. sets, it is necessary to reverse the d.c. meter



DETAILS OF ASSEMBLY PARTS

Figure 2. Shows the method of making the battery clip. Figure 3. The connections for the cable connector plate mounted on analyzer case. Figure 4. Details of Analyzer Case

by means of the double-pole double-throw toggle switch marked "DC Rev."

The general selector switch will provide readings as follows:

E_f. Fil. volts. a.c.-d.c.
E_p. Pl. volts. Reverse for -80 plate.
I_p. Pl. cur.
E_g. Grid volts. Reverse for screen-grid volts.
I_g. Grid cur.
E_{cg}. Cont. grid volts.
E_k. Cath. volts. Audio pent. scr. grid volts. Audio pent. scr. grid current with toggle switch down.
E_{g-p}. Grid to pl. volts. Max. of 1050 volts a.c. across secondary of power transformer.
E_{sg}. Suppressor grid volts. Usually at ground.

The user of this analyzer must be familiar with tube circuits, and must know what voltages to expect at different points of the circuit. It is believed that the arrangement used in this set tester makes for simple adaptation to any new tubes that may appear for some time.

External ranges are available at the three jacks on the panel. All voltage and current ranges are at the black and red jacks, J1 and J3, while resistance measurements are made between the black and blue jacks, J1 and J2. The a.c. voltmeter is useful as an output meter, because it is of the copper-oxide variety. External current measurements are made the same way as explained above. Of course, one of the 100-ohm shunts must be switched into circuit by setting S2 on I_p, for instance.

For resistance measurements turn the two thousand ohm zero adjuster full in, set the voltage selector at some low resistance, short the test prods and adjust the variable resistance until the meter reads zero (resistance). Read directly from the scale. For lower ranges use the meter as for current measurements; that is, turn in one of the one hundred-ohm shunts, and set for either three or nine mills. In either case the scale must be divided by the meter range. To obtain higher resistance ranges it is necessary to use more batteries and the proper resistances in series.

The series resistances and corresponding voltage ranges of the meter are as follows:

Resistance	*d.c. Volts*	*a.c. Volts (approx.)*
3,000 ohms	3	3.5
9,000 "	9	10.5
30,000 "	30	35.0
90,000 "	90	105.0
300,000 "	300	350.0
900,000 "	900	1050.0

List of Parts

J1, J2, J3—General Radio insulated jacks; black, blue and red.
R1, R2, R3—Wire wound resistors made in accordance with instructions in text; or Electrad type B1, 100 ohm resistors (25 watts).
R4—170 ohms
R5—770 ohms
wire wound resistors, made as described in the text; or IRC type W.W. 3.
R6—3000 ohms
R7—9000 ohms
R8—30,000 ohms
R9—90,000 ohms
S. S. White carbon resistors of slightly lower values, altered as directed in text; or IRC type W.W. 3.
R10—300,000 ohms
R11—900,000 ohms
S. S. White carbon resistors, altered as directed in the text; or IRC type W.W. 2.
R12—Yaxley 2000-ohm variable resistance, type 52000.
S1—Best non-shorting single pole, eight point switch.
S2—Weston nine point bi-polar switch.
S3—Yaxley triple pole d.t. switch, No. 763.
S4, S6—Cutler-Hammer d.p.d.t. toggle switch.
S5—Cutler-Hammer s.p. triple throw toggle switch.
S7, S8—Yaxley s.p.d.t. push buttons, type 2003.
VT1—NA-ald four-prong socket, type 422.
VT2—NA-ald five-prong socket, type 423.
VT3—NA-ald six-prong socket, type 426.
1—Case (see text for dimensions).
1—Weston model 301 d.c. 0-1 milliammeter.
1—Tau-rex miniature copper-oxide rectifier.
3—General radio type insulated plugs; black, blue and red.
1—Pair Buddy test prods with phonograph needle chucks
5—Feet red covered flexible wire.
5½—Feet brown covered flexible wire.
1—National grid cap clip.

(*Continued on page* 187)

A DX Super

(*Continued from page* 149)

herewith. The coils and condensers of the input and oscillator circuits are enclosed within a long rectangular shield can immediately behind the front panel. The individually shielded i.f. circuits are enclosed in cans along the rear edge of the chassis and the tubes of the i.f., detector, oscillator and first a.f. stages are mounted in a straight line along the center of the chassis. The two –45's are mounted at the rear right hand corner in line with the i.f. shield cans. Both the chassis and the shields are highly polished and present a most attractive appearance. The front panel carries all of the dials and the visual tuning meter, which is shown just above the dial window.

On the rear wall of the chassis are tip jacks to accommodate a phonograph pick-up or a microphone transformer. If desired either one of these can be left plugged into these jacks at all times as a separate phonograph-radio switch of the toggle type is also provided on the rear of the chassis. The antenna and ground binding posts are also located on the rear of the chassis, at the extreme left end, and at the extreme right are the tip jacks into which the leads from the loudspeaker are plugged.

The power supply for the receiver is provided in the form of a separate unit. This arrangement serves the dual purpose of keeping the chassis down to reasonable proportions and at the same time separating the 60-cycle circuits from the receiver proper thus reducing hum to a minimum. When the outfit is installed in a console, the power supply unit is normally mounted in the compartment with the loudspeaker, thus providing sufficient isolation from the highly sensitive r.f., i.f. and detector circuits.

From the various features that have been discussed, it will be obvious to the reader that this receiver is one which theoretically offers unusually attractive possibilities. That these theoretical advantages are borne out in its practical operation has been clearly demonstrated in the preliminary tests conducted by the author. During the next two or three weeks, more extensive reception tests will be made and the results will be discussed in the article which is to appear next month. The receiver will be considered at that time not only from the standpoints of sensitivity and selectivity but also the actual effectiveness of the various features which have been described in the present article, will be discussed more fully from a practical operating standpoint.

Universal Super Design

(*Continued from page* 154)

the first detector if coupling is tightened up at all. This makes for considerably better sensitivity of the 728SW on the highest-frequency range as compared to the 727SW's highest frequency range.

The balance of the receiver is essentially the broadcast circuit and as such a complete description of it can be had by referring to the August, 1932, issue. It differs in one essential point, however. The –56 driver stage audio tube of the 728 has been replaced in both the 728 and in the 728SW by a –45. This was found desirable as on the signal peaks of sixteen and even twenty watts that the "Class A Prime" audio amplifier will deliver, the –56 would overload slightly, whereas the –45 will not overload at any power output level the output stage will deliver.

The noise suppression system used in the 728SW not only has the advantage of extreme simplicity, but more especially that of being adjustable to the exact degree required for any particular location or for seasonal variations of noise level. This adjustment is extremely simple, and is made upon installation, or at any desired time intervals by the set owner.

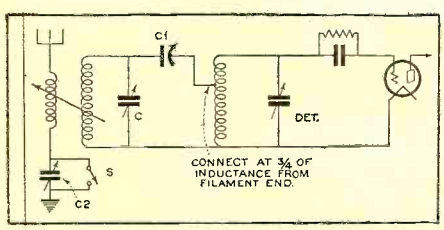
The noise suppression system involves the use of a switch to change the control-grid bias on the first i.f. tube only to a value just sufficient to drop the receiver sensitivity to a point where undesired noise is excluded. This is done by having the switch cut in a variable bleeder resistor to increase the bias of the first i.f. tube only. This resistor is adjustable from the rear of the set chassis with a screw-driver.

In practice, the receiver, employing this system, shows an absolute sensitivity on the order of one microvolt r.f. input needed to produce 50 milliwatts audio output, with audio output rising to a maximum of eight watts (steady state) at 50 microvolts absolute input, the a.v.c. system holding maximum volume constant at this level for all stronger signals. This slope remains constant for varying degrees of lessened sensitivity, the maximum condition of which is when an absolute input of 80 microvolts will produce no signal, but 400 microvolts will produce maximum output. This extreme condition was not needed even in the very noisy location of the trade show at the Stevens Hotel in the Chicago business district with street cars, electric signs and an electric suburban train terminal within a block of the hotel.

A. C.—D. C. Set Tester

(*Continued from page* 186)

5—Feet seven-wire cable.
1—NA-ald six-prong analyzer plug, type 906L.
1—NA-ald 6-5 adapter, type 965 DS.
1—NA-ald 6-4 adapter, type 964 DS.
1—Bakelite or hard rubber panel, 4⅞ inches by 8 inches, ¼ inch thick.
1—Flashlight cell, 1½ volt.
1—Battery clip.
Wire, hardware, etc.



A Correction and Addition

In the July article on Antenna Tuning, by Thos. A. Marshall, reference is made on page 58 to a Figure 4 and Figure 5 which were omitted. Actually, both references should have been to Figure 4, which is shown herewith.

With the Experimenters

(*Continued from page* 167)

prong socket could be substituted for the old four-prong type. But many of my customers did not care to meet the expense of converting the old set when the outcome was doubtful. An adapter to permit a demonstration with the pentode therefore became necessary.

The enclosure shows how such an adapter was constructed at a very low cost. Figure 1 shows a small five-prong socket; Figure 2 an old four-prong tube base with the tube removed and properly notched to permit the mounting of the socket; Figure 3 shows the adapter ready for use. A small one-inch bolt and nut are used for holding the two parts together although the insulated wire used in connecting the plate, grid and filament terminals of socket to the prongs of the tube base are sufficient, if carefully attached.

The flange of the five-prong socket should be cut as shown in dotted section (Figure 1). The remaining extensions fit in notches provided for them in the tube base. This feature prevents the socket from twisting after being assembled and eliminates possible internal short circuiting.

It will also be noted that a small hole is drilled in the bottom of the tube base for the one-inch long bolt, and another in the side nearest the "screen" terminal of tube socket. This is to provide an opening through which a flexible insulated wire lead can be brought and a small battery clip attached.

To use the adapter, insert in the four-prong socket of the power stage and clip on to the 135-volt terminal of the "B" supply. Insert the –33 pentode tube in the adapter and when used with two-volt tubes with the proper filament voltage applied (I use one cell of a 6-volt storage battery) the result will be more than satisfactory.

After a demonstration I always advise the removal of any fixed resistors in the filament circuit and replace the adapter and four-prong socket with a five-prong socket for permanent installation.

W. L. SCOTT,
Paint-Lick, Ky.

Storage Battery Connectors

Radio enthusiasts will find that regular lead-covered battery lugs, such as used on the storage batteries in automobiles, are more rugged and lasting than spring clips for making connection to radio A batteries; although they are not so sightly or so easy to apply. The lugs make better contact with the battery terminals, and will not corrode. Stranded, rubber-covered wire leads can be soldered to the lugs and connected to the receiving set. These lugs can be purchased in any automobile supply store. They are properly marked, and the negative lug has a smaller opening than the positive one.

CHARLES FELSTEAD,
Los Angeles, Calif.

Effective Indoor Antenna

In place of a regular outside aerial, an indoor aerial made of a strip of ordinary galvanized-iron window screening, two to three feet wide and ten or more feet long, can be suspended in the attic close up to the roof, and a lead-in wire fastened to it. While this kind of an aerial is not as good as a one-hundred foot long copper wire, it is far more compact and easier to erect. It can be insulated from the roof beams, or not, just as desired; although it is better to insulate it if possible. Copper or brass screening would be far better. Even chicken-wire netting can be used, however.

CHARLES FELSTEAD,
Los Angeles, Calif.

The Service Bench

(*Continued from page* 165)

condenser plates, chassis and inside of the cabinets.

"Test speakers are located on top of the panel, which is indirectly lighted by six lights in the curved shield at the top."

The service laboratory of the Patton Radio Shop, Anderson, Ind. (Figure 5), provides an excellent idea of what can be done with a minimum of floor space. This test and service bench is built on the sky-scraper pattern, and houses everything from tools to speaker. To a large extent, the bench is designed with telephone switchboard technique; all test prods, clips and permanent leads are weighted, returning to positions flush with the bench when not in use. Tools and small parts are protected from dust and moisture in the liberal chest of drawers located between the test panel and the table top. The test panel itself is mounted as the face of a drawer, facilitating

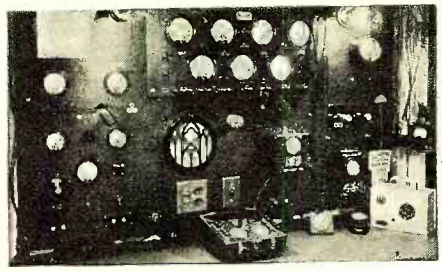


FIGURE 6

Photo of the GEI GEL Hardware Company's service shop which was omitted from the Service Bench for August

RADIO NEWS Export Service

AS a service to our readers in locations outside the United States of America, either commercial, professional or private individuals, RADIO NEWS will arrange to provide contact with leading American manufacturers of radio supplies and receiving equipment.

To utilize this service, clip and fill out coupon below and send it attached to your letter on which you list the types of apparatus you are interested in.

Our Export Service Department will refer your inquiries direct to the proper manufacturers, asking them to send you full particulars, catalogues, prices, etc.

* * *

ALS einen Dienst für unsere Leser, entweder Kaufleute oder Privatpersonen ausserhalb der Vereinigten Staaten von Amerika, kann RADIO NEWS mit den führenden Amerikanischen Fabrikanten von Radio Apparaten Kontakt herstellen.

Für den Gebrauch dieses Dienstes schneide man den Kupon aus und sende denselben mit einer Liste von Apparaten die für Sie von Interesse sind.

Unsere Export Abteilung wird Ihr Schreiben umgehend an die betreffenden Fabrikanten weiter befördern, mit der Bitte Ihnen Auskünfte, Preise und Kataloge zu senden.

* * *

POUR rendre service à nos lecteurs demeurant hors des Etats-Unis d'Amérique (commerçants, professionnels ou particuliers), RADIO NEWS vous fera entrer en relation avec les principaux fabricants d'appareils de T. S. F. en Amérique.

Pour profiter de cette organisation, il vous suffira de remplir et de découper le coupon ci-joint, et de l'envoyer attaché à votre lettre, en énumérant les types d'appareils qui vous intéressent.

Notre service d'Exportation fera suivre directement vos demandes aux fabricants intéressés en les priant de vous adresser tous renseignements, catalogues, prix, etc. . . .

* * *

COMO un servicio especial a nuestros lectores que se encuentran fuera de los Estados Unidos de America, ya sean comerciantes, profesionales o personas privadas, RADIO NEWS tendra a bien ponerlas en contacto con los principales centros manufactureros de radio, de aparatos receptores y accesorios.

Para beneficiarse de tal servicio, sirvase recortar el coupón de esta página, enumere los tipos de aparatos que le interesen, y envienosla con su carta.

Nuestro Departamento de Exportación se encargará de ponerse en contacto directo con dichos centros, pidiendo le envien información completa, catalogos, precios, etc.

* * *

RADIO NEWS Export Service Department

Kindly put me in contact with American firms manufacturing the class of radio apparatus noted on attached sheets.

Name.....

Address.....

Business.....

repairs and adjustment. The meters are provided with the usual multipliers and shunts, and the various electrical testing equipment includes capacity and resistance bridges, two oscillators, grid dip and zero beat meters and a completely universal tube tester and set analyzer. Plenty of light and leg room contribute to the convenience and efficiency of this shop.

THE SERVICE SALESMAN

Arthur Sullivan, specialist in Atwater-Kent and Radiola for the citizens of Berlin, N. Y., has been cashing in on a service idea that has much merit. After pointing out to his clients, in attractive but inexpensive circulars, that the most interesting radio features of the year—the political campaign and election, World Series baseball, the entire football season—are scheduled for September, October and November, he offers an unqualified guarantee on all radio repairs made during the month of August for four months from the date of service.

"This guarantee covers every conceivable trouble from aerial to tubes. I realize that this might let me in for a loss in a few instances, but I actually put the receivers in such good condition that I can make this guarantee with the certainty of a good overall profit. Past experience has amply justified this system. Of course there is no reason why this arrangement cannot be worked out for any four months of the year, and, as a matter of fact, I do quite a bit of servicing on this basis if the customer is willing to stand the slight extra charge for the unusually thorough job of servicing which is essential as a protection to myself. Not that I don't always do a good job, but in the case of a guarantee I insist on additional work which, under ordinary conditions, would only be recommended. However, I have found it easiest to sell insurance of this kind over the fall months."

This idea should work out profitably in conjunction with the sales stunt suggested by George Bromley of Montgomery, Mo., who, through favors for the local express agent, has arranged to have the following circular delivered with every incoming trunk during the months of August and September:

"Welcome home!

"May we put your radio in condition for the fall and winter season? The dust of a vacant house and the general disuse of vacation time is not the best thing in the world for your receiver. Let us check it over from antenna to base-plug. Our rates are very reasonable, our service prompt and our guarantee does not quibble.

"At any rate, just tuck this card under the radio cover. You may need it some time!"

A somewhat similar line of thought has stimulated Mr. George W. Moore, of Glen Ridge, Mo., to write as follows:

"A few years ago I rented a house in El Paso, Texas, and was surprised to receive several letters the morning after I moved in. These epistles were from the neighborhood dry cleaners, bakers, dairies, etc., soliciting my business. Upon investigation, I found that these companies had made arrangements with the gas, electric light and telephone companies, whereby they were furnished with the names of all new subscribers to such services.

"The same sort of a tie-up can be effected with local real estate agents and moving companies."

An Idea for the Rural Serviceman

The Radio Shop, of Liberty, Ind., makes

INDEX TO ADVERTISERS

advertising pay. Liberty is a good size town, surrounded with a fairly populous rural

There's A Reason

Why our business is growing day by day. We try our utmost to give honest conscientious service to each and all of our customers. When we repair your set we want you to get service out of it and we see that you do. When we sell you a set we tell you all about it and if it doesn't perform to your satisfaction we see that it does, without any extra cost on your part. With us, the customer is always right.

OUR RADIO SPECIALS FOR THIS WEEK

Apex 7-tube console, worth much more than we ask. $30.00
Clarion 8-tube console, should sell for $90.00, our price only $38.00
Fuse, 8-tube console, highboy style, only $40.00
R. C. A. 5-tube console $50.00
Stenite Midget, screen-grid and pentode tubes, electric clock. $25.00
Atwater Kent, all-electric 7-tube table-model, only $23.00

No Trade-ins at These Prices.

Burgess "B" Batteries, fresh stock just in ..... $1.75 to $3.50
A few Battery Sets at great away prices ..... $5.00 to $15.00
"B" and "B and C" Eliminators ..... $2.50 to $5.00
All the new tubes as well as the old style in stock at list prices.

TO OUR COUNTRY FRIENDS—

Mr. Walter Nelson, our representative, will call upon you farmer friends soon if he hasn't already come so. He will thoroughly inspect your set at no cost whatever to you and give you an honest opinion of your needs. You are under no obligation to buy. We ask that you give him a cordial welcome when he calls.

BOYS, JOIN OUR RADIO EXPERIMENTERS CLUB

Boys, we have a new stock of American Bell Headphones, just what you need for your crystal sets and for experimental work. Have you joined our Radio club? If not join now. We are giving a special discount to members of the club on all radio equipment and it costs nothing to join.

The Radio Shop

105 College Corner Ave., Liberty W. F. Landes

community. The Radio Shop specializes in out-of-town service, and advertises the fact in the rural newspapers. A sample of one of their wide-awake ads appears herewith.

The Boys' Experimenter Club is another Radio Shop promotion, and was described in this department last month. Their business is growing day by day. As they say in their advertisement—"There's a reason!"

Rates and Charges

Mr. H. A. Hamilton, radio service manager for the Mikesell Motor Company, Chariton, Iowa, has evolved the following combination flat and hourly rate as a fair and equitable compensation. To quote Mr. Hamilton—

"We charge $1.50 per service call. This includes complete inspection and any minor adjustments that can be made in the owner's home. If the set is brought to the shop by the customer, the inspection charge is $1.00. We have flat rates for synchronizing, cleaning, tightening and general adjustment. These charges are $3.00 for the ordinary t.r.f. receiver, $4.00 for neutrodynes and $7.50 for superheterodynes. Miscellaneous

Radio News Technical Information Service

The Technical Information Service has been carried on for many years by the technical staff of RADIO NEWS. Its primary purpose is to give helpful information to those readers who run across technical problems in their work or hobby which they are not able to solve without assistance. The service has grown to such large proportions that it is now advisable to outline and regulate activities so that information desired may come to our readers accurately, adequately and promptly.

Long, rambling letters containing requests that are vague or on a subject that is unanswerable, take up so large a portion of the staff's working time that legitimate questions may pile up in such quantities as to cause a delay that seriously hinders the promptness of reply. To eliminate this waste of time and the period of waiting, that sometimes occurs to our readers as a consequence, the following list of simple rules *must* be observed in making requests for information. Readers will help themselves by abiding by these rules.

Preparation of Requests

1. Limit each request for information to a single subject.
2. In a request for information, include any data that will aid us in assisting in answering. If the request relates to apparatus described in RADIO NEWS, state the issue, page number, title of article and the name of the device or apparatus.
3. Write only on one side of your paper.
4. Pin the coupon to your request.

The service is directed specifically at the problems of the radio serviceman, engineer, mechanic, experimenter, set builder, student and amateur, but is open to all classes of readers as well.

All questions from subscribers to RADIO NEWS will be answered free of charge, provided they comply with the regulations here set forth. All questions will be answered by mail and not through the editorial columns of the magazine, or by telephone. When possible, requests for information will be answered by referring to articles in past issues of the magazine that contain the desired information. For this reason it is advisable to keep RADIO NEWS as a radio reference.

Complete information about sets described in other publications cannot be given, although readers will be referred to other sources of information whenever possible. The staff cannot undertake to design special circuits, receivers, equipment or installations. The staff cannot service receivers or test any radio apparatus. Wiring diagrams of commercial receivers cannot be supplied, but where we have published them in RADIO NEWS, a reference will be given to past isues. Comparisons between various kinds of receivers or manufactured apparatus cannot be made.

Only those requests will be given consideration that are accompanied by the current month's coupon below, accurately filled out.

SEPTEMBER, 1932

Technical Information Coupon
RADIO NEWS Laboratory
222 W. 39th Street
New York, N. Y.

Gentlemen:

Kindly supply me with complete information on the attached question:

☐ I am a regular subscriber to RADIO NEWS, and I understand this information will be sent me free of charge.

☐ I am not yet a subscriber to RADIO NEWS.

☐ I wish to become a subscriber to RADIO NEWS, and enclose $2.50 to receive the magazine regularly for one year, and to receive this valuable technical information service free of charge.

Name.....

Address.....

repair work is charged for at $1.50 an hour. We do not repair work in the home."

ALL IN THE DAY'S WORK

S. W. Wilkinson, of Unity, Sask, Canada, finds that low volume due to a defective or weak type –80 tube can often be spotted by removing one of the push-pull power tubes, thus lessening the voltage drop across the rectifier. The result confirming the suspicion is increased volume with the single power tube.

Motorboating in Majestics

"I have had quite a number of complaints from owners of Majestic Models 90, 91 and 92 of motorboating on strong signals. In the majority of instances this has been due to one weak type –45 tube in the push-pull stage. However, if the trouble is accompanied with crackling sounds, suspect the bias resistor in either the detector or power amplifier circuit."

W. M. JACKSON,
Wilson, Oklahoma.

The Crosley Tuning Condensers

Leo Jacoby, of Jamaica, N. Y., has run into several instances of shorted tuning condensers in Crosley receivers. "These condensers are supported only at one point, and the pressure of the bands tends to displace the rotors. The trouble can be detected by removing the condenser shields and listening for a scrape. The difficulty is remedied by loosening the four screws holding the condenser assembly and adjusting the condenser for ample clearance."

SERVICE NOTES

Wright deCoster has prepared interesting data for the serviceman on the modernization of the Stromberg-Carlson models 635, 636 and 638 receivers, which include the substitution of push-pull power tubes and a modern dynamic speaker. This information can be secured without charge, by writing to Wright deCoster, St. Paul, Minn, on your service letterhead.

Mr. Wright, incidentally, echoes our own thoughts and words in commenting on the public—address system possibilities offered by the present political campaigns, as follows—

"In a very short time the political campaigns will start in earnest, and the air will be filled with political speeches of every kind. You know those broadcasting the speeches must have loudspeakers. During the last presidential campaign we sold more speakers for public-address work than during any other year. Everyone after business should be on his toes to land the public-address work for those campaigners."

Trouble Shooter's Manual, Vol. II

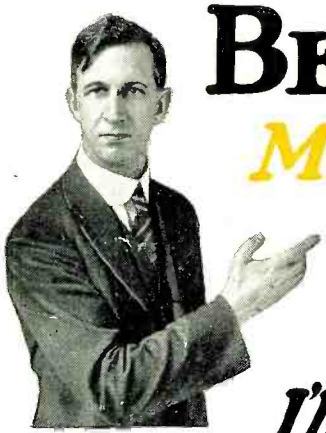
The second volume of John F. Rider's "Perpetual Trouble Shooter's Manual" has just been offered to the serviceman, and contains 700 pages of unusually comprehensive and up-to-date data on commercial receiving circuits. Values are given for all condensers and resistors shown in the wiring diagrams.

Protection and Profit

Littlefuse, Chicago, Ill., announces a new line of "Littlefuses" for meter and radio protection. Meter protection is a subject worthy of consideration by every serviceman, and particularly by the heads of rapidly expanding service organization employing two or more field men. A judiciously placed fuse will often save a costly repair, not to mention the inconvenience caused by a shortage in equipment.

BE A RADIO EXPERT

Many Make $50 to $100 a Week

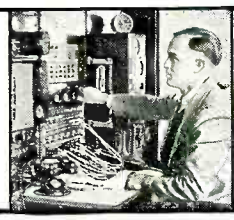


J. E. Smith, President, National Radio Institute, the man who has directed the Home-Study training of more men for the Radio Industry than any other man in America.

I'll Train You at Home in Your Spare Time for RADIO · TELEVISION · TALKING MOVIES

Set Servicing

Spare-time set servicing pays many N. R. I. men $200 to $1,000 a year. Full-time men make as much as $65, $75 and $100 a week.



Broadcasting Stations

Employ trained men continually for jobs paying up to $5,000 a year.

Ship Operating

Radio operators on ships see the world free and get good pay plus expenses. Here's one enjoying shore leave.

Aircraft Radio

Aviation is needing more and more trained Radio men. Operators employed through Civil Service Commission earn $1,620 to $2,800 a year.

Talking Movies

An invention made possible by Radio. Employs many well-trained Radio men for jobs paying $75 to $200 a week.

Television

The coming field of many great opportunities is covered by my course.

If you are dissatisfied with your present job, if you are struggling along in a rut with little or no prospect of anything better than a skinny pay envelope—clip the coupon NOW. Get my big FREE book on the opportunities in *Radio*. Read how quickly you can learn at home in your spare time to be a Radio Expert—what good jobs my graduates have been getting—real jobs with real futures.

Many Radio Experts Make $50 to $100 a Week

In about ten years the Radio Industry has grown from $2,000,000 to hundreds of millions of dollars. Over 300,000 jobs have been created by this growth, and thousands more will be created by its continued development. Many men and young men with the right training—the kind of training I give you in the N. R. I. course—have stepped into Radio at two and three times their former salaries.

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Broadcasting stations use engineers, operators, station managers, and pay up to $5,000 a year. Manufacturers continually employ testers, inspectors, foremen, engineers, servicemen, buyers, for jobs paying up to $6,000 a year. Radio operators on ships enjoy life, see the world, with board and lodging free, and get good pay besides. Dealers and jobbers employ servicemen, salesmen, buyers, managers, and pay up to $100 a week. My book tells you about these and many other kinds of interesting Radio jobs.

Many Make $5, $10, $15 a Week Extra in Spare Time Almost at Once

The day you enroll with me I send you material which you should master quickly for doing 28 jobs common in most every neighborhood, for spare-time money. Throughout your course I send you information on servicing popular makes of sets! I give you the plans and ideas that have made $200 to $1,000 a year for N. R. I. men in their spare time. My course is famous as the course that pays for itself.

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Special training in Talking Movies, Television, and Home Television experiments, Radio's use in Aviation, Servicing and Merchandising Sets. Broadcasting, Commercial and Ship Stations are included. I am so sure that N. R. I. can train you satisfactorily that I will agree in writing to refund every penny of your tuition if you are not satisfied with my Lesson and Instruction Service upon completion.

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J. E. SMITH, President,
National Radio Institute,
Dept. 2-JR
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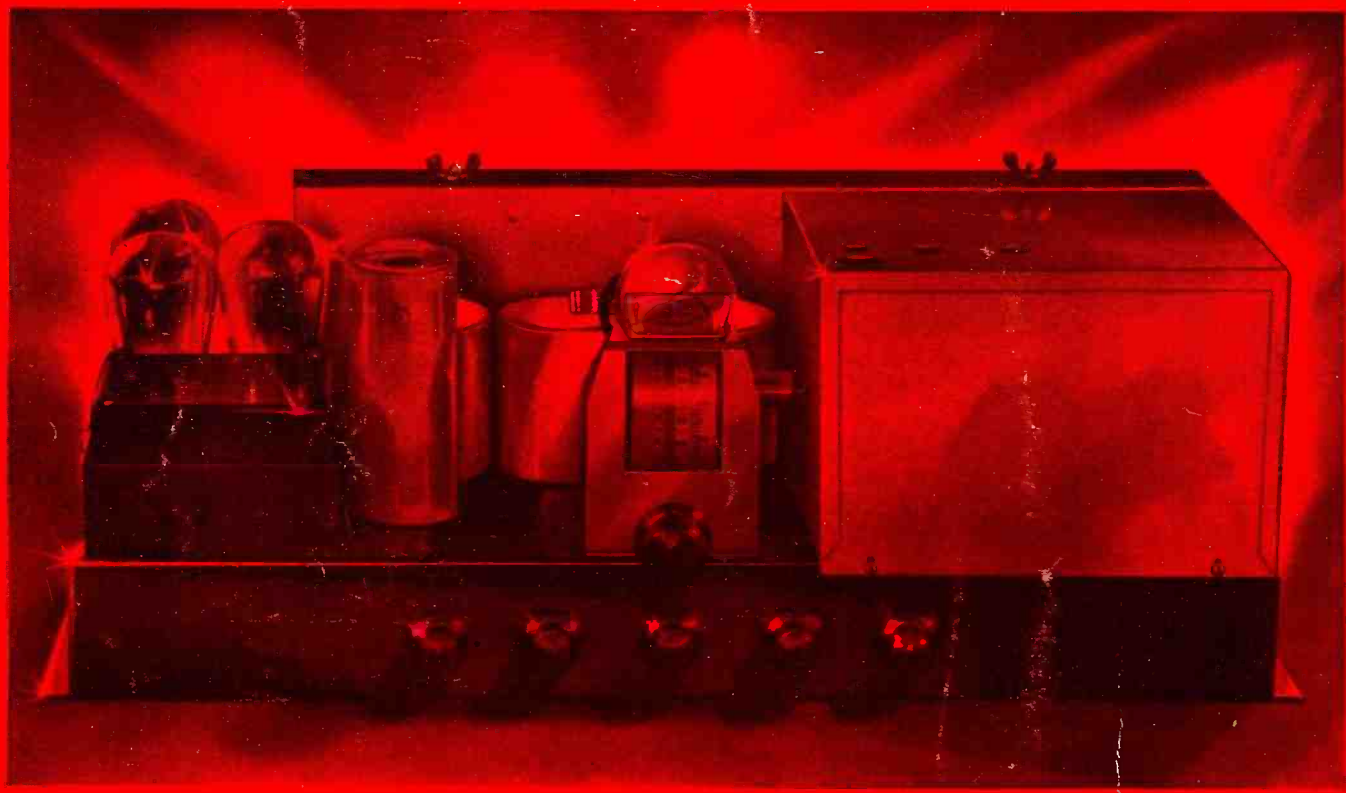
City.....*State*.....

"M"

SM The 728SW Gives You the World —Priced Within Reason



Other excellent pieces of apparatus in the new S-M line are: 550 kc. to 2,500 kc. AC chassis; all-wave tuners, broadcast tuners, amplifiers, 2-volt air-cell battery supers, and a complete line of universal replacement parts.

And S-M now has a COMPLETE line of PA equipment. 10-12-15-25-50-watt amplifiers, mikes, trumpets, transformers, racks, and a panel for EVERY use. The quality is the highest—and the prices the lowest.

If you are in PA work, write for complete information.

The 728SW (illustrated above) is a good example of the complete new line of apparatus for those who KNOW radio.

It is a 12-tube all-wave chassis, covering from 550 kc. to 23,000 kc. It uses 3-'45, 5-'56, 3-'58, 1-'82. The three '45s are used in the exclusive new "Class A-Prime" audio—two in push-pull with the third as a driver. It makes possible better than 8 watts, and easily handles crescendos of 12 watts or more. THAT'S tone quality.

And if it wasn't the most sensitive set you ever saw, it wouldn't be an S-M—it is better than ¼ microvolt per meter.

Of course the 728SW has the famous S-M "Q" circuit built into it—all-waves on one CALIBRATED dial. And it has true automatic volume control and meter tuning.

By way of comparison—it WILL NOT be outperformed. And it's built and tested under McMurdo Silver's personal supervision.

Size: 20¼" long, 10¼" deep, 7½" high.

Price, complete with front panel and 11¼" speaker, is $58.50 NET. And you may buy it on a 10-day free trial basis.

Write for Specifications and Prices

SILVER-MARSHALL, INC. 6405 West 65th Street Chicago - - U. S. A.