DEPENDABLE DX INFORMATION

RADIO NEWS AND SHORT WAVE RADIO

NRA U.S. CODE

JUNE, 25¢

IN CANADA 30¢

LISTEN to the WAR of words in EUROPE

TUNE IN

BELGIUM GERMANY
ENGLAND ITALY
FRANCE RUSSIA

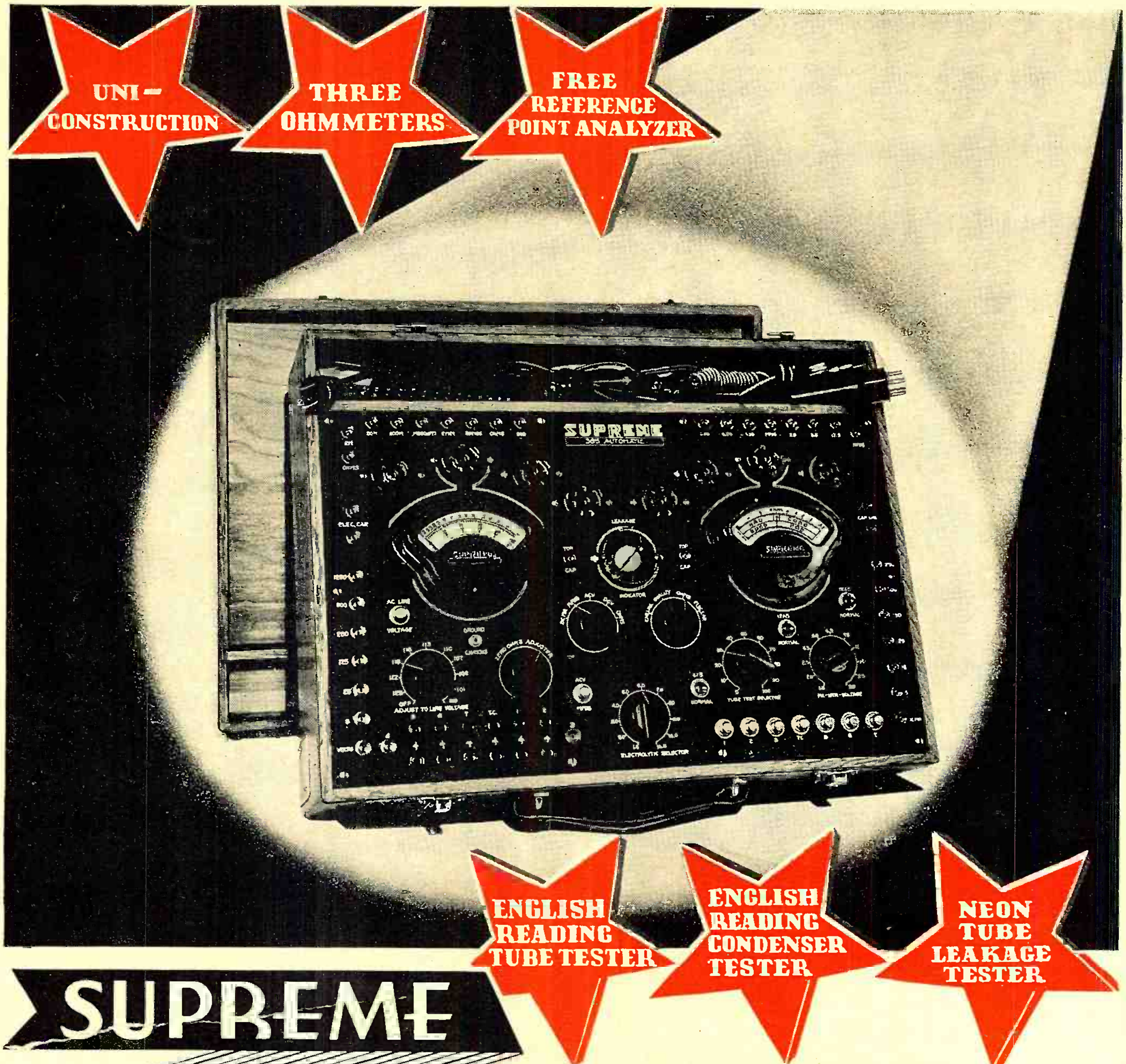
See Short-Wave Time-Table for Hourly Transmissions

BUILD THIS SHORT-WAVE SET

PORTABLE RADIO SETS

A Publication Devoted to Progress in Radio

DX Reception	Short Waves	Service Work
Broadcasting	Set Building	Electronics
Television	Experiments	Engineering
Amateur Activity	Applications	Measurements


UNI-CONSTRUCTION
THREE OHMMETERS
FREE REFERENCE POINT ANALYZER
SUPREME
385 AUTOMATIC
ENGLISH READING TUBE TESTER
ENGLISH READING CONDENSER TESTER
NEON TUBE LEAKAGE TESTER

Vol. XVI
No. 12

RADIO NEWS

June, 1935

Edited by LAURENCE M. COCKADAY

S. GORDON TAYLOR
Managing Editor

WILLIAM C. DORF
Associate Tech. Editor

JOHN M. BORST
Technical Editor

SAMUEL KAUFMAN
Broadcast Editor

EVERETT M. WALKER
Associate Editor

JOSEPH F. ODENBACH
Art Editor

Reading Guide to this Issue—

As a matter of convenience for those having specialized interests in the radio field, the following lists the articles and features in this issue, classified under 14 heads. The numbers correspond with the article numbers in the Table of Contents on this page:

Amateurs—6, 7, 8, 9, 10, 13, 14, 16, 19, 23, 25, 26, 32, 33, 34
Broadcast Fans—3, 4, 6, 23, 25, 26, 27, 28, 29, 33, 34
Dealers—1, 4, 5, 6, 15, 17, 18, 19, 20, 22, 25, 26, 30, 33, 34
Designers—6, 10, 11, 14, 15, 16, 18, 33, 34
DX Fans—23, 25, 26, 27, 28, 33
Engineers—4, 5, 6, 9, 10, 11, 14, 15, 16, 17, 19, 33
Experimenters—5, 6, 7, 9, 10, 11, 13, 14, 15, 16, 17, 18, 19, 25, 26, 30, 31, 33
Manufacturers—4, 5, 6, 11, 12, 20, 33, 34
Operators—8, 10, 16, 19, 23, 32, 33, 34
Servicemen—4, 6, 10, 11, 13, 14, 15, 16, 17, 18, 19, 25, 26, 30, 33, 34
Set Builders—6, 7, 9, 10, 11, 13, 14, 15, 16, 18, 19, 25, 26, 33, 34
S.W. Fans—3, 4, 7, 9, 20, 21, 22, 23, 24, 25, 26, 33, 34
Students—5, 6, 10, 11, 14, 15, 16, 17, 18, 19, 30, 31, 33
Technicians—5, 6, 9, 10, 11, 14, 15, 16, 17, 18, 19, 25, 30, 33

Next Month—

For Constructors and Experimenters—Summer leisure is taken advantage of by many who indulge in experimental and radio construction work for which they cannot find time during the busy Winter season. For the benefit of such experimenters the July Issue will contain important how-to-build articles on various types of receivers and other radio equipment.

For Servicemen—Further information on the Gunsolley "Perpetual" Tube Checker and latest methods of applying oscillators and oscillographs in servicing.

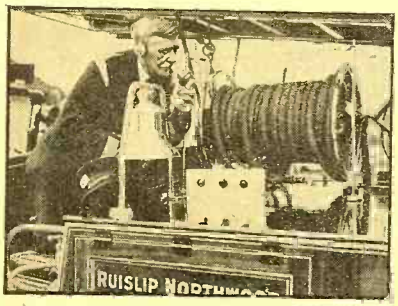
For "Hams"—Constructional details on a 75 centimeter transceiver.

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

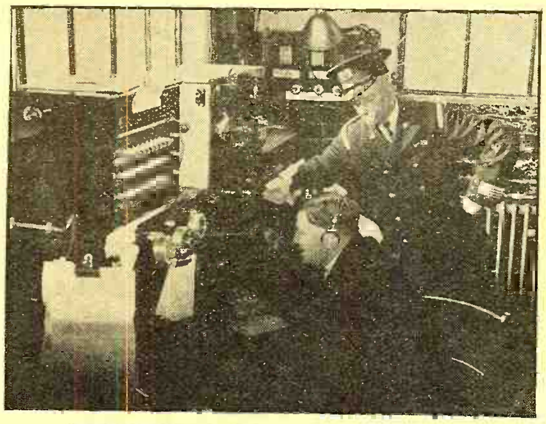
Lee Ellmaker
President and Treas.
H. Holcepl
Secretary
H. D. Crippen W. P. Jeffery
Advertising Management
Virgil Malcher
205 W. Wacker Dr., Chicago
Western Representative

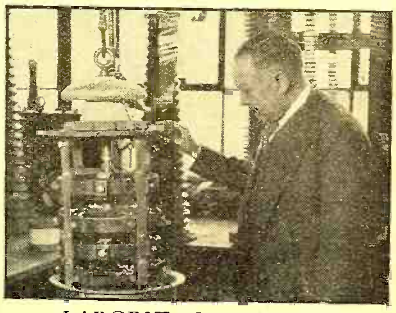
EDITORIAL AND EXECUTIVE OFFICES
461 EIGHTH AVENUE, NEW YORK CITY, N. Y.

25c a Copy, $2.50 a year, $3.00 in Canada, $3.50 in Foreign Countries. Subscribers are notified that change of address must reach us five weeks in advance of the next date of issue.



FIRE-FIGHTING BY RADIO
This new radio apparatus, installed on fire fighting machines and at Headquarters at Northwood, Middlesex, England, works on 5 meters.





LARGEST CONDENSER
William Dubilier, Vice-President of the Cornell-Dubilier Corp., inspects the world's largest mica-dielectric condenser.

DOTS ● ● ● ● ● and — — — DASHES

Short but Interesting Items from the Month's Radio News the World Over

R. M. A. Convention in June

CHICAGO, ILL.—The Radio Manufacturers Association will hold their annual convention and membership meeting in June, in this city. Paul B. Klugh was again chosen chairman of the Convention and Entertainment Committee. Besides being the Eleventh Annual Convention, a number of other special features are being planned to be held during the Convention period at the Stevens Hotel.

Dr. Pupin Passes

NEW YORK, N. Y.—Professor Michael Idvorsky Pupin, world-famous inventor and physicist, passed away recently in his seventy-seventh year. He had been in failing health for six months. He will be remembered for his important work in the development of long-distance telephony, with his Pupin coils and his tuning of electrical circuits (such as used in radio) and his famous mathematical method of analysis of intricate electrical circuits. He has been President of the American Institute of Electrical Engineers and the American Association for the Advancement of Science. He had been honored with medals and many degrees as one of the world's outstanding scientists.

Television in Canada

MONTREAL, CANADA—Mr. William Peck of New York, at last has found a chance to put his television system on the air. The Canadian government has granted him a permit to build a station at Montreal. He will begin with a 60-line picture which will later be changed to a 180 line picture. The transmissions will consist of films as well as studio programs.

Television in Finland

HELSINGFORS, FINLAND—Experimental transmissions are at present being conducted with a television transmitter in the building of the Finnish broadcasting company of Helsingfors. The experiments have advanced so far that it is expected to start a regular television broadcasting service in the fall of this year. The required receiver will be very expensive, therefore there will be public halls equipped with receivers where the public can come to "look in" by paying a small admission fee.

Fire Menaces Mackay Radio Station

SAYVILLE, LONG ISLAND—Spring fires recently menaced, for several hours, the Mackay Radio and Telegraph Station, here, when burning scrub oak and brush flames swept within 100 yards of the communication company's buildings. The flames were checked, however, before any part of the radio station suffered. Communication was uninterrupted.

Television in Germany

BERLIN, GERMANY—Experimental transmissions of television have taken place in Berlin for the last few years. It is now planned to start a regular television service from the station at Witzleben. Transmissions will be on a wavelength of 6.7 meters for the picture and 6.98 meters for the sound. Three programs of 1½ hour duration each will be sent weekly.

Argentina "Adopts" an English Word

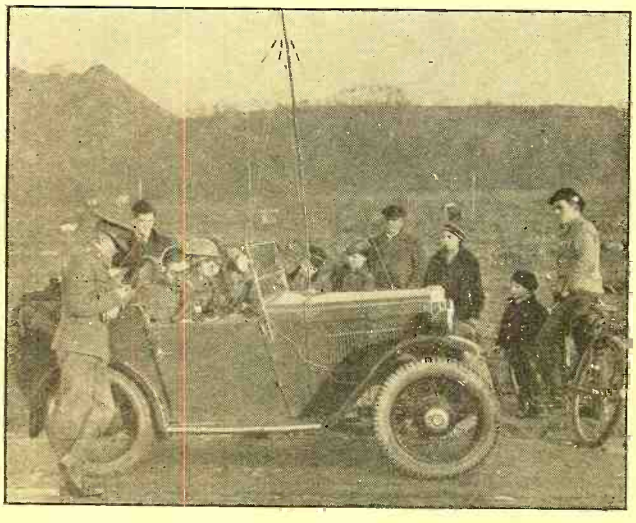
BUENOS AIRES, ARGENTINA—A word heard here quite consistently, now, in Spanish-language broadcast programs is our English word "performance." It is also said this word is being grafted on to the Spanish or Portuguese root languages of other South American countries. It is pronounced to Spanish phonetic rules, however, as "pare-four-man-seh".

Short-Wave Equipment As Ransom

SHANGHAI, CHINA—The Austrian Missionary, the Francescan Father Lorenz, was taken prisoner by Chinese bandits some time ago. His mission finally received a message from the prisoner which contained the bandits' ransom demands. In addition to a sum of money, the bandits demand several hard-to-get supplies including medicine, two short-wave transmitters and three of the latest radio receivers.

"LEGION OF HONOR"
David Sarnoff, President of RCA, is presented with the Cross of a Chevalier of the Legion of Honor, by Consul-General Charles Fontnouvelle of France, in recognition of his pioneering in radio.

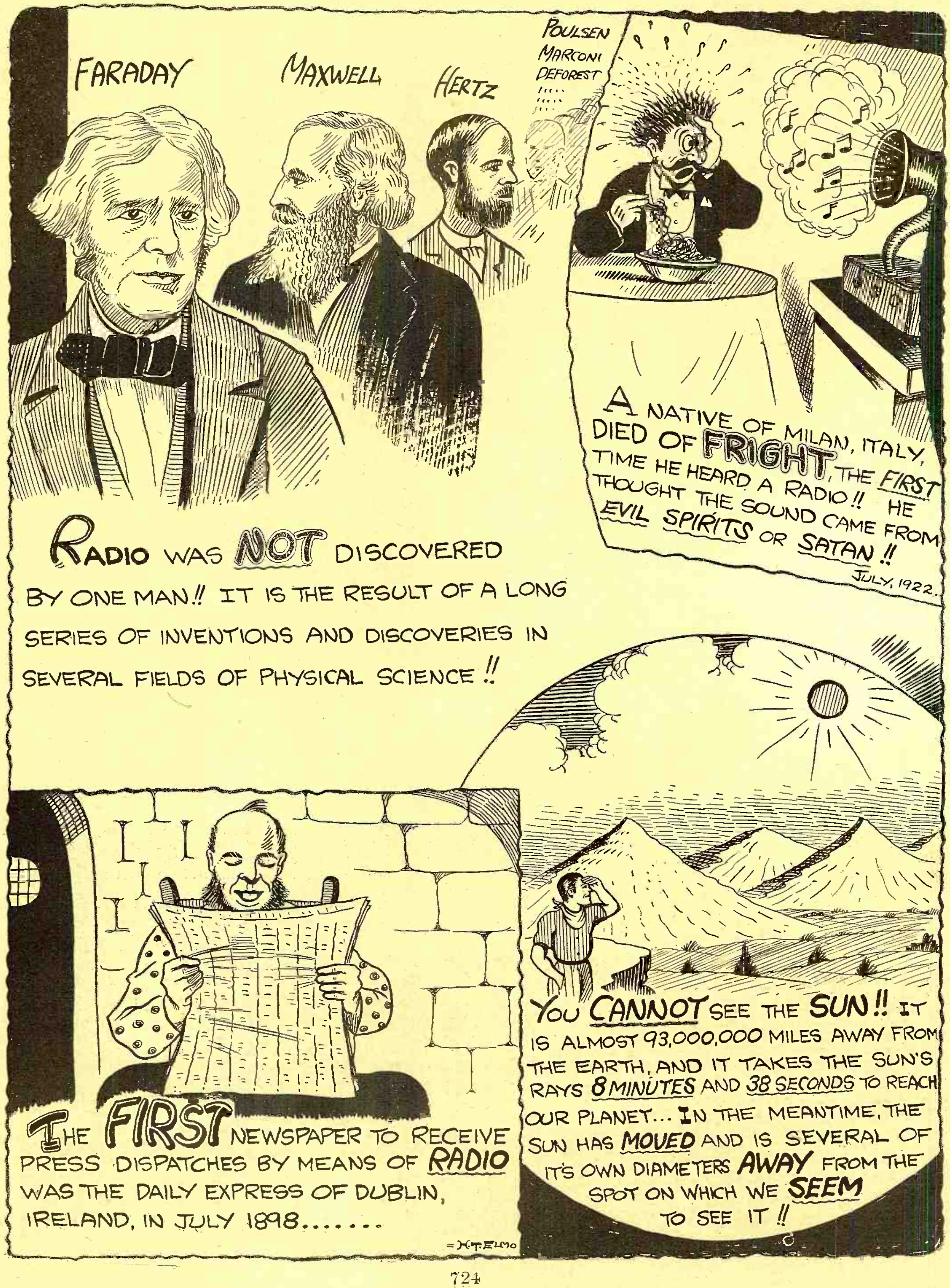
"TOMMIES" TEST RADIO ON EUROPEAN CONTINENT
A British Army Motor-Radio Unit testing communication on the outskirts of the Saarbrucken valley, now a part of Germany.



"SMALLEST RADIO"
T. A. Blanchard, 19-year-old amateur inventor, builds a bread-pan radio transmitting station, in a unit that measures 7 by 4 by 2 inches and weighs less than 2 pounds. It broadcasts voice and music.

RADIO FACTS and ODDITIES....

(Send in your Radio Oddities to "Elmo" and see them illustrated)



Radio News

June, 1935

Listen-in to Europe's

WAR OF WORDS

(The Editor—To You)

Hear the latest political developments in Europe as they unfold in the speeches and the news broadcasts coming over the short waves. You can listen to these broadcasts direct and get a first-hand understanding of the situation without moving from your chair

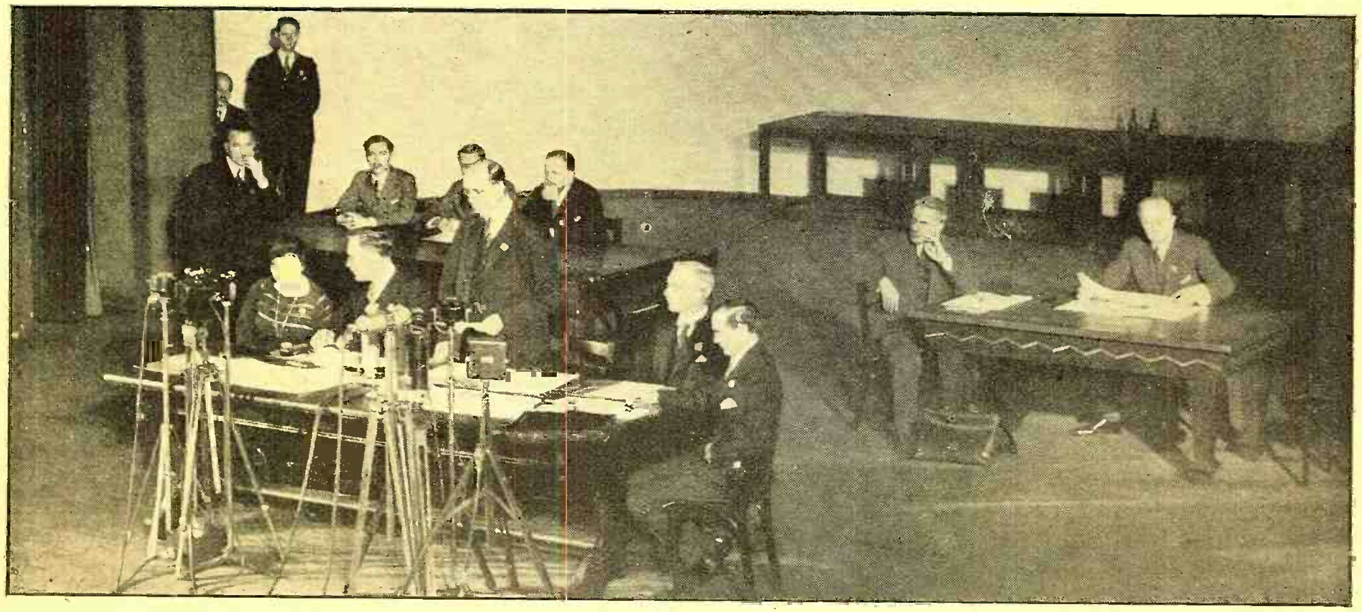
RIGHT through your own All-Wave Receiver you can hear World History in the Making. You don't have to wait for the news to be cabled across oceans or printed before you can read it. You simply tune in a short-wave broadcast from Rome, from England or Germany, from France or Belgium or Russia and there you are! The spoken words tell you the news direct, as fast as radio can carry it to you and in the very words and viewpoint of the Country to which you are listening. Yes, there *are* regular broadcasts of news from all these countries *in English* as well as other tongues.

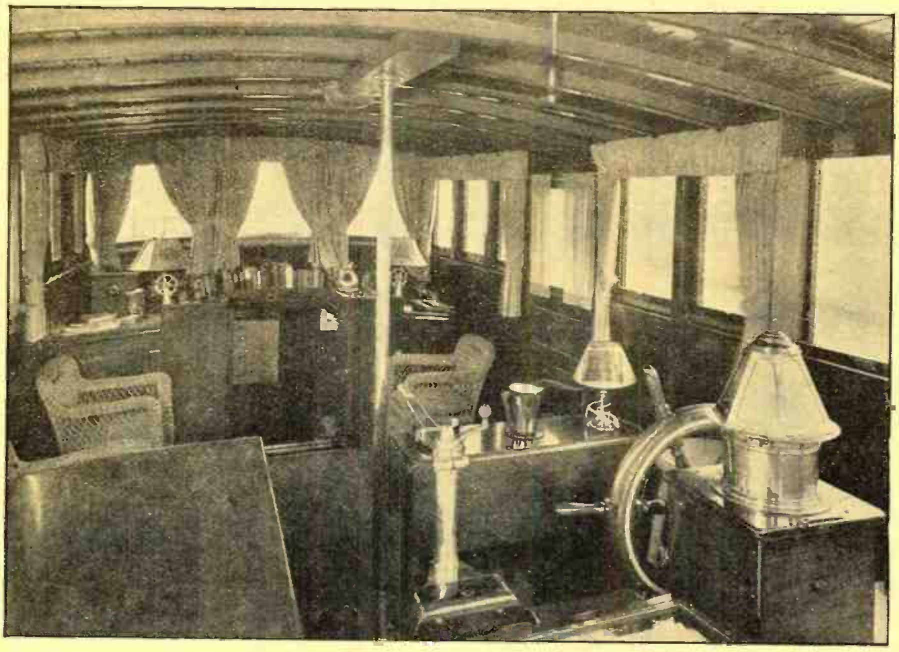
Anyone with a short-wave or all-wave set can find some European station, at any time of day, broadcasting interesting programs interspersed with news and political talks. In this way one may keep up with developments on the continent at first hand. It is extremely difficult, however, to know just when to tune in to a special European station, what wavelength to look for and at what time of day or night they are "on the air". This has always been the limiting factor to a full enjoyment of short-wave programs the world over. But now there is simply no reason for such a limitation to readers of RADIO NEWS. All one has to do is to turn to the World Short-Wave Time-Table, revised and brought up to date in every month's issue of RADIO NEWS, to find out what countries are "on the air," at what time and at what frequencies or wavelengths! All you have to do is to find the time of transmission in the Time-Table and set the dial of your receiver to the proper frequency, turn on the volume control and there's your station.

To illustrate the boon, to short-wave listeners the world over, that the Radio News World Short-Wave Time-Table is proving, we quote an excerpt from a letter taken at random from our readers' correspondence. It is from Manuel Ortiz Gomez, of Mexico City, Mexico. He writes: "I must congratulate RADIO NEWS for the arrangement of the World (*Continued on page* 783)

WHERE WORDS WERE MIGHTIER THAN ANY SWORD COULD HAVE BEEN

The Chairman of the Saar Plebiscite Committee, M. de Jongh, standing before a short-wave microphone and announcing the voting that returned the district to Germany. This broadcast was heard all over the world. The spoken word in propaganda won this district where military force would surely have failed.





YES! THERE IS RADIO ABOARD!

This comfortable cabin of the 50 ft. motor cruiser "Virginia," H. D. Crippen, Sr., of New York, owner, is equipped with a motor-car radio receiver adapted for marine use. The installation is inconspicuous and is shown in the small square on the starboard side.

New Sets For SUMMER RADIO

By W. C. Dorf *and* R. Hertzberg

Newest Portable Receivers for Every Vacation Use

ONE of the trends in the new portable sets is the rapidly increasing variety of receivers now available. The radio industry is in a position, today, to make the 1935 summer season more enjoyable than ever by offering every family a portable type set to meet every occasion, whether ashore or afloat. The summer traveller need never be without a radio to furnish him with the news of this fast changing world, to supply music for dancing or to bring his favorite program right into the summer home, on board his boat along our waterways or while travelling in his motor-car over our fine network of roads.

THE portable sets described in the following columns are suitable for all summer occasions. The new portable sets, including the motor-car type, battery-operated and new universal a.c.-d.c. compact style sets, are a vast improvement over their predecessors of the same general type, due to new circuits, new type tubes and new developments which they incorporate. The fine quality of reproduction, improvement in selectivity and sensitivity, "eye" attractiveness, simplicity of installation and operation and unusual high power that these small sets provide, will be a revelation to the listener.

Some features of the new auto sets are the use of separate loudspeakers mounted above the windshield to give ear-level reception; the employment of special filtering devices for the elimination of ignition noises as well as many other new developments the motorist will receive with enthusiasm. These new sturdy auto-type sets are also finding great favor for their ease of installation on motor boats and yachts. There are new type battery-operated receivers, with special B and C battery units and special A battery. There is also a new set which is equipped with a 6-volt-operated B power supply, which eliminates entirely the use of B and C batteries. Sets of this type are especially adaptable to the unelectrified districts, farms, camps, etc. The new universal a.c.-d.c. compact sets equipped with the handy "zipper type" carrying case are especially desirable for the traveler, for use in the hotel room, summer boarding house and on innumerable other occasions. There are also special combination motor-car and home receivers, equipped with dual power supplies, portable radio-phonograph combinations, complete mobile sound systems and, in fact, low- and high-power portable receiving equipment to meet every summer family need whether at home or traveling.

Portable Set in Zipper Case

A 5-tube a.c.-d.c. superheterodyne designed for high sensitivity and selectivity is offered by Wholesale Radio-Lafayette. Measuring only 12 by 8 by 6 inches, it is easily carried in a soft "zipper" type case, and will appeal to travelers who like a small set that can be used in hotel rooms,

summer cottages, etc. The New Deal, as the receiver is called, tunes from 550 kc. down to 1575 kc., taking in the experimental high-fidelity broadcast channel.

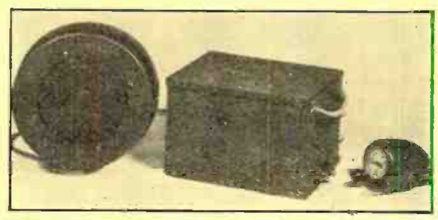
Single-Unit Receiver

The new 1935 line of American Bosch automobile receivers in round metal cabinets is a new innovation in design for which they claim improved tonal benefits. The new line includes the models 634, a 6-tube set shown in the illustration, and the model 524, a 5-tube unit. Additional fea-

tures are anchored construction, balanced sensitivity and a new type of tone control in the model 634.

Separate Speaker for Overhead Mounting

Motor-car owners will be interested in the new General Electric model D52 auto-



mobile set equipped with the attractive stream-lined remote-control unit. The separate speaker meets the new type of overhead mounting to give ear-level reception. The new developments incorporated in the set include a speech-control switch and a new antenna circuit filter.

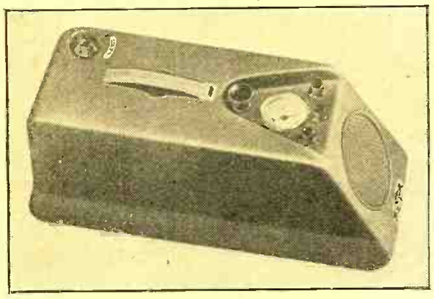
Ford Radio Embodies New Design

The loudspeaker of the custom-built radio receiver supplied for the 1935 Ford cars is located just above the rear-vision mirror in the car header and throws the

sound to both front- and rear-seat passengers. Greater fidelity of tone results from this design. The receiving set proper is mounted above the steering column, with the control unit in the center of the dashboard.

A Portable Receiver for the Auto, Boat or Summer Home

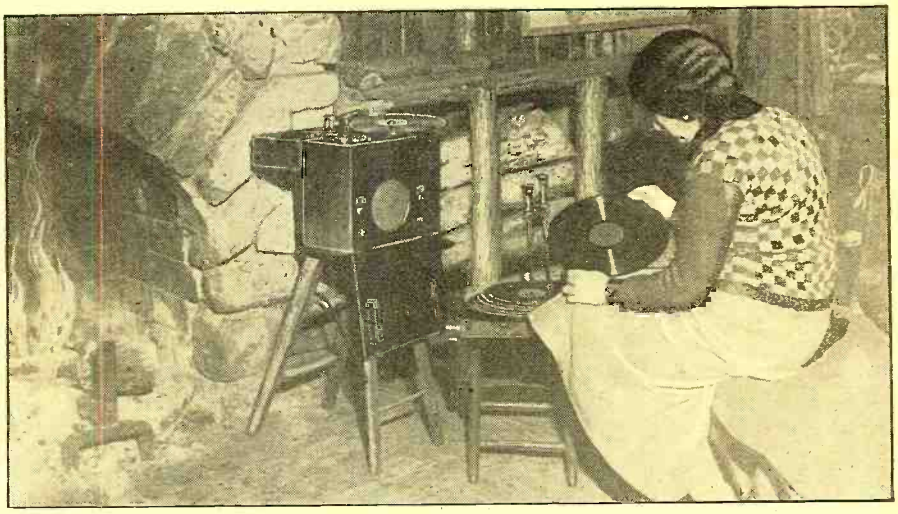
The unique receiver shown in the illustration below is made by the RCA Mfg.



Company and is known as the Portette model M116 receiver. It will operate from either the car storage battery or from 110 volt 60 cycle lighting lines and due to its compact portable design it can be placed anywhere in the car, moved around from place to place as desired and is equally adaptable to motor car, marine use or for the home. The metallic carrying-case contains a compactly-built chassis upon which are assembled a five-tube superheterodyne receiver, an electrodynamic loud speaker and independent B battery eliminators for either type of power supply. A set of this kind should find great favor with vacationists.

A New 7-Tube Set for the Camp

This table type cabinet houses the new Sentinel models 6241 and 7741 battery operated 6 and 7 tube superheterodyne receivers. The model 7741 is a dual-wave job covering the short wavelengths from 18 to 57 meters and 175 to 560 meters. The A battery drain is .620 amperes and 23 ma. for the B batteries. This company manufactures a. c.—d. c. portable sets, auto models, receivers for 32 volt current and battery operated all-wave sets.



MUSIC FOR SUMMER CAMPS

Here is a new portable electric radio-phonograph combination, for summer use. It covers the broadcast band as well as the short-wave band and plays phonograph records.

Portable Radio-Phonograph Combination

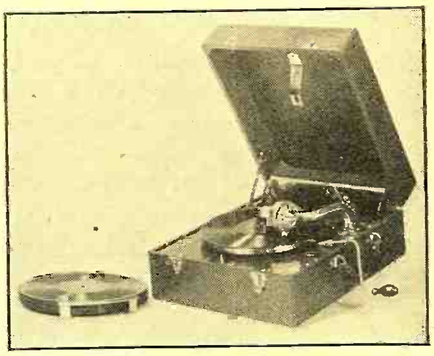
The Ansley portable Radio-Dynaphone will strike a responsive chord among vacationers who like to make their own music as well as listen to broadcast entertainment. It combines a 6-tube a.c.-d.c. superheterodyne in the same case with a phonograph turntable and a high-quality crystal pick-up. The radio tuner covers both the broadcast band and the international 19 to 50-meter short-wave channel. A 6½-inch dynamic speaker is used. This instrument is available for either 110- or 220-volt operation. As the photograph shows, the top and the front of the case open to provide access to the controls.

A COZY MARINE RADIO

A portable installation, taking up but a small space, is pictured in this owner's stateroom in the 48 ft. Chris-Craft cruiser. It uses a full-size speaker which is indicated by the grillwork in the end-panel.

A Portable Phonograph for Summer Hours

The RCA model 2-65 portable phonograph is equipped with a new type orthophonic sound box and a horn of fibrous material which overcomes the usual metallic resonance. It has an automatic start and stop arrangement, weighs 16 pounds



and is sturdily built to withstand jolts and bumps. It measures 17⅛ by 13⅞ by 7¾ inches. An improvised carrier that fits right over the turntable is used to store records.

Motor Boat Receiver

The Philco model 806T is especially designed for installation in yachts and motorboats. It is a 6-tube, single-unit superheterodyne with automatic volume control, full-range tone control, electrodynamic speaker and vibrator type power unit. The black crystal-finished steel case measures 10⅞ by 7½ by 7 inches overall and can be easily mounted in the cabin of a boat.

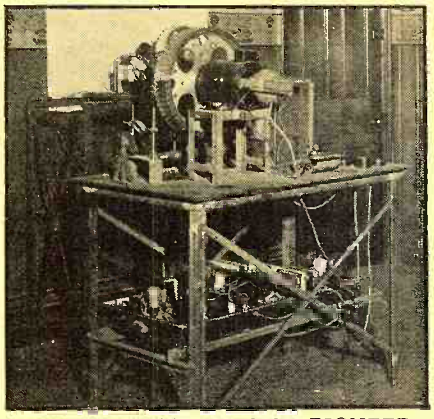
(*Continued on page 772*)

DEMONSTRATES THE PROGRESS OF TELEVISION

Mr. Baird, famous British television expert, shows the progress he has made. Below: An amusing scene showing "Jass and Jessie" in a comedy skit.

CONTROL ROOM OF THE BBC STATION

This is the control room of the television studio with the sound-control engineer, at left, and a visual-control engineer on his right.



AMATEUR TELEVISION PIONEER

Mr. Harold Bailey (at G2UF) with his announcer, Hal Jones, being televised. Above: His receiver.

British
TELEVISION

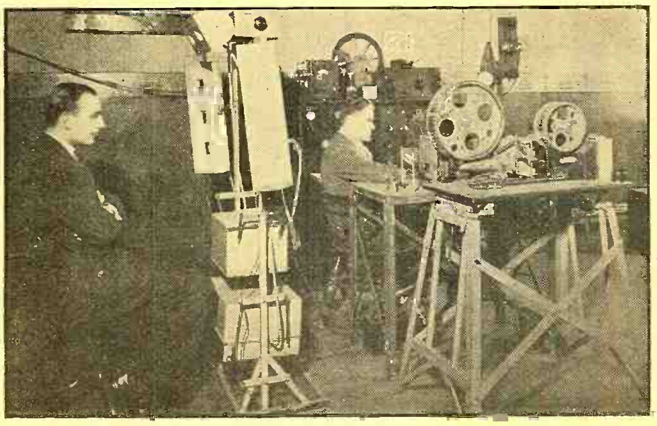
Samuel Kaufman

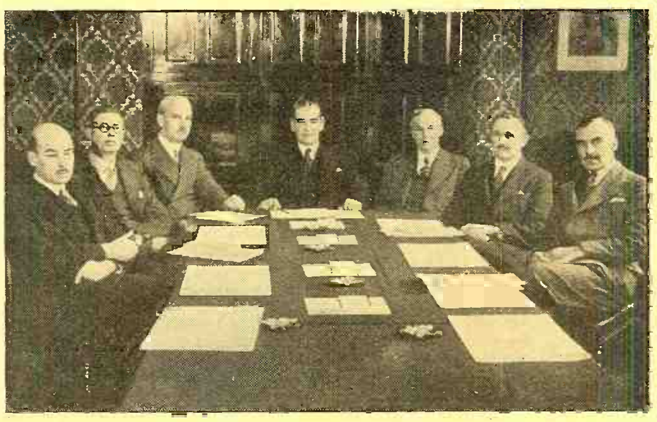
GREAT BRITAIN has decided to go ahead with television and the entire radio world has turned its eyes towards the British Isles to observe just what practical results can be obtained with present-day equipment. The Government's decision was the result of the General Post-Office television committee report. The committee, headed by Lord Selsdon, former Postmaster General, had spent many months in study of the world's television progress and had traveled extensively. Lord Selsdon, himself, headed the group visiting America last autumn.

Sir Kingsley Wood, the present Postmaster General, in announcing that the Government had considered and approved the report of the television committee, stated that television service would be started from the London area station during the latter part of 1935.

It was estimated that the television service would cost £180,000 up to the end of 1936, when the British Broadcasting Corporation's charter will expire. The required amount will be contributed in equal shares by the B.B.C. and the British Treasury.

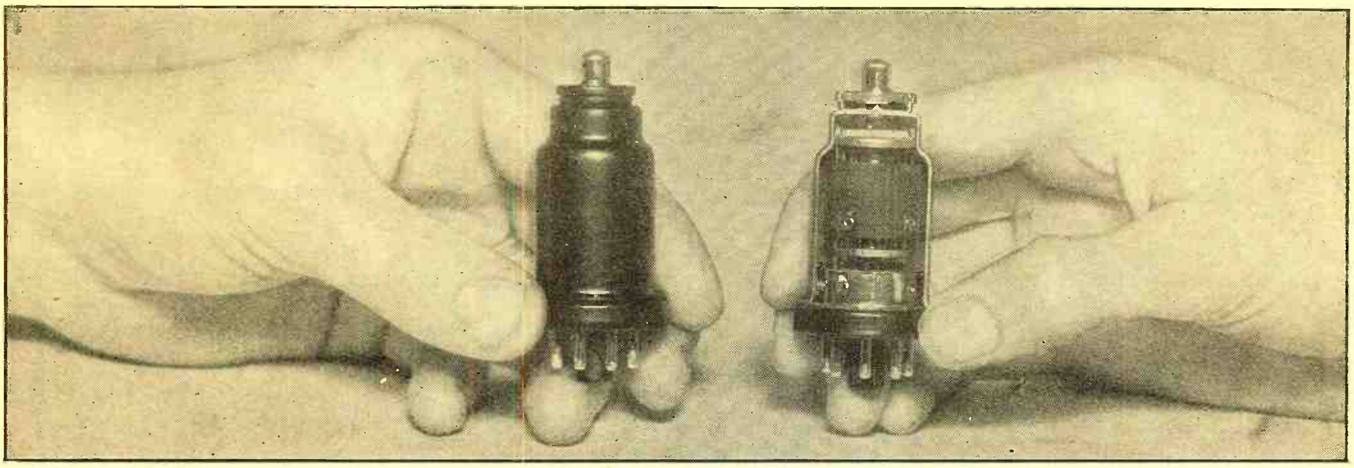
Recommendations and conclusions of the television committee point out that high definition television is in a high enough stage of development to justify initial steps of television service and that the B.B.C. should be assigned jurisdiction of sight programs. The committee further recommended that Sir Kingsley Wood should appoint an advisory committee to form and direct the initiation of Britain's television transmissions. Those designated for the advisory committee are: Lord Selsdon, chairman; Sir Frank Smith, secretary of the Department of Scientific and Industrial Research; Colonel A. S. Angwin, assistant engineer-in-chief of the British Post Office; Mr. F. W. Roberts, assistant secretary of the British Post Office; Mr. Noel Ashbridge, chief engineer of the B.B.C., and Vice-Admiral Sir Charles Carpendale, controller of the B.B.C. Mr. J. Varley Roberts was designated (*Continued on page 772*)





COMMITTEE ON TELEVISION

This is the first meeting, in London, of the British Television Commission. Left to right they are: Noel Ashbridge, O. F. Brown, Sir Frank Smith, Lord Selsdon (Chairman), F. W. Phillips, Colonel Angwin, V. Roberts.



THE OUTSIDE AND THE INSIDE
The new G. E. metal variable-mu pentode. The inside view shows the closer spacing and shorter leads.

NEW METAL TUBES

John M. Borst

NOW, for the first time, a complete new line of American all-metal tubes is presented. As early as September, 1933, RADIO NEWS announced the development of a metal tube. Also the March, 1934, issue contained a story of an experimental all-metal "Lilliput" tube. Sooner or later, we prophesied, they would become standard and here they are!

THE vacuum tube ascended one more step in the ladder of its evolution and now has lost all resemblance to its ancestor, the incandescent lamp. Mr. W. C. White, vacuum-tube engineer; Mr. I. J. Kaar, design engineer, and Mr. G. F. Metcalfe, development engineer, all of the General Electric Company, recently demonstrated and discussed the latest of all vacuum-tube development — the all-metal tube. Besides providing an efficient shield for the tube, the metal shell makes possible a sturdier construction, with better heat radiation, lower internal capacities and a more economical manufacture.

The new tubes, as shown in the illustrations, are smaller than the equivalent glass tubes. At present ten different types have been made, including a power rectifier, a triode output tube similar to the 45, a variable-mu pentode, a pentagrid tube, a hexode, a small triode and a duo-diode. This latter tube is a new type, containing two cathodes and two diode plates. It is shown at the extreme right of the lower illustration. The height of the tube (above the base) is ⅝ inch.

These tubes have an entirely new socket arrangement, which is an enormous improvement over the present one. All types, regardless of the number of prongs, will fit the same 8-contact socket. The pins are all of the same size and are placed at regular intervals. In the center is a larger pin, fitted with a "key."

In order to insert a tube into its socket, it is necessary only to insert this center pin into its hole first, then rotate the tube until the key finds its groove, when the tube can be pushed down. This can be done in the dark; it is no longer necessary to find the big prongs and the big holes and bring them into line. All tubes have one more contact pin than (*Continued on page* 776)

Questions You Might Ask

1. Does the metal tube eliminate tube shields? *Ans.: Yes.*

2. Will their characteristics be similar to present-day tubes? *Ans.: In general, yes; some entirely new types have been added also.*

3. Will prices be higher? *Ans.: No. Since the manufacturing methods are simplified, prices should be lower.*

4. Do the tubes stand up well? *Ans.: The metal envelope contributes to residual gas clean up; so the tubes should last as long or longer than present types.*

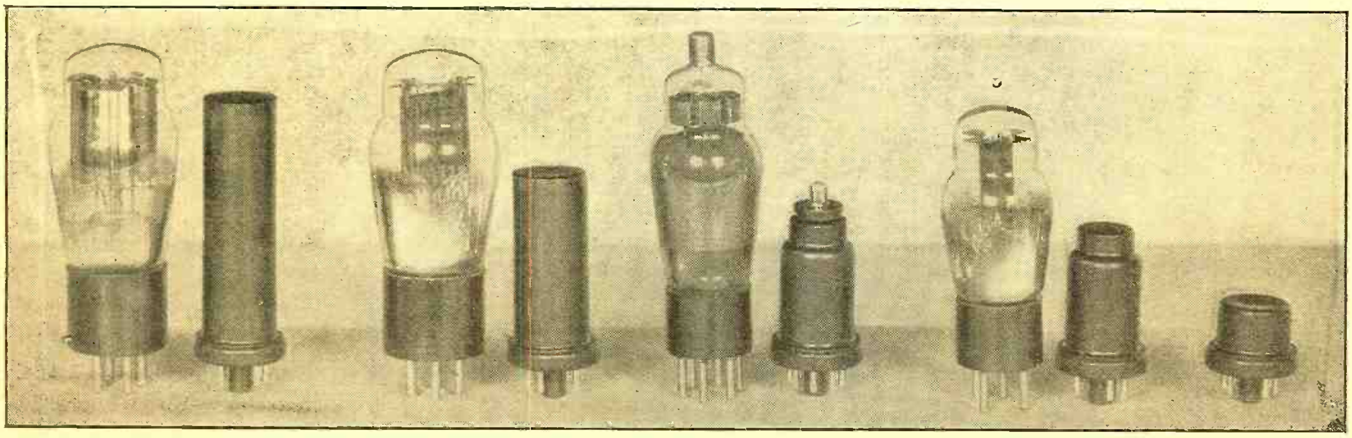
5. Do the tubes get hotter than others? *Ans.: No, the iron is a better radiator than glass and the tubes should operate cooler.*

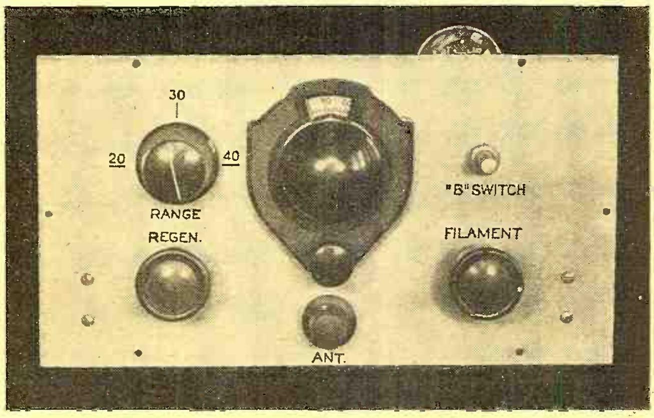
6. Can they be used for short waves? *Ans.: Yes, they are better for short waves, because internal capacities are smaller.*

7. Do you get a shock when touching the shell? *Ans.: No, the shell is grounded.*

NOTE: *Any further questions our readers might like to ask regarding these new tubes will be sent to these engineers for answers.*

THE NEW AND THE OLD
Several metal tubes, next to their glass-enclosed equivalents. From left to right: a full-wave rectifier, an output triode, a variable-mu pentode, a small triode and a duo-diode.





Make This TRI-BAND SHORT

This extremely inexpensive little receiver is an excellent one for the short-wave fan who likes to make his own—and who wants the modern advantage of range switching for the circuits

By Harry D. Hooton

As far as the manufacturer of modern all-wave radio receivers is concerned, the plug-in coil is already a thing of the past. The average set builder, however, still clings to the idea of using plug-in coils, in the belief that plug-ins really represent the best and most efficient type of short wave inductance obtainable for a multi-band receiver and that any kind of substitute, such as the common tapped coil for instance, will cause losses in sensitivity, selectivity and ease in adjustment, especially on the higher frequencies.

Painstaking experiments with various types of "plugless" coils have convinced the author that many of the claims of "dead-end" losses have been very much exaggerated. In fact, we found that in about 95% of the cases the non-sensitive and critical condition was not caused by losses at all, but simply because of an overdose of regeneration due to an improperly proportioned tickler winding. When the proper value of plate coil was used and the windings of the grid coil were spaced as shown in Figure 2, the circuit became normal at once and the sensitivity, selectivity and ease of handling on the 13-24 and the 24-39 meter bands were just as good as when the conventional plug-in coils were used. However, it should be clearly understood that very much of the success obtained with this particular type of "plugless" coil will depend upon the methods of winding and switching. The plate coil must be coupled to *the grid end* of the tapped coil and the windings of the latter must be spaced at least 3/8 inch or more. The band-change switch is arranged in such a manner that the unused portion of the coil is short circuited at all times.

The receiver described here is the result of the experiments mentioned above. The detector portion, with the exception of the coils of course, is similar to the circuit described on page 23 of the July, 1934 issue of RADIO NEWS. This set, however, is more efficient than the earlier model and is considerably easier to operate. The receiver as shown here is ideal for the fellow who wants a good easy-to-handle distance-getting short wave set without too much expense or complicated features.

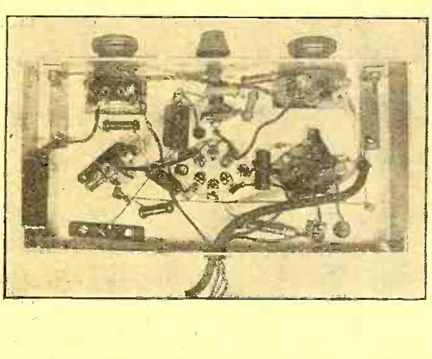
As shown in Figure 1, the circuit consists of a standard regenerative detector followed by two stages of resistance- and condenser-coupled audio-frequency amplification. The receiver has a continuous frequency range from 22 mc. to 4.5 mc. (13 to 65 meters approximately), being divided into bands as follows: band 1—13 to 24 meters; band 2—24 to 39 meters and band 3—39 to 65 meters. This arrangement effectively covers most of the frequencies used in present day short wave activities excepting those included in the 80 meter amateur band. Few persons, unless they happen to be licensed amateurs, are interested in this band anyway; however, later on in this article, we shall give data on a coil which will cover this band also.

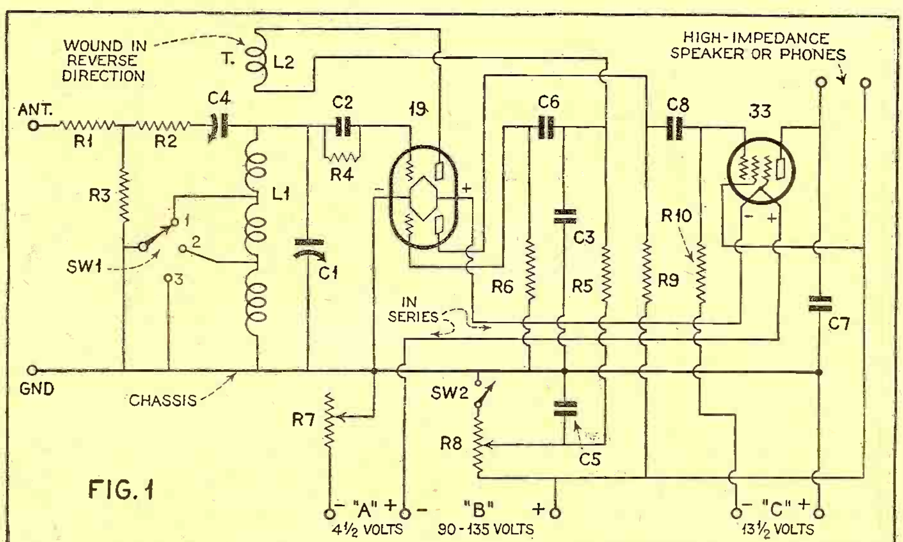
A type 19 "twin" tube is used in the detector and first audio stage and a type 33 pentode is used for output. Since both of these tubes have very high amplification factors, the volume compares favorably with that of similar receivers using four tubes of the ordinary type.

These tubes were not chosen entirely because of this convenience and economy, however; *the type 19, in addition to being an extremely sensitive detector, is the only triode, in the battery series of tubes, which will oscillate with approximately equal sensitivity on either end of the tuning range without changing the value of the tickler coil.* This characteristic is absolutely essential if the tapped coil is to be a success.

The construction of the set is very simple and even the most inexperienced person should have little difficulty in building it. The various parts are mounted on a 1/16 inch thick aluminum panel and chassis 6 by 10½ and 4½ by 10 inches respectively. The chassis is 2 inches deep. With the exception of the tubes, coil, tuning condenser and the two switches, everything is underneath the chassis, giving a very neat appearance to the set. The exact location of each and every part has been selected with efficiency in mind and therefore the layout shown in the photographs should be adhered to if results obtained by the writer are to be duplicated. All wiring, including that of the audio

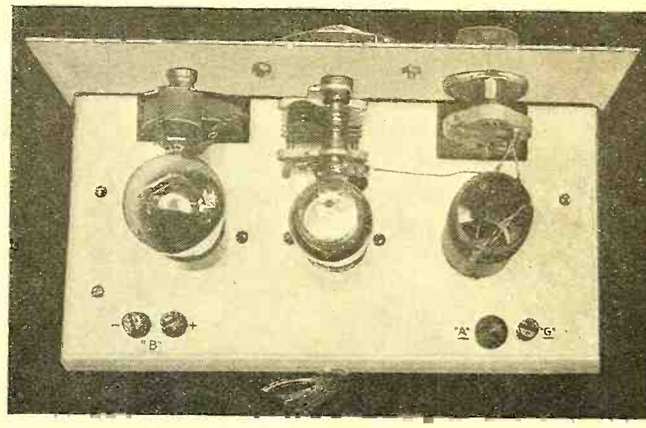
UNDER THE CHASSIS
This view shows the location and wiring of parts.





¶ *Covers ranges 13-24, 24-39 and 39-65 meters without plug-in coils*

WAVE RECEIVER



stages, is kept as short and direct as possible.

The coil and the inductance switch are probably the most difficult items to construct, although even these are easily made. As shown in Figure 2, the coil is of the tapped variety, the change from one band of frequencies to another being accomplished by the simple process of shorting out the unnecessary portion of the winding. In this particular coil the windings are placed on a one inch bakelite form, taps being taken off at the fourth, seven and three-fourths and fifteenth turns. *Whenever a tap is taken off, the next winding must be spaced at least 3/8 inch or more from the turns of the preceding coil.* If the windings are not spaced in this manner losses will take place in spite of every precaution. The tickler coil is wound in the reverse direction to that of the grid winding in order to reduce the detuning effect of the regeneration control and is coupled to the *grid end* of the tuning coil. Do not wind this coil between the turns of the grid coil! Four turns of No. 28 enameled wire, close wound, will give sufficient excitation on all bands without saturation at the high-frequency portion of the tuning range.

If operation over the entire short wave spectrum between 14 and 100 meters is desired, the coil will consists of a total of 19 turns with taps at the fourth, eighth and nineteenth turns. The tuning condenser used with this coil must be of 140 mmfd. (.00014 mfd.) maximum capacity instead of the 80 mmfd. type used in this receiver. In either case the turns must be spaced to eliminate the losses; the tickler coil is the same also—four turns.

The author was reluctant to give up the advantages gained through the use of the new low loss insulating materials; so, after searching through a dozen mail order catalogs and failing to find anything which corresponded to our idea as to what a low-loss inductance switch should be, we built the one illustrated herewith. As shown in Figure 2 the home-made wave-change switch is made from an Eby ceramic socket and an old filament rheostat of the midget type. The rivets holding the socket terminals were drilled out and the contacts were removed from the socket. Three switch points were then fitted to the rivet holes, the tops being rounded off somewhat to allow the rheostat arm to sweep smoothly over them. The resistance element was removed from the rheostat and the arm was reversed on the shaft as shown. Finally the socket and rheostat were assembled as shown in Figure 2, being held together by means of two one inch long machine screws. To obtain a "sure-fire" connection to ground, a flexible "pig-tail" wire is soldered to the arm and to the grounded portion of the switch. The positions of the switch knob for the different ranges are also illustrated in Figure 2.

If the photographs, diagrams and drawings have been carefully studied, even the novice should have little difficulty in wiring the set. Like all short-wave sets the leads must be kept as short as possible, especially the "hot" plate and grid wiring and the wires from the coil taps to the band-change switch. These last mentioned leads must not be over one inch in length at the most and should be straight and direct with no sharp bends or turns.

The various coupling condensers and fixed resistors are mounted directly on the sockets, the tinned leads being of sufficient stiffness to hold them in place. This method is very good unless the set is to be knocked around a great deal. In this case it is advisable to mount the resistors on small bakelite squares or strips to prevent short circuits to the chassis. If any of the plate resistors should come in contact with the chassis while the "B" batteries are connected, both tubes will instantly be destroyed.

Needless to say all connections must be carefully soldered.

Either 90 or 135 volts can be used on the plates with good results. If a speaker is used, the higher voltage will give more volume, of course; if phones are used 90 volts will give plenty of volume and there is less danger of damage to the phones. Three ordinary dry cells are used for the A battery, and since the total drain is only .26 ampere, they should last at least two to three months before a replacement is necessary.

There is no "C" bias used on the 19 unless a "motorboating" sound is heard when adjusting the regeneration control. In case this happens, (*Turn to page* 780)

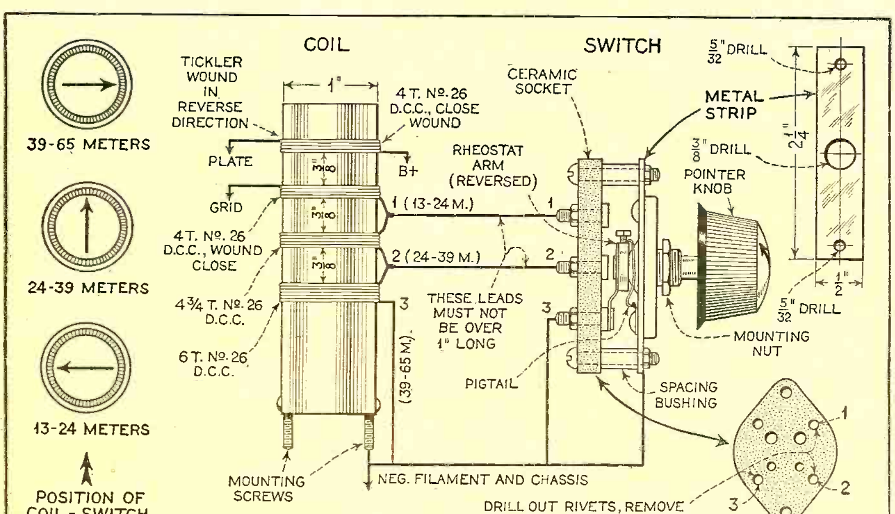
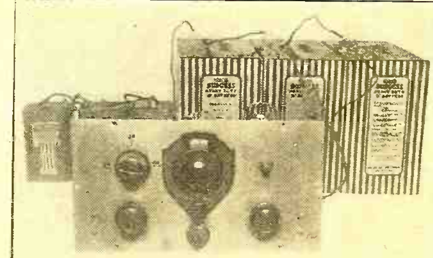
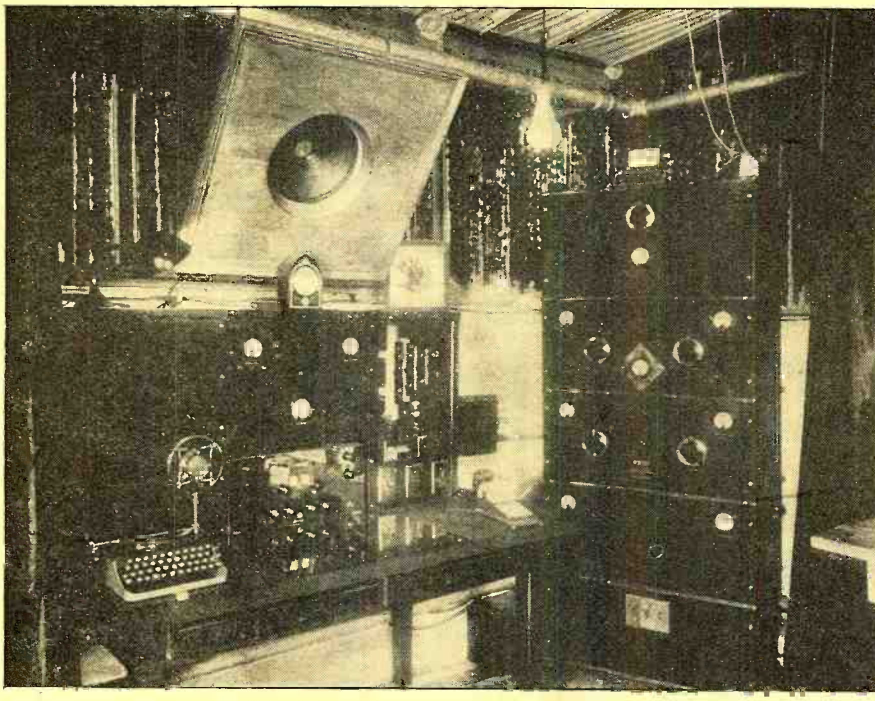


FIG. 2

ALL SET TO GO

Here is this Hooton receiver, ready for operation. The 1½-volt cells at the rear left are the newly developed type which have the life of standard No. 6 cells, but are small in size and of improved appearance.





A PENNSYLVANIA "HAM" STATION
Station W3EOZ, owned and operated by Thomas A. Consalvi, of Bryn Mawr, Pa. The telephone transmitter is shown at the right, and employs a pair of 852 type tubes in push pull with about 700-watts input in the final amplifier. The crystal oscillator is a push-pull arrangement and is operated mostly on 1910 kilocycles. Station W3EOZ operates on both 160 and 20-meter phone bands, and a separate transmitter (not shown in the picture) is used for 20-meter operation. The antenna is a half-wave 160-meter Zeppelin, and is suspended well in the clear on a 300 acre farm. W3EOZ identifies himself on the air as "Three Elegantly Ossified Zebras." Signals from the station have been heard in all parts of the world, and W3EOZ has worked all districts in the United States and Canada but the 4th and 5th Canadian, on 160 meter 'phone.

THE "HAM" SHACK
CQ CQ CQ

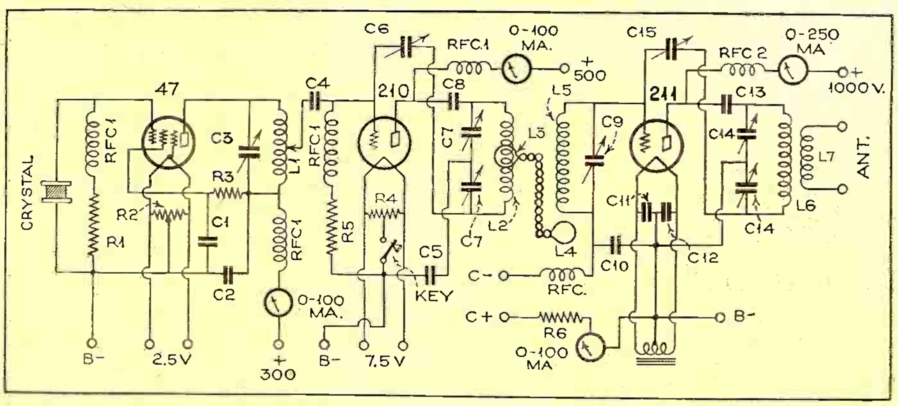
THIS department has received a number of requests for descriptions of amateur transmitters ranging in power from 20 to 30-watts output to higher power ranges. Several requests have been received for a description of a transmitter that could be used with the modulator and amplifier described in the December and January issues of RADIO NEWS.

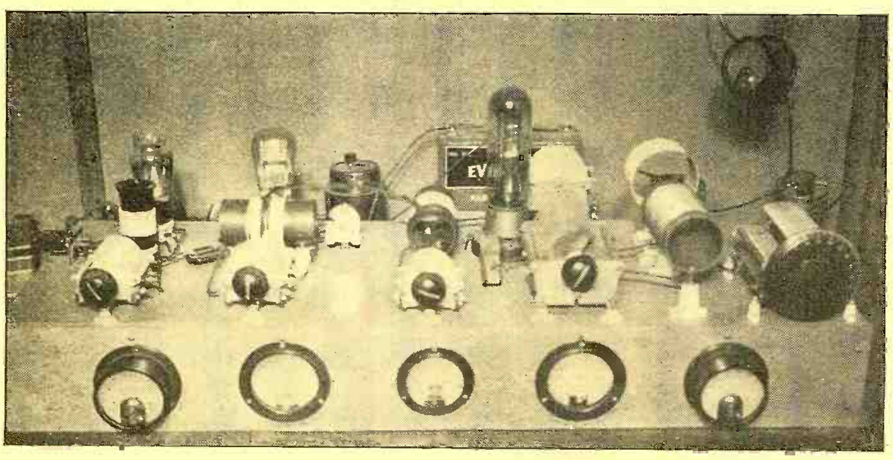
IN these days of modern amateur radio, an amateur transmitter should include all of the latest devices for the transmission of a stable signal that will cause a minimum of interference and provide a maximum of efficiency. The cost of component parts that make up the average station is much lower than it has ever been. For instance, today, it is possible to purchase good crystals for two to three dollars, whereas, five years ago, one would cost seven to ten dollars. Not so very long ago a crystal set the amateur back twenty-five dollars.

It is an undisputed fact that a crystal will provide the most stable type of signal and, despite the advocates of electron-coupled oscillators which may be designed to provide a high degree of stability, there is no comparison between the two. Also, with a very definite trend in amateur circles toward the more extended use of telephonic communication, the amateur planning a new transmitter should design it so it also may be adapted for voice transmission as well as c.w. To the newcomer in the amateur ranks, the crystal transmitter is by far the safest thing to attempt. While its construction and operation may seem to be complicated when described in print, actually it is very simple. The advantage of the crystal transmitter is that one knows at all times whether or not he is operating within a given band. It is impossible to miss, because a good crystal has only one resonant point, and the calibrations supplied by the manufacturers are reasonably accurate—even for the cheaper crystals. It is possible to secure a higher degree of accuracy for a few dollars more, but calibrations estimated to be within 1 percent are accurate enough for general amateur work, as long as they are not on the edge of an operating band.

In designing the amateur transmitter, it is always wise to consider the possibility that, some day, voice transmission may be tried. Therefore, it is almost essential to provide a buffer stage to isolate the oscillator from the modulated amplifier (for reasons of stability and quality of modulation). With this same idea in mind, the modern amateur transmitter should be designed for operation on practically all of the amateur bands. Again the buffer stage is necessary to provide a doubler-amplifier, if the higher frequencies are employed.

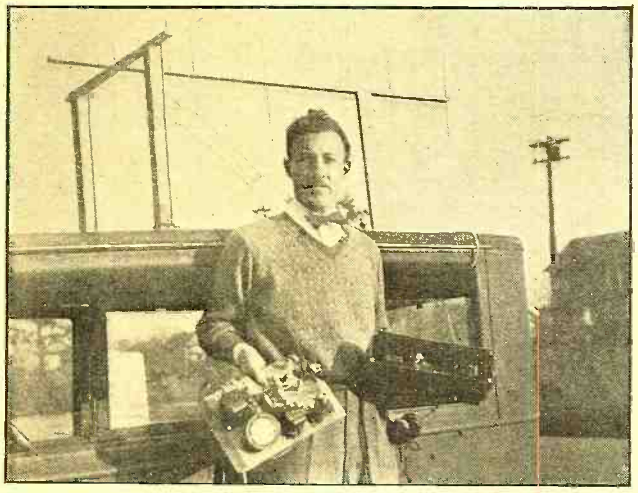
A medium-powered transmitter for all-band operation has been designed and constructed by this department as typical of the average amateur station. It is designed for inputs from 100 to 200 watts and is suitable for voice or telegraph. The transmitter has been laid out in the simplest manner and essentially follows the schematic wiring diagram. It might be described as a baseboard transmitter, but is made to appear somewhat neater by mounting the baseboard on a rectangular box 5 inches high. The box arrangement provides a convenient mounting for all meters and hides all of the small component parts such as small condensers, resistors, etc., leaving only the tube sockets, coils and associated apparatus exposed on the surface.





The transmitter employs a 47 type tube in a crystal oscillator circuit followed by a

(Continued on page 773)



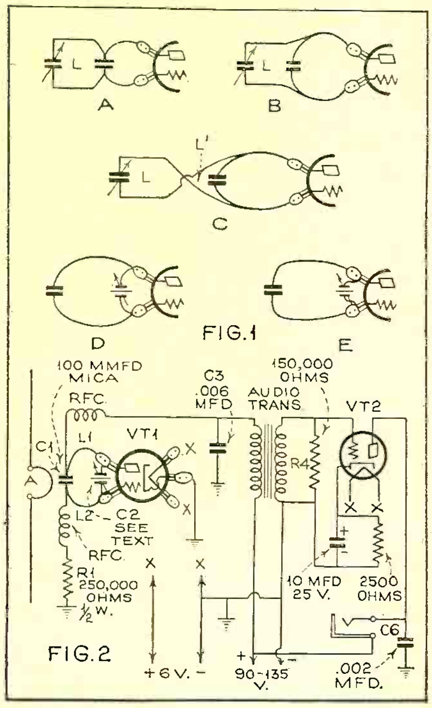
The "Acorn" Tube ON 3/4 METER

(The Receiver)

Equipped with the receiver described, the experimenter will be "in on the ground floor" of pioneer development work contemplated by commercial and private interests, in the range below one meter

Ed Glaser *

Part Two



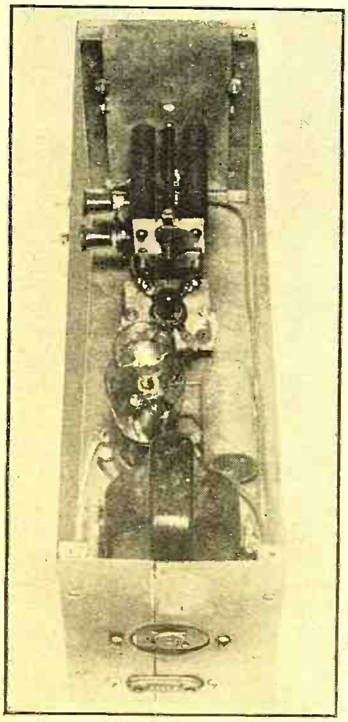
THE receiver utilizes the same circuit as the transmitter described last month, but is made to superregenerate by using a high resistance grid leak, 100,000 ohms or higher being satisfactory. The very thing that was undesired in the transmitter is necessary to receiver operation. The milliammeter should again be used during the tuning-up process, the double dip being essential for proper results. The behavior of the receiver is not unlike a typical "self-supering" 5 meter receiver although the rushing sound is less pronounced. No trouble at all was experienced with the electrical end of the receiver but the problem of tuning was a difficult one to solve satisfactorily.

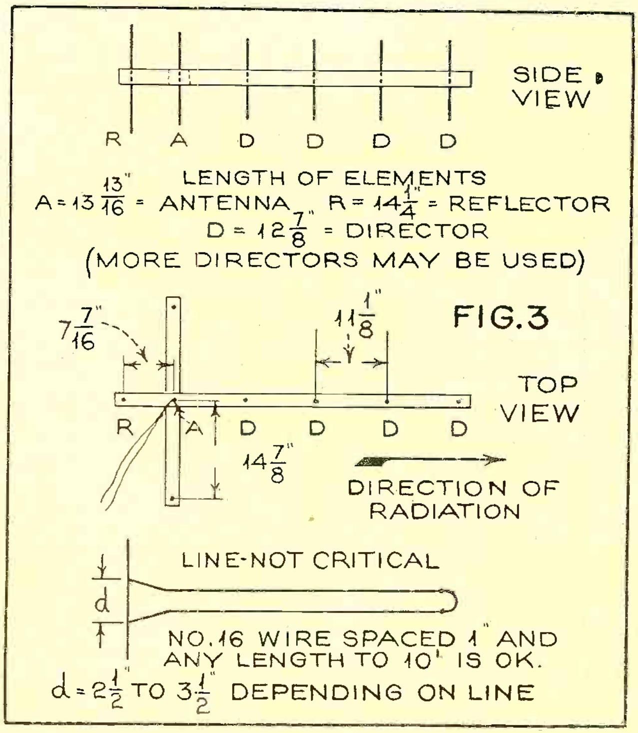
The most suitable tuning condenser would be the disc type about ½ inch in diameter but no such condenser is available. The disc that is movable must always be exactly parallel to the stationary disc necessitating a very rugged mount and a screw without play. The disc, of course, must be insulated from the screw. The writer being but a pseudo-mechanic, this type of construction was not attempted. Instead, a means of tuning was sought using a small, standard variable condenser.

Figure 1 shows some of the schemes tried, only the necessary circuit elements being shown. 1(A) showed some tuning effect but the effect was really incidental to a loading effect caused by the loop "L", which absorbed energy from the main oscillatory circuit. At one point in the range the loop was resonant, completely stopping oscillation. 1(B) shows the condenser connections made to a point of higher r.f. voltage, which made matters worse. By reversing the leads to the condenser, as in 1(C), two loops "L" and "L'" were formed which tended to cancel absorption effects when correctly proportioned. Even so, the system was poor. A Cardwell Trim-Air condenser was cut down to two (*Continued on page 782*)

THE CIRCUIT

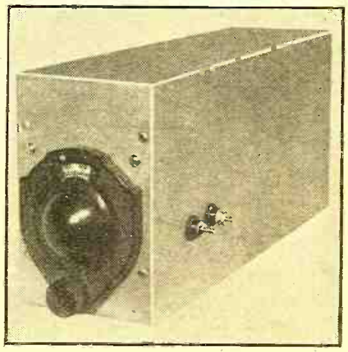
Figure 2. The inductance L1-L2 is similar to that shown in the photo of the ¾-meter transmitter last month. The antenna loop terminates at the 2 porcelain insulators on the wall of the shield and can be bent to provide the desired degree of coupling.

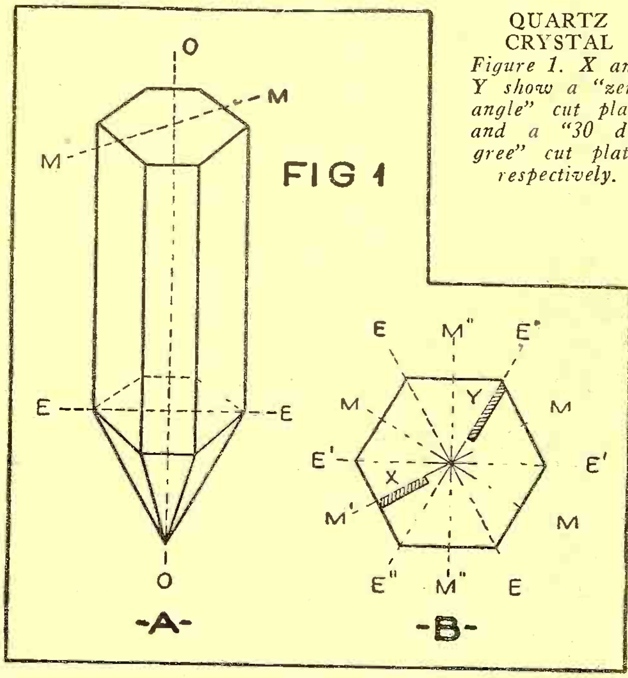




THE YAGI ANTENNA

Figure 3. The details of the antenna used by the author. The photograph of the author, above, shows this antenna mounted on his car.





QUARTZ CRYSTAL
Figure 1. X and Y show a "zero angle" cut plate and a "30 degree" cut plate, respectively.

THE DESIGN OF CRYSTAL

Crystal Filters employed in radio have heretofore been thought of only in connection with very narrow bands; they have been utilized in receiver designs for the purpose of providing super-selectivity in tuned circuits. Recent investigations disclose possibilities for new applications—as *wide*-band filters in modern-type high-quality radio receivers

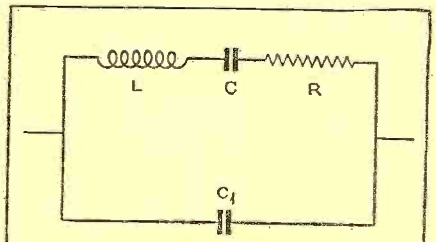


FIG.2

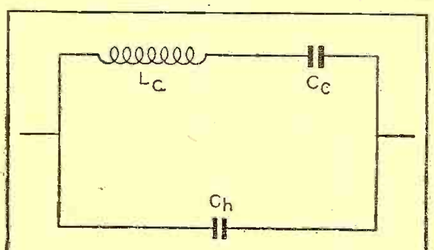
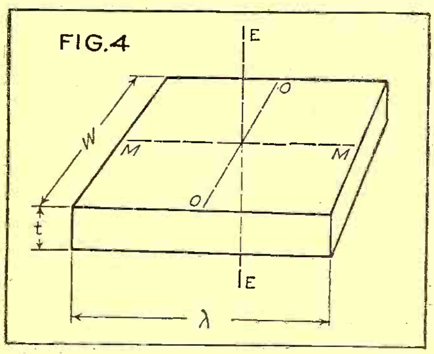


FIG.3



QUARTZ crystals have been in use for many years as frequency standards and stabilizers, but their possible adaptation to the need for low-dissipative circuit elements—such as would be required for a band-pass filter having a truly rectangular response characteristic—seems not to have been completely realized by the radio profession. True, some crystals have been employed for the peaked tuning of the intermediate-frequency amplifier designed for c.w. reception, but the tuning is so critical that even the comparatively narrow band width necessary for intelligible speech (some 2200 cycles) is sharply attenuated. The prospect of using such a system for the reception of broadcast programs promised results too horrible for further contemplation.

Recent developments, however, indicate a probable field of usefulness in quality radio reception. Crystal filters, capable of passing the requisite band width, appear to be a physical possibility. It is the purpose of this series of articles to discuss certain fundamental features of the crystal filter problem and to show, where possible, how the developments mentioned above might be applied to radio use. For the benefit of those to whom the equivalent circuit method of analysis—which will be used throughout—is unfamiliar, several references of value are given at the end of this article.[1, 2]

Quartz crystals occur in nature in a generally hexagonal form, i.e., the cross-section of a perfectly symmetrical crystal would be a hexagon. Three sets of axes are found in every quartz crystal, regardless of what its actual shape may be.

The first of these axes, the optic, is a normal to a cross-section of the crystal; it is shown as the line 00 in Figure 1. Other axes, the electrical, are lines joining the vertices of the cross-sectional hexagon; in Figure 1 these are indicated by the lines of EE, E′E′ and E″E″. Another set of axes occurs at an angle of 30° with the electrical axes and in the same plane. This puts these axes perpendicular to opposite faces of the crystal. They have been called "mechanical" axes by F. R. Lack[3] of the Bell Telephone Laboratories, Inc., and his designation will be used throughout. Lines MM, M′M′ and M″M″ in Figure 1 indicate these mechanical axes.

The piezo-electric effect, which is the phenomenon of dimensional change in the quartz crystal under the influence of an applied electrical field, is most pronounced in directions at right angles to the optic axis and is also much greater along certain axes of the crystal. Plates for radio use are, for this reason, cut with a definite orientation with respect to an electrical axis. The zero-angle cut, sometimes called the X cut, is so called because a normal to the face of the plate is parallel, i.e., makes an angle of zero degrees, with an electrical axis. The 30° cut—known also as the Y cut—has a normal to the face of the plate forming an angle of 30° with an electrical axis; in other words, the normal to the face of the 30° cut plate is parallel to one of the mechanical axes.

Each of these cuts gives a plate with

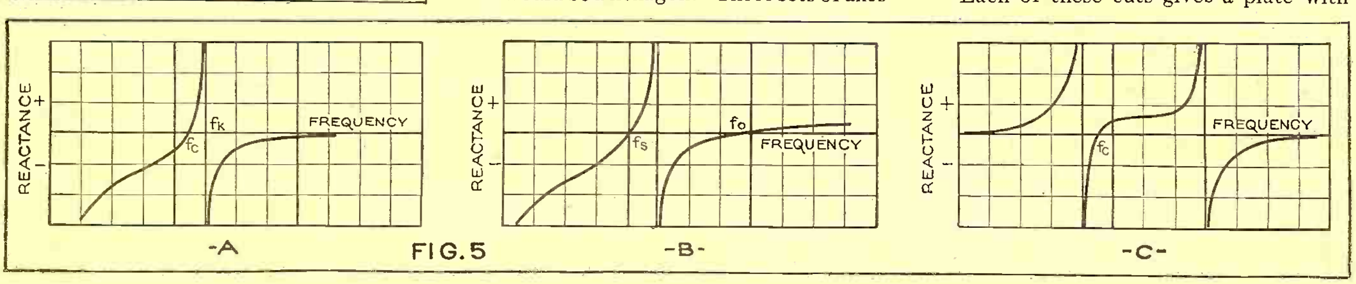
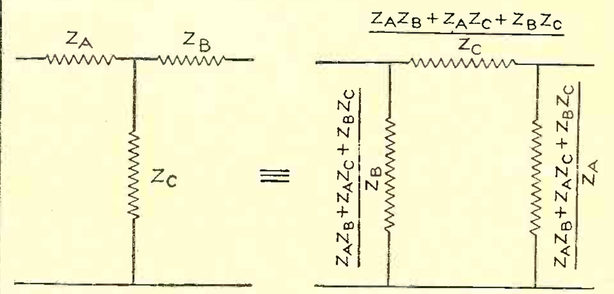


FIG.5

BROAD-BAND FILTERS

W. W. Waltz

Part One



-A- FIG. 6 -B-

somewhat different characteristics. The temperature coefficients are different, being negative to the extent of perhaps 15 to 25 parts per million per degree centigrade for the zero angle cut, and positive some 25 to 100 parts per million per degree centigrade for the 30° cut. Lack[4] discusses various other temperature coefficients obtainable with certain cuts, and C. E. Worthen of the General Radio Company has written on the general subject of quartz plates in greater detail.[5].

Connected into an electrical circuit, the piezo-electric quartz plate "appears" to the rest of the circuit as a sharply tuned combination of inductance, capacity and resistance. K. S. Van Dyke,[6] investigating this equivalence of quartz plates and resonant circuits, found that a crystal having a fundamental frequency of about 1100 kc. gave the following values for the elements of the equivalent circuit shown in Figure 2:

$L = 330$ mh.
$R = 5500\ \omega$ (approx.)
$C = .065$ mmfd.
$C_1 = 1.$ mmfd.

For a sharply tuned circuit, 5500 ohms may seem to be an inordinately high resistance. However, this resistance may, without appreciable error, be considered as inherent in the coil—the condenser C being assumed loss-free. A consideration of these points will show that, at the crystal frequency (1100 kc.), the coil is quite efficient, its Q being about 414. Further consideration will make evident the impracticability, if not impossibility, of physically realizing a coil of 330 mh. inductance with a distributed capacity low enough to insure that the coil reactance will remain inductive at 1100 kc.

Van Dyke points out, and later discussion will show, that the series branch of the circuit of Figure 2 corresponds to the vibrating crystal. The shunt capacity C_1 is, in Figure 2, a function of certain crystal parameters which are not pertinent to this discussion. The preponderance of C_1 over C, however, makes C_1 the dominant factor of the impedance of the equivalent circuit, except in the vicinity of the resonant frequency where the series combination of L and C become controlling.

In Figure 3, which is essentially Figure 2 without the resistance and which will be employed later in the derivation of the elements for the various types of filter networks, the shunt capacity C_h includes the electrostatic capacity of the crystal electrodes, or holder. As will be shown in equations (2) and (3), appearing below, the ratio of C_h to C_c is 125 or greater. This ratio of 125 or more will be used later in the design of the filter networks as a check on certain of the computations.

Crystals for filter use are cut as follows: The length λ is parallel to the mechanical axis; the width w is parallel to the optical axis; the thickness t being parallel to the electrical axis. This plate, shown in Figure 4, is, in effect, a zero angle or X type. Plates cut with different orientations are entirely feasible, especially if the absolute minimum in temperature coefficients is desired. The plate cut as described exhibits, to a point somewhat above its first resonance, an impedance corresponding to that of the simple circuit of Figure 3—provided its length is greater than the width, i.e., $\lambda = 3w$ or more—this impedance being shown in the curves of Figure 5 (A)

The elements of the crystal-equivalent-circuit may be expressed in terms of the crystal dimensions, in centimeters, as follows:

$$L_c = \frac{106.1\ \lambda t}{w} \text{ henries} \qquad (1)$$

$$C_c = \frac{.322\ w\lambda\ 10^{-14}}{t} \text{ farads} \qquad (2)$$

(*Cont. on page* 776)

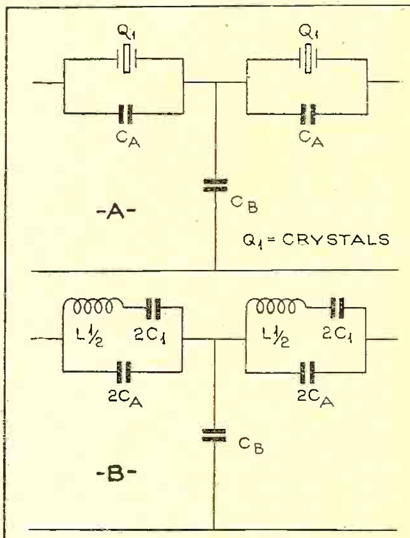


FIG. 7

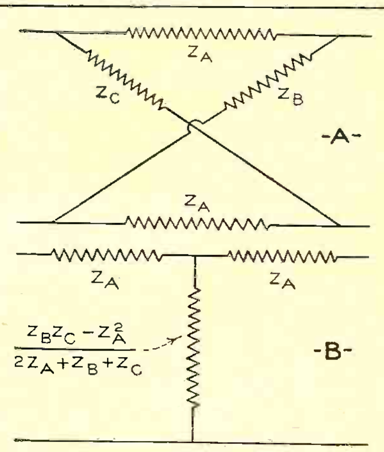


FIG. 8

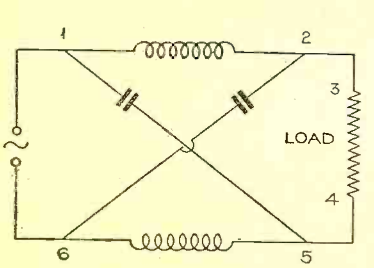
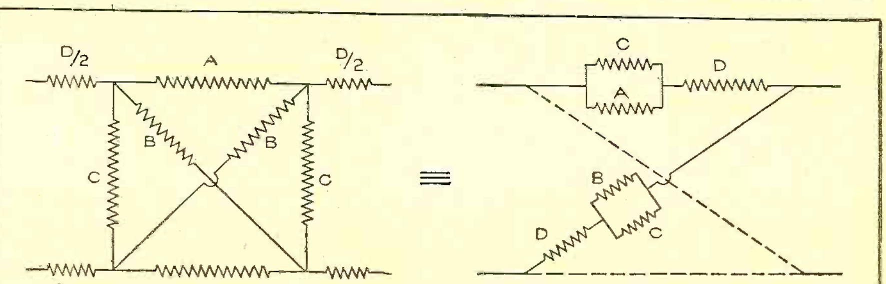


FIG. 9

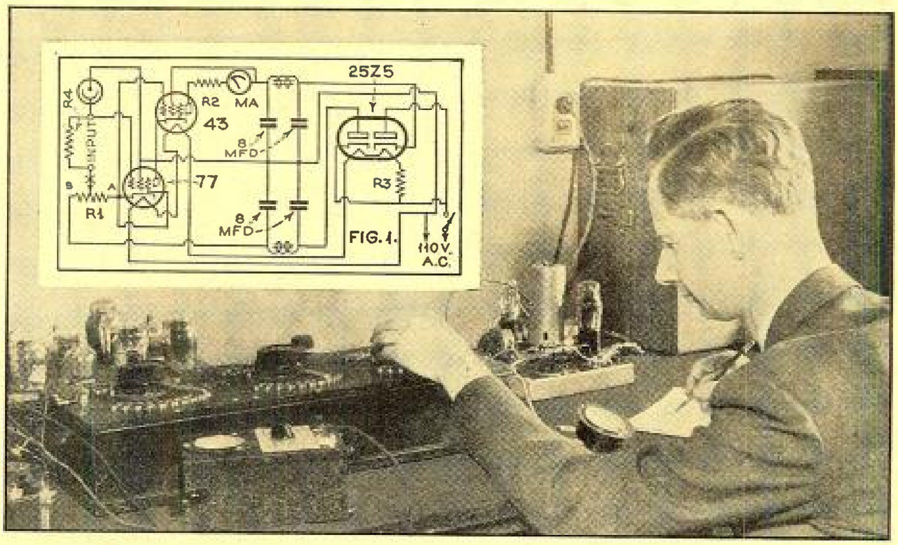


BROKEN LINES REPRESENT ELEMENTS IDENTICAL TO THOSE SHOWN

-A- FIG. 10 -B-

A New DIRECT-COUPLED AMPLIFIER

By the Staff



SO far there have been two types of direct-coupled amplifiers which have found wide application. These are the Loftin-White circuit and the circuit employed with the Triple-Twin tube. Now, another circuit appears which is different from either of these.

For some time an inventor, Otto Greenberg, has been working on an original engraving system employing a photocell and amplifier which scans the picture and controls the engraving tool. The photocell amplifier needed in this case had to be a d.c. amplifier and had to give sufficient output to control the cutting tool. The circuit which he developed to accomplish this end is shown in Figure 1. It provides unusually high variation in plate current with the available light intensity variation and uses an economical power supply. It is believed that this is the highest amplification yet obtained with such a power supply and but two tubes.

The circuit employs a 25Z5 as two separate rectifiers for two power supplies which are connected in series. One of these furnishes the required plate voltage for the 77 tube, the other for the 43 tube. The load (R1) of the 77 tube is in the cathode circuit. Naturally, any change in current in this load results in a change in voltage across the load, and an equal but opposite change in voltage across the tube (the 77). This latter voltage drop is used as the grid bias for the 43 tube and thus the 77 is economically coupled to the 34 without having to worry about high voltage on the grid.

In order to provide a bias for the 77, the inventor employs a potentiometer for R1 and adjusts this for his requirements. It should be noted that the self-bias will cause degeneration and give less amplification; the highest gain is obtained when the arm of the potentiometer is set at A and a suitable biasing battery is used at X. This will be shown later.

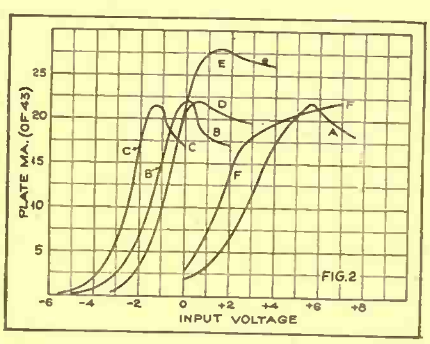
When this amplifier was set up in the RADIO NEWS laboratory, the plate current of the 43 tube was found to vary from 2 ma. to 22 ma. as a paper having dark and light areas was moved across in front of the cell. Holding the paper at greater distances from the cell gave the same results, but then the light and dark areas on the paper had to be larger. The instrument worked entirely from the daylight reflected by the paper, with the cell directed away from a window.

Leaving the adjustment as it was, the photocell and R4 (a 50-megohm resistor) were removed and known d.c. potentials were applied to the input terminals by means of a General Radio voltage divider, noting the plate current of the 43. The results are shown in curve A of Figure 2. In this case R1 was 1 meg. and R2 was 4500 ohms. The arm on R1 was adjusted for 2 ma. plate current in the 43, with no input. Incidentally, the filament resistor R3 was 200 ohms, 30 watts.

Several changes were made, to see what could be done to increase the amplification, and each time another curve was made. Reducing the self-bias until the current in the load (R2) was 22 ma. with no signal, curve B was obtained. This is much steeper than curve A, with the result that changing the input potential from −2.4 to −.4 volts (a change of 2 volts) results in a plate current change of 17 ma.

Next, the self-bias was removed entirely (setting arm of potentiometer at A), this gave the curve C.

Curve D (*Continued on page* 783)

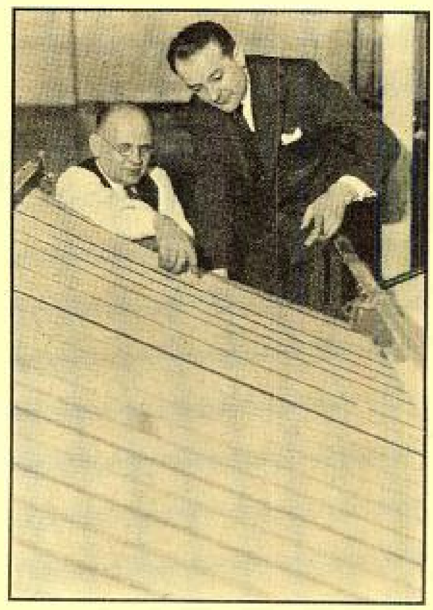


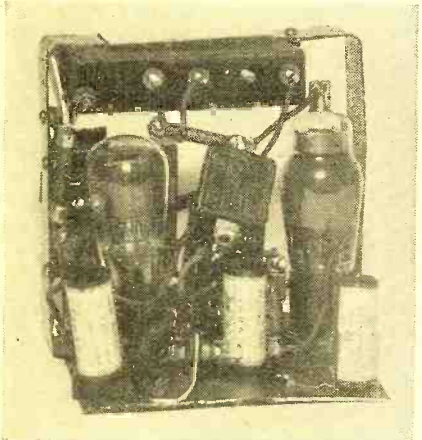
How A PHOTOCELL FOLDS SHEETS

John Strong

A UNIQUE industrial application of the photoelectric cell was recently made at the Hotel New Yorker, New York City. Three levels beneath the street surface, the hotel maintains an elaborate laundry for guests' clothing and house linens. Machines are used for the various phases of laundering on account of the speed and economy of their operation. But one phase of work that defied mechanization was the sheet-folding assignment. Machines that effectively folded the bed linens were long in use. but they had to be preset for sheets of single size. Inasmuch as the hotel used sheets of several sizes, it sought a method that would permit automatic folding of all linens. A photoelectric cell did the trick.

Now, as every sheet comes through the ironing machine, it passes along bands of tape. A beam of light is placed between two of the tape bands and falls upon a photoelectric cell underneath. Thus, when a sheet passes, the beam is broken and the timing of the shadow on the photoelectric cell presets the folding machine for every size of sheet.





THE PRE-AMPLIFIER ASSEMBLY

There is nothing particularly unusual about the amplifier. It is easy to build and inexpensive, employing standard parts throughout

A. C. Operated MICROPHONE PRE-AMPLIFIER

For many experimental uses batteries are highly satisfactory as the source of power for a microphone pre-amplifier. But for amateur station and broadcast service there is much to be said for a.c. operation, providing the design, like that described here, completely avoids hum in the reproduction

Walter Widlar

WITH the advent of the new low-cost condenser microphone heads, such as those described in the August, 1932 and June, 1933 issues of RADIO NEWS, it is possible to use the the a.c. lines as the power supply for both the microphone head and its associted pre-amplifier. Not only that but the cost of the complete equipment may be kept below the level of a good carbon microphone, although the condenser microphone has a number of outstanding advantages which are found in its excellent frequency response, the absence of the so-called "carbon hiss" and the ability of the condenser microphone to function in any position.

This article describes a condenser microphone amplifier designed for a.c. operation, and the power supply unit for use with it. The writer has used this equipment for some time. Recently it was used in an unofficial test at one of the Cleveland broadcasting stations. The program, remote controlled, was on the air for an hour and during this period there was no perceptible hum or noise of any sort and the frequency response was excellent. So good has been its operation, in fact, that there seems to be little justification for bothering with batteries in condenser microphone and pre-amplifier operation.

In Figure 1 is shown the amplifier circuit diagram, it is of conventional design for a.c. operation, with the exception of the grid battery. A fresh battery of reputable manufacture should last the better part of a year. Care must be taken to avoid leakage and resultant noise. The best way to accomplish this is through the use of high quality standard parts, complete shielding and careful construction.

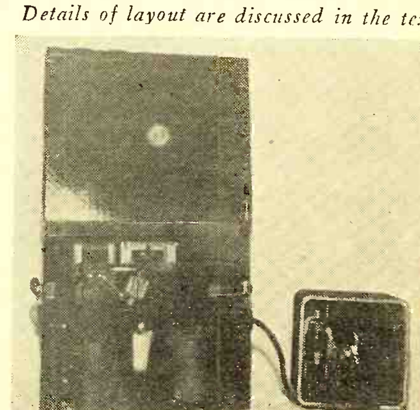
The microphone power supply, Figure 2, should be a separate unit. It is unusual only in the respect that it uses an ample filter. The power transformer should supply in the vicinity of 220 volts at approximately 20 ma. Voltages within 25% plus or minus of this figure do not seem to effect operation to any degree. The greatest limiting factor is the inability of some condenser microphones to withstand a potential of more than 250 volts d.c. Two 30 henry chokes, followed by a good audio transformer primary as the final choke, together with a total of 32 mfds. (450 volts) of electrolytic condenser, comprise the filter. A 5-watt resistor, of about 15,000 ohms, connected as shown, will often improve stability.

As shown in the photographs the amplifier has been made quite compact and is assembled on a metal base and framework which is slipped into a small metal case on the cover of which is mounted the condenser head. The power supply unit is assembled in an ordinary switch box, such as is commonly employed for housing the switches and fuses in electric light installations. These two metal cases provide the complete shielding which is highly important in condenser microphone equipment.

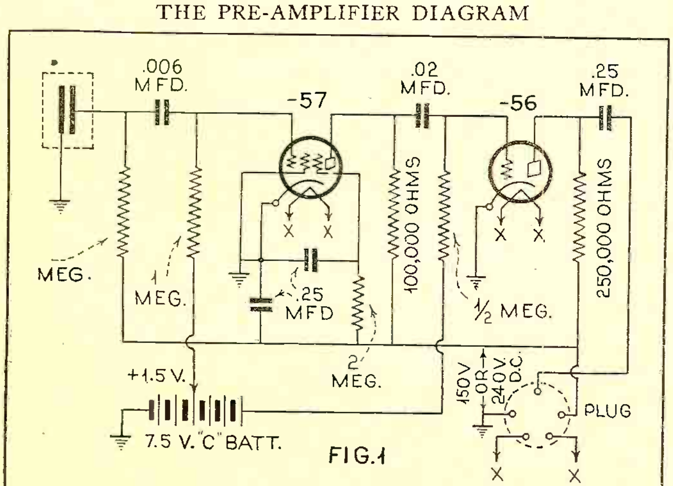
The two units are connected together by means of an unshielded battery cable about 35 feet long, in the case of the writer's equipment. Anyone following this design (*Continued on page* 784)

AMPLIFIER AND POWER SUPPLY EQUIPMENT

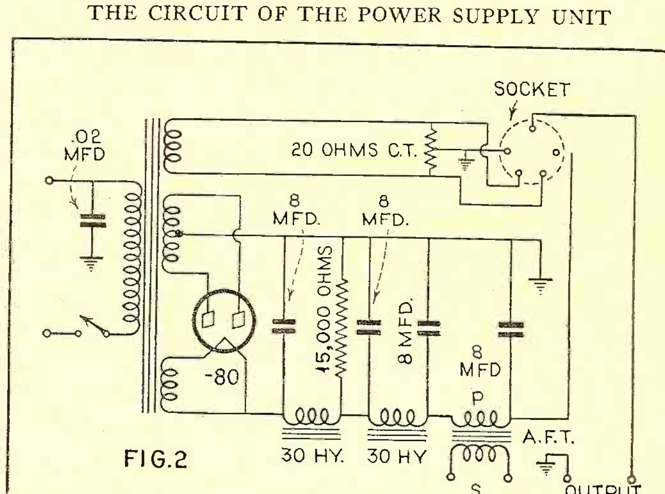
Details of layout are discussed in the text



THE PRE-AMPLIFIER DIAGRAM



THE CIRCUIT OF THE POWER SUPPLY UNIT



VOLTAGE-DIVIDER CALCULATIONS

(An Effective Graphic Method)

Walther Richter

WHEN providing a voltage divider for screen voltages, for instance, especially for variable-mu a.v.c. controlled tubes, it should be borne in mind that a decrease of the negative grid bias on the control grid not only increases the plate current but also the screen current. If the voltage divider from which the screen voltage is taken consists of too high values, the increase in screen current will lead to a decrease in screen voltage which counteracts the action of the a.v.c. The bleeder circuit should therefore consist of sufficiently low values to prevent this voltage drop. On the other hand, for the sake of economy in resistors and power transformer it would be desirable to keep it as high as possible. The following graphical method gives the correct value of the resistors to be used in a very simple and quick way.

If we plot the current through a resistor as a function of the voltage across it, we get a straight line as per Figure 1. As an example, in Figure 1 are plotted the lines for 20,000 ohms (5 milliamperes at 100 volts, 4 milliamperes at 80 volts, 3 milliamperes at 60 volts, etc.), and 50,000 ohms (2 milliamperes at 100 volts, 1 milliampere at 50 volts).

Now assume that we place a resistance of 8000 ohms and one of 12,000 ohms in series across 200 volts as in Figure 2 (a). The voltages across the two resistors must add up to 200 volts, and the currents through them must be alike. Starting from zero voltage, we plot the straight line for the 8000-ohm resistor, which would pass 12½ milliamperes at, for instance, 100 volts, 25 milliamperes at 200 volts, etc. (Figure 3). For R_2 we consider the 200-volt point as zero point, counting our voltage values towards the left; at 200 volts this resistor would pass $\frac{200}{12,000} = 16\frac{2}{3}$ milliamperes. It must now be kept in mind that the horizontal distances between the left vertical line and the line for R_1 represent the voltages across R_1, and, in a similar manner, the horizontal distances between the right vertical line (through the 200-volt point) and R_2 the voltages across R_2. If, for instance, 5 milliamperes were flowing in both resistors, point P_1 tells us that the voltage across R_1 would be 40 volts, point P_2 tells us that the voltage across R_2 would be 60 volts. The two voltages do not add up to 200 volts, the horizontal distance P_1 and P_2 indicating by what amount they fail to do so. Only for the intersection point P do the two voltages add up to 200 volts; the current is 10 milliamperes, the voltage across R_1 equals 80 volts, across R_2, 120 volts.

Now let us put a load in shunt with R_1, as in Figure 2 (b). Let us assume that the load is drawing, for instance, 5 milliamperes. We would like to know now how much the voltage across R_1 decreases due to a 5-millampere load current. Obviously, the voltages across R_1 and R_2 must still add up to 200 volts, but the currents are no longer alike, the current through R_2 being 5 milliamperes more than through R_1. In our diagram, this means we have to find a vertical line to the left of P (because to the left of P the currents through R_2 are larger than through R_1), in such a manner that the vertical distance VW equals 5 milliamperes. It is seen that WR is the current through resistor R_1 with a voltage 0_1R across it, and VR the current through resistor R_2 with the voltage 0_2R across it. The two voltages add up to $0_10_2 = 200$ volts, and the difference VW in the two currents is the load current. We could find the position of this vertical line VR with the help of a compass, fitting a length equivalent to 5 milliamperes between these two lines, (*Continued on page* 781)

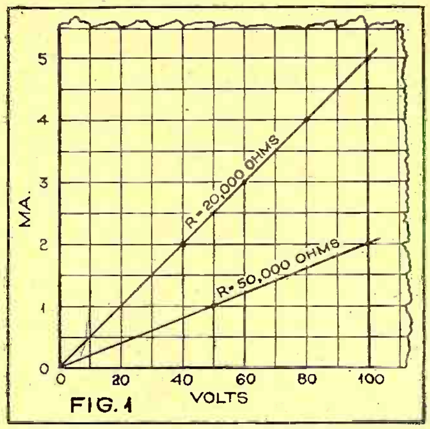


FIG. 1

ILLUSTRATING THE METHOD

By means of these curves, the author calculates values for a voltage divider which holds the desired applied voltage relatively constant in spite of wide variations in circuit conditions.

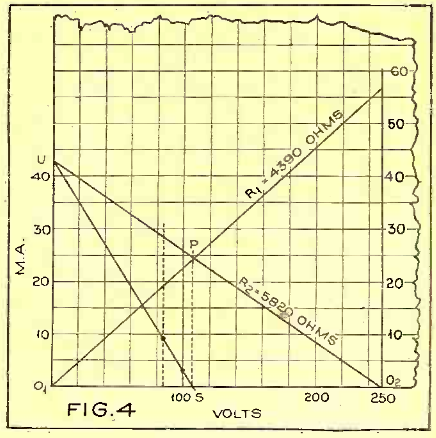


FIG. 4

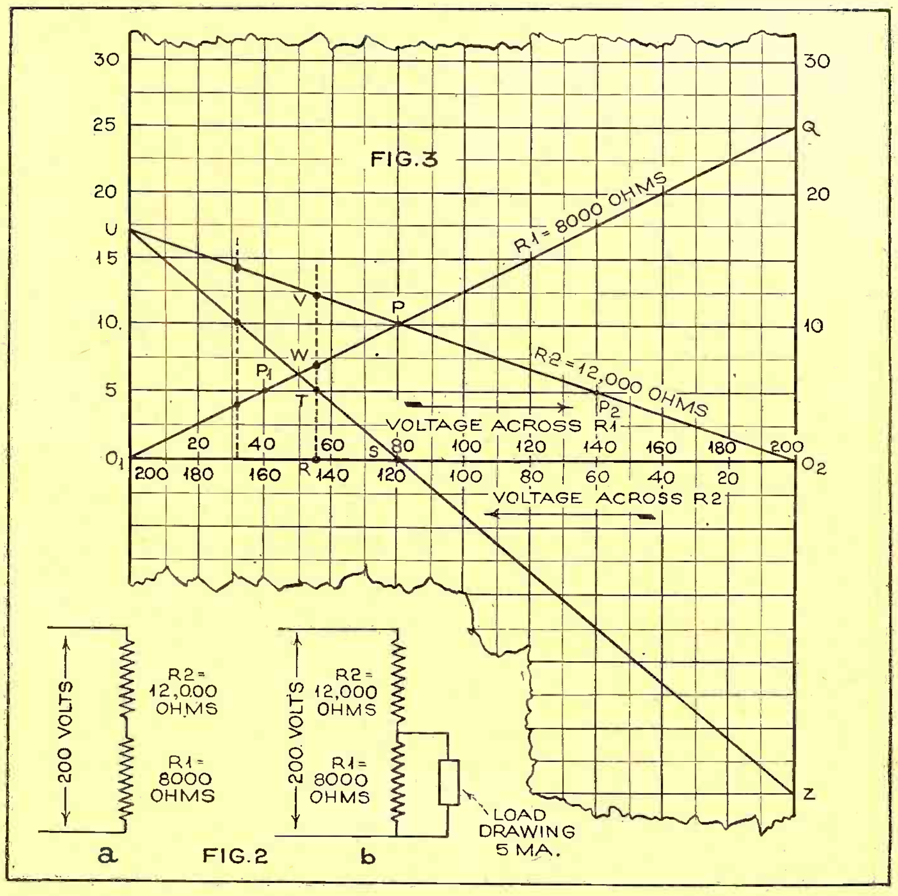


FIG. 2

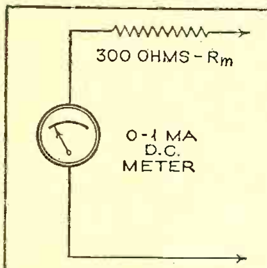


FIG.1

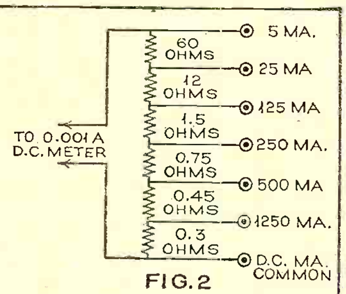


FIG.2

For Servicemen—A New
ALL-PURPOSE TESTER
(Supreme "385 Automatic")

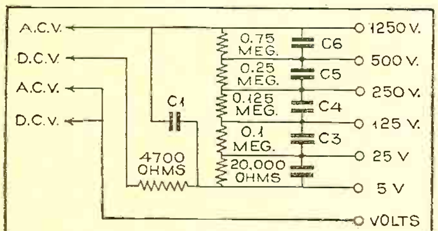


FIG.3

f	CAPACITORS - MICROFARADS					
	C1	C2	C3	C4	C5	C6
60~	0.88	0.109	0.0243	0.0193	0.0103	0.00317

RESISTORS - OHMS				
R1	R2	R3	R4	R5
139	195	319	2069	1019

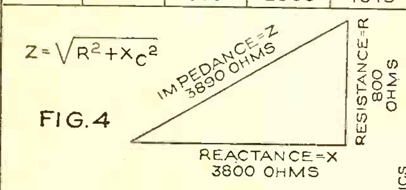


FIG.4

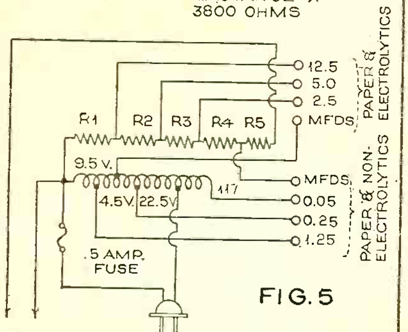


FIG.5

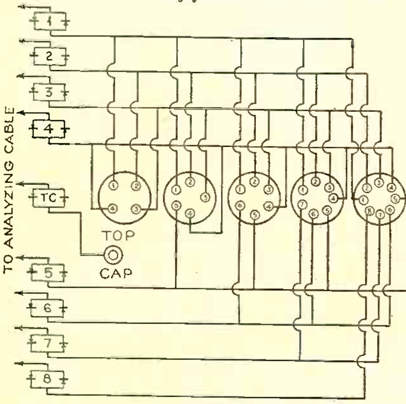


FIG.6

TABLE I	
MILLIAMPERES	OHMS
1.0	500
0.9	530
0.8	560
0.7	620
0.6	685
0.5	760
0.4	870
0.3	1030
0.2	1300
0.1	2000

By Floyd Fausett

It is easy for professional radiomen to appreciate the fact that a large percentage of the cost of a well-designed piece of test equipment is involved in the essential items such as the hardwood carrying case, bakelite panel, the necessary meters, switches, etc., and that the additional cost for the "plus" features which can be added to the essentials is quite nominal. For example, the essential elements which we have just mentioned would be required in a simple voltmeter. The addition of an "OHMS" scale, two or three multiplier resistors and another switch contact represent only a small additional cost. Similarly, other features can be added to the tester at small cost, and, by making each part serve several purposes, a very useful tester can be economically produced.

The principles outlined above have been applied to a remarkable degree in the constructional design of the new Supreme Model "385 Automatic" multi-purpose tester.

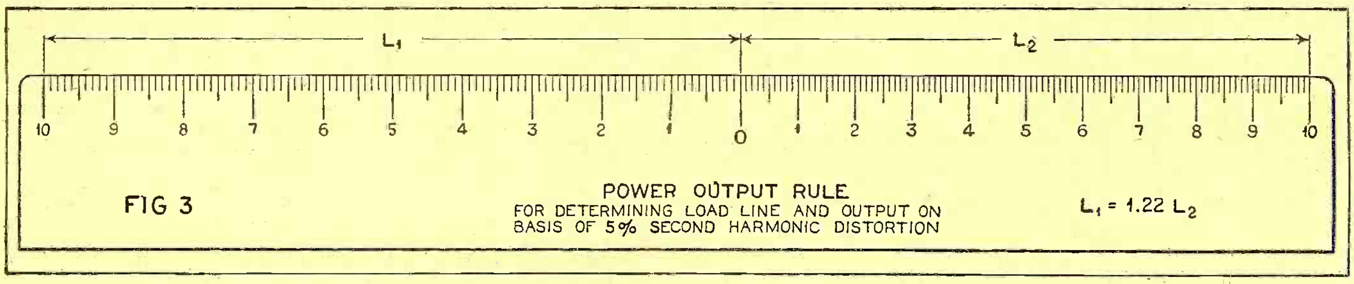
By employing the principles of a single-unit construction and multiple-use of fundamental elements, the sensitive 5-inch fan-shaped d'Arsonval meters are made to provide (1) 6 d.c. voltage ranges, and (2) 6 a.c. voltage ranges (0/5/25/125/250/500/1250 volts), (3) 6 direct current ranges of 0/5/25/125/250/500/1250 milliamperes, (4) 6 capacity-measuring ranges of 0/.05/.25/1.25/2.5/5/12.5 mfds., and (5) 6 resistance-measuring ranges of 0/200/2000/20,000 / 200,000 / 2,000,000 / 20,000,000 ohms (the four lower ranges of the ohmmeter are powered by a self-contained flashlight battery, and the two higher ranges by a self-contained miniature "power pack"). One of the meters is also provided with an English-reading colored tube-testing scale, and a new English-reading electrolytic capacitor leakage scale, so that these capacitors can be tested for "good" or "bad" leakage characteristics in the same manner as tubes. It is obvious to the professional radioman who uses one of these testers that he has, in two meters, the equivalent of 32 single-range meters, in a compact "uni-constructed" tester which is scientifically designed for use as:

1. An up-to-date analyzer with Supreme's exclusive Free Reference Point System of Analysis for all tube circuits, including new metal 8-pin tubes.
2. An English-reading tube tester which tests all tubes under approximate rated load conditions, including new 8-pin metal tubes.
3. A "neonized tester" for detecting any and all tube element leakages.
4. An electrostatic capacitor leakage tester, utilizing the neonized circuit.
5. A new English-reading electrolytic capacitor leakage tester, and
6. A capacitor tester for measuring the capacity of electrostatic and electrolytic capacitors, which may be profitably used on every service job encountered by the busy professional radioman.

The use of a copper-oxide rectifier to adapt a d.c. meter for a.c. potential measurements is necessary for output measurements, as there is no other practical arrangement whereby a sensitive a.c. meter can be realized. The most objectionable feature of copper-oxide rectifiers has been the susceptibility of these units to damage under electrical overloads, and fuses have proven impractical as a safeguard. A rectifier may be damaged by a surge from a transformer, a power choke, or a capacitor in any circuit into which the meter may be connected, so that the user is not always cognizant of his having inadvertently overloaded the rectifier unit of his tester.

In the design of the "385 Automatic," this objectionable feature has been overcome by (1) having the rectifier connected to the functional switch so that it is kept clear of the tester circuits except when the a.c. voltage and capacity-measuring circuits are closed by the meter, and by (2) having the rectifier input shunted with a normally-closed push button switch so that any surge potential will be shunted around the rectifier before the operator opens the switch.

For a study of the details involved in the design of this analyzer, the reader is referred to the accompanying diagrams. The elements involved in the a.c. potential and capacity measurements are indicated in Figure 3, which is helpful in a further study of inherent characteristics of instrument rectifiers. Alternating current values, as measured by ordinary a.c. instruments, will not be indicated as having the same value after being rectified and measured with d.c. instruments. For example, an a.c. potential of 100 volts when measured with an ordinary a.c. instrument will be indicated, after rectification, by a d.c. instrument as having a value of about 90 volts. The reason is that ordinary a.c. voltmeters (*Continued on page* 778)



Calculating POWER OUTPUT

(For Vacuum Tubes)

C. A. Johnson

Part Two

LAST month we showed how maximum power output and percent second harmonic distortion are calculated for a triode, when the operating conditions are known. In this discussion we will outline a technique whereby the experimenter can determine, approximately, the optimum operating voltages and load resistance.

WE will start with the minimum amount of information on this problem. Suppose we have a given triode, with a rated filament voltage, E_f. Let us suppose, further, that we have an available plate voltage supply of E_b volts. Now, if we have no further information about this tube, how would we proceed to find the optimum operating conditions? First of all, note that the required information is the following:

E_p = plate voltage
= E_b — d.c. voltage drop across coupling device

I_o = average plate current (i.e., direct plate current with no signal applied to grid)

E_c = grid bias necessary to give L_o when E_p is applied to plate

R_L = optimum value of load resistance
= value of load resistance to give maximum power output with not more than 5% second harmonic distortion

Each of these values may be obtained by following the procedure outlined below. In the first place, the tube should be mounted in a socket, or test circuit, so that all of the terminal connections are available. Then the proper filament voltage should be connected and checked with a voltmeter. With the filament operating at normal temperature, you must find a trial value of E_p. If transformer or choke-coil coupling is to be used, you can assume that $E_p = E_b$. If resistance coupling is to be used, E_p will probably be somewhere between two-thirds and three-fourths as large as E_b. An average value, for most triodes, is about $.7E_b$. We need only an approximate value at this point. Next make $E_g = 0$. This doesn't mean merely connecting the grid lead to the negative end of the filament. In the first place, the grid potential values are calculated from the center of the filament. Hence, when the grid lead is connected to —F there is a negative bias on the grid to equal $\frac{E_f}{2}$. In addition to this there is an inherent negative bias produced, due to a "contact potential," in the filament circuit. For oxide-coated filaments this is equivalent to about .7 volt. Hence, to actually place the grid at zero potential, it is necessary to add a positive bias to the grid equal to $\frac{E_f}{2} + .7$ volt. This second correction may be neglected except in cases where extreme accuracy is important.

If the C-bias connection is made to an indirectly heated cathode or to the center tap of a filament transformer, the $\frac{E_f}{2}$ correction will be made automatically, so that it will be unnecessary to add any external bias to correct for it.

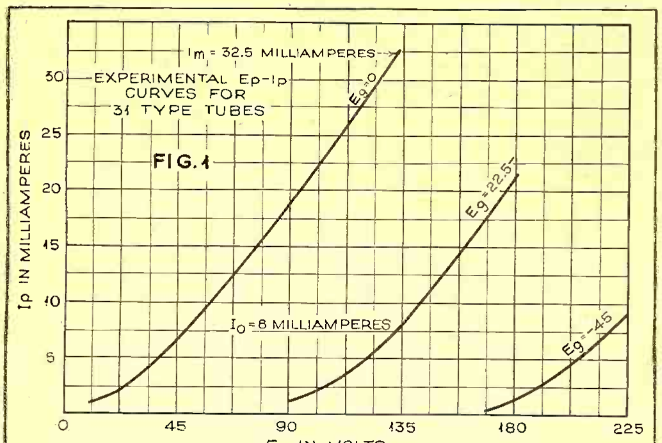
With $E_g = 0$, and E_f equal to its rated value, connect E_p to the plate in series with a milliammeter of sufficient range to be safe. It is best to arrange this connection so that it can be broken quickly by means of a switch. Close the switch and read the plate current. This is the value of I_p when $E_c = 0$. Call this I_m. Do not allow the tube to operate under these conditions longer than is absolutely necessary, for the plate may become overheated. Now I_o can be calculated and is given by the relation:

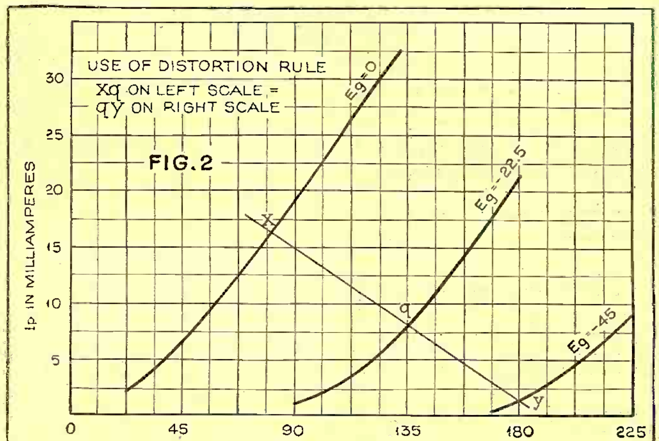
$$I_o = I_m/4$$

Adjust E_c so that the plate current is I_o for a plate voltage of E_p. This value of E_c is the normal grid bias to be used with the tube. Now make an $E_p — I_p$ characteristic from the tube for the three following conditions:

$E_g = 0$
$E_g = E_c$
$E_g = 2E_c$

Do this by varying E_p in steps of about 22½ volts from 0 to E_b for each of the three grid-bias conditions. Record the plate current readings for each of the voltage values, and plot the results on graph paper as shown in Figure 1. This step will not be necessary, of course, if you already possess a set of $E_p — I_p$ (*Continued on page 779*)





The OSCILLATOR *as a* SERVICE TOOL

O. J. Morelock, Jr.

Part One

DATA FOR THIS ARTICLE

The author actually "digs in" to collect the necessary technical and practical data for this article

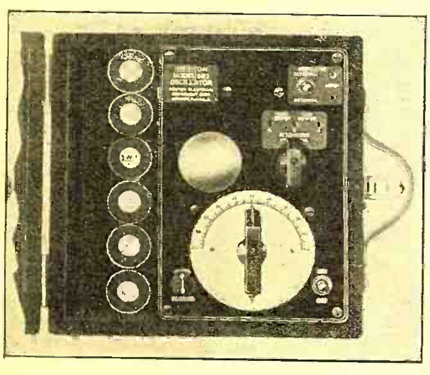
NOT so long ago, an oscillator was pressed into service for alignment purposes only when a good incoming signal was not available. Today incoming signals are used for receiver alignment only when a good test oscillator is not available. The full advantages of such a controlled source of signal input in general servicing, however, are still not always recognized.

ESSENTIALLY, a service oscillator is simply a calibrated local signal source in which both frequency and output (signal amplitude) are completely under control. Any desired test condition within the range of the equipment, therefore, can be maintained or duplicated at will.

In respect to frequency, the range of a good oscillator should extend over the complete radio spectrum from the lowest intermediate frequency used in superheterodyne receivers up to and including at least one short-wave band. The higher frequencies are becoming more important every day, due to the increased use of all-wave receivers. Above 3 megacycles, however, these receivers can be aligned on harmonics in most cases.

The radio-frequency output, or amplitude, of the oscillator must also cover a wide range. On the low side, it should approach a minimum of one microvolt for servicing automatic volume control receivers—a level well below the point where the a.v.c. starts to function. This requirement calls for careful attenuator design and complete shielding with copper or brass, since iron or steel have poor shielding properties at the higher frequencies. On the high side, the signal at the oscillator output terminals should approach 0.1 volt. Adjustable high and low output ranges are usually required to cover this 100,000 to 1 voltage ratio.

A MODERN SERVICE OSCILLATOR



These are the requirements set up in our Radio Engineering Department when developing the Weston Oscillator for servicemen. Provision should also be made for cutting out the internal modulation of the oscillator, so that it can be used as a radio-frequency generator for zero beat calibration or other beat-frequency measurements. An arrangement permitting external modulation is also desirable, so that approximate fidelity measurements of receivers can be made.

A rapid method of trouble-shooting, effective on any receiver, becomes possible with a test oscillator. In most cases, it can be carried out without removing the receiver from the cabinet.

After the set has been turned on and allowed to heat up, the detector tube (second detector in a superheterodyne) should be removed from its socket. A loud click in the speaker as the tube is removed indicates that the audio frequency section of the receiver is functioning, and that the trouble lies somewhere in or before the detector tube circuit. If no sound is heard, then the trouble should be looked for in the audio end of the receiver, the speaker, the power supply or connecting cable.

Let us assume that this quick check shows continuity beyond the detector tube. The tube should then be replaced, and the oscillator turned on and adjusted for maximum signal. The antenna lead from the oscillator is then touched to the grid terminal of the tube immediately preceding the detector. For a superheterodyne receiver, the test-oscillator should be tuned to the intermediate frequency of the receiver. When the tuning control of the test oscillator is rotated back and forth, the signal should be heard in the speaker if the set is functioning correctly from this tube on.

If the receiver is of the tuned radio-frequency type, the same procedure is followed except that the oscillator must be tuned to the broadcast band frequency to which the receiver is tuned. In either case, if no signal comes through, then the trouble lies in the detector tube input circuit or the radio frequency stage directly preceding this tube.

On the other hand, if a signal has indicated that the set is functioning from this point on, then the oscillator lead is touched to each of the tubes in turn, working back to the antenna and ground connections, or to the first detector stage in the case of a superheterodyne. In the latter case, the test oscillator must be retuned to the broadcast band for checking the radio-frequency stages.

After the operator has become familiar with this test, it can be completed in about two or three minutes, and the defective section of the set isolated without removing the chassis from the cabinet. (This, of course, assumes that the receiver is equipped with screen-grid tubes having top grids which are easily accessible.) The tube in the defective stage may then be tested or a new one substituted. If this does not clear the circuit, then the chassis may be removed and the volt-ohmeter put to work checking the socket voltages and the resistance in the defective stage. This should quickly locate the defective part.

There has been so much discussion about receiver alignment that it would seem wise to cover the correct procedure in some detail. As the method of aligning the tuned radio-frequency receiver is different from that required in the case of a superheterodyne, the two procedures involved will be discussed separately.

In the case of a radio-frequency receiver the oscillator output posts should be connected to the antenna and ground posts of the receiver. A good output meter, sufficiently sensitive to indicate a low-volume signal should be connected (through a series condenser) from the plate of the output tube to the chassis, or from plate to plate of the push-pull output tubes if this type of output circuit is used. The receiver should be turned on with its volume control in the maximum position and allowed to heat up. The test oscillator should then be turned on and the signal tuned in at approximately 1400 kilocycles.

Next the oscillator attenuator is rotated until a (*Continued on page* 779)

How to Build the

"PERPETUAL" TUBE CHECKER

An unusually effective tube checker, most of the parts for which can be made by anyone who is handy at mechanical work

Verne V. Gunsolley

Part One

FIGURE 1

FREQUENTLY the serviceman lugs his new high-priced, universal tube tester out to the job only to find a receiver having all old-type tubes that could have been tested with the old-style tester weighing but a fraction of the new one. The "perpetual" tube tester herein described, in addition to being only 10½" x 7½" x 3½" in size and weighing only 6½ lbs, has the following up-to-date features.

1. Permits either single or grouped element testing.
2. Automatic cutoff switch which turns off supply when tube is withdrawn.
   - (a) Tester always on line avoids nuisance of switching.
   - (b) Perfect safety from fire hazard.
   - (c) Saves many tubes from being burned out since heater terminals are not hot until tube is pushed all the way "home", thereby allowing an absent-minded operator to catch himself in time, often, when filament switch is on too high a voltage setting.
3. Permits preheating.
4. Permits rejuvenation.
5. Coordinate designation of switching simplifies operation and aids memorization.
6. Permits gas test.
7. Has ample reserve space on panel for new socket types so that tester should be free from obsolescence.
8. Low cost of construction.
9. Suitable for counter, shop and laboratory.

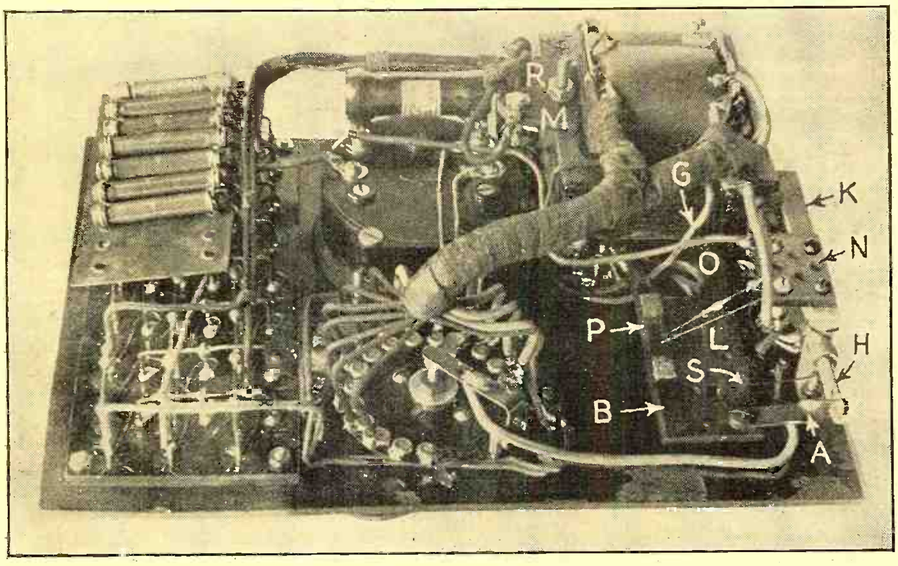
Figure 3 is a schematic of the fundamental circuit. It is of the conventional self-rectifying, self-biasing design met with in most testers. The only unconventional feature is the switching. Here are three vertical busses marked B+, B— and C—, and five horizontal busses numbered 1, 2, 5, 6, C, and 7 (not shown in Figure 3), which numbers correspond to the RMA number of the socket terminal to which they are connected. By means of the contactors any horizontal bus may be connected to any vertical bus, consequently any terminal but the heaters may be made either a plate, a screen, a control grid, or a cathode. As shown, the tube is without bias. Pressing G slightly, makes the tube self biasing through the 1000 ohm resistor. Pressing G all the way down puts an independent positive bias of 5 volts on the tube. This is useful on tubes of such high plate impedance as to be unable to decisively bias themselves; giving a more pronounced and reliable reading.

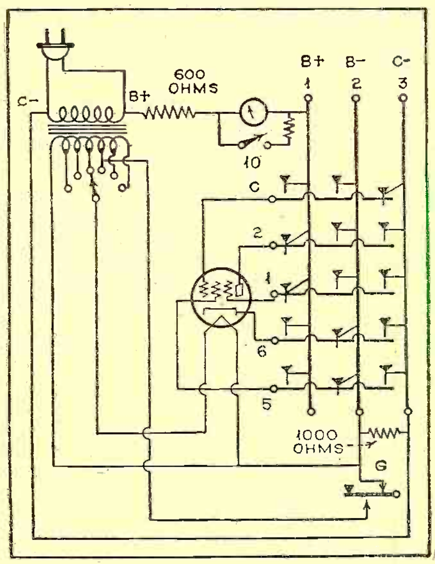
Figure 4 is the same as Figure 3, but has the additional sockets added. All socket terminals having the same RMA number are tied together and to their respective horizontal busses. Thus to close the No. 2 element of any tube on the B+ bus it is only necessary to close the No. 2 horizontal bus on the No. 1 vertical bus, and we may designate this operation by the exceedingly simple number "21" in which the first digit is the number of the horizontal bus and the second digit is the number of the vertical bus. Thus the connections for the 58 (or similar type) tube shown in Figures 3 and 4 are: 11, 21, 52, 62, C3. In Figure 4 it will be noted are two additional but unused busses, and on the panel is sufficient space for three more socket types and two more grid caps. These are to take care of new tube types in the future.

Figure 4 also shows all the horizontal busses connected to the B— bus through 1 megohm resistors. These serve a double purpose. First, for rapid testing it is not necessary to close certain elements to the cathode bus such as the suppressor grid or the screen grid. If these keys are left open, and there were

REAR VIEW

Figure 2. This view of the completed tester shows the automatic power switch, as well as the keys and springs. Figure 3, at right, is the general circuit principle employed





no resistor to ground the element, it would collect a charge, thus biasing the element like a control grid and giving erratic readings. Second: in testing for gas, the control grid key is opened and closed without bias on the tube. The greater the difference in the plate readings obtained, the greater the amount of gas in the tube. Thus if a grid current of 1 microampere flows through the 1 megohm resistor, the grid will be biased one volt and this will be reflected by a change in plate reading when the Key C3 is opened and closed. Most tubes show a slight reading varying from 0.1 to 0.5 ma. even when new. If the difference greatly exceeds the average value for a new tube, the gas content is excessive. Gas tubes like the 200A give marked readings.

To preheat a tube it is only necessary to turn the filament voltage one or two steps higher, generally about double the voltage, and as soon as the plate meter begins to indicate well, turn the filament voltage down to normal. This simple means prevents overheating.

The process of rejuvenation of thoriated filament tubes such as some of the battery types is too well known to require description. It is entirely obvious that the tester is ideal for the purpose.

Figures 2 and 5 show the construction of the automatic switch. Its principle is very simple. A bakelite strip, B, about 1¼ inches wide and 5½ inches long lays centrally over the group of sockets. At each end a metal arm (A) is screwed and this is soldered to the round bar (H) which is free to rotate in the supporting standard (K) and prevented from slipping endwise by the collars (C) which were made from old rheostat parts. A bronze wire spring (S) keeps the bakelite strip close against the bottom of the socket terminals. When the tube is inserted in any socket, one or more of its prongs push the bakelite away and this latter motion moves a plate (P) cemented to the bakelite into contact with two prongs (L) connected into the primary circuit of the transformer, "shorting" them and closing the line current on the tester. These prongs are mounted on the bakelite piece (N), and are also made of bronze spring wire. In the middle of the movable bakelite strip is bored a large hole (O) to admit the grid cap wire (G). This wire is lashed to the transformer mount to permit it to be freely pulled out for use; and tucked back inside the tester when not in use.

The sockets are of the wafer type with the top plate removed. The panel is of thin bakelite (about ⅛ inch) to permit the tube prongs to be long enough to reach the socket clips with sufficient margin to operate the automatic switch. Further, all soldering terminals must be pared down to the level of the prong clips to permit the bakelite strip to fall flat against the clips. The wiring must then be carefully soldered and tucked well between sockets so that in the region covered by the strip, no part of any socket or wiring is more than about ¼ inch high off the back of panel. Figure 6 shows three such sockets with the soldering terminals clipped and the wire tucked flush.

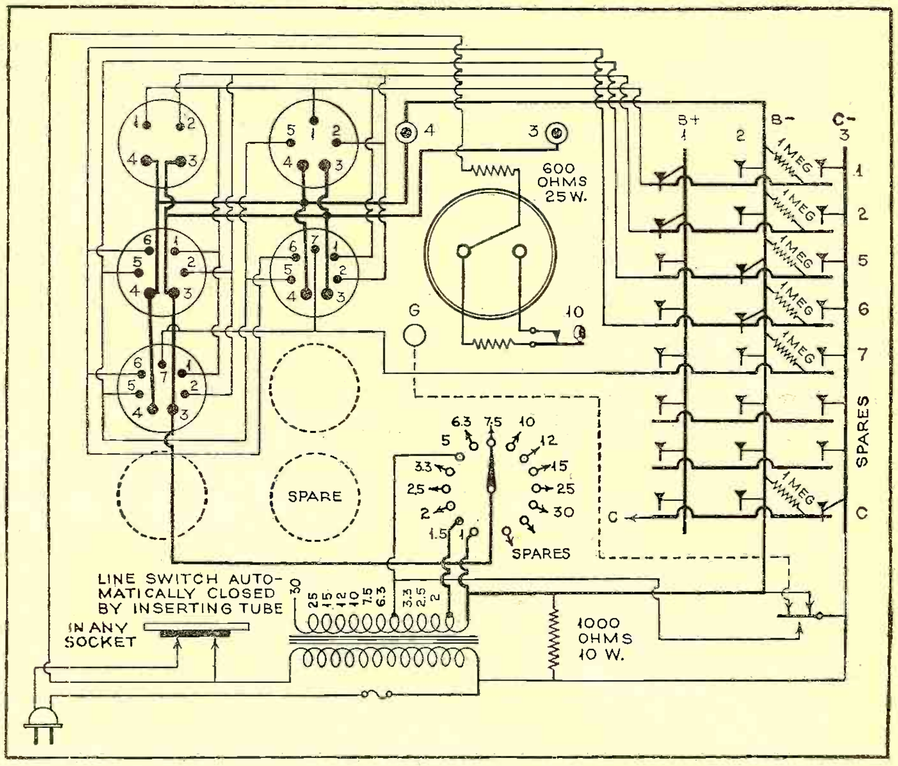


FIGURE 4

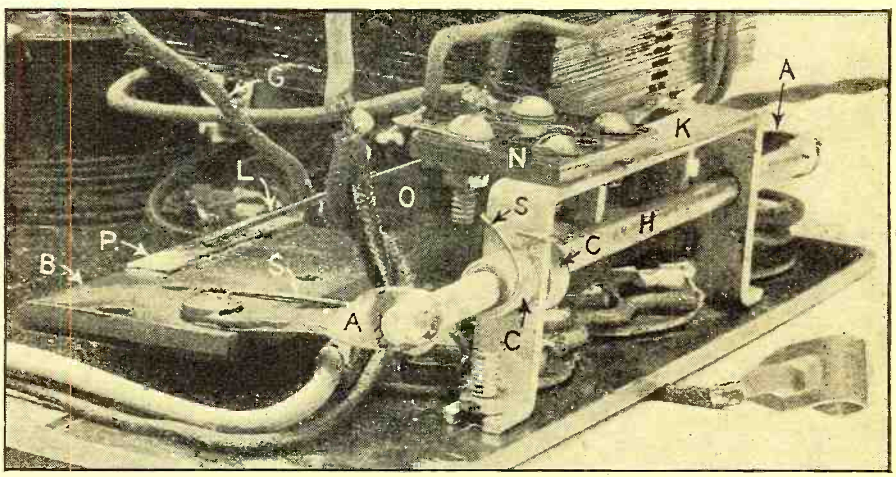
The wafer sockets were trimmed out round and nested closely, only one 4-32 steel flat-headed screw being used in the center to mount each one. The two screws mounting the 4-prong and the 6-prong socket are longer, to permit mounting a yoke, to which in turn is mounted one side of the transformer. The opposite side of the transformer is mounted directly on a large bolt M, that passes through the panel just to the right of the meter in Figure 2. To the end of this bolt is fastened a bakelite plate (R) to which the line cord is lashed and terminated.

To drill the panel for the socket openings, first take the wafer sockets and secure their pattern on paper by holding a clean sheet of paper over the face of the socket and rubbing with the flattened side of the lead of a pencil. This brings out the outlines of the holes and the wafer. Trim each one of these out round and paste the patterns on a sheet of paper in their proper positions just as they will be on the panel. Trim this sheet so that it is the same size as the panel and has the sockets in proper relative location. Place the pattern over the panel on the top side and with the aid of a very sharp prick punch such as a stylus, and a reading glass, carefully prick a hole in the exact center of the outline of each socket hole, with sufficient force to plainly mark the bakelite. Make sure the paper does not slip by using a few C clamps.

With all holes marked, remove the paper and with an ordinary center punch enlarge the marks by pushing straight down and twirling the punch at the same time. Never use a hammer. To drill, choose the same size drill as the original holes in the sockets, and now observe closely. Here is something that every radio man should know. To drill accurately, (*Continued on page* 783)

AUTOMATIC SWITCH

Figure 5. A close up of the unique switch which automatically opens the circuit when the tube is removed

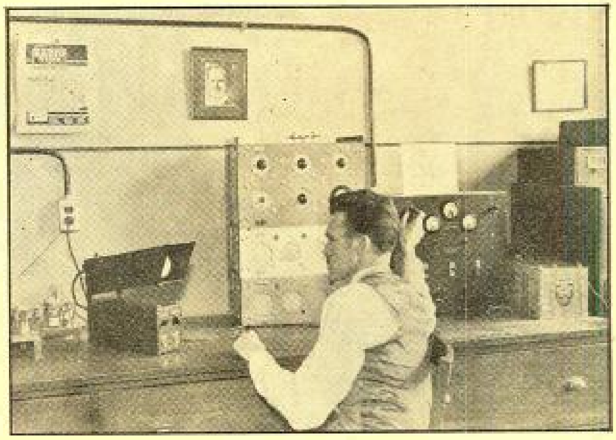


Using the CATHODE-RAY OSCILLOGRAPH

(Basic Patterns)

Kendall Clough

Part Two



IN THE RADIO NEWS LAB

The oscillograph finds wide application in analyzing audio-frequency systems.

LAST month the author explained the fundamental principles of cathode-ray tubes. In this article he continues with some of the simplest cathode-ray oscilloscope applications.

IN most of the applications discussed in the following paragraphs, the two sets of deflecting plates have been used, but coils for electromagnetic deflection can be substituted in any application where it is more convenient to draw current than voltage.

It has been shown how with one set of deflecting plates or deflecting coils, it is possible to observe the peak voltage or current in a circuit. The most useful applications of cathode-ray equipment come, however, from its ability to show not only the peak value of a wave but also its value at all points of the cycle. In addition, other data such as phase and frequency relationship can be observed by applying the tube to the circuit under test in the correct manner.

Thus if separate generators or sources of a. c. voltage are attached to each set of plates and they are of the same frequency and in phase, a straight line trace, tilted at some angle will result as in Pattern 8. If the voltages are of the same value, the tilt of the line will be 45 degrees. Should the generators be out of phase, then figures will be produced such as shown in Patterns 9 to 12. Below each is marked the difference in phase between the generators producing the pattern.

A slight difference in frequency between the generators will cause the figures produced on the screen to wax and wane through the complete range of figures illustrated in Patterns 8 to 12, as the difference in frequency causes the instantaneous phase relationship to shift. Thus the appearance of the pattern will be that of a hoop rolling over and over, and the rate of the rolling will be that of the difference between the frequencies of the two generators.

This is the simplest application of the principles of Lissajou's Figures. Such figures are extensively used for comparison of an unknown frequency with a known one for frequency calibration. These patterns take the form of "figure eights" or more complex forms. They are illustrated in most elementary physics texts.

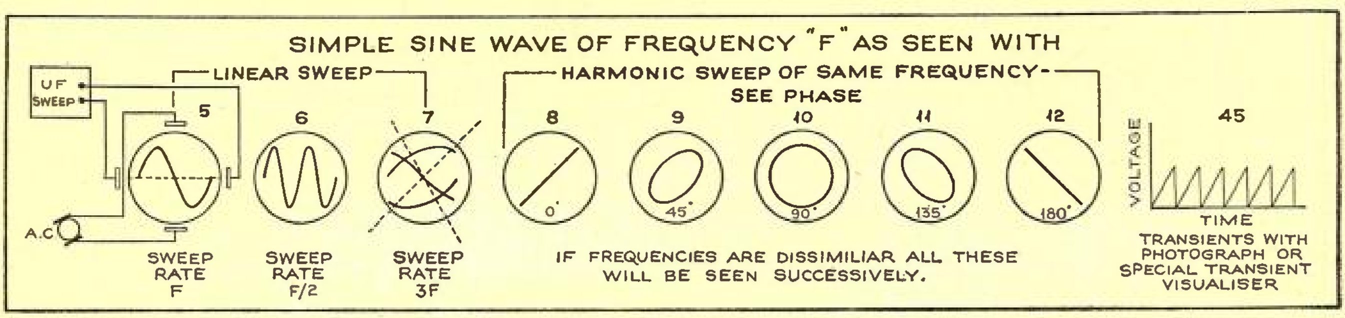
Suppose that instead of an ordinary source of a. c. voltage, a special voltage generator such as the Clough-Brengle Model UFS-A Linear Sweep is connected to the "horizontal" plates of the cathode-ray tube. This unit is an oscillating circuit in which the charge and discharge of a condenser is governed by a gas filled triode tube. Its output voltage wave is graphed in Pattern 45, and is sometimes called a sawtooth wave.

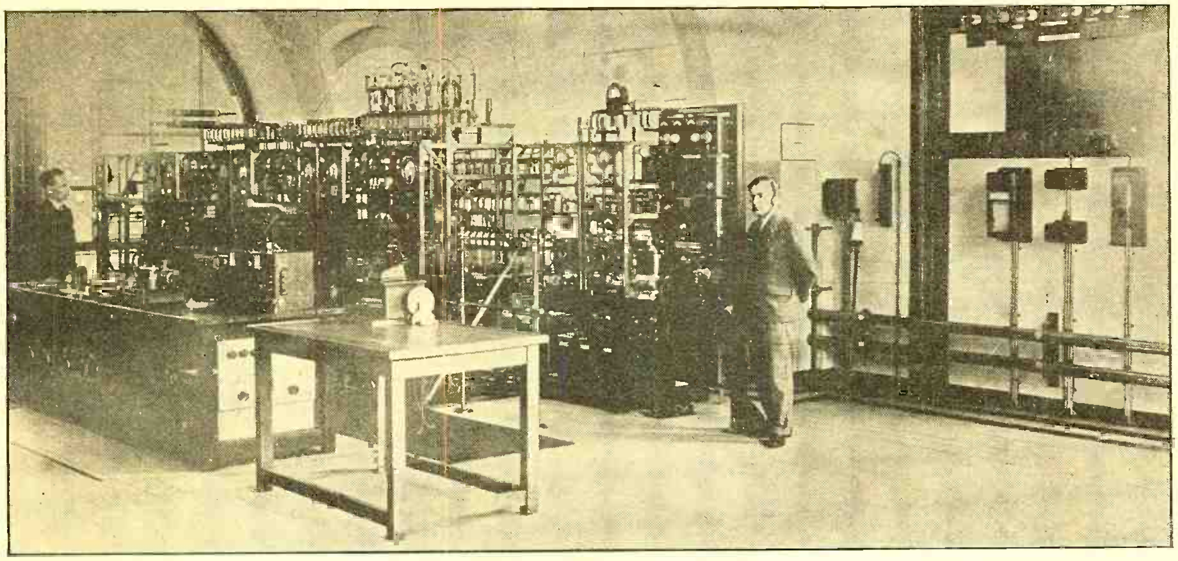
It can be seen from this graph that the voltage starts at zero and rises at a uniform rate, as time progresses, to a peak value. After the peak is reached, it almost instantaneously drops to zero due to the discharge of the condenser by the gas filled tube.

If this wave is applied to the horizontal deflecting plates of the cathode-ray tube as in Pattern 5, a trace represented by the dotted line of this illustration, will result. This is not the same trace as in Pattern 2, due to the difference in the wave producing it. What actually happens is that the spot starts at the left of the screen and moves across to the extreme right and then snaps back to the starting point in such a short time that the material of the screen does not glow on the return. This operation repeats continuously as shown in the graph of voltage, Pattern 45.

Suppose an a. c. sine-wave generator is connected to the "vertical" plates of the cathode-ray tube as in Pattern 5. (This may be the ordinary 60 cycle a. c. power line if it is free from harmonics.) If the linear sweep is now adjusted so that it pulses every 60th of a second, the sinusoidal variation of the potential from the a. c. generator will be plotted across the screen of the tube as indicated by the solid line curve in Pattern 5. In order for such a pattern to be stationary and readily observable the rate of the sweep circuit must be in absolute synchronism with the frequency of the voltage being observed. This is accomplished in practice by using a little current from the generator or other source being investigated, to control the timing of the voltage pulses from the linear sweep. When the oscillating circuit of the linear sweep is adjusted to approximate synchronism with the observed wave, the control circuit holds the pulsing of the linear sweep in constant ratio to the observed wave, resulting in a steady pattern on the screen, despite drifting of the observed potential's frequency.

If instead of setting the linear sweep to a 60 cycle rate, it is set to a 30 cycle rate, then two cycles of the 60 cycle current applied to the "vertical" plates would occur while the spot is driven horizontally across the screen by the linear sweep potential. Thus the steady pattern will be that of two cycles of the observed voltage rather than a single one. Such a figure is shown in Pattern 6. It is the same wave sine shape as in Pattern 5, but the pattern is compressed horizontally to accommodate the two waves. In the same way, the sweep frequency may be set to other submultiples of the observed frequency to show more cycles of the same voltage phenomena. (*Continued on page 775*)





THE BELGIAN TRANSMITTER ORK AT RUYSSELEDE
This is the 9 kw. short-wave transmitter which utilizes 60 percent modulation and is heard throughout America in the early afternoon.

The Future of
SHORT-WAVE RECEPTION

In this installment Mr. Morrison, president of the International DX'ers Alliance, tells of some of his own personal ideas of how short-wave reception can be improved in the future.

It can be readily seen by anyone looking ahead that sooner or later some definite international understanding must be had as to the allocation of certain national short-wave channels, in order that each country may have an equal chance to express itself on the air. The present congestion of the 49-meter band is a good example of the need for action on this line. Many really fine broadcasts are spoiled nightly by some station thoughtlessly wandering from one wavelength to another like a lost soul, first settling on some established wavelength and spoiling some regular program and perhaps the next night going to some other channel and repeating the performance. Each country should be allotted a specific allocation on each band which would neither encroach upon or affect the channels of some other country. International agreement will no doubt remedy this congestion of the ether lanes in the near future, just as it was finally remedied to a great extent upon the broadcast band.

One of the factors that has brought about improved international short-wave reception is a vastly improved knowledge of transmitting antennas. Marconi, the father of beam transmission, was the first to really put to a practical use the theoretical knowledge that short-wave energy, concentrated into a single beam instead of spread around omni-directionally, would give a strong signal to those living within the confines of the beam and a weak signal

Chas. A. Morrison
Part Three

to those outside of the beam. Engineers now make use of this knowledge in the construction of directional antenna "arrays." Thus all the energy of a station may be pointed or directed at a particular direction and, taking into consideration the time of the season, time of the day and hour, project a broadcast program with almost rifle-like precision at some distant country. This concentration of energy tends to overcome that old bogey of short waves—fading. A good example of directional antenna systems was that used by KFZ at Little America in their weekly broadcasts for the Byrd Expedition. It can be readily seen that to have this tiny station in the Antarctic wastes spread its power around aimlessly would have been futile effort and it would be unlikely that it would be picked up with any consistency whatsoever. Instead, this antenna is aimed like a rifle at short-wave station LSX at Buenos Aires which is a huge commercial station and with fine receiving equipment picks up this tiny signal, reamplifies it and sends it out again by its directional antenna to Riverhead, New York, the receiving point of R.C.A., where it is again picked up and then sent by land wires to the key station of the C.B.S. network for the chain programs.

In the future we shall see as great an improvement in transmission equipment and antennas as we have witnessed in the past, and with greatly increased power, which is bound to come, fading will practically be eliminated at the point of transmission.

Short-wave receiver design is also in for some definite evolutions in design. On account of the local electrical interference (man-made static), which is the greatest single handicap to short-wave reception, the majority of receivers in the past have been far too noisy. In the race between manufacturers to see who can provide the greatest number of tubes and the greatest amount of fractional microvolt sensitivity, the thought has sometimes been lost sight of that it it is not the loudest signal that is the best signal, but the signal that shows *the greatest ratio of signal strength to noise level!* This is clearly demonstrated by a comparison of several different makes of receivers. It is sometimes found that those utilizing a carefully designed and isolated circuit brought in stations that could not even be heard above the noise level of the receivers on test. Practically every receiver today provides enough volume to fill a large hall, but if the receiver was turned on fully, the noise level would also be raised to a prohibitive point when working with a weak signal. It is the *usable* sensitivity that counts, and all that tends to increase the noise of a set without increasing the signal ratio, is wasted. Therefore my contention is that in the future we will see a lesser number of tubes providing an adequate volume for home use and with a very high ratio of signal strength to noise. Tubes performing two or even three separate operations have been developed from time to time. It was no doubt the idea of the tube manufacturer that in building such tubes it would not be necessary to build such a large receiver, but that more receivers could be turned out at a smaller cost of manufacture, thus producing a simpler set with less inherent tube noise. (*Cont'd on page* 780)

S. W. TIME SCHEDULE

LAURENCE M. COCKADAY

THE twenty-seventh installment of the DX Corner for Short Waves contains the World Short-Wave Time-Table for 24-hour use all over the world. The list starts at 01 G.M.T. and runs 24 hours through 00 G.M.T., right around the clock! This Time-Table contains a List of Short-Wave Stations, logged during the last month in the RADIO NEWS Westchester Listening Post (in our Editor's home), as well as at our official RADIO NEWS Short-Wave Listening Posts throughout the world. It provides an hour-to-hour guide to short-wave fans, whether experienced or inexperienced. The Time-Table shows the Call Letters, Station Locations, Wavelength and Frequency in the middle column. The column at the left gives the Times of Transmission in G.M.T. a.m., and the column at the right gives the Times of Transmission in G.M.T. p.m. The corresponding time in E.S.T. is also given and space has been left for filling in your own Local Time. The time, E.S.T., in the U. S. would be 8 p.m., E.S.T., for 01 G.M.T., as there is a five-hour difference. The time, E.S.T., for 13 G.M.T. would, therefore, be 8 a.m., E.S.T. These two features can be seen at the beginning of each outside column in the Time-Table. The times, C.S.T., for these two corresponding hours would be 7 p.m., C.S.T., and 7 a.m., C.S.T. The times, M.S.T., for the corresponding hours would be 6 p.m., M.S.T., and 6 a.m., M.S.T. The times, P.S.T., for corresponding hours would be 5 p.m. and 5 a.m., P.S.T. In this way American listeners can easily fill in their own Local Times at the top of the columns. Foreign listeners would probably prefer to use G.M.T., anyway, or, if not, can compute the time difference from G.M.T. and fill in their Local Time in each column head. At the end of the Time-Table is given a List of Symbols covering the various irregularities of transmission, etc.

Affiliated DX Clubs

We are hereby placing a standing invitation to reliable DX Clubs to become affiliated with the DX Corner as Associate Members, acting as advisers on short-wave activities, in promoting short-wave popularity and reception efficiency. A list of associate organizations follows: International DX'ers Alliance, President, Charles A. Morrison; Newark News Radio Club, Irving R. Potts, President, A. W. Oppel, Executive Secretary; Society of Wireless Pioneers, M. Mickelson, Vice-President; U. S. Radio DX Club, Geo. E. Deering, Jr., President; the Radio Club Venezolano of Caracas, Venezuela, President, Alberto Lopez; The World-wide Dial Club of Chicago, Illinois, President, Howard A. Olson.

Any DX fan wishing to join any one of these Clubs or Associations may write for information to the Short-Wave DX Editor, and his letter will be sent to the organization in question. Other Clubs who wish to become affiliated should make their application to the Short-Wave DX Editor. Clubs associated with the DX Corner have the privilege of sending in Club Notes for publication in RADIO NEWS.

Your DX Logs Welcome

Please keep on sending in your information on any s.w. stations that you hear during the coming month, getting them in to the short-wave DX Editor by the 20th of the month. In this way you share your "Best Catches" with others readers and they, in turn, share with you, making for improved knowledge on short-wave reception. Also send in any corrections or additions that you can make to the short-wave identification charts, including station addresses, station slogans, station announcements, and any identifying signals the stations may have. Our Editors are doing the same thing, working with you day and night to bring you the best and most reliable short-wave information. Your logs are welcome and are sincerely invited.

Let's See Your DX Corner!

Readers are invited to send in photographs or snapshots of themselves in their Listenings Posts, for publication in the DX Corner. Let other readers see what you and your equipment look like! RADIO NEWS will pay $1.00 for each photo used, to help defray expenses. If a copy of RADIO NEWS appears in the photo, this payment will be doubled.

Listening Post Observers and Other Fans Please Notice

Listed on next page is this month's partial information regarding short-wave stations, heard and reported by our World-Wide Listening Posts. Each item in the listening is credited with the Observer's surname. This will allow our readers to note who obtained the information

S.W. PIONEERS

Official RADIO NEWS Listening Post Observers

LISTED below by states are the Official RADIO NEWS Short-Wave Listening Post Observers who are serving conscientiously in logging stations for the DX Corner.

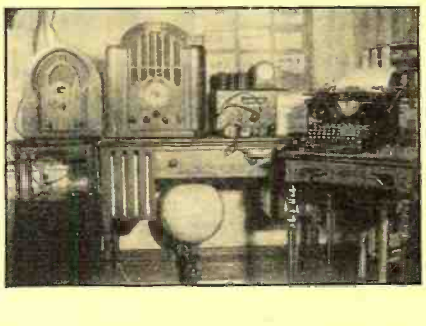
United States of America

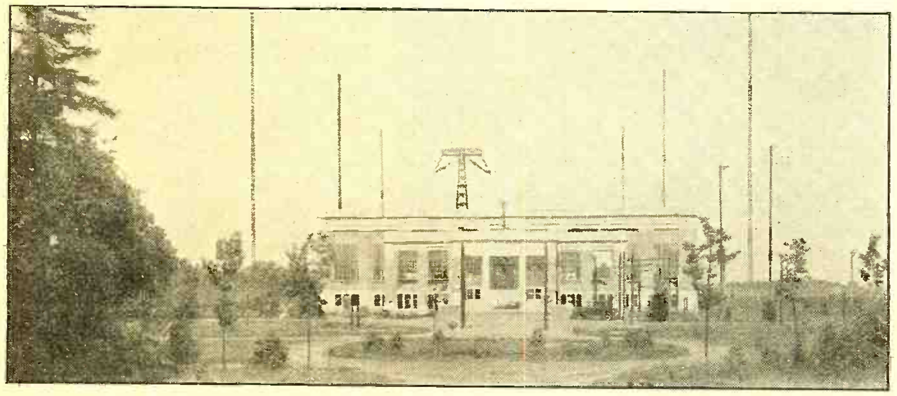
Alabama, J. E. Brooks, L. T. Lee, Jr.; Arizona, George Pasquale; Arkansas, Don Pryor, James G. Moore; California, E. G. DeHaven, C. H. Canning, O. I. Noda, E. S. Allen, A. E. Berger, George C. Sholin, Wesley W. Loudon, G. C. Gallagher, Robert J. McMahon, Werner Howald; Colorado, William J. Vette; Connecticut, Phillip Swanson, George A. Smith, H. Kemp; District of Columbia, Douglas S. Catchim; Florida, George H. Fletcher, E. M. Law, James, F. Dechert; Georgia, James L. Davis, C. H. Armstrong, Guy R. Bigbee, John McCarley, R. W. Winfree; Idaho, Bernard D. Starr, Lawrence Swenson; Illinois, Phillip Simmons, E. Gergeman, Robert L. Weber, Floyd Waters, Charles A. Morrison, Larry Eisler, Samuel Tolpin, Ray A. Walters, Robert Irving, J. Ira Young; Indiana, Freeman C. Balph, J. R. Flannigan, Henry Spearing, Arthur B. Coover; Iowa, J. Harold Lindblom; Kansas, C. W. Bourne, William Schumacher; Kentucky, James T. Spalding, Charles Miller, William A. McAlister, George Krebs; Louisiana, Roy W. Peyton; Maine, Danford L. Adams, M. Keith Libby; Maryland, Howard Adams, Jr., James W. Smith, J. F. Fritsch, August J. Walker; Massachusetts, Armand A. Boussey, J. Walter Bunnell, Harold K. Miller, Donald Smith, Elmer F. Orne, Arthur Hamilton, Roy Sanders, Robert L. Young, Walter L. Chambers, Sydney G. Millen; Michigan, Stewart R. Ruple, Ralph B. Baldwin; Minnesota, E. M. Norris, Dr. G. W. Twomey, M. Mickelson; Mississippi, Dr. J. P. Watson, Mrs. L. R. Ledbetter; Missouri, C. H. Long; Montana, Henry Dobrovalny; Nebraska, P. H. Clute, G. W. Renish, Jr., Harold Hansen, Hans Anderson; Nevada, Don H. Townsend, Jr.; New Hampshire, P. C. Atwood, A. J. Mannix; New Jersey, William Dixon, R. H. Schiller, William F. Buhl, Paul B. Silver, Morgan Foshay, George Munz; New Mexico, G. K. Harrison; New York, Robert F. Kaiser, William Koehnlein, T. J. Knapp, Joseph M. Malast, Capt. Horace L. Hall, S. G. Taylor, John M. Borst, William C. Dorf, R. Wright, I. H. Kattall, H. S. Bradley, Donald E. Bame, Albert J. Leonhardt, Edmore Melanson, John C. Kalmbach, Jr., J. H. Miller, W. B. Kinzel, Ray Geller; North Carolina, H. O. Murdoch, Jr., W. C. Couch, E. Payson Mallard; Ohio, William Oker, R. W. Evans, C. H. Skatzes, Donald W. Shields, Albert E. Emerson, Samuel J. Emerson, Clarence D. Hall, Charles Dooley, Stan Elcheshen, Paul Byrns; Oklahoma, H. L. Pribble, Robert Woods; Oregon, Virgil C. Tramp, James Haley, George R. Johnson, Ned Smith, Harold H. Flick, Ernest R. Remster; Pennsylvania, Edward C. Lips, K. A. Staats, C. T. Sheaks, George Lilley, John A. Leininger, F. L. Stitzinger, Hen F. Polm, Charles Nick, Oliver Amlie, R. O. Lamb, Harold W. Bower, Roy L. Christoph, Walter W. Winand; Rhode Island, Joseph V. Trzuskowski, Carl Schradieck; South Carolina, Ben F. Goodlett, Edward F. Bahan; South Dakota, Paul J. Mraz; Tennessee, Charles D. Moss, Eugene T. Musser; Texas, Heinie Johnson, Bryan Scott, John Stewart, Carl Scherz, James Brown, James W. Sheppard, Overton Wilson; Utah, Harold D. Nordeen, Earl Larson, A. D. Ross; Vermont, Joseph M. Kelley, Eddie H. Davenport, Dr. Allen E. Smith; Virginia, Gordon L. Rich, G. Hampton Allison, D. W. Parsons, L. P. Morgan; Washington, A. D. Golden, Charles G. Payne, Glenn E. Dubbe; West Virginia, Kenneth Boord, R. E. Sumner; Wisconsin, William M. Hardell, Walter A. Jasiorkowski, Wyoming, Dr. F. C. Naegeli, L. M. Jensen.

Applications for Official Observers in the remaining States should be sent in immediately to the DX Corner.

WELL EQUIPPED
N. Y. LISTENING POST

At the right, a photograph of Enrico Scala, Jr.'s DX corner, with some of the equipment he uses.





THE FAMOUS SHORT-WAVE PLANT AT RUYSSELEDE

Here is a view of the buildings and antennas of Stations ORK and ORP. The signals from Station ORK are now being received in America at very high levels in the early afternoon.

given. If any of our readers can supply actual Time Schedules, actual Wavelengths, correct Frequencies, or any other Important Information regarding these items, the DX Corner Editor and its readers will be glad to get the information. There are some hard stations to pull in in these listings, but we urge our Listening Posts and other readers to try their skill in logging the stations and getting correct information about them. When you are satisfied that you have this information correct, send it in to the editor; or if you have received a "veri" from any of the hard-to-get stations, send in a copy of the "veri' so that the whole short-wave fraternity may benefit. The list follows:

GSL, Daventry, England, 49.09 meters, 6110 kc., 2:30-3:30 p.m., G.M.T This transmission is also duplicated by GSC. (Young, Flick, Friedl, Clarkson, Gallagher, Eisler, Mack, Tallman, Ferguson, Dilg, Waters, Morgan, Libby, Winfree, Hickson, Christoph, Chambers, Roy, Balph, Evans, A. Smith, Winand, Naegeli, J. H. Miller, Boatman, Wright, Pryor, Kemp.)

I2RO, Rome, Italy, has changed its wavelength to get away from code interference from EAM. The new wavelength is on 31 meters, and the frequency is about 9650 kc. Their schedule remains the same. They have a new schedule on 25.4 meters, 11810 kc., 6:30-8:30 a.m., E.S.T., and are heard testing at later hours. (Friedl, Clarkson, Chambers, Libby, Jensen, Irving, Munz, J. H. Miller, Wright, and Young.)

ZHJ, Penang, F. M. S., reported heard on 49.16 meters, 6072 kc., 5-8 a.m., E.S.T., on Mondays, Wednesdays, Saturdays. (Lawton, Donaldson.) Styles reports them on from 2-3 a.m., E.S.T., as well.

PKYDL2, Java, reported heard on 62 meters, 11:30-2:30 p.m., G.M.T. (Lawton.)

WTDW, Virgin Islands, reported heard on the air on 69.85 meters from 4-6 and from 9-11 p.m., E.S.T. (Lawton.)

VK3ME, Melbourne, Australia, reported heard using the call 3ME on the air Weds., Thurs. and Sat., 5-7 a.m., E.S.T. (Hamilton, Hallet, Gaunt, Williams, Robinson and Wright.)

YV6RV, Valencia, Venezuela, has changed their wavelength to 46.1 meters, 6520 kc., 5:30-9:30 p.m., 11-1 a.m., E.S.T. (Skatzes, N. C. Smith, Saldana, Bower, Foshay, Dickes, Shields, Chambers, Hamilton, Cooke, A. Smith, Betances, Winand, Gallagher, Radio Club Venezolano, Ferguson, Sholin, Donaldson.

CT1AA, Lisbon, Portugal, reported changed to 31.17 meters. (Dodge, Bower.)

HJ4ABA, Medellin, Colombia, reported heard on 25.6 meters, 11710 kc. (also 11720 kc.), 6:30-11:30 p.m., E.S.T. (Christoph, West, Atkinson, Grey, Cobb, Dickes, Chambers, World-Wide Dial Club.)

TPK, Costa Rica, 46 meters, reported heard playing records of foreign transmissions; announced "La Vox de Victor." (J. H. Miller.)

VP1A is reported as the correct call for VPD, 13080 kc. (Sholin, N. C. Smith.)

CT1GU, Aporto, Portugal, reported heard on 14275 kc., 2 p.m., E.S.T. (Meinhardt.)

CT1AA, Lisbon, Portugal, reported heard testing on 25.02 meters, 11990 kc., 9-10 a.m., E.S.T. (Kinzel). Also reported transmitting on 50.1 meters, 5980 kc., 5-7 p.m., E.S.T. (Kinzel, Robinson and N. C. Smith.)

HJ4ABL, Manizales, Colombia, 49.14 meters, 6100 kc., reported heard evenings up until midnight. (Amore, Clarkson, Foshay, Gallagher, Catchim, Herrara, Christoph, S. J. Emerson, Skatzes, Young, J. H. Miller.)

HJ4ABN, Manizales, Colombia, reported on the air, only on Saturday nights, after 11 p.m., on approximately the same wavelength as HJ4ABL. (Kemp.) These are two reported calls about which there has been much controversy, some listeners reporting that there are two stations quite certainly.

TG2X, reported as the new short-wave station call for an outlet for the long-wave station TGW at Guatemala, reported to be on 5980 kc. (Lips.)

HP5J, Panama City, Panama, 31.25 meters, 9590 kc., 11:30-1 p.m., and 9:30-10 p.m., E.S.T. (J. H. Miller, Kemp, Gallagher, Herrera, A. Smith, Chambers, Skatzes, Winand.)

FIQA, Tananarive, Mad., reported heard on 49.9 meters at 8 a.m., GM.T. (Vassallo.)

TI3WD, Cartago, Costa Rica, reported heard on 14100 kc., 7 p.m. (Meinhardt.)

XGOX, Nanking, China, reported soon to be on the air with Chinese and English programs on 16.85 meters, 17500 kc.; 25.11 meters, 11910 kc.; 31.56 meters, 9500 kc.; 49.97 meters, 6000 kc. (Stevens, Donaldson.)

HBO, Prangins, Switzerland, reported heard on the air 24.9 meters, 12030 kc. (Hampshire.) Who knows time schedule? (*Cont. on page* 750)

S.W. PIONEERS
Official RADIO NEWS Listening Post Observers

LISTED below by countries are the Official RADIO NEWS Short-Wave Listening Post Observers who are serving conscientiously in logging stations for the DX Corner.

Alaska, Thomas A. Pugh.
Argentina, J. F. Edbrooke.
Australia, C. N. H. Richardson, H. Arthur Matthews, A. H. Garth, A. E. Faull.
Bermuda, Thursten Clarke.
Brazil, W. W. Enete, Louis Rogers Gray.
British Guiana, E. S. Christiani, Jr.
British West Indies, E. G. Derrick, N. Hood-Daniel, Edela Rosa.
Canada, J. T. Atkinson, C. Holmes, Jack Bews, Robert Edkins, W. H. Fraser, Charles E. Roy, Douglas Wood, A. B. Baadsgaard, Frederick C. Hickson, John E. Moore.
Canal Zone, Bertram Baker.
Canary Islands, Manuel Davin.
Central America, R. Wilder Tatum.
Chile, Jorge Izquerdo.
China, Baron Von Huene.
Colombia, J. D. Lowe. Italo Amore.
Cuba, Frank H. Kydd, Dr. Evelio Villar.
Czechoslovakia, Ferry Friedl.
Denmark, Hans W. Priwin.
Dutch East Indies, E. M. O. Godee, A. den Breems, J. H. A. Hardeman.
Dutch West Indies, R. J. Van Ommeren.
England, N. C. Smith, H. O. Graham, Alan Barber, Donald Burns, Leslie H. Colburn, Frederick W. Cable, C. L. Davies, Frederick W. Gunn, R. S. Houghton, W. P. Kempster, R. Lawton, John J. Maling, Norman Nattall, L. H. Plunket-Checkemain, Harold J. Self, R. Stevens, L. C. Styles, C. L. Wright, John Gordon Hampshire, J. Douglas Buckley, C. K. McConnan, Fred C. Hickson.
France, J. C. Meillon, Jr., Alfred Quaglino.
Germany, Herbert Lennartz.
Hawaii, O. F. Sternemann.
India, D. R. D. Wadia.
Irish Free State, Ron. C. Bradley.
Iraq, Hagop Kouyoumdjian.
Italy, A. Passini, Dr. Guglielmo Tixy.
Japan, Massall Satow.
Malta, Edgar J. Vassallo.
Mexico, Felipe L. Saldana, Manuel Ortiz Gomez.
New Zealand, Dr. G. Campbell Macdiarmid, Kenneth H. Moffatt.
Norway, Per Torp.
Philippine Islands, Victorino Leonen.
Portugal, Jose Fernandes Patrae, Jr.
Puerto Rico, Manuel F. Betances.
Scotland, Duncan T. Donaldson.
South Africa, Mike Kruger, A. C. Lyell, H. Mallet-Veale.
South Australia, R. H. Tucker.
Spain, Jose Ma. Maranges.
Switzerland, Dr. Max Hausdorff, Ed J. DeLopez.
Turkey, Herman Freiss, M. Seyfeddin.
Venezuela, Francisco Fossa Anderson.

Applications for Official Observers in the remaining countries should be sent in immediately to the DX Corner.

OUR OBSERVER AT PRAGUE

Here is Ferry Friedl of Prague, Czechoslovakia, recently appointed L. P. O. for short waves. He uses a Telefunken set with wavebands from 19-2000 meters.

WORLD SHORT WAVE TIME-TABLE

Compiled by LAURENCE M. COCKADAY

Hours of transmission for the World's Short Wave Broadcast Stations

FILL IN LOCAL TIME

HOURS OF TRANSMISSION

8	9	10	11	M	1	2	3	4	5	6	7	Meters Wave-length	Call Letters	Frequency Kc.	City Country	8	9	10	11	N	1	2	3	4	5	6	7
01	02	03	04	05	06	07	08	09	10	11	12				GREENWICH MEAN TIME	13	14	15	16	17	18	19	20	21	22	23	00
											D	13.9+	W8XK	21540	Pittsburgh, Pa.	D	D	D	D	D	D						
										D	D	16.8+	GSG	17790	Daventry, England	D											
												16.8+	W3XAL	17780	Bound Brook, N. J.		XS						XX				
											P	16.8+	PHI	17775	Huizen, Holland	P	P	P	P								
											I	16.8+	DJE	17760	Zeesen, Germany	I	I	I	I								
												19.4	PRADO	15440	Riobamba, Ecuador								U	U	U	U	
												19.5	HAS3	15370	Budapest, Hungary	S	S										
												19.5	W2XAD	15330	Schenectady, N. Y.							D					
				D	D							19.6+	DJQ	15283	Zeesen, Germany												
											D	19.6+	W2XE	15270	New York, N. Y.	D	D	D	D								
										D	D	19.6+	FYA	15243	Pontoise, France	D	D	D	D	D							
											Q	19.6+	PCJ	15220	Huizen, Holland	Q	Q	Q	Q								
											D	19.7	W8XK	15210	Pittsburgh, Pa.	D	D	D	D	D	D	D	D	D			
				D	D		D	D	D	D	D	19.7	DJB	15200	Zeesen, Germany												
										D	D	19.8	GSF	15140	Daventry, England	D	D	D									
									XS			19.8	HVJ	15123	Vatican City			I									
												19.9+	RKI	15040	Moscow, U.S.S.R.		I	I	I								
												22.0	JYK	13610	Kemikawa-Cho., Jap.												
												22.3+	TIEP	13420	San Jose, Costa Rica					S	S	S					
												22.4+	YVQ	13340	Maracaibo, Ven.				I	I	I	I					
												22.7+	ORP	13200	Ruysselede, Belg.						D	D	D				
				Sa	Sa							22.9+	VP1A	13080	Suva, Fiji Islands					S	S						
											S	23.3	CNR	12830	Rabat, Morocco	S											
												24.2	CT1GO	12396	Parede, Portugal			S	S		XX	XX	XX				
											S	24.8+	CT1CT	12082	Lisbon, Portugal	S	S	S					Th	XS	XS		
		S							S	W		24.9+	RW59	12000	Moscow, U.S.S.R.			S									
												25.2	FYA	11900	Pontoise, France			D	D	D	D	D	D	D	D		
D	D	D										25.2	W8XK	11870	Pittsburgh, Pa.									D	D	D	D
												25.2+	GSE	11860	Daventry, England	D	D	D	D	D							
										D	D	25.3+	W2XE	11830	New York, N. Y.						D	D	D				
												25.4	I2RO	11810	Rome, Italy	D	I	I	I	I	I						
			D	D								25.3	DJD	11770	Zeesen, Germany					D	D	D	D	D			
												25.5	GSD	11750	Daventry, England						D	D	D	D	D	D	
											Q	25.5+	PHI	11730	Huizen, Holland	Q	Q	Q	Q								
D	D	D	D									25.6	CJRX	11720	Winnipeg, Canada						I	I	I	D	D	D	D
D	D	D	D									25.6	FYA	11720	Pontoise, France					I	I	I	I	I	D	D	D
												25.6	YV5RMO	11720	Maracaibo, Venez.										I		
D	D	D	D									25.6	HJ4ABA	11711	Medellin, Col.											D	D
				I	I	I	I	I	I	I	I	27.9+	JVM	10740	Nazaki, Jap.												
				I	I	I	I	I	I	I	I	28.1+	JVN	10660	Nazaki, Japan												
						AH						28.3+	FYB	10578	Paris, France							AD	D				
I	I	I	I									28.9+	LSX	10350	Buenos Aires, Argen.								I			D	D
												29.0+	ZFD	10335	Hamilton, Bermuda							I	I	I			
												29.0+	ORK	10330	Ruysselede, Belgium						D	D	D				
												29.4	CMHB	10200	SanctusSpiritus,Cuba						I	I	I	I	I	I	I
												30.4	EAQ	9860	Madrid, Spain						Sa	Sa			D	D	I
												30.5+	IRM	9820	Rome, Italy			I				I	I	I	I	I	I
C	C											30.6+	GCW	9790	Rugby, England					I	I	I	I	I	I		
												31.0+	I2RO	9650	Rome, Italy							D	D	D			
												31.2+	CT1AA	9600	Lisbon, Portugal									G	G	G	G
												31.2+	W3XAU	9590	Philadelphia, Pa.				D	D	D	D	D	D	D	D	
					S	S			S	S	S	31.2+	VK2ME	9590	Sydney, Australia	S	S	S	S								
	D	D										31.2+	HP5J	9590	Panama City, Pana.				D	D							
												31.3	HBL	9580	Geneva, Switzerland										Sa	Sa	AF
			XS	XS	XS	XS	XS	XS	XS	XS	XS	31.3	VK3LR	9580	Lyndhurst, Victoria, Australia												
	D	D										31.3	GSC	9575	Daventry, England										D	D	
D	D	D	D	D							XS	31.3+	W1XK	9570	Springfield, Mass.	D	D	D	D	D	D	D	D	D	D	D	D
										I	I	31.3+	VUB	9565	Bombay, India	I	I	I	I	I							
D	D											31.3+	DJA	9560	Zeesen, Germany	D	D	D	D						D	D	D
												31.4+	LKJ1	9540	Jeloy, Norway			D	D	D	D	D	D	D	D	D	D
D	D	D					D	D	D	D	D	31.4+	DJN	9539	Zeesen, Germany	D	D	D	D						D	D	D
D	D	D										31.4+	W2XAF	9530	Schenectady, N. Y.										D	D	D
									AK	AK	AK	31.5	VK3ME	9510	Melbourne, Australia	AK	AK										
			D	D								31.5	GSB	9510	Daventry, England				D	D	D	D	D	D			
												31.5+	PRF5	9501	Rio de Janeiro, Braz.										D	D	I
D	D											31.7+	COH	9428	Havana, Cuba			D	D						D		
											D	31.8	PLV	9415	Bandoeng, Java	D	XA	D									
												32.8+	HAT4	9125	Budapest, Hungary											D	
												33.1+	TFK	9050	Reykjavik, Iceland												I
D	D											37.4+	HC2JSB	8000	Guayaquil, Ecuador												
												38.4+	HBP	7790	Geneva, Switzerland										Sa	Sa	AF
												38.5	YNLF	7788	Managua, Nicaragua											D	
D	D	D										40.5+	HJ3ABD	7402	Bogota, Colombia					XS	XS				D	D	D
D												40.5+	XEPR	7400	Mexico City, Mex.											D	D
												40.5+	EA8AB	7403	Tenerife, C. I.											D	
XS	XS											41.1+	HJ1ABD	7281	Cartegina, Col.												XS
												41.8	CR6AA	7177	Lobito, Angola. Port. West Africa							L	L	L			
D	Z	D										42.0	HJ4ABB	7138	Manizales, Col.					XA		S	S	S		XA	Z
I												42.0	OA4R	——	Lima, Peru									D		I	I
												42.1+	HB9B	7118	Basle, Switzerland									Th			
				I								43.4+	HI3C	6900	La Romana, D. R.					I	I						
D							S					44.0	HIH	6818	San Pedro, D. R.					D	D	I	I	S	S		D
				D	D	D	D	D	D	D	D	44.5+	JVT	6750	Nazaki, Japan												
D	D	I	I									44.6+	TIEP	6710	San Jose, Costa Rica										I	D	D
	T	T	T	T								45.0+	HC2RL	6668	Guayaquil, Ecuador										S	S	S
	Th	Th	Th									45.3	PRADO	6616	Riobamba, Ecuador		T	T									
D	D											45.3+	RW72	6611	Moscow, U.S.S.R.					I							
D	D											45.9+	YV6RV	6520	Valencia, Ven.				D	D					D	D	D
D	D	D										46.2	HJ5ABD	6490	Cali, Colombia				D	D	D			D	D	D	D
												46.2+	HI4D	6482	San Domingo, D. R.				XS	XS	XS			XS	XS	XS	XS
D	D	L										46.5+	HJ1ABB	6447	Barranquilla, Col.				D	D	D			S	S	D	D
	I											46.6+	VE9AS	6425	Fredericton, N. Bru.									D	D	D	D

WORLD SHORT WAVE TIME-TABLE

(*Continued from the Previous Page*)

Hours of transmission for the World's Short Wave Broadcast Stations

FILL IN LOCAL TIME

8	9	10	11	M	1	2	3	4	5	6	7	EASTERN STANDARD TIME				8	9	10	11	N	1	2	3	4	5	6	7
01	02	03	04	05	06	07	08	09	10	11	12	GREENWICH MEAN TIME				13	14	15	16	17	18	19	20	21	22	23	00
HOURS OF TRANSMISSION												Meters Wave-length	Call Letters	Frequency Kc.	City Country	HOURS OF TRANSMISSION											
AJ	AJ	AJ	AJ									46.6	HJA3	6425	Barranquilla, Col.												
D	D	D										47.0	YV4RC	6375	Caracas, Venez.										D	D	D
	Sa	Sa	Sa									47.5	HIZ	6315	San Domingo, D. R.					S	S	S		S	D		
XS	XS	D										47.8	HJ3ABF	6275	Bogota, Colombia				D								XS
V	V											48.1	OAX4B	6230	Lima, Peru												V
												48.1	HJ4ABC	6230	Pereira, Col.		D	D									D
XY												48.4	CT1GO	6198	Parede, Portugal				S	S	S						XY
D	D	I	I	I								48.4	HI1A	6188	Santiago de Los Caballeros, D. R.				Z	Z	D	D					D
D	D	D	D									48.7+	CJRO	6160	Winnipeg, Manitoba						I	I	I	I	D	D	D
XS												48.7+	HJ2ABA	6150	Tunja, Colombia				E	E					I	XS	XS
D	D	D										48.7+	YV3RC	6150	Caracas, Venezuela			D	D	D	D			D	D	D	D
			Sa	Sa								48.7+	VE9CL	6150	Winnipeg, Man.												
												48.7+	CSL	6150	Lisbon, Portugal						D	D	D	D	D	D	D
D	D	D										48.7+	CO9GC	6150	Santiago, Cuba		D	D	D	D	D		D	D	D		
D	D	D	D	D								48.8+	W8XK	6140	Pittsburgh, Pa.									D	D	D	D
										O	O	48.9	ZGE	6132	Kuala Lumpur, F. M. S.												O
												48.9+	LKJ1	6130	Jeloy, Norway			D	D	D	D	D	D	D	D		
			XS	XS			D	D	XS	XS		48.9+	ZTJ	6122	Johannesburg, Africa	S	D	D	XS	D	D	D	XS	Sa			
D	D											49.0+	W2XE	6120	New York, N. Y.										D	D	D
						D	D	D	D	D	D	49.0+	PKYDA2	6120	Bandoeng, Java	D	D	S									
D	D	D										49.0+	YV2RC	6112	Caracas, Ven.	D	D	D	S			S	S	S	D	D	D
D	D	D	D	D								49.0+	VE9HX	6110	Halifax, N. S.		D	XA	XA	XA	XA	XA	XA	D	Sa	D	D
	D	D										49.0+	GSL	6110	Daventry, England												
												49.0+	VUC	6109	Calcutta, India		I	D	D	Sa							
				Sa								49.1+	W3XAL	6100	Bound Brook, N. J.										Y		
	XSa				D	S						49.1+	W9XF	6100	Chicago, Ill.												
D	D	D	O	I								49.1+	HJ4ABL	6100	Manizales, Col.											D	D
D	XS	XS	XS								R	49.1+	VE9GW	6090	Bowmanville, Can.	R	R	R	R	R	AB	AB	D	D	D	D	D
												49.2+	I2RO	6085	Rome, Italy											C	C
D	D	I										49.3+	CP5	6080	La Paz, Bolivia										I	I	I
S												49.3+	W9XAA	6080	Chicago, Ill.		XS	XS	D	D	D	D	D	D	D	S	S
I	I	I										49.3+	DJM	—	Zeesen, Germany					I	I	I	I	I	I	I	I
							K	K				49.3+	CQN	6073	Macao, Asia												
							D	I	I	I	I	49.3+	OER2	6072	Vienna, Austria	I	D	D	D	D	D	D	D	D	D	I	
S	S	S	AG	AG	T							49.3+	VE9CS	6070	Vancouver, B. C.						S	S	S	S	S	D	D
												49.3+	HJ1ABF	6070	Barranquilla, Col.												
							T		C	C		49.4+	VQ7LO	6060	Nairobi, Kenya, Afr.	Th		Y	XF	XF	Sa	S					
			D	D	D	Sa				XS	XS	49.4+	W8XAL	6060	Cincinnati, Ohio	D	D	D	D	D	D	D	D	D	D	D	D
D	D											49.4+	W3XAU	6060	Philadelphia, Pa.												D
												49.4+	OXY	6060	Skamlebaek, Den.	U			A		D	D	D	D	D	D	
												49.5+	GSA	6050	Daventry, England												
D	D	D										49.6+	HJ1ABG	6042	Barranquilla, Col.											D	D
E	E											49.6+	W1XAL	6040	Boston, Mass.										S	S	E
D												49.6+	PRA8	6040	Pernambuco, Brazil								D	D	D	D	D
D	D	D										49.7+	HP5B	6030	Panama City, Pan.					D				I			
D	D	D	D	D	Th	Th						49.7+	VE9CA	6030	Calgary, Alberta, Can.		XS	XS	XS	D	D	D	XS		S	S	D
D	D	D										49.8	DJC	6020	Zeesen, Germany					D	D	D	D	D	D	D	D
		S	S	AA	AA				N	N	N	49.8+	ZHI	6018	Singapore, Malaya			S	S	AA							
I	I	I	Sa	Sa								49.8+	COC	6010	Havana, Cuba	D	D	D	D	D				D	D	I	I
D	D	D	D	D								49.8+	XEBT	6010	Mexico City, Mex.			D	D	D	D	D	D	D	D	D	D
				Sa								49.9+	VE9DN	6005	Montreal, Quebec							D					
												49.9+	RW59	6000	Moscow, U.S.S.R.									B	I		
XS	XS	XS	XS							XS	XS	50.1	TGX	5984	Guatemala City				XS	XS						XS	XS
												50.1+	CT1AA	5980	Lisbon, Portugal											I	I
D		D	D	D								50.1+	XECW	5980	Xantocam, Mexico												D
Z	Z	Sa	Sa									50.1+	HIX	5980	San Domingo, D. R.					D							I
									S			50.2+	HVJ	5969	Vatican City							D					
D	D	D	D									50.5+	HJ1ABJ	5940	Santa Marta, Col.												D
G	C	C	S									50.5+	HJ4ABE	5930	Medellin, Colombia				XS	XS					I	G	G
D												51.0+	HJ2ABC	5870	Cucuta, Colombia												D
XS	XS											51.2+	YV5RMO	5850	Maracaibo, Venez.				XS	XS					XS	XS	XS
L	L	L	L									51.8+	OAX4D	5780	Lima, Peru												
XS	XS	XS										52.0	TIXGP3	5777	Almatica, San Jose, Costa Rica												XS
									D	D	D	52.7+	XQAJ	5660	Shanghai, China	I											
							XS					52.7	FIQA	5692	Tananarive, Mad	D		XS		Sa	Sa	S					
M												55.5+	HAT	5400	Budapest, Hungary								S				
	L	L										64.5+	HC2EP	4650	Guayaquil, Ecuador												
O	D											69.5	YNLF	4316	Managua, Nicaragua												
					I	D	D	D	D	D	D	70.2	RW15	4273	Khabarovsk, Siberia	D	D	D	D								
XM	XM	XM	XM									73.0	HCJB	4107	Quita, Ecuador						XM	XM					
D												74.9+	CT2AJ	4002	San Miguel, Azores										L	L	D
												79.5+	HB9B	3770	Basle, Switzerland										Th		
												79.9+	CT1CT	3750	Lisbon, Portugal		S										
												84.6+	CR7AA	3543	Lourenzo Marques, Mozambique						AC	AC	AC		L	L	
												85.0+	HB9AQ	3525	Switzerland										Th		

KEY TO TIME TABLE SYMBOLS

A—Sunday, Winter only
B—Sunday, Monday, Wednesday, Friday
C—Monday, Wednesday, Friday
D—Daily at hours indicated
E—Tuesday, Thursday
F—Friday
G—Tuesday, Thursday, Saturday
H—Wednesday, Friday, Sunday
I—Irregularly
J—Thursday, Saturday
K—Monday, Friday
L—Wednesday, Saturday
M—Monday

N—Monday, Wednesday, Thursday
O—Tuesday, Friday, Sunday
P—Except Tuesday, Wednesday, Summer only
Q—Except Tues., Wed., Winters
R—Thursday, Friday, Saturday
S—Sunday
T—Tuesday
TH—Thursday
U—Sunday. Summer only
V—Wednesday, Sunday
W—Wednesday
Y—Monday, Wednesday, Saturday

Z—Tuesday, Friday
AA—Saturday, Sunday
AB—Except Monday, Tuesday, Wed.
AC—Monday, Tuesday, Saturday
AD—Time at 20 G.M.T.
AE—Except Monday, Wednesday, Friday
AF—Saturday irregularly
AG—Tuesday, Sunday
AH—Time at 7:30 G.M.T.
AI—Tuesday, Friday, Saturday
AJ—Wednesday, Thursday
AK—Wed., Thur., Sat.

SA—Saturday
XA—Except Saturday, Sunday
XF—Except Friday
XG—Except Tuesday, Thursday, Saturday
XM—Except Monday
XS—Except Sunday
XSa—Except Saturday
XT—Except Tuesday
XTh—Except Thursday
XW—Except Wednesday
XX—Tuesday, Thursday, Friday
XY—Except Tuesday, Sunday

INAUGURATES AMERICAN HOUR
Senator Guglielmo Marconi at the initial broadcast from 12RO, Rome, a program enjoyed three times a week by listeners of America.

PSK, Rio de Janeiro, Brazil, reported back on the air on 36.6 meters, 8125 kc., 7-10 p.m., E.S.T., irregularly. (Cook, Canfield.)

TI5JJ, Alajuela, Costa Rica, reported on the air between 6000 and 6700 kc. (Kalmbach.)

YV5RMO, reported heard on 25.6 meters, 11710 kc. (Winand, J. H. Miller.) Some readers report this a harmonic. How about it, friends?

YNLF, reported moved to 5950 kc. (Winand.) Who has latest data?

HVJ, Vatican City, announces in Italian Monday, in English Tuesday, in Spanish Wednesday, in French Thursday, in German Friday, and Dutch Saturday. (Dawson, Deering, Morse and the U.S.S.R. DX Club.)

ZEA, St. George, Bermuda, reported heard testing with records on 5025 kc. (Hickson, Eisler.)

PKPMA, reported playing records on 19350 kc. (Hampshire.) Can anyone identify?

PI1J, Dordrecht, Holland, reported now transmitting on 42.35 meters on Monday irregularly, and on Saturdays 16:10-17:10, G.M.T.

VK2ME, Sydney, Australia, now announces as 2ME and are on the air Sundays 6-8 a.m., 10-2 p.m., 2:30-4:30 p.m., G.M.T. (Scott, Adams, Remster, Etheridge, Styles, Self, Ferguson, Robinson, McCormick, Koivisto, Lussier, Flick, Wilson, McMahon, Musser, Gaunt.)

HI3C, Dominican Republic, reported on 43.8 meters, 6900 kc., testing records at midnight. Also heard 12:30-2 p.m., E.S.T., Tuesdays and Wednesdays. (Lussier.)

JVT, Nazaki, Japan, reported as the best station at present on 6750 kc. Two other good Japs are JVM, 10740 kc., and JVN, 10660 kc. (Gallagher, Haylor, Kemp, McMahon, Pryor.)

JVP, reported as a phone station on 7510 kc., heard 6:30-7 a.m., E.S.T.

HB9B, Basle, Switzerland, reported transmitting on 42.1 meters, 7115 kc., Thursday, 21-21:30, G.M.T., and on 3750 kc., Thursday, 22, G.M.T. (Stuber.)

HB9AQ, Switzerland, reported transmitting on 3525 kc., Thursday, 21:30, G.M.T. (Stuber.)

HI1J, San Pedro de Marcoris, reported on 51.9 meters, 5780 kc., 7-10 p.m., E.S.T. (Bigbee and Betances.)

XEPR, Mexico City, likewise reported XEBR and XECR on 40.5 meters, 7400 kc., 6-9 p.m., E.S.T. (Myers, Catchim, Gomez.)

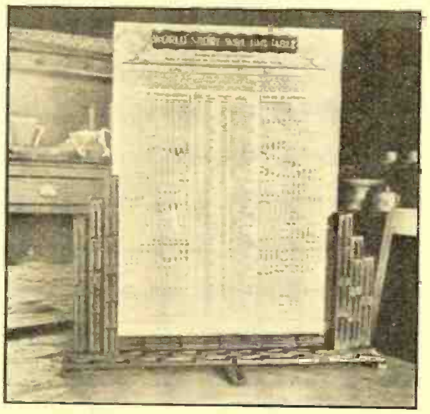
XQAJ, Shanghai, China, reported heard on 5660 kc., 5-7 a.m., E.S.T. (Duncan.)

VUB, Bombay, India, reported heard on 31 meters, Sundays, 1:30-2:30 p.m., G.M.T., Wednesday and Saturday 4:30-5:30 p.m., and on Mondays irregularly, G.M. (Styles.)

W8XAL reported heard on 24 meters (Clarkson.) Was it a harmonic?

YN1GG, Managua, Nic., also reported as YN1AA on 46.88 meters, 6350 kc., 7-9 p.m., E.S.T. (Irving, Kalmbach.)

A GOOD TIME-TABLE IDEA
Here is how Manuel Gomez of Mexico City frames his time-table between two glasses in a very handy way for use in his Listening Post.



HC2AT, Guayaquil, Ecuador, reported heard on 35.72 meters, 8400 kc., 9-11 a.m., 2-4 p.m., 8:30-9:30 p.m., E.S.T. (Kalmbach and Irving.)

HAS3, Budapest, Hungary, reported transmitting on 19.5 meters, 15370 kc., 14-15 G.M.T. (Tomlinson.)

HAT4, Budapest, Hungary, reported heard on 32.88 meters, 9125 kc., 23-24 G.M.T.

EDO, Madrid, Spain, reported heard on 43 meters, 6976 kc., 9-9:30 p.m., E.S.T. (Myers.)

VE9CA, Calgary, Alberta, Canada, reported transmitting on 49.7 meters, 6030 kc., irregularly. (Ross, McCracken, Holmes, Howald, Gallagher, Bews.)

W9XBY, Kansas City, Missouri, reported heard on 1530 kc. (Schumacher.) Isn't this an amateur harmonic?

YV2RC, Caracas, Venz., reported heard on about 12700 kc., 2:50-3:05 p.m., E.S.T. (Irving.) Another harmonic?

HJA7, Cucuta, Colombia, reported heard on 5400 kc., 4:30 to 7:45 p.m., E.S.T. (Brown.)

Our own O.R.N.S.W.L.P.O. Vette conducts a short-wave hour on KLZ, 560 kc., at 11:30 a.m., E.S.T., Friday nights under the name "The Dial Twister."

W2XHI is the call for the new short-wave station at Carteret, New Jersey, the short-wave outlet for WOR. Who has heard and who knows schedule?

TIX, **TIXGP3** and **TIXGPH** are all one and the same station, according to the latest information. The short-wave call is TIXGP3, but the long-wave call, often heard announced on the short-wave station, is TIXGPH.

W9XBS, Chicago, reported heard on 6425 kc., at 3:15 p.m. (Waters.) Another "Ham" harmonic?

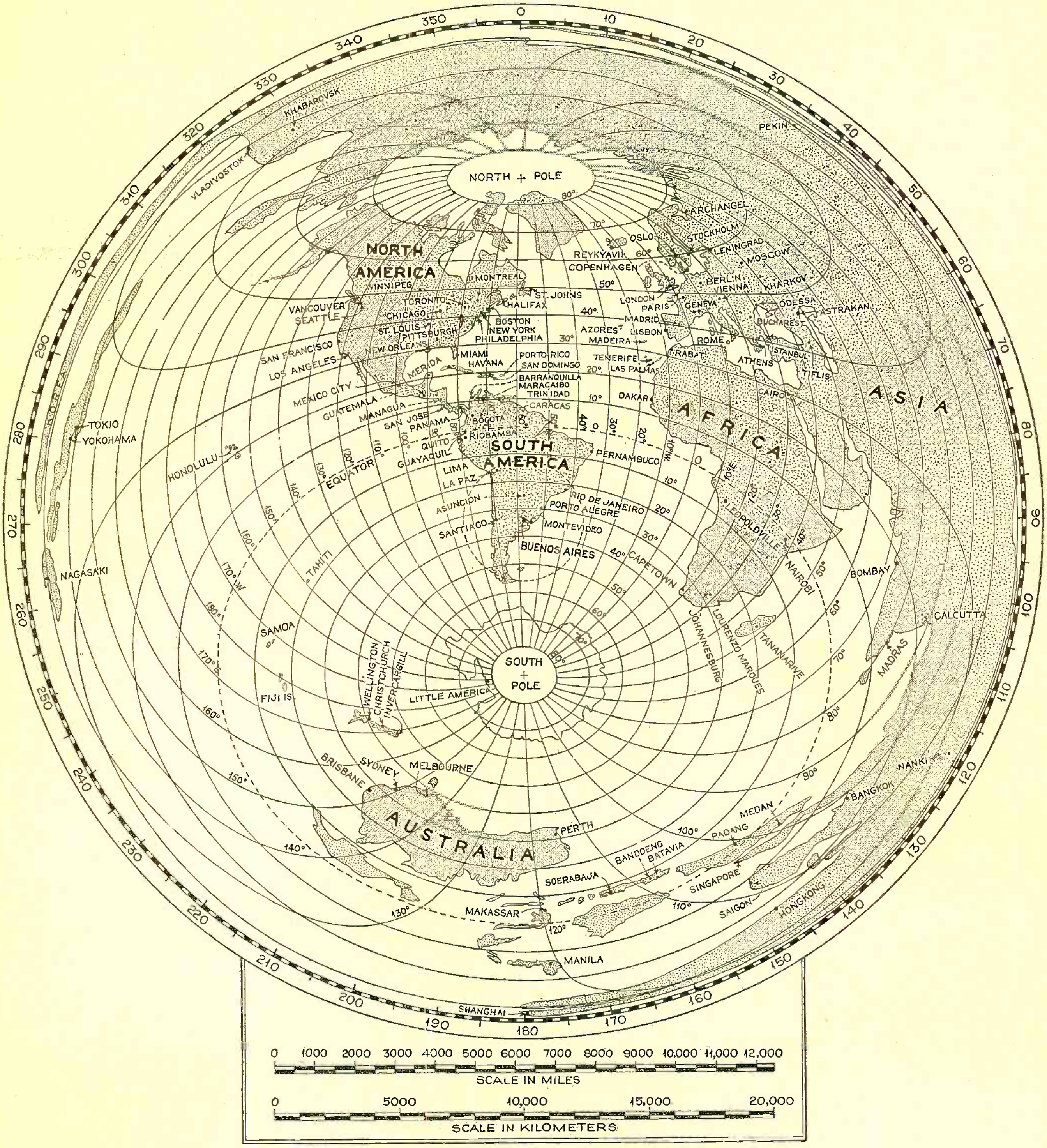
GBS reported heard on 12145 kc., 4:30-6 p.m. (Morgan.)

HRP1, San Pedro, Honduras, reported heard on 42.68 meters, 7080 kc., 7-10 p.m., E.S.T. (Kinzel.)

W8XAL (WLW), Cincinnati, Ohio, gives an interesting short-wave program at 11:30 p.m., twice weekly. (Skatzes.) Who knows exact days?

DO YOU HEAR HOLLAND?
If you do listen to Station PHI here is the studio from which most of the programs originate.

WORLD DISTANCE CHART No. 7



HBJ, Switzerland, reported heard on 14450 kc., 12:30-1 p.m. (Adams.) Any schedule?

TITE, San Jose de Costa Rica, reported on 6650 kc., 9:11 p.m., E.S.T. (World-Wide Dial Club and Grey.)

CMHD, Tallarin, Cuba, reported on 6700 kc., 7-10 p.m. (Saldana.)

SUV, Cairo, Egypt, reported heard 29.8 meters, 10055 kc., at 12:42 and from 2-4:30 p.m., E.S.T.

HJN, Bogota, Colombia, reported transmitting on 19.94 meters, 10:30-11 a.m., E.S.T.

KEE, Bolinas, Calif., is reported as a good station to listen for on 38.8 meters, 7715 kc. (also reported as 7720 kc.), during the evening hours until midnight. (Kay, Lyell, Skatzes, Pearce and Lussier.)

VP6YB, Barbados, B. W. I., 42.5 meters, 7070 kc. (also reported as 7072 kc.), is on the air 4-5 p.m., E.S.T. (Styles, Libby, N. C. Smith, Betances, J. H. Miller, Kinzel.)

Who has heard Czechoslovakia on 44.68 meters, 6-6:15 p.m., E.S.T. (Young.)

HJ4ABE, Medelin, Colombia, is reported moved to 5930 kc. (Winand.)

HJ1ABD, Cartagena, Colombia, reported heard on 41.2 meters, 7281 kc., daily except Sundays, 7:30-9:30 p.m., E.S.T. (Hall.) (*Continued on page 754*)

THE WORLD DISTANCE MAP FOR SOUTHERN S. AMERICA

Here is the seventh Radio News *Azimuthal map, which is for the southern part of South America, centered at Buenos Aires. Measurements can accurately be made from any spot within the dotted circle to any other place on earth. Simply lay a ruler connecting any spot within this circle to any other location on the map and refer this distance to the scale in miles or kilometers; this will give the actual great circle distance. This is the seventh exclusive* Radio News *Distance Chart published in this series.*

SHORT-WAVE PAGE

WITHIN the last few months we were all pleasantly surprised at certain important happenings on the 40 to 49-meter band. When a South American changes from one wavelength to another, we are not even mildly surprised, but when a Spanish-speaking station announces in English we are deeply impressed and pleased beyond words. By degrees we are tuning in friendly stations to the southward and hear our own language spoken.

STATION HC2RL, the world-known in Guayaquil, Ecuador, which is owned and operated by Dr. Roberto Levi, owes its great American popularity to its "Hello, America. This is HC2RL." Listening to this station 2915 miles away from New York City has another lure in the charming voice of the artist par excellence, Miss Parquita Parra, who sings songs of her native Ecuador, as only an accomplished vocalist can.

Another station in Guayaquil that announces in English is HC2AT. This station, operating on 8400 kilocycles (35.7 meters), is rather a newcomer to the ether waves. This station is heard with good quality and volume during their late transmission, 8 to 10 p.m., E.S.T., and informs us that they will answer all correspondence. The address is: Post Office Box 872, Guayaquil, Ecuador, South America.

A popular station, HJ1ABB, Barranquilla, Colombia, whose transmissions are heard round the world, must have a rather hectic system when it comes to answering correspondence in which a verification is requested. From fellow short-wave listeners living in England, New Zealand and even South Africa, they write me and ask, "Does HJ1ABB verify?" Now, just what would you answer in this case? I know hundreds of fans who "sport" three and four veris from this Colombian station, therefore I *could* answer with a decided *yes*. But then there are just as many fans who complain bitterly about this same station not answering. I really think if Señor Pellet realized the importance of sending his very fine "QSL" card to all listeners who correctly report his station's transmissions, HJ1ABB would be benefited in added popularity.

Mr. Clarence Jones, of HCJB fame, whose station operates on the fairly unfrequented band of 73 meters, announces in English and verifies promptly. So what more can we ask?

The quintuplets in Venezuela, YV2RC, YV3RC, YV4RC, YV6RV and YV5RO, are excellent when verifications are requested and each one, during some time of their transmitting hours, informs their English-speaking listeners who they are.

A program of clever repartee, all in English, that should never be missed by any real short-wave listener, is that from HJ4ABL (49.18 meters), Manizales, Colombia. The announcer requests "friendly" letters, stamps for the son of the station's owner and reads the names of all who send reports of their transmissions. This very interesting program begins about 11 p.m., E.S.T., on Saturday night, and is interspersed with beautiful Colombian music. The writer, for one, makes it a point to tune in HJ4ABL at that time.

Thos. A. Archer, of Barbados, West Indies, owns and operates VP6YR. Mr. Archer informs us that he "puts on" broadcasts of the English cricket matches for the benefit of listeners throughout the islands. When YP6YB's signals are heard beyond that part of the country, the owner, who is an amateur, is more than pleased. "Tom's" station utilizes 40 watts when on phone and 100 watts on code. The frequencies used are 14144 and 14356, with occasional transmissions on the 40-meter band.

HJ1ABD is one of the stations in Cartagena, Colombia, who is kind enough to notify listeners when they intend to change their wavelength and schedule time on the air. Mr. Ignacio de Villarreal, the station director, informs us that "ABD" is now on 7281 kilocycles (41.2 meters) daily from 7:30 to 9:30 p.m., E.S.T., except Sunday and holidays.

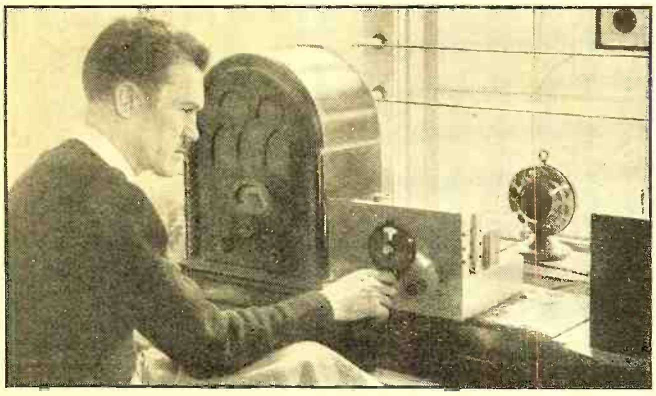
Antonio and Rafael Fuentes work at their own laboratories and in their spare time operate the well-known HJ1ABE. Similar to HJ1ABD, this twin station is located in Cartagena, Colombia. When "Tony and Rafa" went to Penn University in Philadelphia and Saint Luke's in Wayne, New Jersey, they played for about six months on WEAF and were known as the "Spanish Duet." All this may account for the fine verifications HJ1ABE sends out to all listeners who report reception of their station, which operates on 6115 kilocycles, and is known as "La Voz de los Laboratorios Fuentes."

Few fans have been fortunate to log the elusive XECW, Mexico. As all Spanish-speaking stations must be known as "La Voz de something or other"! XECW attaches "del Caballero Santoken" onto their assigned call. The listeners who snared XECW on their 50-meter transmission should now look for this 10-watter on 6135 kilocycles (48.89 meters). The card they send out is very original.

For several years it has been an unwritten law among the army of listeners to the stations operating below the broadcast band that, with the coming of the warm days, our reception of the stations below the Rio Grande would be nil. This change of season has to a certain extent caused all of us to be greatly dissatisfied with reception, but the South American stations are not suffering from their usual attack of summer static nearly as much as the Europeans. At this time it is not unusual to find that many of the stations that used to disappear with the coming of spring are just as clear and free of interference as they were all winter.

There are several reasons that can be put forth, why this should be the case. The main one is that radio in all its branches, and particularly in transmitting equipment, has advanced tremendously within the last year. Stations that never dreamed of using more than 30 or 40 watts have increased their power in some cases double and in others triple. Say what you may, power means something when it comes to the point. The German and English stations, with their retinue of engineers, found this out long ago. The foreign locals, Zeesen, Daventry, Madrid and Pontoise, will have rivals just as soon as some of the other short-wave broadcasters, ORK, CT1GO, etc., increase their power and beam their antennas. The Roman station is rapidly advancing into the A1 class. I2RO's transmissions are an acknowledged success since they abandoned the 30-meter commercial code band and are operating on 31.3 meters. Their 49-meter transmission, known as the "American Hour," is not received regularly all over, but there are some evenings when it does come through free of all interference. Rome, the home of grand opera, certainly "puts across" programs of value to any and all lovers of music. In passing, we think it obligatory to mention the fact that since Italy revamped their short-wave station and adjusted their schedule to suit the average listeners, they are one of the best of the European station. Besides, everyone is remarking how promptly they verify all correct reports.

With so many short-wave fans now operating custom-built receivers that have band-spread arrangements, it is not at all unusual to see many QSL cards from amateurs or hams in their collections. Personally, I think it is far more difficult to log an African amateur than a short-wave broadcaster. This, of course, is a subject always open for argument. To the listener who hovers around the 20-, 40- and 75-meter bands, we write these tips. Arrange your time of DXing so that you will be tuning on Thursday mornings from 3 a.m., E.S.T. At that hour the Thursday Morning Club goes on the air! Then is your opportunity to log Hawaiian, Cuban, Canadian and American amateurs. The thrill comes when W6HXP calls YWC in Spanish and by a quick change to the 40-meter band one can hear him answer. H17G is the official master of ceremonies of the Spanish-speaking amateurs. Others you may hear on this American chain are: CO7HF, HI6F, HI8H, on 40 meters; VE5BY, VE5JB (Canadian) and K6CMC, K6LQL, K6FJF (Hawaiian), all on 75 meters. A worth-while achievement by this "club" was a two-way transmission between W5DVK (on 160 meters) and K6LQL (on 75 meters). All these "hams" are on *voice!*



TESTING THE RADIO NEWS

SHORT-WAVE CONVERTER

S. Gordon Taylor

Part Three

DURING the development of the RADIO NEWS Converter it was tried with different types of receivers, and was put through numerous "air tests." However, to make doubly sure of its effectiveness and its freedom from "bugs" of any kind, a new series of tests has been completed and the results described here. The constructional details of this converter were given in the April and May issues.

IN considering any converter, several questions immediately come to mind, the foremost being, "Will it work with my receiver?" To answer this question, the widest variety of types from among the receivers on hand were selected and the converter put into operation with the six receivers selected, one after the other. The receivers were: 1. An 8-year-old, home-built, t.r.f. receiver using 3 tuned r.f. stages with 201A tubes. 2. A 6-year-old home-built Hammarlund "Hi-Q," a t.r.f receiver having two tuned stages, utilizing type 222 screen-grid tubes. 3. A Columbia, Model 120B, battery superheterodyne (about 1932) employing 2-volt tubes in a circuit which includes 1 t.r.f. stage and 1 i.f. stage. 4. An Atwater Kent, Model 92 mantel type superheterodyne. Includes latest type tubes and has 1 t.r.f. stage and 1 i.f. stage. 5. A Motorola, Model 5-10, 7-tube superheterodyne, about 2 years old. 6. A Scott XV, 15-tube custom-built superheterodyne, employing 1 tuned r.f. stage and 3 i.f. stages.

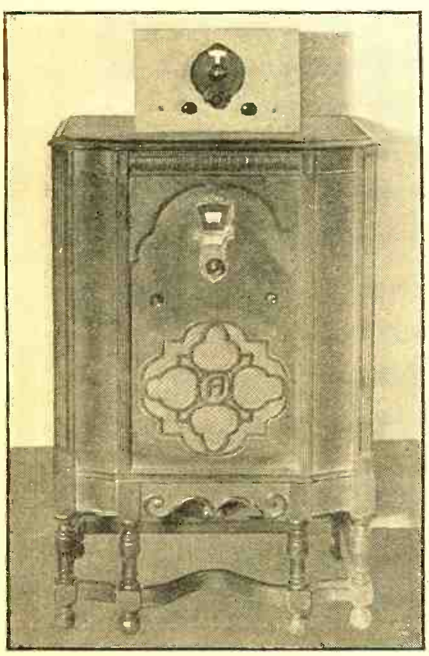
The first step in the tests was to try the converter with all of these models, tuning in a few foreign stations in each case and looking for any evidence of instability, heterodyne whistles or any other undesirable features resulting from the various combinations. As was anticipated, each one of these receivers in combination with the converter proved capable of not only bringing in European short-wave stations but bringing them in with more than adequate volume. No undesirable operating features of any kind were found, with the single exception that in the case of the air-cell receiver and the Atwater Kent 92 it was found desirable to place the converter on a sponge rubber pad and keep it 2 or 3 feet from the receiver to avoid microphonism. A rubber kneeling pad from the 5- and 10-cent store was used.

The test up to this point showed conclusively that the converter provides a high degree of short-wave sensitivity and selectivity with just about every type receiver that any fan might care to use it with. What is of equal importance, the test showed complete freedom from undesirable heterodyne interaction, circuit instability, etc. Incidentally, it might be mentioned that these receivers use various intermediate frequencies. The Atwater Kent is 130 kc., the Columbia air-cell receiver, 175 kc., and the Scott 465 kc. The Motorola intermediate frequency is not known. It may seem rather unusual that the all-wave Scott receiver was used as one of the test receivers. The reason was that it was deemed necessary to include one highly-sensitive receiver among those tested and a straight broadcast-band receiver of extreme sensitivity was not available for the purpose.

The second and final stage of the tests consisted of selecting and running extensive tests on the one of the receivers which was considered most nearly typical of the average receiver in use today. It was believed that the Atwater Kent 92 came closest to filling this requirement, so it was taken up to the Westchester Listening Post and was operated there off-and-on for a period of ten days. The (*Continued on page 777*)

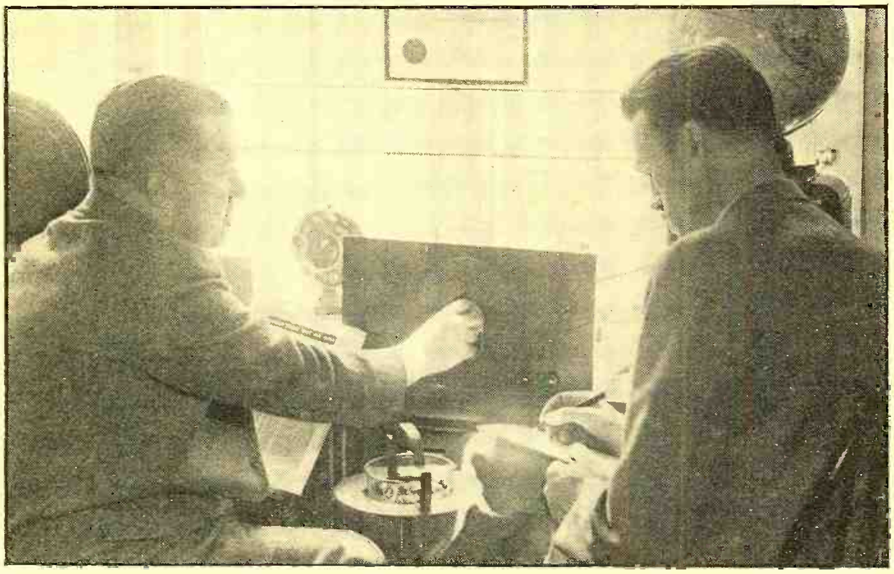
BLUEPRINTS

A SET of RADIO NEWS Converter prints, including a full-scale picture wiring diagram, full-scale working drawings of chassis and panel, schematic circuit diagram, etc., may be obtained by sending 50c to RADIO NEWS, Blueprint Dept., 461 Eighth Ave., New York City. These prints are sufficiently accurate for direct use as drilling templates if desired.



SOME OF THE TESTS

The photos show the converter set up with three different receivers; part of the tests conducted to demonstrate the universal adaptability of this unit.



Four Months' Tests On The

BROWNING 35

Laurence M. Cockaday

NOISE! This has been one of the most disturbing factors interfering with short-wave reception. It has been the bane of Short-Wave Listening Post Observers for years. In some excellent locations the noise-to-signal ratio is low enough to permit good reception on short-waves the year round with only a bothersome day once in a while, when natural static rises to a maximum or when some world-wide magnetic disturbance reduces signal strength to a minimum. In some other locations the short-wave listener is not so fortunate—the disturbance from man-made static being a serious all-year-round handicap. Motors, electric signs, inductive machinery, household appliances and automobiles make such a racket that short-wave reception in these locations is sometimes entirely blotted out. Here we need drastic measures to overcome these obstacles. Some precautions that should be taken are: interference-preventing antennas, filters on the offending apparatus wherever possible, etc. But one of the most necessary precautions can be taken in the receiver itself—in its very design! A receiver *can be* designed for exceptional sensitivity to a signal to which it is tuned but at the same time able to disregard, absolutely, interference and static on adjacent channels. It can also be designed so that it is entirely insensible to disturbance coming in over the power circuits. This is just what a Listening Post Observer wants.

SOMETIME during January, Glenn Browning brought down to the Westchester Listening Post the receiver pictured above. He said, "Larry, I would like to see what this set will do in your famous receiving room." "All right," said I, "let's try it." Accordingly we hooked it up and tested the receiver far into the night and the next morning, which resulted in this series of articles on the Browning 35, in RADIO NEWS. Since then this same receiver has been in constant use in the Listening Post and has been relied on, more and more, for routine logging of stations for the Time-Table. The reason for this is its exceptionally high signal-to-noise ratio. In other words, we must admit that it will bring in distant short-wave stations with a minimum of noise and interference. The quiet operation of the receiver is probably mainly due to two design features: first, the type of circuit employed which includes a sharply tuned preselector to insure a selectivity curve in which the side bands fall off rapidly above the necessary consonant frequencies of speech, and second, another important consideration is the manner in which the circuits are filtered against inductive surges leaking in over the power lines. (The transformer supplying power contains a static shield as as well as a helpful filtering circuit in connections to the lighting lines. This latter point is one which was sometimes overlooked in earlier receivers.)

In order to be sure that the receiver being tested was not just a freak model, we purchased (in the open market) a kit which was built up by an amateur in the neighborhood and put through its paces, along with the first model, during the final tests. The second model, to our surprise, was even superior to the first. This brings to mind a few points where the receiver showed up extremely well. It contains a volume control, as well as a radio-frequency sensitivity control, which enables using the utmost sensitivity, late at night, without raising the whole neighborhood and at the same time keeping the noise-level below audibility. Another well-designed control is the tone control, which in most cases takes out the last trace of "S" static without spoiling speech understandability on distant station announcements. Another feature is the ability of the operator to use, at will, the automatic volume-control system or to use a manual control; a switch turns this "off" and "on." The dial system offers another great advantage, in that all frequencies are well spread out and the smaller dial makes an additional band-spread arrangement that can be logged so that one can always come back to an exact setting for a particular station. Quite frankly, the only thing that I do not care for particularly, in the whole design, is the placing of the beat-frequency oscillator on the back of the chassis rather than on the front panel. This is not a serious handicap, however.

I suppose many short-wave fans would like me to publish a list of short-wave stations logged during these tests, but space does not permit anything like a representative listing. But here are a few of the Best Bets gleaned from 100 or more of our daily log sheets for the 4-month period. From the Orient some of the best were: JVT, JVM, JVN, PKYDA2, VP1A, ZGE, CQN, PLV, PLE, RW15, VUB (India). From the European continent HAS3, HB9B, CT1GO, CT1CT, CT2AJ, CT1AA, RW59, RW15, LKJ1, ORK, OER2, and, of course, those "locals," the British Daventry Stations, the German Zeesen Stations, including PJE, DJQ. Pontoise France, Geneva, Switzerland, Prato Smeraldo, Italy, Madrid, Spain, PCJ and PHI, Holland. From the African Continent ZTJ, ZHJ, CR7AA, etc., and from South America, many stations in Colombia, Venezuela, Argentine, Brazil, Peru, etc. including a number of stations of only a few watts power. The same is true of Central America, Mexico, Cuba and Canada. All three of the Australian Stations VK3LR, VK3ME and VK2ME were logged consistently. As this report is being written I have just logged a new station in Cuba, CMHB, on 10.2 Megacycles. They announced their address as P. O. Box 85, Sanctus Spiritus, Cuba. I first picked them up on this set at 1 P.M., today, Saturday. Yes, it's a good receiver for identifying new stations and getting their calls.

The DX Corner (Short Waves)

(*Continued from page* 751)

HJ3ABF, Bogota, Colombia, reported moved to 6180 kc. (Schumacher.)

HJ3ABH, Bogota, Colombia, reported heard on 5950 kc. (also 6012 kc.), 8-11:30 p.m. (Grant, Betances.) Which is right?

HJ2ABC, Cucuta, Colombia, reported moved to 5890 kc. (Others say 5870 kc., and 50.27 meters.) Everyone cannot be right.

HJ5ABC, Cali, Colombia, reported on 53 meters, 5.6 megacycles, 9-10 p.m., E.S.T. (Wilson.)

(*Continued on page* 771)

EUROPEAN STATION LIST

AUSTRIA

(Data furnished by RAVAG, Vienna.)

Call	Location	kc.	kw.
......	Innsbrueck	519	0.5
......	Vienna	592	100.0
......	Graz	886	7.0
......	Linz	1294	0.5
......	Klagenfurt	1294	5.0
......	Dornbirn (Vorarlberg)	1294	2.0
......	Salzburg	1348	0.5

BELGIUM

(Data furnished by the American Consular Service at Brussels)

......	Brussels	620	15.0
......	Brussels	932	15.0
......	Schaerbeek	1122	0.1
......	Brussels	1122	0.1
......	Antwerp	1465	0.1
......	Chatelineau	1491	0.1
......	Courtrai	1491	0.1
......	Binche	1491	0.1
......	Liege	1500	0.1
......	Andrimont	1500	0.1
......	Verviers	1500	0.1
......	Liege	1500	0.1
......	Liege	1500	0.1
......	Seraing	1500	0.1
......	Vellereille-le-Brayeux	1500	0.1

BULGARIA

(Data furnished by the American Consular Service at Sofia)

......	Sofia (to be increased to 2 kw.)	850	0.3
......	Varna (to be increased to 2 kw.)	1276	0.015
......	Stara Zagora (under construction)	1402	2.0

CZECHOSLOVAKIA

(Data furnished by the American Consular Service at Prague.)

......	Prague (Liblice)	638	120.0
......	Brno	922	32.0
......	Bratislava	1004	13.5
......	Moravska Ostrava	1113	11.2
......	Kosice	1158	2.6
......	Prague (Strasnice)	1204	5.0

DANZIG

(Data furnished by the Government of Danzig.)

......	Danzig	1303	0.5

DENMARK

(Data furnished by the Government of Denmark.)

OXP	Kalundborg	238	60.0
OXQ	Copenhagen	1176	10.0

ESTONIA

(Data furnished by the Estonian Government.)

......	Tartu	517	0.5
......	Tallinn	731	20.0

FINLAND

(Data furnished by the American Consular Service at Helsingfors.)

......	Lahti (to be increased to 220 kw.)	166	40.0
......	Oulu (to be increased to 10 kw.)	431	1.5
......	Viipuri	527	10.0
......	Pori	749	1.0
......	Sortavala	749	0.25
......	Helsingfors	895	10.0
......	Vasa (under construction)	1420	1.5
......	Turku	1429	0.5
......	Pietarsaari	1500	0.5
......	Tampere	1500	0.5

FRANCE

(Data furnished by French Government and American Consular Service at Paris.)

......	Paris	182	80.0
......	Grenoble	583	15.0
......	Lyons-P. T. T.	648	100.0
......	Paris	695	120.0
......	Marseilles	749	90.0
......	Toulouse-P. T. T.	776	80.0
......	Strasbourg	859	25.0
......	Toulouse	895	8.0
......	Limoges-P. T. T.	913	0.5
......	Paris (Poste Parisien)	959	60.0
......	Rennes-P. T. T.	1040	40.0
......	Bordeaux-Lafayette	1077	12.0
......	Nice	1185	60.0
......	Lille-P. T. T.	1213	60.0
......	Montpellier	1339	5.0
......	Paris, "RadioVitus"	1348	0.7
......	Juan-les-Pins	1348	0.8
......	Paris, "Radio LL"	1429	0.8
......	Beziers	1429	0.3
......	Bordeaux (Sud OUest)	1491	2.5
......	Nimes	1491	0.7
......	Fecamp (Radio Normandie)	1500	0.63
......	Montpellier	1500	0.6

GERMANY

(Data furnished by the Reichsrundfunkgesellschaft.)

......	Deutschlandsender (Berlin)	191	60.0
......	Muehlacker	574	100.0
......	Langenberg	658	100.0
......	Munich	740	100.0
......	Leipzig	785	120.0
......	Berlin	841	100.0
......	Hamburg	904	100.0
......	Breslau	950	100.0
......	Heilsberg	1031	60.0
......	Frankfurt	1195	17.0
......	Kaiserslautern	1195	1.5
......	Kassel	1195	1.5
......	Trier	1195	2.0
......	Freiburg	1195	5.0
......	Gleiwitz	1231	5.0
......	Augsburg	1267	0.25
......	Nuernberg	1267	2.0
......	Dresden	1285	0.25
......	Bremen	1330	1.5
......	Flensburg	1330	1.5
......	Hanover	1330	1.5
......	Magdeburg	1330	0.5
......	Stettin	1330	1.5
......	Koenigsberg	1348	1.5

HUNGARY

(Data furnished by the Hungarian Government.)

HAL2	Budapest II	359	120.0
HAL	Budapest I	546	120.0
HAE	Nyiregyhaza	1122	6.25
HAE2	Magyarovar	1321	1.25
HAE3	Miskolc	1438	1.25
HAE4	Pecs	1465	1.25

ICELAND

(Data furnished by the Icelandic Government.)

TFU	Reykjavik (temporarily on 208 kc.; power will be increased to 100 kw.)	183	17.0

ITALY

(Data furnisehd by the American Consular Service at Rome.)

......	Bolzano	536	1.0
......	Palermo	565	3.0
......	Firenze	610	20.0
......	Rome I	713	50.0
......	Milan I	814	50.0
......	Genoa	986	10.0
......	Bari	1059	20.0
......	Naples	1104	1.5
......	Turin I	1140	7.0
......	Trieste	1222	10.0
......	Rome III	1258	1.0
......	Milan II	1357	4.0
......	Turin II	1366	0.2

IRISH FREE STATE

(Data furnished by the Irish Government.)

......	Athlone	531	60.0
6CK	Cork	1240	1.0
2RN	Dublin	1348	1.0

LATVIA

(Data furnished by the Latvian Government.)

......	Riga	583	15.0
......	Madona	1104	50.0
......	Kuldiga	1258	10.0
......	Liepaja	1734	0.1

LITHUANIA

(Data furnished by the Lithuanian Government.)

LYT	Kaunas	155	7.0

LUXEMBURG

(Data furnished by the Government of Luxemburg.)

......	Luxemburg	230	200.0

NETHERLANDS

(Data furnished by Dutch Government and the U. S. Consular Service at The Hague.)

......	Kootwijk	160	50.0
PX-II	Huizen	160	7.0
......	De Bilt	182	....
PX-I	Huizen	995	25.0
......	Bloemendaal	1222	0.1

NORWAY

(Data furnished by the Norwegian Government.)

LKO	Oslo	260	60.0
LKJ	Finnmark	355	10.0
LKH	Hamar	519	0.7
LKT	Trondelag	629	20.0
LKF	Frederikstad	776	0.7
LKB	Bergen	850	1.0
LKD	Bodo	850	0.5
LKP	Porsgrunn	850	0.7
LKA	Aalesund	850	0.35
LKM	Tromso	1204	0.1
LKG	Narvik	1222	0.3
LKS	Stavanger	1276	0.5
LKK	Christiansand	1276	0.5
LKR	Rjukan	1348	0.15
LKN	Notodden	1357	0.15

POLAND

(Data furnished by the American Consular Service at Warsaw.)

......	Warsaw	224	120.0
......	Wilno	536	16.0
......	Katowice	758	12.0
......	Lwow	795	16.0
......	Poznan	868	16.0
......	Torun	986	24.0
......	Krakow	986	2.0
......	Lodz	1339	2.0

PORTUGAL

(Data furnished by the American Consular Service at Lisbon.)

......	Lisbon	629	20.0
CT1GL	Parede	1031	5.0
CT1BO	Lisbon	1411	0.5
CT1DH	Lisbon	1411	0.5
CT1DR	Lisbon	1411	0.02
CT1EB	Lisbon	1411	0.05
CT1DS	Lisbon	1411	0.03
CT1AA	Lisbon	1411	0.05
CT1HX	Cacem	1411	0.5
CT1AN	Lisbon	1411	2.0
CT1SR	Oporto	1411	1.5
......	Oporto	1411	0.02
......	Oporto	1411	0.05
......	Oporto	1411	0.02
......	Oporto	1411	0.05
CS1RB	Braga	1411	0.02
......	Abrantes	1411	0.02
CT1CC	Abrantes	1411	0.02

RUMANIA

(Data furnished by the Rumanian Government.)

......	Bod, Brasov	160	150.0
......	Bucharest	823	12.0
......	Moldova	1411	20.0

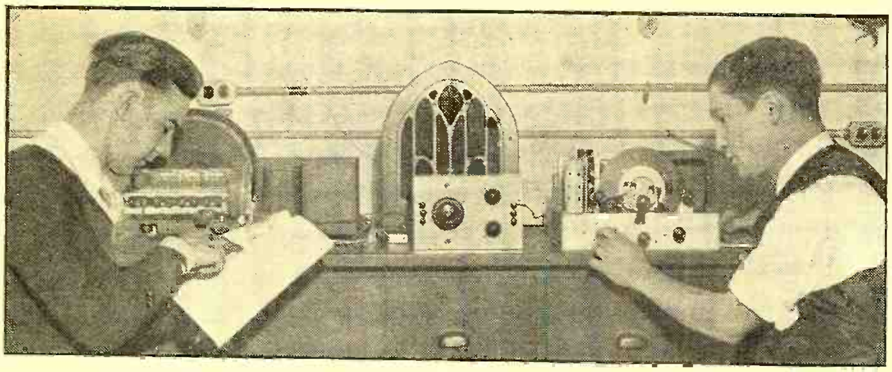
SPAIN

(Data furnished by the Spanish Government.)

EAJ2	Madrid	731	0.75
EAJ5	Seville	731	5.0
EAJ1	Barcelona	795	7.5
EAJ3	Valencia	850	0.75
EAJ15	Barcelona	1022	1.0
EAJ19	Oviedo	1022	1.0
EAJ7	Madrid	1095	3.0
EAJ8	San Sebastian	1258	1.0
EAJ4	Santiago de Compostela	1491	0.1
EAJ6	Pamplona	1491	0.1
EAJ9	Malaga	1491	0.1
EAJ10	Zaragoza	1491	0.1
EAJ12	Alcoy	1491	0.1
EAJ13	Palma de Mallorca	1491	0.1
EAJ16	Granada	1491	0.1
EAJ17	Murcia	1491	0.1
EAJ20	Sabadell	1491	0.1
EAJ21	Melilla	1491	0.1
EAJ23	Gandia	1491	0.1
EAJ24	Cordoba	1491	0.1
EAJ27	Burgos	1491	0.1
EAJ28	Bilbao	1491	0.1
EAJ31	Alicante	1491	0.1
EAJ33	Tarragona	1491	0.1
EAJ34	Gijon	1491	0.1
EAJ39	Badalona	1491	0.1
EAJ41	La Coruna	1491	0.1
EAJ42	Larida	1491	0.1
EAJ43	S. C. Tenerife	1491	0.1
EAJ44	Albaceta	1491	0.1
EAJ46	Ceuta	1491	0.1
EAJ47	Valladolid	1491	0.1
EAJ48	Vigo	1491	0.1
EAJ51	Manresa	1491	0.1
EAJ52	Badajoz	1491	0.1
EAJ54	Alcira	1491	0.1
EAJ57	Orense	1491	0.1
EAJ58	Jerez Fra	1491	0.1
EAJ60	Almeria	1491	0.1
EAJ61	Jaen	1491	0.1
EAJ65	Ciudad Real	1491	0.1
EAJ66	Tudela	1491	0.1
EAJ67	Talavera Ra	1591	0.1
EAJ11	Reus	1500	0.1
EAJ14	Castellon	1500	0.1
EAJ18	Logron	1500	0.1
EAJ22	Huesca	1500	0.1
EAJ25	Tarassa	1500	0.1
EAJ26	Antequera	1500	0.1
EAJ29	Alcala de H.	1500	0.1
EAJ30	Onteniente	1500	0.1
EAJ32	Santander	1500	0.1
EAJ35	Va y Geltru	1500	0.1
EAJ36	Jativa	1500	0.1
EAJ37	Linares	1500	0.1
EAJ38	Gerona	1500	0.1
EAJ40	Pontevedra	1500	0.1
EAJ45	Denia	1500	0.1
EAJ49	Toledo	1500	0.1
EAJ50	Las Palmas	1500	0.1
EAJ53	Elche	1500	0.1
EAJ55	Algeciras	1500	0.1
EAJ56	Salamanca	1500	0.1
EAJ62	Vitoria	1500	0.1
EAJ63	Leon	1500	0.1
EAJ64	Segovia	1500	0.1
EAJ68	Lugo	1500	0.1

NEXT MONTH

This list will be continued in the July issue with stations in Sweden, Switzerland, Turkey, United Kingdom, U.S.S.R. and Yugoslavia.



THE DX CORNER

(For Broadcast Waves)

S. GORDON TAYLOR

THE broadcast-band DX season is definitely on the wane but it is the intention to continue this department through the summer. It is possible that the "Consolidated Foreign 'Best Bets'" will be discontinued until fall. In its place it is planned to publish a monthly list of new stations, changes in present station frequency, power, etc.—as well as other information of this type received from the Federal Communication Commission. In addition work is now under way on the development of a battery operated DX superheterodyne and it is hoped that full constructional details will be ready for the July or August issues. Development work is also contemplated on a new antenna tuning system and on a broadcast-band superheterodyne converter. Back in 1925 the editor developed a unit of this latter type which gave amazing results in the way of improved sensitivity and selectivity when connected ahead of the t.r.f. receivers of that day. To the many DX fans who are still using t.r.f. receivers a good broadcast-band converter will give a great increase in sensitivity and at the same time will improve selectivity radically. It is now planned to include a constructional article on such a converter in one of the summer issues.

Attention! DX Club Officials

Secretaries or other officials of all DX clubs are invited to register their clubs with the DX Corner. There are many DX listeners who are not now affiliated with any club. RADIO NEWS feels that these clubs are doing an excellent job for the DX fraternity in general, and that every DX'er should belong to one or more clubs. With these two ideas in mind it is planned to include a "DX Club Register" in this department each month. This will give the name of each club, the name and address of the official to whom applications should be sent, and perhaps the dues, etc. We should like to make this register as complete as possible, and to include both local and national organizations.

If you want your club listed in this Register each month just address a letter to the editor of this department giving full information about your organization. In this letter it would be desirable to include the number of members, a description of the activities of your club, a copy of your "Tip Sheet" or other publications, your affiliation with other clubs, etc.

It would be very much appreciated if this department would be put on the mailing lists of all clubs on which it does not now appear, so that it will regularly receive "Tip Sheets" during the coming year. RADIO NEWS is anxious to co-operate with DX Clubs in every way possible and will welcome any suggestions toward this end.

Advance DX Calendar

The following list shows periodic DX broadcasts (E.S.T.) which have been brought to the attention of this department by observers or by the DX clubs or broadcast stations participating. This month no notices of special broadcasts have been received sufficiently far in advance to permit publication here.

Periodic DX Broadcasts

Tuesdays, 12-12:30 a.m., CFQC Saskatoon, Sask., 840 kc., 1 kw. (DX tips).

Thursdays, 12-12:30 a.m., CFQC, Saskatoon, Sask., 840 kc., 1 kw. (DX tips).

Fridays, 7:45-8 p.m., WORK, York, Pa., 1320 kc., 1 kw.

Saturdays, 12-12:30 a.m., KDKA, Pittsburgh, Pa., 980 kc., 50 kw.

Saturdays, 12-12:30 a.m., CFQC, Saskatoon, Sask., 840 kc., 1 kw. (DX tips).

Saturdays, 12:50-1 a.m., WLAC, Nashville, Tenn. 1470 kc., 5 kw. (DX tips).

Saturdays, 12:15-12:30 a.m., CKCK, Regina, Sask., 1010 kc., .5 kw. (DX tips).

Saturdays, at sign-off, WCCO, Minneapolis, Minn., 810 kc., 50 kw. (DX tips—CDXR).

Saturdays, 2:30 a.m., KFI, Los Angeles, Calif., 640 kc., 50 kw. (DX tips).

Sundays, 12-12:30 a.m., KQV, Pittsburgh, Pa., 1380 kc., .5 kw. (DX tips).

Sundays, 2-4 a.m., CMQ, Havana, Cuba, 840 kc., 5 kw.

Sundays, 1-3 a.m., XEWZ, Mexico City, 1150 kc., .1 kw.

Sundays, 12:45 a.m., WTCN, Minneapolis, Minn., 1250 kc., 1 kw. (DX tips).

Sundays, May 5th, May 12th, 4-5 a.m., KXL, Portland, Ore., 1420 kc., .1 kw. (CDXR).

Monthly (the 28th) 4-5 a.m., WKAQ, San Juan, P.R., 1240 kc., 1 kw.

Monthly (second Sunday), 2-4 a.m., WNEL, San Juan, P.R., 1290 kc., .5 kw.

Monthly (fourth Sunday), 5-7 a.m., WNEL, San Juan, P.R., 1280 kc., .5 kw.

F.C.C. Monitor Schedules

The complete schedule of monitor transmissions was given in this department of the March issue. Following are the changes which bring that schedule up to date, as of March 20, as supplied from Washington:

Add

Monday, 2:40 a.m., 1310 kc., WMFF, Plattsburgh, N. Y.; 7:30 a.m., 1420 kc., KRLC, Lewiston, Idaho.

Wednesday, 5:40 a.m., 1370 kc., KFRO, Longview, Texas.

Thursday, 4:20 a.m., 1420 kc., KABR, Aberdeen, S. D., 4:40 a.m., 1310 kc., KIUJ, Santa Fe, N. M.; 4:50 a.m., 1370 kc., KFGQ, Boone, Iowa.

Delete

Monday, 54:30 a.m., 1200 kc., WNBO, Silverhaven, Pa.

Change

Monday, 4:20 a.m., KGVO frequency changed to 1260.

Tuesday, 2:00 a.m., 1210 kc., substitute call WPAX for WQDX; 3:00 a.m., WMBR's location changed to Jacksonville.

Wednesday, 3:10 a.m., KGIW's location changed to Alamosa, Colo.

Thursday, 4:30 a.m., WKBZ's location changed to Muskegon; 5:10 a.m., WHBD's location changed to Portsmouth, O.

Friday, 3:30 a.m., KGEK's location changed to Sterling, Colo.; 5:00 a.m., KWCR's location changed to Des Moines.

Saturday, 3:00 a.m., WJBC's location changed to Bloomington, Ill.

Official RADIO NEWS Broadcast Band Listening Post Observers

United States

California: Roy Covert, Randolph Hunt, Warren E. Winkley
Connecticut: Fred Burleigh, James A. Dunigan, Philip R. Nichols, R. L. Pelkey
Illinois: Herbert H. Diedrich, Ray E. Everly, H. E. Rebensdorf, D. Floyd Smith
Indiana: E. R. Roberts
Iowa: Lee F. Blodgett, Ernest Byers.
Maine: Danford Adams, Steadman O. Fountain, Floyd L. Hammond.
Maryland: William Rank, Henry Wilkinson, Jr.
Massachusetts: William W. Beal, Jr., Walter C. Birch, Russell Foss, Simon Geller, Evan B. Roberts
Michigan: John DeMyer, Howard W. Eck
Minnesota: F. L. Biss, Walter F. Johnson
Missouri: Dudley Atkins, III.; T. E. Gootee, C. H. Long
Montana: R. W. Schofield
New Jersey: Henry A. Dare, Jack B. Schneider, Alan B. Walker
New York: Jacob Altner, Edward F. Goss, Robert Hough, Robert Humphrey, John C. Kalmbach, Jr., Harry E. Kentzel, Maynard J. Lonis, R. H. Tomlinson
North Carolina: Marvin D. Dixon
Ohio: Stan Elcheshen, Donald W. Shields, Richard J. Southward
Oregon: David Hunter
Pennsylvania: Robert Hoffman Cleaver, Edward Kocsan, J. Warren Routzahn, Joseph Stokes
Texas: E. L. Kimmons
Washington: John Marshall, Junior High School Radio Club
West Virginia: Clifford Drain
Wyoming: J. H. Woodhead

Foreign

Australia: Albert E. Faull, Victoria; George F. Ingle, New South Wales
Canada: William H. Ansell, Saskatchewan; C. R. Caraven, British Columbia; Claude A. Dulmage, Manitoba; C. Holmes, British Columbia; Philip H. Robinson, Nova Scotia; Art Ling, Ontario
England: R. T. Coales, Hants; F. R. Crowder, Yorkshire; George Ellis, North Stockport
Irish Free State: Ron. C. Bradley
Newfoundland: A. L. Hynes, Clarenville
New Zealand: L. W. Mathie, Hawke's Bay; R. H. Shepherd, Christchurch; Eric W. Watson, Christchurch
South Africa: A. C. Lyell, Johannesburg
Sweden: John S. Bohm, Malung
Switzerland: Dr. Max Hausdorff, Viganello

Consolidated Foreign "Best Bets"

Following is a list of the foreign stations reported heard by Official Observers in different sections of the U. S. and Canada. An asterisk (*) denotes that the station has been heard in the part of the country represented by the column in which it appears. Where the time is reported a number is employed instead of an asterisk; light face numbers represent a.m. and bold numbers p.m., local time. These records provide an excellent tuning guide for DX'ers.

The Canadian, Mexican, and Cuban stations included in this list are low-power stations and are situated far enough from the location of Observers reporting them to represent good DX work.

Following are the sections of the country represented by each column, and the Official Observers whose catches are included in this record:

Column 1 (Vicinity New York City and Conn.) Observers Altner, Burleigh, Cleaver, Dunigan, Goss, Nichols, Tomlinson.

Column 2 (Mass., Maine, Newfoundland) Observers Adams, Beal, Birch, Foss, Geller, Hynes.

Column 3 (New York, Northern and Western) Observers Kalmbach, Kentzel, Lonis).

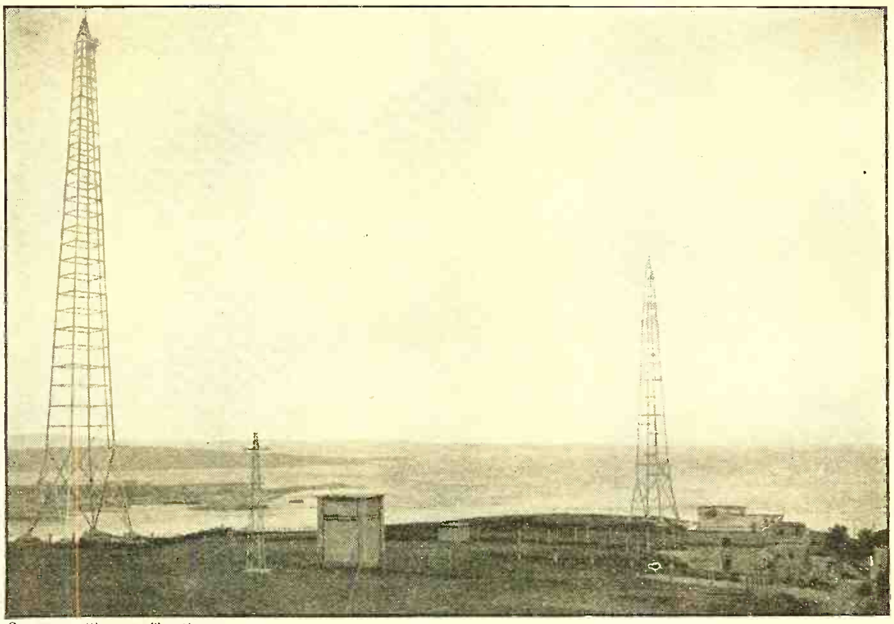
Column 4 (North Carolina, Georgia) Observers Dixon and Applicant Roberts.

Column 5 (Pa., West Virginia, Maryland, Ohio) Observers Drain, Elcheshen, Kocsan, Routzahn, Shields, Stokes, and Applicant Zelinka.

Column 6 (Illinois, Missouri, Minnesota) Observers Atkins, Everly, Johnson, Rebensdorf, Smith.

Column 7 (Wyoming, Manitoba, Saskatchewan) Observers Ansell, Dulmage, Woodhead.
Column 8 (California, Oregon, Washington, British Columbia) Observers Covert, Holmes, Hunter, J.M.J.H.S. Radio Club, and Applicant Pruner.
Column 9 (Texas) Observer Kimmons.

Kc.	*Call*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
550	CFNB	-	*	-	-	*	2	-	-	-
556	Beromunster	-	-	-	-	*	-	-	-	-
560	2CO	2	-	6	5	-	5	3	-	-
565	TGW	3	3	5	4	2	3	*	-	-
570	2YA	*	-	-	5	*	4	3	*	4
574	Stuttgart	-	2	-	-	-	-	-	-	-
580	CHRC	-	*	-	-	*	-	-	-	-
580	7ZL	-	-	-	-	-	-	4	-	-
580	CKUA	-	-	-	-	-	*	-	-	-
590	JOAK-2	-	-	-	-	-	-	*	2	-
600	CJOR	-	-	-	-	*	-	-	*	-
601	Rabat	-	*	-	-	-	-	-	-	-
610	XFX	1	3	*	-	1	-	-	*	-
610	3AR	-	-	-	-	-	-	4	-	-
610	JODK-1	-	-	-	-	-	-	4	-	-
618.5	KZRM	-	-	-	-	-	-	-	5	-
629	Lisbon	-	**10**	-	-	-	-	-	-	-
630	CKOV	4	-	-	-	-	*	-	-	-
630	CJGX	-	-	-	-	*	-	*	*	-
630	CFCY	-	-	3	-	*	-	-	-	-
630	XEZ	-	-	-	-	*	-	-	-	-
635	JODG	-	-	-	-	-	-	4	-	-
635	5CK	*	-	6	5	*	5	4	3	-
640	XEOX	-	-	-	-	-	-	-	4	-
645	JQAK	-	-	-	-	-	-	3	-	-
650	1YA	5	-	5	5	4	3	2	3	3
650	CX6	-	**9**	-	-	-	-	-	-	-
658	Cologne	-	-	-	-	*	-	-	-	-
660	XGOA	-	-	-	-	*	-	*	4	4
665	2FC	2	-	5	5	-	-	3	-	-
670	JFAK	-	-	-	-	-	-	3	4	-
675	YV6RV	-	**9**	-	-	-	-	-	-	-
677	Sottens	-	**5**	-	-	-	-	-	-	-
681	HJN	-	**7**	-	-	1	-	-	-	-
690	CJCJ	-	-	-	-	3	2	*	-	-
690	6WF	-	-	-	-	-	-	4	-	-
695	PTT	-	2	-	-	-	-	-	-	-
710	LS1	-	-	3	-	-	-	-	-	-
713	I1RO	-	2	-	-	-	-	-	-	-
720	3YA	2	-	-	-	*	4	2	-	-
720	JFBK	-	-	-	-	-	-	3	-	-
725	CMK	-	-	-	**9**	-	-	-	-	-
730	5CL	-	-	-	-	-	-	3	-	-
740	Munich	-	2	-	-	2	-	-	-	-
750	JOBK-1	-	-	-	-	-	-	3	3	-
750	KGU	*	-	3	5	4	2	*	2	-
760	4QG	5	-	6	5	4	2	*	2	-
770	JOHK	-	-	-	-	-	-	2	2	-
785	Leipzig	-	2	-	-	2	-	-	-	-
790	JOGK	-	-	-	-	-	-	*	2	-
790	4YA	-	-	-	-	*	-	2	-	-
790	LR10	-	-	-	-	**9**	-	-	-	-
795	EAJ-1	-	**6**	-	-	-	-	-	-	-
800	3LO	2	-	6	-	*	5	3	3	-
804	West Regional	-	*	-	-	-	-	-	-	-
810	JOCK-1	-	-	-	-	-	-	3	3	4
810	CX14	-	**8**	-	-	-	-	-	-	-
814	I1MI	2	2	-	-	2	-	1	-	-
830	LR5	2	**8**	**8**	-	**9**	**7**	-	-	-
830	JOIK	-	-	-	-	-	-	3	2	4
835	CMC	1	-	-	-	-	-	*	-	-
841	Berlin	-	-	-	-	2	-	-	-	-
850	XFC	-	*	-	-	-	-	*	-	-
850	JOFK	-	-	-	-	-	-	3	2	4
855	2BL	5	-	6	5	5	5	2	3	-
865	CMCX	-	**10**	-	-	-	-	-	-	-
870	LR6	*	**9**	-	-	**8**	-	-	-	-
870	JOAK-1	-	-	-	-	-	-	3	2	4
877	London Regional	-	5	-	-	-	-	-	-	-
900	W3XBD	-	-	-	-	3	-	-	-	-
900	JODK-2	-	-	-	-	-	-	*	4	-
904	Hamburg	-	-	-	-	2	-	-	-	-
910	CMX	*	-	-	**9**	-	**7**	*	-	-
910	CJAT	3	-	-	-	-	1	-	-	-
910	LR2	-	-	-	-	3	-	-	-	-
910	CMHW	-	-	-	-	4	-	-	-	-
910	4RK	*	-	6	5	5	5	3	3	-
913	Toulouse	-	**4**	-	-	2	-	-	-	-
920	HHK	*	-	-	4	*	2	-	-	-
920	XEAA	-	-	-	-	4	-	-	-	-
930	CFLC	1	-	3	-	-	-	-	-	-
930	3UZ	-	-	-	-	-	-	*	-	-
950	2GB	*	-	6	-	-	-	*	3	-
950	LR3	2	**8**	5	-	-	-	-	-	-
950	Breslau	*	2	-	-	-	-	-	-	-
959	Poste Parisien	**6**	**4**	-	-	2	-	-	-	-
960	YV1RC	**6**	**8**	**6**	**7**	**7**	-	-	**7**	-
978	XGOD	-	-	-	-	-	-	-	5	-
980	4AY	-	-	-	-	-	-	*	-	-
980	JOXK	-	-	-	-	-	-	*	-	-
986	Genoa	-	2	-	-	-	-	-	-	-
990	JOFG	-	-	-	-	-	-	3	-	-
990	XES	-	4	-	-	-	-	-	-	-
990	XEAF	1	-	-	-	-	*	-	*	-
990	XEK	2	-	-	-	1	-	-	-	-
990	LR4	1	-	-	-	7	1	-	-	-
1010	CKWX	-	-	-	-	3	*	-	*	-
1010	CKCD	-	-	-	-	-	-	-	*	-
1010	CHML	-	-	-	-	*	-	-	-	-
1010	CHWC	-	-	-	-	*	-	-	-	-
1010	CKCK	-	-	-	-	2	2	-	-	-
1010	3HA	-	-	-	5	-	-	*	-	-
1025	2UE	*	-	6	5	*	-	4	-	-
1031	CT1GL	-	5	-	-	1	-	-	-	-
1035	CMBC	-	-	-	-	1	-	-	-	-
1037	CMHI	1	-	-	-	-	-	-	-	-
1040	5PI	-	-	-	-	*	-	*	-	-
1040	PTT	2	3	-	-	2	-	-	-	-
1040	CP4	*	-	-	2	2	*	-	-	-
1050	CX26	-	-	-	-	1	-	-	-	-
1077	Bordeaux	-	**4**	-	-	3	-	-	-	-
1080	XEMA	-	-	-	-	3	-	-	-	-
1085	JOBK-2	-	-	-	-	-	-	3	4	-



Courtesy—Observer Tomlinson

THE ANTENNAS OF STATION I1TR, TRIESTE, ITALY

This station, operating on 1222 kc., with 10 kilowatts, is widely heard in the U. S. during the Winter months. The best time to hear it is after 1:45 a.m., E.S.T.

Kc.	*Call*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
1090	CX28	-	7	-	-	-	-	-	-	-
1095	EAJ7	-	6	-	-	-	-	-	-	-
1100	CMCY	-	**9**	-	-	1	-	-	-	-
1120	CKX	-	-	4	-	-	-	-	-	-
1120	CHSJ	-	-	-	-	5	-		-	-
1125	2UW	-	-	-	-	-	-	*	-	-
1130	CX30	-	**8**	-	-	-	-	-	-	-
1140	Turin	-	2	-	-	2	-	-	-	-
1145	4BC	*	-	-	5	*	4	3	-	-
1150	XEWZ	1	-	-	-	2	3	-	-	-
1150	LR8	-	**8**	-	-	-	-	-	-	-
1160	XEFL	-	-	-	-	-	-	-	*	-
1160	XED	-	-	-	-	2	1	-	-	-
1170	4TO	-	-	-	5	-	-	*	-	-
1175	JOCK-2	-	-	-	-	-	-	3	4	-
1175	COA	-	*	-	-	2	2	-	-	-
1180	3DB	-	-	-	-	-	-	*	-	-
1190	VE9EK	-	-	-	-	4	-	-	-	-
1190	LS2	**6**	**7**	*	-	**7**	-	-	-	-
1193	EAJ-15	-	**5**	-	-	-	-	-	-	-
1195	Frankfurt	-	1	-	-	1	-	-	-	-
1200	CHAB	-	-	-	-	-	*	-	-	-
1200	1OAK	*	4	*	-	*	-	-	-	-
1200	CMCJ	-	5	*	-	1	-	-	-	-
1210	CKBI	3	-	-	-	3	-	-	-	-
1210	XEE	-	-	-	-	*	-	-	-	-
1210	CKBI	-	-	-	-	-	*	-	-	-
1210	KWFV	-	-	-	-	-	-	-	*	-
1222	I1TR	-	2	-	-	2	-	-	-	-
1230	CPX	*	-	5	-	-	*	-	-	-
1230	XEFJ	2	-	-	-	5	-	-	-	-
1230	CJOC	-	-	-	-	*	-	*	-	-
1230	CMCA	-	-	-	-	4	2	-	-	-
1230	CMOK	-	-	-	-	2	-	-	-	-
1240	CJCB	**4**	-	-	-	2	-	-	-	-
1240	WKAQ	3	-	5	-	*	2	-	*	*
1258	San Sebastian	-	*	-	-	-	-	-	-	-
1267	Nurnburg	-	2	-	-	-	-	-	-	-
1270	LS9	**9**	-	-	-	-	-	-	-	-
1270	XFB	-	-	-	-	-	2	-	-	-
1270	2SM	-	-	-	-	-	-	*	-	-
1280	CMCO	-	-	-	-	2	-	-	-	-
1290	WNEL	6	*	*	5	*	2	-	-	*
1310	CJLS	2	*	-	-	4	*	-	-	-
1310	XETB	-	-	-	-	3	-	-	-	-
1310	CJKL	-	-	-	-	3	-	-	-	-
1310	CHCK	1	-	3	-	*	-	-	-	-
1320	KGMB	-	-	-	5	*	4	-	4	-
1325	CMOX	-	-	-	-	2	-	-	-	-
1350	3KZ	-	-	-	-	-	-	*	-	-
1370	XEFZ	2	-	-	-	-	-	-	-	-
1380	4BH	-	-	-	-	-	-	*	-	-
1395	HIH	-	-	-	-	3	-	-	-	-
1400	CMCR	-	-	-	-	3	-	-	-	-
1410	CKMO	-	-	-	-	-	-	-	*	*
1415	2KO	-	-	-	-	-	-	*	-	-
1420	XEFB	-	-	-	-	4	-	-	-	-
1425	3AW	-	-	-	-	-	-	*	-	-
1435	CMBX	3	-	-	-	5	3	-	-	-
1450	CMCS	*	-	-	-	-	-	-	-	-
1450	CHGS	-	-	-	-	2	-	-	-	-
1450	CFCT	*	-	-	-	-	*	-	-	*
1456	Radio-Normandie	2	2	-	-	2	-	-	-	-
1460	7UZ	-	-	-	-	-	-	*	-	-
1510	CFRC	**5**	-	-	-	2	-	-	*	-

Foreign Station Location

This list provides the call, location, frequency, and power of stations listed in the "Consolidated Foreign 'Best Bets'". See this "Best Bets" list to determine what stations were heard in your section of the country:

Kc.	*Kw*	*Call*	*Location*
550	.5	CFNB	Fredericton, N.B., Canada
556	100	Beromunster	Switzerland
560	7.5	2CO	Corowa, N.S.W., Australia
565	10	TGW	Guatemala City, Guatemala
570	5	2YA	Wellington, New Zealand
574	100	Stuttgart	Germany
580	.1	CHRC	Quebec, Canada
580	1	7ZL	Hobart, Tasm., Australia
580	.5	CKUA	Edmonton, Canada
590	10	JOAK-2	Tokyo, Japan
600	.5	CJOR	Vancouver, Canada
601	6.5	Rabat	Morocco
610	1	XFX	Mexico City, Mexico
610	4.5	3AR	Melbourne, Vict., Australia
610	10	JODK-1	Keijo, Korea, Japan
618	50	KZRM	Manila, Philippine Islands
629	15	Lisbon	Portugal
630	.1	CKOV	Kelowna, B.C., Canada
630	.5	CJGX	Yorkton, Canada
630	1	CFCY	Charlottetown, P.E.I., Canada
630	.5	XEZ	Merida, Mexico
635	.5	JODG	Hamamatsu, Japan
635	7.5	5CK	Crystal Brook, Australia
640	.25	XEOX	Saltillo, Mexico
645	.5	JQAK	Dairen, Japan
650	.5	1YA	Auckland, New Zealand
650	5	CX6	Montevideo, Uruguay
658	100	Cologne	Germany
660	75	XGOA	Nanking, China
665	3.5	2FC	Sydney, N.S.W., Australia
670	10	JFAK	Taihoku, Formosa, Japan
675	......	YV6RV	Valencia, Venezuela
677	25	Sottens	Switzerland
681	1	HJN	Bogota, Colombia
690	.1	CJCJ	Calgary, Canada
690	3.5	6WF	Perth, W. Austr., Australia
695	7	PTT	Paris, France
710	5	LS-1	Buenos Aires, Argentina
713	50	I1RO	Rome, Italy
720	2.5	3YA	Christchurch, New Zealand
720	1	JFBK	Tainan, Formosa, Japan
725	3.15	CMK	Havana, Cuba
730	2	5CL	Adelaide, Australia
740	100	Munich	Germany
750	10	JOBK-1	Osaka, Japan
750	2.5	KGU	Honolulu, Hawaii
760	2.5	4QG	Brisbane, Qnsld., Australia
770	10	JOHK	Sendai, Japan
785	120	Leipzig	Germany
790	10	JOGK	Kumamoto, Japan
790	.5	4YA	Dunedin, New Zealand
790	8	LR10	Buenos Aires, Argentina
795	5	EAJ-1	Barcelona, Spain
800	5	3LO	Melbourne, Vict., Australia
804	50	WestReg'nal	Great Britain
810	10	JOCK-1	Nagoya, Japan
810	1	CX14	Montevideo, Uruguay
814	50	I1MI	Milan, Italy
830	16	LR5	Buenos Aires, Argentina
830	10	JOIK	Sapporo, Japan
835	.5	CMC	Havana, Cuba
841	100	Berlin	Germany
850	.35	XFC	Aguas Calientes, Mexico
850	10	JOFK	Hiroshima, Japan
855	3	2BL	Sydney, N.S.W., Australia
865	.15	CMCX	Havana, Cuba
870	2.1	LR6	Buenos Aires, Argentina
870	10	JOAK-1	Tokyo, Japan
877	50	London Reg.	Great Britain
900	5	W3XBD	Whippany, New Jersey
900	10	JODK-2	Keijo, Korea, Japan
904	100	Hamburg	Germany
910	1	CMX	Havana, Cuba
910	.25	CJAT	Trail, B.C., Canada
910	6	LR2	Buenos Aires, Argentina
910	.1	CMHW	Cienfuegos, Cuba
910	2	4RK	Rockhampton, Australia

Kc.	Kw	Call	Location
913	60	Toulouse	France
920	1	HHK	Port-au-Prince, Haiti
920	.2	XEAA	Mexicali, Mexico
930	.1	CFLC	Prescott, Canada
930	.4	3UZ	Melbourne, Australia
950	1	2GB	Sydney, N.S.W., Australia
950	12	LR3	Buenos Aires, Argentina
950	17	Breslau	Germany
959	100	PosteParisien	France
960	5	YV1RC	Caracas, Venezuela
978	1	XGOD	Hangchow, China
980	......	4AY	Ayr, Australia
980	.5	JOXK	Tokushima, Japan
986	10		Genoa, Italy
990	.3	JOFG	Fukui, Japan
990	.25	XES	Tampico, Mexico
990	.25	XEAF	Nogales, Mexico
990	.1	XEK	Mexico, D.F., Mexico
990	12	LR4	Buenos Aires, Argentina
1010	.1	CKWX	Vancouver, Canada
1010	.1	CKCD	Vancouver, B.C., Canada
1010	.05	CHML	Hamilton, Canada
1010	.5	CHWC	Pilot Butte, Sask., Canada
1010	.5	CKCK	Regina, Sask., Canada
1010	.3	3HA	Hamilton, Vict., Australia
1025	1	2UE	Sydney, N.S.W., Australia
1031	.5	CT1GL	Parede, Portugal
1035	.15	CMBC	Havana, Cuba
1037	.15	CMHI	Santa Clara, Cuba
1040	.05	5PI	Port Piric, Australia
1040	2.5	PTT	Rennes, France
1040	10	CP4	La Paz, Bolivia
1050	2	CX26	Montevideo, Uruguay
1077	12	Bordeaux	France
1080	.05	XEMA	Tampico, Mexico
1085	10	JOBK-2	Osaka, Japan
1090	2	CX28	Montevideo, Uruguay
1095	7	EAJ7	Madrid, Spain
1100	.5	CMCY	Havana, Cuba
1120	.1	CKX	Brandon, Canada
1120	.1	CHSJ	St. John, New Brunswick
1125	1	2UW	Sydney, N.S.W., Australia
1130	.5	CX30	Montevideo, Uruguay
1140	7	Turin	Italy
1145	.75	4BC	Brisbane, Qnsld., Australia
1150	.1	XEWZ	Mexico, D.F., Mexico
1150	5	LR8	Buenos Aires, Argentina
1160	.5	XEFL	Tijuana, Mexico
1160	.5	XED	Guadalajara, Mexico
1170	.2	4TO	Tounsville, Qnsld., Australia
1175	10	JOCK-2	Nagoya, Japan
1175	.072	CMOA	Havana, Cuba
1180	.4	3DB	Melbourne, Australia
1190	.01	VE9EK	Montmagny, Quebec, Canada
1190	5	LS2	Buenos Aires, Argentina
1193	1	EAJ-15	Barcelona, Spain
1195	17	Frankfurt	Germany
1200	.1	CHAB	Moose Jaw, Sask., Canada
1200	.015	10AK	Stratford, Canada
1200	.4	CMCJ	Havana, Cuba
1210	.1	CKBI	Prince Albert, Sask., Canada
1210	.05	XEE	Durango, Mexico
1210	.1	CKBI	Prince Albert, Canada
1210	.1	KWFV	Hilo, Hawaii
1222	10	I1TR	Trieste, Italy
1230	......	CPX	La Paz, Bolivia
1230	.1	XEFJ	Monterrez, Mexico
1230	.1	CJOC	Lethbridge, Canada
1230	.15	CMCA	Havana, Cuba
1230	.25	CMOK	Havana, Cuba
1240	1	CJCB	Sydney, N.S., Canada
1240	1	WKAQ	San Juan, Puerto Rico
1258	3	San Sebastian	Spain
1267	2	Nurnburg	Germany
1270	3	LS9	Buenos Aires, Argentina
1270	1	XFB	Jalapa, Mexico
1270	1	2SM	Sydney, N.S.W., Australia
1280	.15	CMCO	Havana, Cuba
1290	.5	WNEL	San Juan, Puerto Rico
1310	.1	CJLS	Yarmouth, N.S., Canada
1310	.125	XETB	Torreon, Mexico
1310	.1	CJKL	Kirkland Lake, Canada
1310	.05	CHCK	Charlottetown, P.E.I., Canada
1320	.25	KGMB	Honolulu, Hawaii
1325	.25	CMOX	Havana, Cuba
1350	.4	3KZ	Melbourne, Australia
1370	.1	XEFZ	Mexico, D.F., Mexico
1380	.6	4BH	Brisbane, Qnsld., Australia
1395	.015	HIH	San Pedro de Macoris, Dominican Republic
1400	.15	CMCR	Havana, Cuba
1410	.1	CKMO	Vancouver, Canada
1415	.5	2KO	Newcastle, Australia
1420	.1	XEFB	Monterrey, Mexico
1425	.5	3AW	Melbourne, Australia
1435	.15	CMBX	Havana, Cuba
1450	.25	CMCS	Havana, Cuba
1450	.05	CHGS	Summerside, P.E.I., Canada
1450	.05	CFCT	Victoria, B.C., Canada
1456	10	Radio-Normandie	Fecamp, France
1460	.25	7UZ	Ulverston, Australia
1510	.1	CFRC	Kingston, Canada

New Australian Frequencies

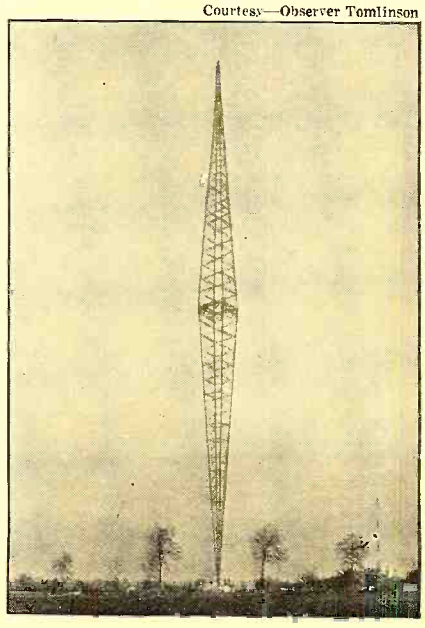
The Australian Government is planning a wholesale shift in the frequency assignments of Australian broadcast stations. These changes will take effect on September 1, 1935. Herewith are given the new frequencies as well as the present ones. This list is provided through the courtesy of Observer Ingle, Narrabri, N.S.W., Australia.

Kc. New	Kc. Old	Call	Location
550	....	2CR*	Central Regional, N. S. W.
560	....	6WA*	S. W. Regional, W. A.
580	....	3WV*	West Regional, Vic.
590	580	7ZL	Hobart
600	....	4QN*	North Regional, Qld.
610	665	2FC	Sydney
630	610	3AR	Melbourne
640	635	5CK	Crystal Brook
670	560	2CO	Corowa
690	690	6WF	Perth
700	....	2NR*	Northern Rivers Regional, N.S.W.
720	1220	6GF	Kalgoorlie
730	730	5CL	Adelaide
740	855	2BL	Sydney
750	....	7NT*	North Regional, Tas.
770	800	3LO	Melbourne
800	760	4QG	Brisbane
820	890	7HO	Hobart
830	....	3GI*	Gippsland Regional, Vic.
850	940	5RM	Renmark
870	950	2GB	Sydney
880	880	6PR	Perth
900	900	3MA	Mildura
900	900	4WK	Warwick
910	910	4RK	Rockhampton
930	930	3UZ	Melbourne
950	1025	2UE	Sydney
960	960	5DN	Adelaide
970	970	3BO	Bendigo
980	980	4AY	Ayr
980	980	6BY	Narrogin
990	....	....	Central, N.S.W.
1000	1000	4GR	Toowoomba
1010	1010	3HA	Hamilton
1020	1070	2KY	Sydney
1030	1180	3DB	Melbourne
1040	1040	5PI	Crystal Brook
1050	1050	2CA	Canberra
1060	1060	3YB	Mobile
1060	1060	4MB	Maryborough
1070	....	2KB	Katoomba
1070	1090	6AM	Northam
1080	1080	3SH	Swan Hill
1100	1100	7LA	Launceston
1110	1125	2UW	Sydney
1120	1145	4BC	Brisbane
1130	1135	6ML	Perth
1140	1110	2HD	Newcastle
1150	1155	2WG	Wagga
1160	1190	4MK	Mackay
1170	1170	4TO	Townsville
1180	1350	3KZ	Melbourne
1190	1210	2CH	Sydney
1200	1200	5KA	Adelaide
1210	1220	2GF	Grafton
1210	1220	6KG	Kalgoorlie
1220	....	....	South Queensland
1230	1245	2NC	Newcastle
1240	1280	3TR	Sale
1260	1260	3WR	Shepparton
1270	1270	2SM	Sydney
1280	1425	3AW	Melbourne
1290	1290	4BK	Brisbane
1300	1490	2TM	Tamworth
1310	1310	5AD	Adelaide
1320	1300	3BA	Ballarat
1330	1330	4RO	Rockhampton
1340	1340	2XN	Lismore
1350	1400	3GL	Geelong
1360	1360	2BH	Broken Hill
1360	....	4PM	Port Moresby
1360	1360	7BU	Burnie
1370	1370	3HS	Horsham
1380	1380	4BH	Brisbane
1390	1390	2GN	Goulburn
1400	1470	6IX	Perth

HAL, BUDAPEST NO. 1, HUNGARY

The gigantic "wire-less" antenna employed by this 120 kilowatt station, which operates on 456 kc. Best time for reception in U. S. is 12:45 to 1:15 a.m., E.S.T.

Courtesy—Observer Tomlinson



Kc. New	Old	Call	Location
1410	1415	2KO	Newcastle
1420	....	3XY	Melbourne
1430	1435	2WL	Wollongong
1440	1320	2MO	Gunnedah
1450	1450	5MUJ	Murray Bridge
1460	1460	7UV	Ulverstone
1470	....	....	Bega
1470	1450	4CA	Cairns
1480	1480	2AY	Albury
1490	....	....	South, N.S.W.
1500	....	....	Hobart
1500	1500	3AK	Melbourne (Night Service Station)

* New stations not now in operation.

Our Readers Report—

Observer Lyell (South Africa): "There has been an improvement in reception conditions although still somewhat erratic. European stations come in from 11 p.m. on and North and South American stations from 3:30 a.m. on, South African Time. European stations heard were Hamburg, 904 kc.; Bordeaux, 1077 kc.; Monte Ceneri, 1160 kc.; Madona, 1104 kc.; Rome, 713 kc.; Berlin, 841 kc.; Budapest, 546 kc.; Breslau, 950 kc.; Brno, 922 kc.; Cologne, 658 kc.; Moscow, 832 kc.; Lwow, 795 kc.; Milan, 814 kc. American stations heard were WTAM, WOAI, KMOX, WBT".

Observer Coales (England): "The exact location of British transmitters may be of interest to other readers. The larger ones are: Midland Regional-Droitwich, Worcestershire; North Regional and North National-Mooreside Edge, Yorkshire; Scottish Regional and Scottish National-Westerglen. Sterlingshire (Scotland); West Regional and West National-Washford Cross, Somersetshire; London Regional and London National-Brookman's Park, Hertfordshire. Our other stations are all low-power and the transmitters are in or near the towns after which they are named. Daventry, where the Empire transmitters are located, is in the County of Northamptonshire".

Observer Ingle (Australia): "I want to thank you a mighty lot for getting me so much correspondence as a result of the request which you printed in the DX Corner. I have at the time of writing received 52 letters, 10 books, 4 snapshots and a paper from DX'ers in the United States and Canada".

Observer Mathie (New Zealand): "If any of your readers desire to purchase New Zealand stamps, I will procure them or exchange at par rate of 50 one-penny New Zealand stamps for 100 United States one-cent stamps. WOR, Newark, New Jersey, has several times been heard testing with their 50 kw. transmitter. At times these tests are heard 'as good as a local'. The best heard American stations recently have been KOA, KPO, KFI, WLW, WBBM, KGER, XEPN, WMAQ, KNX, LR5, WRUF, KGMB, KTAB, KSL, KFWB. DX is rather quiet here at present but is improving. I have been fortunate in winning the Hawkes Bay District Certificate for the most overseas verifications.

"It would be a good idea to call the attention of American DX'ers to the fact that New Zealand station announcers pronounce the letter Z as zed, as for instance 2 zed H for 2ZH, etc. (*This is a distinct improvement over the American pronunciation zee, and is commonly employed by English-speaking countries outside of the United States and Canada.*—THE EDITOR.) American broadcast-band listeners are advised to enclose return postage when asking for verifications from the Class B stations in New Zealand. These Class B stations are privately operated and, inasmuch as advertising and sponsored programs are not permitted in New Zealand, they have no source of revenue such as the United States stations".

Observer Shepherd (New Zealand): European stations are gaining in strength now (March). Between 20 and 30 can be heard each morning with readable strength. It will be some time, however, before they are at their best—at which time from 50 to 60 should be audible on a good morning. The American stations heard best now are KFI, KPO, KNX, KSL, CFCN, WLW, KOA, XEPN and XELO".

Observer Watson (New Zealand), in a letter dated February 21: "Reception of evening Americans is now good, the best being KFI, KPO, KFSD, KFRC, WBBM, WLW, KGO, KHJ, KNX, KMOX, and KFOX. The early morning Americans are now very weak. European and Japanese reception is good.

"The Sydney station, 2UW, 1125 kc., is now broadcasting 24 hours daily.

"The following interesting comment from *Tune In* offers more than a little sense: 'much was argued on its commencement that 1934 was going to be a peak year for DX but most listeners will agree that the prophets were very far out in their estimates, although as the year progressed conditions did improve somewhat. 1935 augurs well, but will it be a peak year? We think it will amount to this: the DX'er will be rewarded to the extent warranted by his patience and perseverance. The lazy periods will assuredly result in a scarcity of verifications'.

"We regret to inform our American cousins that courtesy programs from the class B stations of New Zealand are out of question. Owing to stringent Government regulations a class B station, in order to go on the air for special programs, must sacrifice some part of its regular schedule—a matter which is difficult to arrange".

(*Continued on page 765*)

ART JARRETT

CARLYLE STEVENS

ELEANOR HOLM

LUCILLE MANNERS

BACKSTAGE IN BROADCASTING

Samuel Kaufman

ART JARRETT, the youthful radio songster who swiftly soared the heights of radio stardom, is now heard on NBC as conductor of his own orchestra. And, as an added "box-office" feature to his programs, his charming wife, Eleanor Holm, is his band's vocalist. Eleanor, you know, is the swimming champion and Olympic star who established a reputation as a radio contralto. The Jarrett-Holm program combine seems a radio natural in view of the ballyhooed romantic atmosphere built around the pair in recent seasons.

MAJOR EDWARD BOWES, long featured as the "genial father of the Capitol Family" on NBC Sunday mornings, came forward with his Amateur Hour on WHN, New York, last year and, within a few weeks, won more fame through the local program than through his long-established network feature. While his Amateur Hour could not be called a brand new radio idea, it was the first program of the type to gather such wide attention and it started a major trend both on local and network stations. Amateur hours began springing up everywhere and, in due time, Major Bowes himself, was signed by Chase & Sanborn to bring his amateur show to the Sunday NBC spot once occupied by Eddie Cantor and, more recently, by the Opera Guild programs. To his old audience, Major Bowes revealed a hitherto latent comedy talent. His extemporaneous remarks as he presides over the gong are among the brightest microphone lines heard in recent seasons.

PATTI CHAPIN, a young songstress from Atlantic City, New Jersey, has earned network stardom in short time. As the stellar vocalist of Jack Pearl's Wednesday night CBS program of CBS, Miss Chapin gained considerable listener attention. She studied piano between the ages of 9 and 12, and her vocal talent was self-acquired as an adjunct to her instrumental efforts. She made her professional début as a singer and pianist at convention entertainments in her native city—a town famous for conventions and recreation.

THE American Academy of Arts and Letters did not make its customary good diction award to a radio announcer last season, but the microphone spielers were not entirely neglected. A new award known as the "BBDO award for Good Announcing" was established by the advertising firm of Batten, Barton, Durstine & Osborne, Inc. (now you know what BBDO means!) and Carlyle Stevens, of CBS, was the lucky winner of the initial year's competition. The award was a "substantial check," accompanied by an appropriately engraved stop-watch. In making the award, Mr. Roy Durstine, executive of the advertising agency, said Carlyle "has definitely not been a member of the stilted school of broadcasting that has come to be resented alike by the public and the sponsors of broadcast programs." Stevens is only 27 years old and has spent four years in broadcasting as announcer, writer and production man. His CBS affiliation was preceded by broadcasting work with WXYZ, Detroit, and WLTH, Brooklyn.

LOU HOLTZ, Broadway dialiect comic who has been intermittently featured on the air with considerable success, has returned to the NBC Thursday nights as a starred performer on Paul Whiteman's Music Hall presentation. Holtz spent three years on the vaudeville stage followed by a similar period with George White's Scandals. Then he alternated between vaudeville and the legitimate stage until he scored one of the greatest successes of his career in "Manhattan Mary," another George White production. During the 1931-1932 season, he appeared in his own musical show "You Said It," and since that time has alternated between footlight and microphone endeavors.

LUCILLE MANNERS, a comparative newcomer to the airlanes, got the type of assignment every young singer yearns for when she was named to substitute for Jessica Dragonette as featured soloist of the Cities Service Concerts on NBC Friday nights during the latter's recent vacation. Lucille, a coloratura soprano, made out exceptionally well on the program and NBC is looking forward to big things for her. Miss Manners, who hails from Newark, New Jersey, made her microphone début over a local station in her home state and soon attracted the attention of network executives.

MAJOR EDWARD BOWES

PATTI CHAPIN

LOU HOLTZ

NED WEVER AND ROSE KEANE

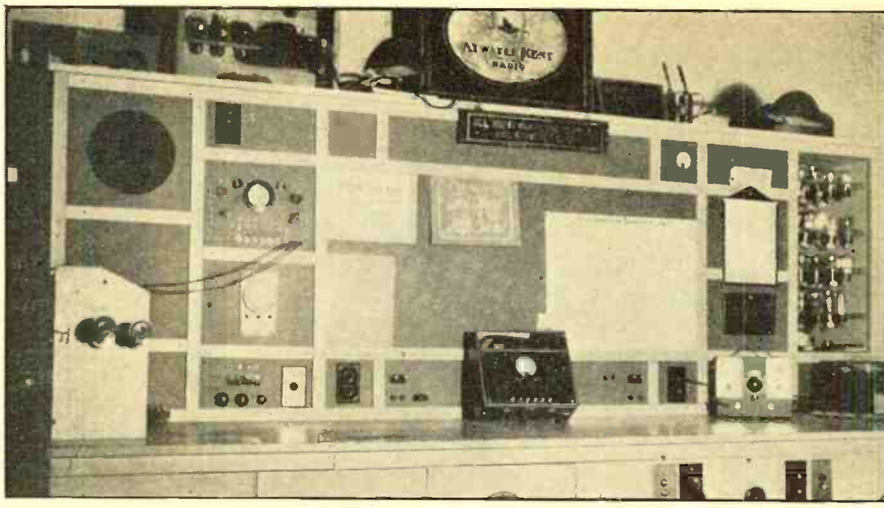
JOE COOK

THE radio trend of converting newspaper comic strips into radio sketches is still growing. The latest addition of the type is the Dick Tracy series heard over CBS Mondays through Thursdays of each week. Ned Wever is starred on the melodramatic series as the super-sleuth, Dick Tracy, while the Tess Trueheart love interest is portrayed by Rose Keane.

A NEW Friday night production, chock-full of stellar artists, is the "Circus Night in Silvertown" series of NBC. Joe Cook is ringmaster of the all-star program melange. The efficient B. A. Rolfe Orchestra, Tim Ryan and Irene Noblette, Peg La Centra, Lucy Monroe, Phil Duey and others are co-featured. It is seldom that so many headlining microphone personalities are grouped into a single feature. Joe Cook is a stage comedian whose early microphone efforts somewhat missed fire. He seems in his best radio form to date on his current series.

IN radio's early days, it used to be quite an event when Al Jolson signed for a single radio appearance. Somehow, the mammy singer of stage and screen fame did not hold a firm grip on radio popularity on all subsequent radio endeavors. He slipped considerably in his rating as a vocalist and comedian but earned applause as a radio actor. On his recent appearances with Paul Whiteman, his microphone adaptations of famous stage roles were among the greatest contributions toward the advancement of radio drama. He left the air at the peak of his dramatic efforts and, after a few month's sojourn in Hollywood, has returned to NBC as star of the Saturday night Shell Hour. It is too soon to determine his new rating, but it is quite certain that, if he continues in the vein of the Whiteman programs, he should immediately regain his former following.

AL JOLSON



THE SERVICE BENCH

ZEH BOUCK

GO SOUTH, YOUNG MAN, GO SOUTH!

YOUR service editor receives a monthly quota of letters from men just starting in the service business, as well as from those dissatisfied with their present locations, asking that we suggest a territory where there is a reasonably good chance of making a living. This is a very difficult recommendation to make, and the most one can do is to treat the subject in more or less of a general way.

THE best location is *always your home community* if conditions are half-way favorable. Local possibilities should be thoroughly sounded before a decision is made to move on. Assuming that there is a good reason (other than the sheriff) for seeking new fields, we would suggest a rural, or at least suburban, territory. With the power lines snaking out into the hills, and the battery sets being engineering to a state of perfection comparable with the "all-electric" models, the farmer is a radio prospect of no mean potentiality. Also, the cost of living—rents and seasonable vegetables—are considerably lower than in the city. Sidelines, from truck gardening to servicing the town hall's sound-picture projectors, are all within the suburban or rural serviceman's province.

The Southern States present a promising market, during the next few years, to the serviceman who can take on a line of low- and medium-priced receivers. In a wide survey made recently enough to have significance today, it was shown that the percentage of "radio" homes in the Southern States is considerably below the northern average. In eleven states south of the Mason-Dixon Line, only 21.4 percent of the homes had radio sets. Mississippi was the lowest, with 10.1% radio-equipped homes. The average for the New England States, as a matter of contrast, was 69 percent radio homes! So, paraphrasing Horace Greeley, we say, "Go South, young man, go South!" (You'll save coal in the winters, too.)

Sound-Head Servicing

As we have mentioned on previous occasions, the burden of servicing talking motion-picture projecting equipment often devolves upon the radio serviceman—particularly in rural and suburban areas. We have received numerous requests for data on this sort of work. It happens that we have on hand material from David W. Scott, Chief Technician with the S. O. S. Corporation, New York City, which came through simultaneously with a manuscript especially prepared for RADIO NEWS by Eddie Scribner, of Scribner Brothers, Schoharie, N. Y., with whose work on P.A. equipment readers of the Service Bench are already familiar. As the information contained in these two articles is somewhat complementary, it seems desirable to combine them in a single revision. The credit is pretty equally divided between Messrs. Scott and Scribner. There is no place in this department for a *detailed* treatise on sound movie projectors. This subject is adequately covered in several texts, and the Service Bench recommends Ghirardi's "Radio Physics Course," and the section on sound recording in Henney's "Radio Engineering Handbook."

Servicing of sound projector equipment can be divided into two classes—that of the amplifier and associated apparatus, and service of the sound-head. The former does not differ materially from service work on public-address systems and so will not be considered at this time.

The major problem in servicing the sound-head is the delicate matter of adjustment. There are four different kinds of adjustment, each one of which is essen-

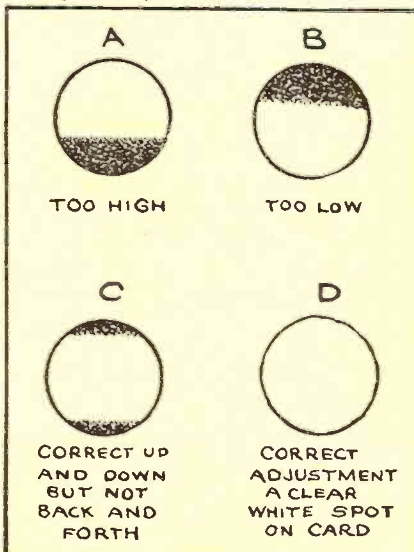
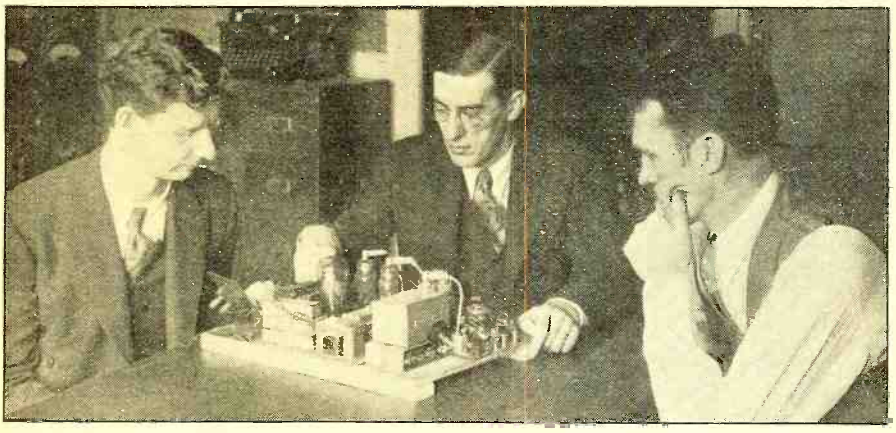


FIG. 1



SERVICEMEN!

Would you like to have an instrument which, when connected across your present service oscillator, will measure its output accurately in terms of microvolts?

The experimental model of such an instrument, a development of John H. Potts, is shown here, in the RADIO NEWS *Lab. It is a vacuum-tube microvoltmeter capable of providing r.f. or a.f. measurements down to one microvolt. It has no coils or tuned circuits and when the design is completed should be neither expensive nor difficult to build.*

Watch RADIO NEWS *for the constructional article.*

tial to clear, undistorted reproduction and these apply equally to the variable-width and variable-density recordings. These adjustments affect the position of the exciter lamp in respect to the optical system, the centering of the aperture in reference to the sound-track, and the rotational adjustment. The exciter lamp is so mounted as to admit the necessary movements for correct alignment. This is checked by removing the photo-electric cell and placing a piece of white cardboard in its place—about as far away from the sound-gate or aperture plate (the plate with the slit in it against which the film is in contact during projection) as the elements of the photocell. The exact distance is not important. An image will be seen in accordance with Figure 1, which is self-explanatory. The indicated adjustments should be made on the lamp until the spot of light appears as in Figure 1-D.

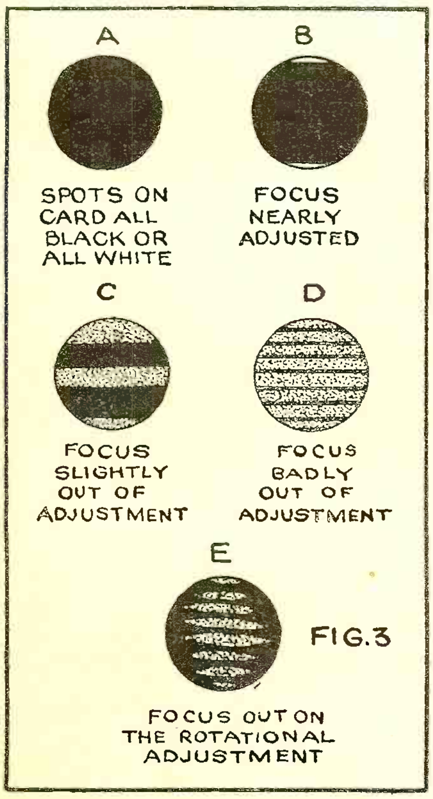


FIG.3

The optical adjustment is effected by threading through a few feet of frequency film—from 5000 to 10,000 cycles (the

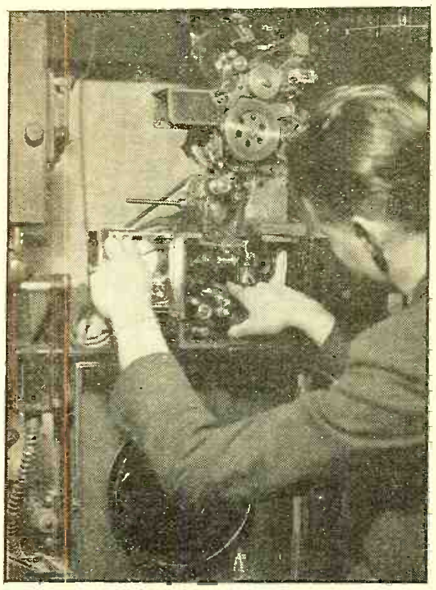


FIGURE 2

higher the frequency, the better and more difficult the adjustment). This film can be seen in Figure 2. Run through sufficient film to make sure it is in proper alignment. The image on the card will now correspond to one of the illustrations in Figure 3—probably C or D. The lens tube should be worked back and forth as the film is moved slowly—turning the machine by hand—until the spot of light fades in and out, showing no horizontal lines. (By referring to a "black spot" in Figure 3-A, we are, of course, not to be taken literally. There will not appear a "black" spot on the white cardboard—merely no light at all.)

If the spot of light becomes weaker as the film passes, but will not disappear completely (still no horizontal lines), it is due to the slit of light not being centered in the sound track—overlapping on one side or the other. In projection, if the light slit touches the sprocket holes, a 200-cycle "ripple" will be heard. If, on the

(*Continued on page* 774)

RADIO PHYSICS COURSE

ALFRED A. GHIRARDI

Lesson 41. Self-inductance

A CONTINUOUS or direct current is one which flows always in one direction, and is usually assumed to be of constant strength. A pulsating direct current is one which flows always in one direction but which may vary in strength. An *alternating current* is one which not only changes its direction of flow periodically, but also varies in strength. While all three forms of current exist in radio transmitting and receiving circuits, alternating and pulsating direct currents and voltages play the most important part in their operation. We shall now see that circuits in which alternating or pulsating direct current flows, usually behave entirely different than those in which steady current flows. It is very important for us to know and understand just what causes these peculiar effects.

If an alternating e.m.f. is applied to a circuit containing a resistor, an alternating current will flow through the resistor. If it has no associated inductance or capacitance whatsoever, it is called a "pure" resistor and it will behave exactly as it does in a direct-current circuit. The relation of the voltage and corresponding current at any instant will be exactly in accordance with Ohm's law, $I = \frac{E}{R}$. The opposition which a circuit or electrical device offers to the flow of current through it, merely because of the natural resistance properties of the material of which it is made, is often called its *ohmic resistance*. Whenever an electric current flows through a conductor, a magnetic field is produced around it. If the current is varied in any way, the magnetic field varies correspondingly. If an alternating current flows through a conductor, the field around it will be changing periodically both in direction and strength, and consequently a counter or self-induced e.m.f. will be set up in the conductor by self-induction. The e.m.f. is always in such a direction as to oppose the change which produced it. The higher the frequency of the alternating current, the faster the magnetic field varies and so the greater is the self-induced counter-e.m.f. The effect is greater if the conductor is wound in the form of a coil, because then the field is concentrated into a relatively small space and the magnetic field of every turn affects every other turn. If an iron core is put into the coil, the magnetic field is greatly strengthened and the self-induced e.m.f. is stronger. As this self-induced counter-e.m.f. is at every instant opposite in direction to the applied e.m.f. (Lenz's law), it tends to reduce the effect of the applied e.m.f. in producing a flow of current through the conductor. This opposition to the current flow caused by the self-induced e.m.f. in an alternating current (essentially the same effect exists in a pulsating direct-current circuit) is called the *inductive reactance*. If the circuit also has resistance, this will exert an additional opposition to the flow of current. The effects of inductance in an a.c. circuit may be shown by the following experiment: Connect a solenoid in series with a 110-volt, 110-watt incandescent lamp across a 110-volt source of alternating e.m.f. as shown at (A) in Figure 1. If an alternating-current ammeter with a range of 0 to 2 or 0 to 5 amperes is available this may also be connected in series with the crcuit. Notice that the lamp does not light up to full brilliance, due to the fact that the ohmic resistance and the self-induced counter-e.m.f. of the solenoid are opposing the applied e.m.f. and thereby reducing the current. Now slowly move an iron core into the hole in the solenoid, as shown at (B). Notice that the lamp gets dimmer and dimmer as the core is pushed in and the magnetic flux is increased The increase of flux increases the self-induced counter-e.m.f. and thereby reduces the current. The resistance of a solenoid like this of 100 feet of No. 18 wire is approximately .65 ohm. If the solenoid is now removed from the circuit and a non-inductive resistor of .65 ohm is connected in its place, as shown at (C), the lamp will burn brighter than when the coil was connected in the circuit, indicating that the flow of electrons or current was not only opposed or "impeded" by the "ohmic" resistance of the solenoid, but also by the counter-e.m.f. of self-induction developed in it by the alternating magnetic flux. If an ammeter is used in the circuit, the exact amount of current flowing in each case may be determined. If a non-inductive resistor of .65 ohm is not available, the solenoid itself may be unwound and straightened out so its inductance is practically zero, and it may then be connected back into the circuit since its ohmic resistance only will now be present.

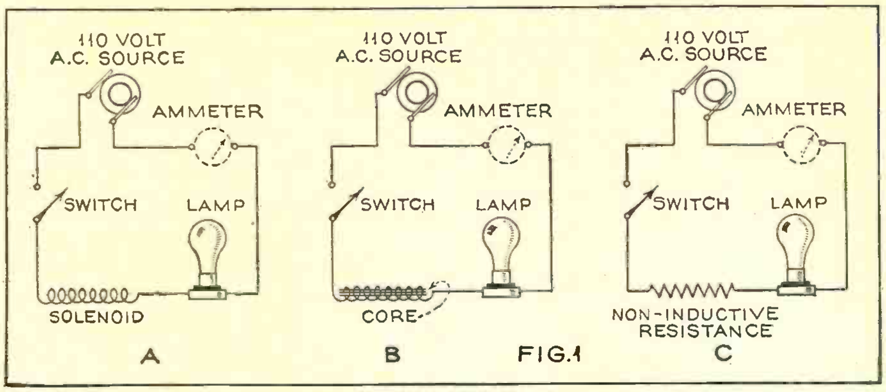


Figure 1. Experiment showing the effect of connecting an inductance in an a.c. circuit.

Electric Eye Uses Sun's Power

SCHENECTADY, N. Y.—A photoelectric device, a flat disc a couple of inches wide, that drives a small electric motor from power furnished by the sun has been constructed by Dr. C. W. Hewlett of the General Electric Laboratories at Schenectady. The practicability of the device was demonstrated recently before a number of engineering societies by Dr. Ellis L. Manning of the same laboratories. Iron, selenium, and platinum are used in the construction of this cell. It converts sunlight directly into electric energy.

The DX Corner (Broadcast Band)

(*Continued from page 759*)

Observer Atkins (Missouri): "I would like to know whether radio club papers are permitted to use material published in the Broadcast Band DX Corner of RADIO NEWS"?

(RADIO NEWS *hereby gives permission to all DX Clubs to republish any material in this department. The only requirement is that* RADIO NEWS *be credited as the source of such material.* —EDITOR'S NOTE.)

Observer Everly (Illinois) submits a number of stations for listing in the Advance DX Calendar. Also writes that KDKA will test from midnight to 5 a.m. from March 23rd to June 23rd using the call letters W8XARC.

JMJHS Radio Club (Seattle, Wash.) has just received an appointment as RADIO NEWS Listening Post Observer for the State of Washington. This is the Radio Club of John Marshall Junior High School. Any other clubs or DX organizations desiring similar appointment are invited to address their applications to this department.

Observer Woodhead (Wyoming): "What I thought at first was going to be the best DX season ever has turned out to be, in my opinion, the worst. The stations have been putting in good signals—many of them even louder than other years—but during the whole season the static level has been very high. Even in the middle of winter (we have had summer here all winter) the static was high".

Observer Ansell (Saskatchewan): "I enclose a copy of the verification card and letter received from Station 4AY, Ayr, Queensland, Australia, which I believe will create a near record for this continent, especially as I operate only a 7-tube t.r.f. receiver".

(*The verification is certainly an excellent one as it states that 4AY was using only 30 watts unmodulated antenna power at the time.*—EDITOR'S NOTE.)

Observer Elcheshen (Ohio): "I have increased my log to 647 from the frequency checks. WJBC, 1200 kc., 100 watts, has a late program every Friday night from 11 to 12. This information comes from George M. Belleaux, operator at this station".

Observer Kocsan (Pennsylvania): "Here are some stations I have been trying for all winter without success and wonder if anyone else has had any luck with them: KWJJ, KGIR, WCAT, KLPM, KFXJ, KGGM, VOGY, KGVO, KTW, XEFJ, CFCT, 10BP, CKWX, CKOV, CFJC. I heard nothing of CPX or CP4—or of the 'mystery' station which was scheduled to broadcast a special program on March 17th. By the way who was the 'mystery' station"?

As yet we have heard nothing definite concerning this 'mystery' broadcast. We have received reports that the broadcast has been called off, but more recently we have heard that the broadcast actually did take place as scheduled. Does anyone know definitely about this—and who this station was?—EDITOR'S NOTE.

Observer Routzahn (Pennsylvania): "I have succeeded in raising my log total to 810. Australian reception is going strong. A sure catch for anyone trying is 1YA any time after 3:30 a.m. KGU is also good at this time, 2BL, 4QG, 5CK and 4BC are the 'best bets' at the present time".

Observer Stokes (Pennsylvania): "Conditions on the whole have been very unfavorable all season at this listening post. Without a doubt LR5 has consistently put a first class signal into North America. Their dozen or so special broadcasts have enabled thousands of fans to add South America to their logs. TGW has been another consistent station on its special programs.

"After a four-year lapse yours truly is taking another fling at the short waves. What a difference! The air is literally filled with signals nowadays where as back in 1929-31 you *hunted* for them—and I don't mean maybe"!

Observer Kalmbach (New York): WTCN, Minneapolis, broadcasts DX tips every Sunday morning at 12:45 a.m. WTRC, a 100 watt station in Elkhart, Indiana, has been heard in 38 states, all Canadian provinces and in New Zealand. WSVS (the station which dedicated their March 6th frequency tests to the RADIO NEWS DX Corner) was heard in Sidney, Australia, although a power of only 50 watts was used.

QRD? QRD? QRD?

CONDUCTED BY GY

AH, me hearties, it is indeed wondrous to be on the very grounds of a skirmish battle . . . to be in it . . . and yet sufficiently outside of it not to get one's toes stepped upon. And such was the situation down in the sunny clime of Miami, Fla. . . . . Brother Vaadis, of known pedigree, has upon his shoulders the worriment of the ARTA nephews in that thar territory, and while stepping around town keeping tabs on the brethren and shipping industry he occasionally negotiates various and sundry contracts with shipping companies. His system is quite simple and also rather effective. Here it is. . . . A half hour before sailing time the operators walk up to the captain of the vessel and announce rather casually that they are on strike and would like to have their papers signed to the effect that service was satisfactory up to sed date. Thence the skipper becomes irate and denounces everyone, including himself, for having followed the sea and being forced to associate with such ingrates. Meanwhile Brother Vaadis walks down to the office of the company, where he finds the Super choking the telephone in a rage and in this condition he signs anything that comes in front of his pen only that "the ship must go on." Just a trouper, see. Quite an idea and sometimes it works.

THE pacifists and diplomats sitting on the sidelines of the biggest show on earth now going on under their very noses are greatly incensed over the methods used by organizations toward gaining their ends. It is indeed a dishonorable stunt to take advantage of a situation just because there is a dire need for operators by taking them off just before a ship is starting to sail with a total load of passengers aboard. But the defense given is that the iron is best struck when it is the hottest, *n'est-ce pas, mes amis?* Of course, we cannot condone these high-handed methods and shot-gun affairs, but what would you do when others are unreasonable and will not even take cognizance of a moving world right on their front doorstep, or should I say gangplank? More power to those with the gumption to take a necessary fight to the enemies' territory.

We think that advertisement in a certain magazine for a position by an operator was a gag . . . or mayhap it might have been just puns and coffee, eh? Bye the bye! We wonder how soon it will be when there are regular television operators needed in the radio industry as per the heading photo this month, where Mr. W. H. Peck is showing the operating secrets of his system to Dr. C. C. Clarke, of the Science Department of the School of Commerce, New York University.

Brother Ted Lupien, recently with the foundered *S.S. Lexington* of the Colonial Line, is now out of the hospital and doing duty on the *S.S. Cambridge* of the same line. He modestly tells the story of the ramming and sinking of the ship by the freighter *S.S. Jane Christianson* on January 2nd, in the East River, New York. Knocked against a stanchion by the crash, his head spun for a minute, but he recovered quickly and ran into the radio shack to stand by for orders from the bridge. No orders being sent down, and noticing six tugs had come alongside and were taking passengers aboard, Lupien immediately went below and began directing passengers to the upper deck and onto the tugs. Many acts of heroism occurred in the short ten minutes the ship was afloat. After all the passengers were safely stowed aboard the tugs and the *Lexington* started to turn over, Lupien realized with a start that he was the last man aboard. Just then the *Lexington* "went down" and he was thrown into the icy waters of the river. As he went down, the spreader on the antenna caught his coat and he was dragged under. He finally freed himself and, fighting the suction, he came up and grabbed a life preserver going by. He was swept downstream by the powerful current and managed to pull himself up on a piece of wreckage floating by, remaining there until rescued. He was treated at the hospital for submersion and we are indeed fortunate in having him with us today.

Only the timely presence of several tugs almost alongside prevented the *Lexington* sinking from becoming a major ship disaster. Another night boat, the *S.S. Larchmont* of the old Joy Line, sank years ago off Point Judith, with a loss of over 300 lives. She was not equipped with radio, so not a word was heard from her until next day's papers printed that she had failed to arrive as per schedule, which was too late for a rescue to be attempted. *These night boats should be protected by radio law!*

We suggest that the F. C. C. ought to recommend to Congress that the law should require a continuous radio watch on all passenger vessels running, especially Sound boats, and now is the time when Congress is anxious to do something that will tend to prevent a recurrence of the needless loss of life in passenger ship disasters the past year. After all, the water between ports 150 miles apart is just as dangerous as those between ports over 200 miles or more apart. And it seems that the worst maritime disasters have occurred within the very sight of land, too.

Captain Hooper, U. S. N., whose recent article on "Communications Officers in the Merchant Marine" caused such controversy, states in refutation of the various arguments which have arisen that "... comments have been received which lead me to believe that clarification and further discussion of some points therein are desirable. . . . It was written in the hope that it might arouse interest in a situation which it is believed all will agree, is in need of vast improvement. . . . Radio aids to navigation are today as important to the navigating officer as are the lights and sound signals along the coast. My own experience is that the radio personnel are well trained and doing their job admirably and it is unfortunate that some portions of my previous article have been interpreted as reflecting upon the efficiency of radio operators. . . . Many deck officers do not have sufficient communications knowledge to determine the reliance to be placed on bearings, etc., taken by the radio op. . . ."

Increased communication knowledge, Captain Hooper adds, on the part of masters and deck officers would be not only to their advantage, but to that of radio ops as well. Masters would then be in a position to appreciate and to support operators' requests for more modern and efficient equipment and an adequate complement of radio personnel. They would not expect a two-man complement to guard numerous channels, such as news, traffic and distress frequencies simultaneously, as though there were a radio complement of eight. They would insure that the radio room was well supplied with latest editions of all documents required. They would be in a better position to present problems of the radio men before the managers and directors of their company.

At the recent cruise of the V. W. O. A., held at the Hotel Montclair in N'Yoik, the annual gold medal was awarded to G. W. Rogers of the *S.S. Morro Castle,* and at the same time testimonial scrolls were handed to G. I. Alagna, first radio op on the above vessel. Those who also received a testimonial scroll were Chief Op Russell McDonald and First Op E. H. Cole of the *S.S. Mohawk,* E. J. Robertson of the *S.S. Usworth,* Wm. J. Kirchoff of the *S.S. Sea Thrush,* and R. Lilkebakhan of the Norwegian motorship *Childer.* These scrolls are not handed out indiscriminately, and it is with pleasure that we note to whom these envied awards were made. These men carried on the tradition of the radio operation. Viva and a huzzah!

So we end another chapter of these weird nightmares with another perusal of the fan mail from the hinterlands . . . our western correspondent declares that whilst there is sunshine in California, he will remain there basking under it, but declines to work. . . . Here is something you would never know if we hadn't told you. . . . A Navy radioman walks around aboard ship with a blanket under his arm for the purpose of laying his head down on a soft spot. . . . Steel decks are so hard. . . . Phoenix, Arizona, Airways station comes in with a blast, stating that things in general are swell—that is, conditions, etc.,—but demands that more space be devoted the hayseeds than the salt-water boys. . . . Well, isn't it the hayseed what makes the salt-water boy? . . . Or maybe we're all wet. . . . Howsomever, we shall do our very best to improve. . . . Well, so long and keep that chin up, with 73. . . ge . . . GY.

THE TECHNICAL REVIEW

CONDUCTED BY ROBERT HERTZBERG

Electronics and Electron Tubes, by E. D. McArthur, General Electric Co., Schenectady, New York. This bulletin is a reprint of articles which appeared in the General Electric Review from March to December, 1933. It discusses in simple language the fundamentals underlying the vacuum tube and gas-filled tube and how they can be used. The bulletin begins with the electron and atomic theories and continues with elements of electron tubes. The reader is informed successively of the properties and applications of rectifiers, triodes, screen-grid tubes, gas-filled triodes and special tubes. Experimental Electronics (Bulletin GET-566), General Electric Co., is a manual of experiments to accompany the course described above. It describes some 23 experiments which are designed to illustrate the principles of various electron tubes. It begins with experiments on emissions of a tungsten filament and ends by constructing and studying the operation of an oscillator, v.t. voltmeter, thyratron inverter, etc.

Experimental Electronics (Bulletin GET-620), another manual of experiments which describes 11 experiments. These are again different from the previous bulletin. Some of the experiments deal with photo-tube relays, others with thyratrons. These three bulletins can be obtained from the General Electric Co. at a nominal charge.

Review of Articles in the March, 1935, Issue of the Proceedings of the Institute of Radio Engineers

Vacuum Tubes for Generating Frequencies Above 100 Megacycles, by C. E. Fay and A. L. Samuel. The failure of the conventional vacuum tube to oscillate above some critical frequency is analyzed and illustrated by data on a tube which will oscillate up to 300 megacycles. A Barkhausen tube (giving output in the order of 5 watts in the range from 450 to 600 megacycles) is described.

Designing Resistive Attenuating Networks, by P. K. McElroy. A collection of material, largely old but in part new, presented in one place for ease of reference and use. A large chart, bound in, will prove a valuable time-saver for the engineer who has occasion to calculate networks for different purposes.

Multi-range Rectifier Instruments Having the Same Scale Graduation for All Ranges, by Frederick E. Terman. The character of the scale in a rectifier instrument depends only upon the impedance of the network connected across the rectifier input. Combinations of single-series and shunt elements are shown which enable this impedance to be constant and at the same time permit various voltage and current sensitivities.

Barkhausen-Kurz Oscillator Operation with Positive Plate Potentials, by L. F. Dytrt. The experimental results presented in this article are chiefly concerned with the wavelength-plate potential characteristic and the oscillator behavior.

Automatic Syntraction of Two Broadcasting Carriers, by Verne V. Gunsolley. Describing a phase meter which is adapted to controlling automatically the space phase between two carriers at any desired point in the area of common frequency broadcasting. Experimental results of syntraction between a crystal-controlled oscillator and a broadcast carrier are given.

Review of Contemporary Literature

The Ionosphere, by W. M. Goodall. Bell Laboratories Record, March, 1935. Description of interesting experimental measurements of the height of the ionized region above the stratosphere, from which radio waves are reflected.

A Universal Network Chart. Electronics, March, 1935. A chart designed to solve all of the simpler types of network problems of the fixed value type and to permit the design of variable networks by a point-to-point method.

Beat Oscillators for Modern Radio Receivers, by Arthur G. Manke. Electronics, March, 1935. An improved method for applying the beat oscillator to a receiver having automatic volume control on all *i.f.* amplifier tubes and obtaining an audible beat-note signal at resonance for strong or weak signals.

Waveform Errors in the Measurement of Filter Characteristics, by A. E. Thiessen. General Radio Experimenter, March, 1935. Engineers whose work includes the design and manufacture of electric wave filters have often been concerned with the discrepancy that appears to exist between the calculated and the actual performance. This paper discusses the influence of waveform distortion and tells how to overcome it.

The Interaction of Radio Waves, by V. A. Bailey and D. F. Martyn. The Wireless Engineer, March, 1935. An explanation of how the waves of one radio station are influenced during their transmission by radiations from a second station. The interaction is believed to take place in the Kennelly-Heaviside layer.

Generating Sine Waves with a Gas Discharge Tube, by Winston E. Kock. Electronics, March, 1935. By using an inductance in series with the condenser of a simple discharge-type oscillator, the voltage across the condenser can be made to approach a pure sine wave at the resonant frequency.

Oscillator Padding, by Hans Roder. Radio Engineering, March, 1935. A complete discussion of the problem of padding is given. For its solution, a new, simple method is derived, suitable for graphical or mathematical evaluation.

Service Applications of the RCA Cathode-Ray Oscillograph. Service, March, 1935. Tells how the service man can use this newest of service tools in repairing radio receivers and accessories.

A Simple Photographic Recorder for the Experimenter, by Ross A. Hull. QST, March, 1935. The design and construction of an instrument suited for signal measurement work are described. Amateurs with a slight knowledge of photography should be able to make this device without much trouble.

More Audio Watts from a Single Type 10, by Robert McConnell and August Raspet. QST, March, 1935. Interesting application of the popular type 10 tube in an unconventional but simple compensated Class AB circuit. A type 45 triode is used as a driver.

More Effective Pre-Selectors for Receivers. QST, March, 1935. Some practical data on converting tuned r.f. receivers into two-stage units and adding regeneration to the single stage.

Information On New Antenna Kit

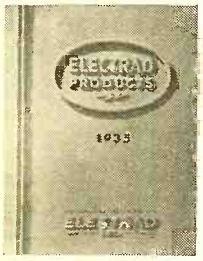
RADIO NEWS offers, through the courtesy of the Cornish Wire Company this interesting folder on the new Corwico "Noise-Master" doublet type aerial kit designed to eliminate radio interference on either the broadcast or short-wave bands. To obtain this folder simply send in your request to RADIO NEWS, 461 Eighth Avenue, New York City.

Booklet on New Short-Wave Receiver

This manual describes the new Skyrider crystal superheterodyne short-wave receiver manufactured by Hallicrafters, Inc. It contains a detailed discussion of the outstanding features of the set, including a new crystal filter circuit, high-gain r.f. preselector circuit, five-band coverage and other new developments. Our readers can obtain a copy of this manual free, by simply addressing their request to RADIO NEWS, 461 Eighth Avenue, New York City.

New 1935 Catalog

This is new Hammarlund Manufacturing Company 1935 parts catalog is offered free to all RADIO NEWS readers. Among the many new products described in this 12-page highly illustrated catalog are the new XP53 type coil forms, the new short-wave coil kits and the new variable coupling air-tuned i.f. transformers. Simply address requests for this catalog to RADIO NEWS, 461 Eighth Avenue, New York City.



Resistor Parts Catalog

Readers will find this new 19-page catalog extremely helpful in their work. It lists a complete line of standard replacement controls, vitreous enamelled resistors, Truvolt adjustable and flexible type resistors, precision wire-wound resistors, T type attenuator controls, and other resistor products. The book contains helpful re-

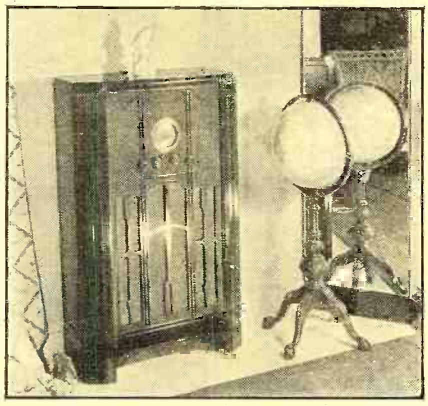
(*Continued on page* 771)

WHAT'S NEW IN RADIO

WILLIAM C. DORF

Two-Range Console

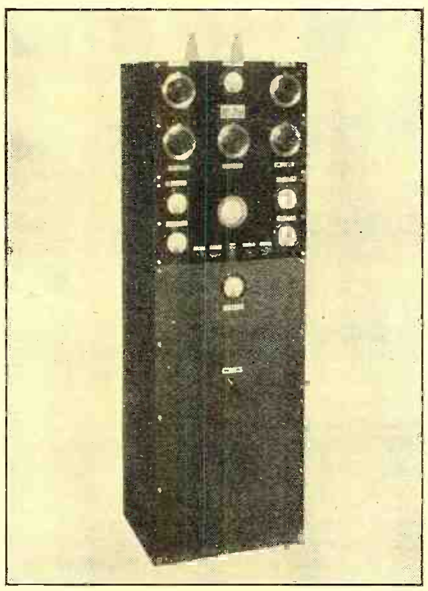
The new RCA Victor Model 214 Console Grand is a five-tube, two-band superheterodyne covering 540 and 1720 kc. and 2250 and 6850 kc. Features include 10 to



1 ratio tuning dial, 2-point tone control and 3.5 watts audio output.

100-Watt Transmitter

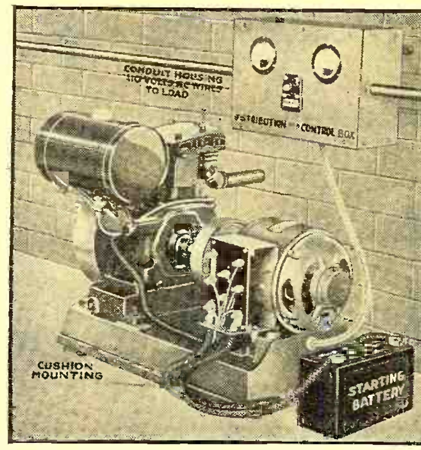
Amateurs will be interested in the new 100-watt "Ham" 'phone and c.w. transmitter recently announced by the Marine Radio Company. It is equipped with a built-in cathode-ray oscilloscope which acts as a visual distortion and modulation percentage indicator so as to maintain 100 percent modulation. Additional features



include permanent neutralization, built-in bias supply, high fidelity audio channel and an antenna matching network. The speech amplifier has a gain of 125 db. The dimensions are 60 by 19½ by 15 inches. The transmitter is housed in a baked crackle enameled finish broadcast station type cabinet rack with detachable hinged rear door.

Self-Contained Power Plant

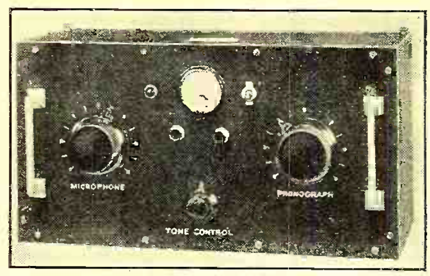
A 750-watt a.c. lighting plant, complete in one unit, is announced by the Kato Engineering Company. Burning either gasoline or kerosene, and furnishing 110 volt, 60 cycle alternating current, it is ideal for home lighting, oil stations and large sound trucks. It can be made self-starting. Remote control by convenient push-buttons may also be attached. The generator is mounted on rubber cushioned



floating bolsters and does not need to be bolted to the floor.

New High-Power Amplifiers

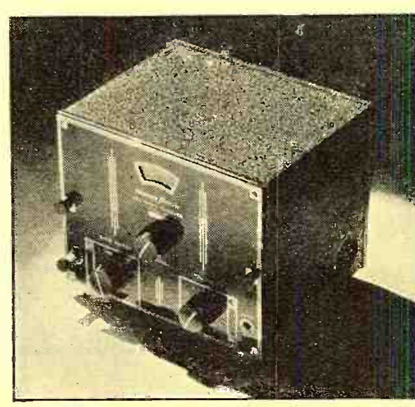
The latest additions to the Webster Company line of amplifying equipment are the new model A-30 and B-50 units. The model A-30 delivers 30 watts output, uses push-pull amplification throughout and is class A. The model B-50 has 50 watts output, class B. These amplifiers are similar in construction, have individual volume controls for both the microphone and radio input circuits, with mixing arrangement and carbon microphone voltage supply self-contained. Additional controls



include milliammeter for reading microphone current, on-off switch with pilot light, and tone control.

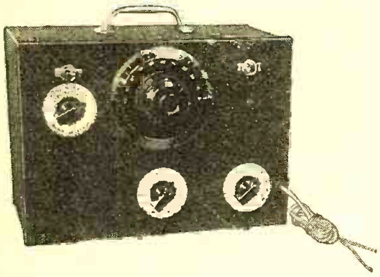
Superhet for Private Fliers

A new 3-tube superheterodyne receiver for private fliers, which receives on both the weather-broadcast band and the commercial broadcast channels, is a recent product of Western Electric Company. It is compact and has only three controls: band switch, tuning and volume.



New Signal Generator

The Hetro Electrical Industries announce a new model 22 all-wave signal generator designed to meet the requirements of the radio manufacturer, serviceman, dealer and radio engineer. The instrument has a radio-frequency range, continuously vari-



able from 100 kc. to 27 megacycles without resort to harmonics, and an output control which is calibrated directly in microvolts. An audio-frequency signal of 400 cycles is also available. The instrument operates from 110 volts 60 cycle supply.

The Technical Review

(*Continued from page* 769)

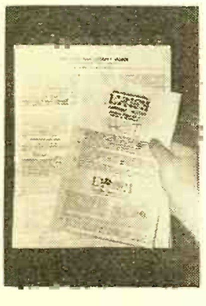
sistor computations and charts. Through the courtesy of Electrad, Inc., this book is free to all our readers. Address requests to RADIO NEWS, 461 Eighth Avenue, New York City.

Free Booklet on Tube Checkers

The Supreme Instruments Corporation offers our readers a copy of this new book entitled "Tests—Thousands of Them," which is a complete discussion of tube testers. The instructive information on the instruments is accompanied by circuit diagrams and we know that our readers, especially radio dealers, servicemen and constructors, will find this book a valuable aid in their work. Address requests to RADIO NEWS, 461 Eighth Avenue, New York City.

Radio Service Course

The book illustrated above entitled "Practical Mechanics of Radio Service" contains a descriptive outline of the 28-lessons on the new radio service course conducted by F. L. Sprayberry. Information on the outstanding features and also the price of the course is included in the book. Our readers can obtain a copy of this book free by writing to RADIO NEWS, 461 Eighth Avenue, New York City.



A New 1935 Parts Catalog

RADIO NEWS offers through the courtesy of Alden Products Company this 16-page illustrated catalog which shows the most popular Na-Ald products comprising analyzer plugs, and associate adapters, connectors and microphone cables, plug-in coils, dials, short-wave condensers and Victron insulated short-wave and transmitting products. Accompanying the catalog is a data sheet on modernizing set analyzers and building a selective set tester adapter. To obtain this catalog and data sheet simply send in your requests to RADIO NEWS, 461 Eighth Avenue, New York City.

New Antenna Literature

Through the courtesy of Arthur H. Lynch, Inc., the following instructive literature on antenna systems is available to our readers, free for the asking. The large folder entitled "Practical Ham Antenna Design" discusses various types of antenna systems for receiving and transmitting. The small leaflet contains instructions for installing a new auto-radio under-car antenna system. Address requests to RADIO NEWS, 461 Eighth Avenue, New York City.

Information on New Radio Courses

Through the courtesy of the Capitol Radio Engineering Institute, this book is offered gratis to all RADIO NEWS readers. It gives detailed information on their practical radio engineering courses now available in three convenient forms: home study, residence or a combination of both. Send requests to RADIO NEWS, 461 Eighth Avenue, New York City.

Book on the Elimination of Radio Interference

"Radio Noises and Their Cure" is a 75-page book measuring 8½ inches by 11 inches, published by the Tobe Deutschmann Corporation. It contains a vast amount of instructive data and information for tracking down man-made static for its elimination. This data is accompanied by illustrations and circuit diagrams. The price of the book is fifty cents and any reader desiring a copy of the manual can obtain same by writing RADIO NEWS, including stamps or money order, 461 Eighth Avenue, New York City.

The DX Corner (Short Waves)

(*Continued from page* 754)

Readers Who Helped Log Stations for This Month's Report

Ferry Friedl, Enrico Scala, Jr., H. F. Etheridge, Fred M. Craft, J. J. Dziedzina, Howard A. Olson, Robert B. Holland, Jack Bews, Howard Adams, Jr., Emerson Cobb, William G. Bergeron, Dale Akins, R. W. Evans, J. T. Atkinson, Andrew MacFarlane, Clifford Pryor, L. M. Jensen, John Wojtkiewic, L. J. Plunket-Checkemian, Danford Adams, Albert E. Emerson, L. Clarkson, A. Passini, Donald W. Shields, Arthur Meinhardt, C. McCormick, Guy R. Bigbee, Roy L. Christoph, A. C. Lyell, N. C. Smith, A. B. Baadsgaard, Thomas A. Pugh, J. Harold Lindblom, C. Holmes, E. S. Latimore, L. P. Morgan, Edgar Vassallo, W. B. McKean, J. B. McCracken, Leon Tallman, Harold H. Flick, Felipe L. Saldana, Werner Howald, W. W. Gaunt, Jr., H. S. Bradley, Oliver Amlie, Arthur Lussier, Arvid E. Koivisto, J. V. Duncan, Robert Irving, John Pearce, R. Wright, Dr. Ing. Max Hausdorff, United States Radio DX Club, W. H. Boatman, A. H. Garth, J. Waters, Charles E. Roy, Harold J. Self, Morgan Foshay, C. D. Hall, William J. Vette, M. T. Cooke, L. C. Styles, P. H. Robinson, Overton Wilson, Dr. F. C. Naegeli, Jack Cook, James L. Davis, Robert J. McMahon, R. Ferguson, Virgil Scott, H. Kemp, William Koehnlein, G. L. Harris, Douglas S. Catchim, Charles S. Potts, Charles Q. Williams, R. W. Winfree, Lynn Millburn, L. W. Sherwin, W. H. Moseley, Warren D. Carpenter, Abram W. Pierce, Harry W. Porr, Robert A. Hallett, Chester W. Mack, Arthur Hamilton, William Schumacher, J. G. Hampshire, J. C. Grambling, Francis D. Gilliland, O. S. Calvert, Thomas J. Weaver, Robert F. Gwinner, Charles D. Isaacson, F. L. Stitzinger, F. K. McKesson, Lino C. Herrera, M. Mickelson, Arthur Whitehair, Carl Scherz, N. A. Kay, Rudolf Stuber, Rein J. G. VanOmmeren, George Pasquale, H. C. Chestnut, Arthur Leutenberg, Manuel Davin, Manuel Gomez, George J. Munz, Jesse E. Squires, W. Kempster, Jack Dunlevie, J. R. Dunne, J. B. Canfield, Frank Campbell, Dalton Forth, Thursten Clarke, H. H. Parker, Fred C. Hickson, Freeman C. Balph, Eugene T. Musser, Manuel E. Betances, Arthur B. Coover, Paul Byrus, James W. Sheppard, Ray Geller, Allyn M. Freese, Eddie C. Zarn, Forrest W. Dodge, M. Keith Libby, Walter W. Winand, John E. Greene, Paul B. Silver, J. Ira Young, Evan J. Maloney, Ernest R. Remster, R. Lewis Davenport, B. O. Reynolds, D. A. MacLeod, Arthur E. Hohman, James Brown, Leonard Theodore, T. J. Knapp, Ambrose McMullen, C. K. McConnan, W. B. Kinzel, John E. Moore, August J. Walker, Carl Schradieck, A. D. Ross, E. L. Myers, R. H. Tucker, L. T. Lee, Jr., Frederick W. Cable, J. D. Buckley, Ralph B. Baldwin, Samuel J. Emerson, Walter J. Chambers, E. F. Bahan, Paul W. Dilg, R. Lawton, Italo Amore, R. H. Tomlinson, William Harriman, Kurt Sell, E. Kikutis, Dr. Alan E. Smith, C. H. Skatzes, Lewis F. Miller, Arthur Haylor, John C. Kalmbach, Jr., R. Stevens, George A. Sholin, Joseph H. Miller, Robert L. Young, G. C. Gallagher, Harold W. Bower, Duncan T. Donaldson, R. B. Holmgren.

British Television

(*Continued from page 728*)

secretary of the committee. Further on, the report recommended that ultra-short-wave image transmitters should be erected at elevated sites with antennae as high as possible. The committee believes that at least half the population of the British Isles could be served by ten stations of this type.

Regarding the apparatus, the committee suggested that a television patent pool should eventually be organized. Baird Television, Ltd., and the Marconi-E.M.I. Company were favored in the report to supply essential equipment for the operations of the London station where two systems, functioning alternately, will be employed. It is understood that the Scophony, Cossor and other firms will be permitted to bid along with Baird and Marconi-E.M.I. when additional stations are built outside the London zone. Initial transmissions from London will be on 6 to 7 meters with synchronized sound on ultra-short waves.

Sponsored television programs by advertisers were sort of frowned upon, but the B.B.C. has a bit of leeway on this point. It seems that direct advertising is banned, but the power granted in the B.B.C.'s existing agreement to accept certain types of sponsored programs should be applied to the television transmissions, the committee said. The committee opposed any rise in the present 10-shilling listener license fee and held that there should not, at the start, be any separate license for television reception.

Reaction to England's television decision has varied. British television stocks immediately rose, but manufacturers of broadcast receivers came forward with the emphatic "warning" that television was still in an experimental stage and that it would be a long time before the present type of sound receiver would be obsolete. Lt.-Col. J. T. C. Moore-Barbazon, retiring president of the British Radio Manufacturers Association, asserted that it will take years to develop the technic of television entertainment to the standard that radio broadcasting has attained and for that reason alone the present types of modern radio receiver will still be in popular use.

Several British firms had been marketing television receivers for a long period preceding the Government's television committee report, but there had not been mass sales in view of the absence of a general program schedule. Baird's transmissions from Crystal Palace, London, have been satisfactorily received, it is said.

Summer Radio

(*Continued from page 727*)

Battery Operated Superhet for Camps

Allied Radio has brought out the Knight 5-tube, 6-volt, battery-operated superheterodyne, designed to work entirely off an ordinary 6-volt storage battery. This set

is suitable for use in camps, summer cottages and rural homes. It is an all-wave receiver, tuning from 18 to 555 meters. A built-in vibrator type power unit furnishes all required plate and grid voltages. The current drain from the storage battery is only 3 amperes.

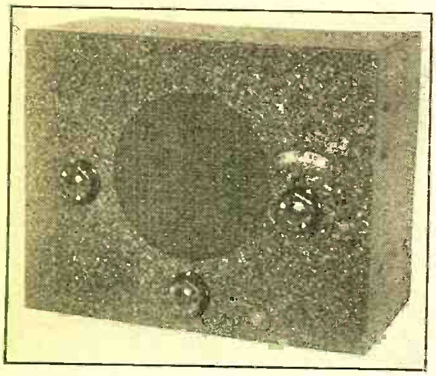
New Portable Marine Receiver

The Freed-Eisemann portable set shown in the illustration is especially designed for use aboard small boats, using either 6 or 32 volts power supply. The set is extremely compact and may be moved around from place to place as the occasion requires. A

small motor generator for supplying 250 volts d.c. to the plates of the radio tubes is an integral part of the receiver. The ship's power supply of either 6 or 32 volts direct current supply operates the motor generator and supplies filament current to the set. It is built into a waterproof Dupont fabrikoid covered 3-ply veneer carrying case.

A Portable 3-Tube Kit

This compact a.c.-d.c. three-tube receiver announced by Experimental Radio Labs. employs the following tube equipment: one 6D6, one 76 and a 12A7 type tube. It has a wavelength range from 14 to 550 meters, and the cabinet measures 9 by 7½ by 4½ inches. The receiver is available either in kit form or completely



wired ready for operation. They also have a 3 tube kit using this same type cabinet, for battery operation.

The "Ham" Shack

(*Continued from page 732*)

210 type tube as a buffer-amplifier or doubler and uses a 211 type tube in the final amplifier. In place of the latter tube a 203-A type tube might be substituted, but it will be found that the 211 is much easier to excite than the higher "mu" tube and therefore easier to handle.

The components are laid out almost exactly as they appear in the schematic wiring diagram. The baseboard is 48 by 14 inches. The crystal oscillator is mounted at the left, with the crystal itself placed in a convenient place so others of different frequency may be substituted with ease. The coil and condenser associated with the crystal circuit are mounted immediately in front of the tube. An ordinary plug-in type form is used for the crystal tuning circuit, providing a vertical mounting for the coil. Coupling to the buffer stage is provided through a 100-mmfd. fixed condenser which taps on the crystal oscillator tank circuit one-quarter of the total number of turns from the plate end of the coil. This connects directly to the grid of the buffer-amplifier. The essential components of this stage are the tuning condenser, coil and neutralizing condenser. It will be noted a stator tank condenser is employed. This is used to facilitate all-band operation, as it simplifies neutralization by making it permanent for all bands once it is set. Also only two connections to the coil are necessary. This makes it possible to use "banana plug" mountings. The coils are wound on 2-inch forms. Coupling to the final amplifier is accomplished by means of the "link" method. While this necessitates an extra tuning circuit, it provides greater efficiency in transfer of energy from the buffer-amplifier to the final amplifier by virtue of a better impedance match. The link coupling should consist of three turns wound about the buffer plate tank-and-grid coils for 160-meter operation, two turns for 80- and 40-meter operation and one turn if a 40-meter crystal is used for 20-meter operation. The link is coupled to a tuned circuit in the grid of the final amplifier. A high L-to-C (i.e., large coil and small capacity) is desirable in this circuit. The number of turns and design of the coils is identically the same as the tank circuit in the buffer stage.

Aside from the grid tuning, the remainder of the final amplifier stage is identically the same as the buffer-amplifier, except a coil and condenser designed to accommodate the higher power is provided. The plate tank coil is one made by the Gross Radio Company of New York. They are available for the three most popular amateur bands, i.e., 160, 80 and 40 meters. A coil for the 20-meter band is easily constructed. Switches are provided in the plate circuits of the buffer-amplifier and the final amplifier. This greatly facilitates tuning. If the transmitter is to be used exclusively for telephone transmission, it is possible to use automatic bias throughout. On the other hand, if c.w. is to be used, combination battery and resistor bias should be used on the final amplifier. The 211 requires in the neighborhood of 260 volts, minus grid bias, for Class C operation, i.e., twice cut-off. Therefore, at least 135 volts of battery bias, used in conjunction with a biasing resistor, must be used in the final amplifier for this type of operation. Such a voltage will provide complete cut-off when excitation is taken off the grid of the final amplifier by keying in the buffer-amplifier filament-center-tap circuit.

List of Parts

C1, C2, C5, C8, C11, C12—.002 mfd. fixed condensers (Aerovox).
C4, .0001 mfd. fixed condenser (Aerovox).
C10, C13—.002 mfd. fixed condensers (Aerovox, 5,000 volts).
C3, C9—100 mmfd. variable (Cardwell Midway).
C7—Split stator variable condenser, 150 mmfd. per section (Cardwell).
C14—Split stator variable condenser, 100 mfd. per section (Hammarlund double spaced).
C6—50 mmfd. midget variable condenser (Hammarlund).
C15—50 mmfd. variable transmitting condenser (Cardwell).
R1—25,000 ohms 10 watts.
R2—R4—100 ohms center tapped.
R3—50,000 ohms 10 watts.
R5—10,000 ohms 25 watts.
R6—10,000 ohms, tapped, 100 watts.
R.F.C. 1—Radio frequency choke coils (National receiving type).
R.F.C. 2—Radio frequency choke coil, transmitting type (National).

Data on Coils

160 METERS: L1, 70 turns No. 22 DSC wire wound close on 1½ inch receiving coil form; L2, 60 turns No. 22 DSC wound on 2 inch form; L5, 50 turns No. 22 DSC wound on 2 inch form; L6, 45 turns No. 14 wire wound on 3 inch form (Gross); L7, 15 turns No. 14 wire wound on three inch form (should be experimented with for best results) L3 and L4, three turns wound around enter of buffer plate tank and coupled to filament end of grid circuit of final amplifier.

80 METERS: L1, 30 turns No. 18 DSC wire wound close on 1½ inch form; L2, 35 turns No. 18 on 2 inch form; L5, 35 turns on 2 inch form; L6, 30 turns No. 14 on 2½ inch form; L7, 10 turns No. 14, 3 inch diameter; L3, L4, see text.

40 METERS: L1, 18 turns No. 18 DSC, 1½ inch diameter; L2, L5, 8 turns No. 14 close wound 2 inches in diameter; L6, 12 turns No. 14 wire spaced slightly more than the diameter of the wire; L7, same as 80 meters; L3 and L4, one turn.

20 METERS: L1, same as 40 meters, if 40 meter crystal is used; L2 and L5, 5 turns No. 14 spaced slightly on 2 inch form; L6, 7 turns 3/16 inch copper tubing two inches in diameter and spaced about 3/16 inch between turns. (Banana plugs are mounted in holes drilled through flattened ends; L3 and L4, one turn.

All coils for L1 are tapped one-quarter the total number of turns from the plate end of the coil. It will be found that the antenna coil, L7, may vary somewhat depending on the type of antenna, length of feeders, etc. For additional information of types of antenna and methods of coupling for the various bands, the reader is referred to the articles in last month's issue of Radio News.

Annual Hamfest and Convention

The Tenth Annual Hamfest of the Hudson Division A. R. R. L., dinner and dance and short-wave radio exhibit will be held this year in New York City, May 25. (See Roy Neira for the exact meeting place.)

The Lansdowne Hamfest

The Lansdowne Radio Association, one of the oldest Radio Clubs in the country, will hold its 16th Anniversary Hamfest on June 1st, at Lansdowne, Pa. Fernand Causse, W3ECI, an old-timer, is chairman of the committee in charge of the event. A number of door prizes ranging from valuable pieces of apparatus to vacuum tubes, including a year's subscription to RADIO NEWS, will be offered. It is expected that a large number of Eastern amateurs will attend the event. The Association's address is 16 North Wycombe Avenue, Lansdowne, Pa.

The Service Bench

(*Continued from page 763*)

other hand, it touches the frames (the individual pictures), the result will be a low-frequency "flutter." In some sound-heads the slit can be adjusted by moving the aperture plate horizontally, thus centering the slit in the sound-track. In other systems, the rollers, guiding the film, are shifted laterally, to center the sound-track over the aperture. The aperture slit should, of course, be at right angles to the length of the film (parallel with the lines on the frequency film). It is also desirable to check the rotational adjustment while focusing the optical system. The slit within the lens tube (which cannot be seen) must parallel the slit in the aperture plate. If the lens barrel is rotated slightly, so that the slit within the lens tube does not parallel that in the sound aperture, the pattern of the lines on the cardboard (the optical system being slightly out of focus, so that these lines exist) will be distorted as shown in Figure 3-E. The lens tube should be turned until the lines are of constant width and horizontal, and the focal adjustment then corrected as outlined above.

If the sound-head is badly out of adjustment, it may be necessary to check and recheck these settings several times. Dirt, oil and wax will collect in the aperture slit and on the front lens of the lens tube, making cleaning and inspection desirable every week or more often in cases of unsatisfactory reproduction. As soon as exciter lamps turn black on the inside, they should be replaced, as this is a warning that their usefulness will shortly be terminated, if left in the sockets, with an *embarrassing return to silent pictures!* Care should be observed to burn them at the rated voltage only. Excessive current will shorten their usefulness all out of proportion to the overload.

The "volume" output of both sound-heads should be equalized. This is usually effected by varying the polarizing voltages on the respective photocells. Adjustment should be made with two reels of the same picture in both projectors, as recordings differ in output levels. Change over the sound from one projector to the other, making the necessary adjustments until the volume from both projectors is the same.

Photoelectric cells should be replaced once a year. After about three months of service the effective response has usually dropped to around 25 percent of the original sensitivity. If used cells are stored in the dark, they can be employed in emergencies, as, when so kept, they have a tendency to recuperate.

Service calls on sound projectors are usually a matter of unsatisfactory operation, complete failure, or routine. Minor faults can usually be traced to weak P.E. tubes, poor optical alignment, dirty lens and aperture, or battery trouble in the case of a system depending on this source of power. A pipe-cleaner, dipped in Carbona or commercial carbon tetrachloride, will do a satisfactory cleaning job between the excited lamp and the photocell. Dirt in the gap of the dynamic speakers may cause low volume and distortion. In instances of total failure, the first check is to note whether the exciter lamp is burning and if the light is reaching the film. Again dirt or a burned-out lamp may be at fault. Upon eliminating the optical system as the source of trouble, the amplifier is the next suspect. If the monitor speaker operates, but the stage speakers are dead, the voice coils and field supplies are obviously in line for examination. If a phono pick-up is used for incidental music, it should be employed in an effort to establish the probable limits of the difficulty. Change P.E. cells—and test batteries if used. Different sound systems have different change-over devices, which should be checked carefully.

Most emergency service work can be avoided by periodical, routine and thorough examination about once every thirty-two shows. The entire system, from exciter lamp to speakers, should be checked and tested. Tube prongs and all switching devices, faders, etc., should be cleaned. The photocell socket, as well as the prongs, must be scrupulously clean. Batteries, especially on the photocell, should be replaced when a 45-volt unit drops to 35 volts.

THIS MONTH'S SERVICE SHOP

Just to substantiate our preaching in the May issue to the effect that the business end of servicing is as important as the technical angle, Roger J. Hertel, of Clay Center, Nebraska, sends us the accompanying photo shown in our heading this month and which shows his well-planned service shop. The shop equipment is standard and complete—even to the necessary power supply for 32-volt radios. The individual panels are cut from 3- by 9-foot sections of beaver-board, and can be removed individually by unscrewing the moldings. We haven't seen a neater layout—and the same goes for the official arrangement. A full set of manuals are in view—not to mention the adding machine, which we hope Mr. Hertel found it necessary to install as the profits began piling up.

Using Cathode Rays

(Continued from page 744)

A frequent error in the adjustment of a linear sweep is to set the sweep frequency at a rate greater than the frequency of the observed voltage. In this case the spot traverses horizontally before the observed cycle has completed, with the result that a multiple trace is seen. Pattern 7 illustrates the trace caused by sweeping at a 180 cycles while attempting to observe a 60 cycle voltage.

Therefore it must be born in mind that the number of cycles which will be viewed on the screen depends upon the ratio of the observed frequency to the sweep rate. This ratio must be an even multiple, and greater than one. Multiple traces occur while securing adjustment, but they are not useable.

The above notes should make clear the function of the apparatus and the actual circuit connections for test so that the resulting patterns may now be considered.

In most measurements, the voltage applied to the horizontal deflecting plates is known as the sweep voltage. In the previous paragraph the action of the linear or saw-tooth sweep has been described. In some measurements, a sinusoidal voltage is applied to the horizontal plates as was done in the construction of Patterns 8 to 12 and as will be done in some of the subsequent patterns. When this is done the sweep voltage is referred to as a harmonic or sinusoidal sweep.

It should be noted that in many measurements the use of the harmonic or linear sweep yield the same information if the pattern can be properly interpreted. In many cases, however, the linear sweep yields patterns which are more easily interpreted, though in other types of measurements there is little choice in the selection of the proper type of sweep voltage.

An important application of this equipment is in observation of the performance of public address amplifiers and speech amplifiers for use with radiophone transmitters.

In examining performances of the amplifier, it will be convenient to use for input potential to the amplifier, a variable frequency audio oscillator, although, much may be learned by the use of 60-cycle line voltage to drive the amplifier. A simple potentiometer will serve to reduce the voltage of the source to the proper level for the amplifier. The cathode-ray tube is connected to the high end of the potentiometer thereby securing sufficient voltage for good horizontal deflection when the linear sweep is not used.

Public address amplifiers should have a resistor connected across the output transformer secondary, of the same value as the normal load. In this way the input voltage to the amplifier can be increased to a point where distortion is apparent as observed in the cathode-ray tube and the voltage or current in the output resistor measured, from which the true undistorted output can be calculated.

Speech amplifiers used to modulate Class C stages, should likewise be connected to their modulated stage, or to an equivalent resistance.

With these circuit arrangements made, it is possible to secure oscillograph patterns and to determine the significance of the various forms.

At low values of input and output with the Circuit B, it will be possible to observe undistorted waves such as Pattern 5 or 6. The actual number of cycles observed will depend on the ratio of the sweep frequency to the test frequency, as previously mentioned. Should the pattern appear as a form not readily recognizable as a sine wave, it may assist to alter its proportions by adjustment of the horizontal or vertical amplitude controls on the oscilloscope until the pattern has suitable relationship of length to width to allow easy interpretation. This same adjustment will be found helpful in studying nearly all patterns.

When the harmonic sweep is used, having the same frequency as the signal, the undistorted condition for the amplifier will be one of those shown in Patterns 8 to 12 inc. If the input and the output of the amplifier are exactly in phase, the straight line of Pattern 8 will result. Varying degrees of phase relationship will produce the succeeding patterns.

It will be recalled that in a perfect amplifier, the phase of the signal voltage reverses or alters by 180 degrees with each stage of amplification. In the average amplifier this condition is altered by the presence of coupling transformers or condenser reactances, so that this condition does not actually exist. Were this not the case, Patterns 8 or 12 would indicate the undistorted condition dependent upon the number of stages embodied in the amplifier. Phase relationships in an amplifier for public address or speech amplification in a transmitter, are not the most important consideration.

The important thing is to be able to recognize the Patterns 8 to 12 inclusive, as being one and the same thing as far as wave distortion is concerned, but having different phase displacements as a secondary consideration.

Crystal Filters

(Continued from page 735)

$$C_h = \frac{40.2\ w\lambda 10^{-14}}{t} \text{ farads} \qquad (3)$$

Figure 5 shows impedance curves, (A) being that for the crystal alone. The point f_c, where the curve crosses the abscissa, is the resonant frequency of the crystal. Incidentally, a single crystal is incapable, when used as a band-pass filter, of passing a band width greater than about .7 percent of the mean band frequency—1225 cycles at 175 kc!

But putting a small inductance in series with the crystal, the point of resonance is moved down to f_s and a new point of resonance is established at f_o—curve (B). The crystal alone exhibits an anti-resonance at f_k, and by adding an inductance in parallel to the crystal, additional anti-resonance points are established at f_s and f_o—curve (C). This latter condition also shows an intermediate resonance at f_c, the point of resonance for the crystal alone. The fundamental crystal resonance f_c and the anti-resonance f_k can be found in terms of the crystal dimensions in centimeters:

$$f_c = \frac{10^6}{3.68\ \lambda} \qquad (4)$$

$$f_k = 1.0035\ f_c \qquad (5)$$

A consideration of the above remarks concerning the curves of Figure 5 will indicate a possible method of attack for the problem of broad-band filters. From the curves it can be seen that inductance in series with the crystal has the effect of lowering the point of resonance of the crystal and introducing a new point of resonance somewhat higher. An inductance in parallel with the crystal maintains the original point of resonance and establishes anti-resonances corresponding to the points of resonance of the crystal and inductance in series. If the inductance is varied, the upper point f_o is shifted without appreciably changing the position of f_s. By adding capacity in parallel with C_h, the inverse effect obtains, i.e., the upper point of resonance is moved closer to f_c without changing f_s.

The proper design of filter networks, however, involves more than a simple combination of a crystal with a series or shunt inductance and capacity. As in all filter design, terminating impedances are of great importance, and must be considered, along with lattice type networks. The references previously cited (1 and 2), may be consulted profitably for excellent discussions of the lattice network and its derivation from the more familiar ladder type.

Most radio men are familiar with the networks used as filters in power supply units. These take the form of what the telephone engineer calls a T or a Π network; to the power engineer the T and Π are, respectively, the star and delta circuits. These networks are illustrated in Fig. 6. Examination of this diagram will show the existence of a certain relationship between the elements of each of the two networks. The equivalence between the T network of Fig. 6 (A) and the Π network, Fig. 6 (B), is shown by the expressions appearing on the latter figure. In structures like these the series and shunt impedances can be determined from a knowledge of the open-circuit and the short-circuit impedances of the network measured from either end.

In order that there shall be no loss occasioned by a mismatch of impedance at the junction of these networks and other portions of a circuit, it is necessary that the network be terminated in such a way that at either junction the impedances in both directions are identical. This is equivalent to stating that the image impedance at either end is the geometrical mean of the open and the short circuit impedances of the network as measured from that end. If there is an impedance miss-match there will be a loss, known as the reflection loss, which, in decibels, is given by:

$$20 \log_{10} \frac{Z_s + Z_r}{\sqrt{4 Z_s Z_r}} \qquad (6)$$

in which Zs, the impedance of the source, is not equal to Zr, the impedance of the receiving circuit.

These T and Π networks are the simplest forms of filter structures. In actual filters, of course, the impedances indicated in the diagram are made up of various series or shunt combinations of coils and condensers; and, obviously, these coils and condensers add a certain amount of resistance to the filter circuit.

The effect of putting a coil or a condenser in series with or in shunt to a crystal was pointed out earlier. A consideration of these remarks and of the curves which accompanied them will show that by selecting the proper value of coil or condenser the points of resonance and anti-resonance of the crystal can be shifted about at will.

Consider, then, a T section made up of crystals and condensers. The physical structure might assume the form shown in Figure 7(A); the electrical equivalent will be that of Figure 7(B). This structure, or any other of the ladder type comprising crystals and condensers alone, has certain very definite limitations; these are such that only three types of filters are possible. While these three types are band pass filters, the maximum band width which can be passed is only about the same as for a single crystal filter such as is used for sharply tuned i.f. systems in cw receivers. As was mentioned in the preceding article, this is about 0.7 per cent of the mean band frequency.

These restrictions, i.e., type of section and band width, can be eliminated by use of the lattice type filter section. This network in its general form, and its equivalence to the previously discussed ladder type networks are shown in Figure 8. It might be of interest to point out here that t[he] lattice network of Figure 9 is the only netw[ork] which will pass with no attenuation all frequencies from zero to infinity; as is quite obvious, the only change throughout this entire frequency range (0-8) is a phase shift of 180 degrees. This is evident when one considers that for d.c. (zero frequency) the path is 1-2-3-4-5-6; while for infinite frequency (where the coils are assumed to be of infinitely high impedance) the path is 1-5-4-3-2-6.

To the lattice type network can be applied a theorem which is of the utmost importance in filter design, namely, the bi-section theorem of A. C. Bartlett, discussed in the Philosophical Magazine (London) volume 4, number 24, November 1927. This theorem provides a means for concentrating all of the resistance in the elements of a filter circuit in the terminal resistances of the filter network. Between sections of the filter the resistances can be combined with others to make a constant resistance attenuator of the same impedance as the filter section. In the case of the resistance inherent in a coil in the series arm of the filter, this can be added to the terminal resistance by putting a shunt resistance between the sections; for a coil in the lattice (shunt) branch it is done by placing an appropriate series resistance between the sections. When it is remembered that resistance in the coils of the ordinary filter adds a loss which varies with frequency, and hence destroys the sharpness of cut-off of the filter, the advantage of removing the coil resistance from the calculation at once becomes obvious. The only effect which the resistance has, under these new conditions, is that of adding a certain amount of attenuation, which does not vary with frequency, to the filter. This principle is illustrated in Figure 10, in which the equivalence of the networks is shown; C and D of the figure being the inherent resistance of coils which are assumed to be a part of the A and B branch impedances.

Metal Tubes

(Continued from page 729)

the corresponding glass-envelope tubes. This pin is connected to the shield and the corresponding socket contact should be grounded.

The metal envelope is a more efficient radiator of heat than glass. The construction of the tube has been greatly simplified, due to the elimination of the "stem." The leads come up through the bottom end-plate and make shorter, sturdier supports possible. This helps to minimize microphonism and reduces the internal capacity. In fact, the tubes will oscillate at higher frequencies than their corresponding glass-envelope types.

The construction of the tube is simpler and different from the method now employed. The shell is made of iron 1/50 inch thick. The construction is started with the bottom end plate; it looks somewhat like the cover of a salt shaker. In order to bring the leads through this plate, small eyelets of a special alloy are welded into the holes. This alloy, "Fernico," consisting of iron, nickel and cobalt, has the same expansion coefficient as glass; it was developed especially for the metal tube. A small glass bead with a wire passing through it is fused into the eyelet. The entire cylinder (forming the tube) is welded into the end-plate by a very heavy electric current, around 20,000 amperes, flowing only 1/20 of a second. This time is sufficient to weld the tube all around. A thyratron controls the timing in this process. After pumping, the tubes are sealed electrically.

In order to "clean up" the tube, the usual high-frequency inductor coil cannot be used because of the metal shell. Instead, the tube is simply heated to red heat by means of a gas flame.

Metal tubes have been on the market in Europe for some time. The "Catkin" tube, made in England, is of a different construction; its envelope constitutes the anode and is therefore at high potential. A second shield is then necessary to safeguard against shocks or shorts. These new American tubes are constructed differently and are considered a great improvement; the outside shell is the shield and is at ground potential. No further tube shield is required; moreover, the shielding is much more efficient, due to closer spacing between the shield and the elements.

The tubes, the first standard American all-metal tubes, are not yet available on the market. They will make their first appearance in the new all-wave line of General Electric sets. They are not interchangeable with present glass tubes, due to the different construction of the socket. The ten types now planned for production all have 6.3-volt filaments.

Following are the tentative characteristics of six types of these metal tubes as supplied by RCA manufacturing company who will manufacture the tubes for the General Electric company and others. These six types are the 6A8, pentagrid converter; the 6C5, a detector amplifier triode; the 6D5, a power amplifier triode; the 6H6, a twin diode; the 6J7, triple-grid detector amplifier; and the 6K7, a variable-mu, triple-grid amplifier.

6A8

Heater voltage (a.c. or d.c.)	6.3 volts
Heater current	0.3 ampere
Plate voltage	250 max. volts
Screen voltage (G3 and G5)	100 max. volts
Anode-grid voltage (G2)	200 max. volts
Control-grid voltage (G4)	-3 min. volts
Total cathode current	14 max. ma.
Maximum overall length	3⅛ in.
Maximum diameter	1⅜ in.
Base	small 8-Pin

6C5

Heater voltage (a.c. or d.c.)	6.3 volts
Heater current	0.3 ampere
Plate voltage	250 max. volts
Grid voltage	-8 volts
Plate current	8 ma.
Plate resistance	10,000 ohms
Amplification factor	20
Mutual conductance	2,000 micromhos
Maximum over all length	2⅝ in.
Maximum diameter	1⅜ in.
Base	small 6-Pin

6D5

Heater voltage (a.c. or d.c.)	6.3 volts
Heater current	0.7 ampere
Maximum over all length	3¼ in.
Maximum diameter	1⅜ in.
Base	small 6-Pin

As Single-Tube Class A Amplifier

Plate voltage	275 max. volts
Grid voltage	-40 volts
Plate current	31 ma.
Plate resistance	2,250 volts
Amplification factor	4.7
Mutual conductance	2,100 micromhos
Load resistance	7,200 ohms
Undistorted power output	1.4 watts

As Push-Pull Class AB Amplifier (Two Tubes)

Plate voltage	300 max. volts
Grid voltage (fixed bias)	-50 volts
Plate current (per tube)	23 ma.
Load resistance (Plate to plate)	5,300 ohms
Power output	5 watts

6H6

Heater voltage	6.3 volts
Heater current	0.3 ampere
Voltage per plate, a.c.(RMS)	100 max. volts
Output current, d.c.	2 max. ma.
Maximum overall length	1⅝ in.
Maximum diameter	1⅜ in.
Base	small 7-Pin

6J7

Heater voltage	6.3 volts
Heater current	0.3 ampere
Plate voltage	250 max. volts
Screen voltage (G2)	100 volts 125 max.
Grid voltage (G1)	-3 volts
Suppressor (G3)	Connected to cathode at socket
Plate current	2 ma.
Screen current	0.5 ma.
Plate resistance	Greater than 1.5 megohms
Amplification factor	Greater than 1,500
Mutual conductance	1,225 micromhos
Maximum overall length	3⅛ in.
Maximum diameter	1⅜ in.
Base	small 7-Pin

6K7

Heater voltage (a.c. or d.c.)	6.3 volts
Heater current	0.3 ampere
Plate voltage	250 max. volts
Screen voltage	100 volts 125 max.
Grid voltage	-3 volts
Suppressor	Connected to cathode at socket
Plate current	7.0 ma.
Screen current	1.7 ma.
Plate resistance	0.8 megohm
Amplification factor	1,160
Mutual conductance	1,450 micromhos
Grid voltage (for Gm. = 10 micromhos)	-35 volts
Grid voltage (for Gm. = 2 micromhos)	-42.5 volts
Maximum overall length	3⅛ in.
Maximum diameter	1⅜ in.
Base	small 7-Pin

Testing a S.W. Converter

(*Continued from page 753*)

listing given herewith shows the stations tuned in during this period, omitting many of the more common ones.

Kc.	Meters	Call	Location
15370	19.5	HAS3	Budapest, Hungary
15140	19.8	GSF	Daventry, England
15123	19	HVJ	Vatican City, Rome
15040	19.9+	RKI	Moscow, U.S.S.R.
13340	22.4+	YVQ	Maracaibo, Venez..
13200	22.7	VPD	Suva, Fiji Islands
12396	24.2	CTIGO	Paredo, Portugal
12000	24.9	RW59	Moscow, U.S.S.R.
11720	25.6	CJRX	Winnipeg, Canada
11720	25.6	YV5RMO	Maracaibo, Venez.
11710	25.6	HJ4ABA	Medellin, Colombia
10330	29.0	ORK	Ruysselede, Belgium
9600	31.2	CT1AA	Lisbon, Portugal
9590	31.2+	VK2ME	Sydney, Australia
9580	31.3	VK3LR	Lyndhurst, Victoria, Aus.
9570	31.3	W1XK	Springfield, Massachusetts
9565	31.3+	VUB	Bombay, India
9510	31.5	VK3ME	Melbourne, Australia
9428	31.7+	COH	Havana, Cuba
7072	42.2	VP6YB	Barbados, B. W. I.
6900	43.4+	HI3C	La Romana, D. R.
6750	44.5+	JVT	Nazaki, Japan
6447	46.5+	HJ1ABB	Barranquilla, Col.
6375	47.0	YV4RC	Caracas, Venez.
6275	47.8	HJ3ABF	Bogota, Colombia
6160	48.7+	CJRO	Winnipeg, Manitoba
6150	48.7+	YV3RC	Caracas, Venezuela
6130	48.9+	ZGE	Kuala Lumpur, F. M. S.
6120	49	PKYDA2	Bandoeng, Java
6112	49.0+	YV2RC	Caracas, Venez.
6110	49.0+	GSL	Daventry, England
6100	49.1+	HJ4ABL	Manizales, Col.
6085	49.2+	I2RO	Rome, Italy
6072	49.3+	OER2	Vienna, Austria
6042	49.6+	HJ1ABG	Barranquilla, Col.
6030	49.7+	HP5B	Panama City, Pan.
6030	49.7+	VE9CA	Calgary, Alberta
6030	49.7+	YV6RV	Valencia, Venezuela
6012	49.8	HJ3ABH	Bogota, Colombia
6000	49.9+	RW59	Moscow, U.S.S.R.
5984	50.1	TGX	Guatemala City
5860	50.6+	HJ4ABE	Medellin, Colombia
5850	51.2+	YV5RMO	Maracaibo, Venez.

A study of this list shows that the converter and this medium sensitive receiver provided all that could be desired in the way of short-wave sensitivity. While extensive tests were not made with the less sensitive t.r.f. receivers listed above, it is probable that they would have brought in practically all of the stations shown in the accompanying list. Certainly the Atwater Kent provided more sensitivity than could be used and the Scott and Motorola receivers would, of course, have done likewise.

All-Purpose Tester

(*Continued from page 739*)

have a desirable characteristic of indicating R.M.S. values, whereas sensitive d.c. instruments indicate average values which are lower than R.M.S. values by the ratio of 1:1.11. This characteristic suggests that some means must be provided for correcting the sensitivity of the meter between the a.c. and d.c. values, to take care of this ratio between R.M.S. and average values. It might be well to state here that the ratio 1:1.11 may be modified by the electrical characteristics of the rectifier unit, or of other circuit elements. This correction is effected by means of a series capacitor and parallel capacitors, which have the effect of reducing the total impedance of the circuits for measuring a.c. values, so that more current is permitted to pass through the meter movement than is the case when using the tester for d.c. measurements.

A "current density" characteristic manifests itself in the form of an increase in rectifier resistance with a decrease in electrical load and must be taken into consideration in designing a universal tester, thus accounting for the departure from a linear scale in the usual rectifier instrument. The effect of the current density is reduced, however, by the usual multiplier resistors as used in the rectifier type a.c. voltmeters. A table has been compiled (Table I) to show the current and corresponding resistance values. Let us suppose, for example, that we want to use an instrument rectifier, which has the tabulated characteristics, in a 5-volt circuit, with a meter which requires a current load of 1 milliampere for full-scale deflection. Since we must increase the current by the ratio of 1:1.11, as explained above, we must decrease the multiplier resistance by the same ratio; that is, we must divide 5000 ohms (1000 ohms per volt) by 1:1.11, which leaves us a multiplier resistance value of 4500 ohms, 500 ohms of which is included in the rectifier, as indicated in Table I. At a half-scale meter deflection the rectifier resistance will increase about 260 ohms (from 500 to 760 ohms), so that the total circuit resistance will increase from 4500 to 4760 ohms. This is an overall increase of 5.8% as contrasted with an increase of 52% in the rectifier resistance. This illustrates the minimizing effects of multiplier resistors on the rectifier errors, but an error of 5.8% is too much for the 5-volt range, and some means must necessarily be devised for reducing this error.

In the design of the a.c. potential-measuring functions of the Model 385, it was found advantageous to minimize the "current density" characteristic of the instrument rectifier by using a series capacitor (C1, Figure 3) for the low range as a multiplier reactor, instead of using a multiplier resistor. This arrangement constitutes an impedance circuit wherein the capacitive reactance is about 90 degrees out of phase with the meter and rectifier resistance. The adjustment of the 5-volt a.c. range of each tester is accomplished by adjusting the capacity C1 until the meter needle deflects to the full-scale position with an applied 5-volt a.c. potential. The resultant impedance is 3890 ohms as represented by the triangle of Figure 4, in which the resistance value is 500 ohms for the rectifier and 300 ohms for the meter, or a total of 800 ohms. Now, if the resistance is increased by 260 ohms, as described above, the impedance is increased by only 50 ohms, from 3890 to 3940 ohms; this value representing the square root of the sum of the squares of 1060 and 3800. An increase of 50 ohms in 3890 ohms is only 1.3% when a capacitive multiplier is used as contrasted to an increase of 5.8% when a resistive multiplier is used. Thus the readings are made to conform very closely to uniform scale distribution for practically all measuring requirements. The multiplier capacitor also serves to isolate a.c. from d.c. measuring functions; in other words, the meter will not register a.c. potentials when the switch is in d.c. position and vice versa. The capacitors which parallel the multiplier resistors serve to calibrate the 25-volt and higher a.c. ranges by by-passing enough current to conform to the form factor ratio of about 1:1.11.

The power transformer which is utilized in this tester provides the potentials indicated in Figure 5 to accommodate the different values of unknown electrostatic and electrolytic capacitive values, thereby constituting the capacity-measuring functions of this tester. A tapped resistor is used for the dual purpose of a shunt and series resistor with respect to the rectifier and meter. A fuse in the primary circuits is an effective safety element against possible shorted capacitors. One side of the a.c. potential is applied to one of the a.c. input terminals of the rectifier and to one side of R1, while the other side of the a.c. potential (approx. 9.5 volts) is connected directly to the "Mfds. Common" pin-jack terminal.

The analyzer cable circuit of the Model 385, as indicated in Figure 6, are especially interesting because of their association with the new 8-pin socket for the new metal vacuum tubes (*described elsewhere in this issue.—The Editors*). While there have been many rumors of the advent of such tubes, there has been no definite announcement, until the present time, of the actual terminal and socket details, so that the design engineers of testing equipment could incorporate facilities for the accommodation of 8-pin tubes. This is probably the first tester to be announced for complete tests of all 8-pin tubes and circuits.

It is interesting to observe the clever scheme which has been developed by the manufacturer of these new tubes, whereby one socket can be used for the accommodation of 4-pin, 5-pin, 6-pin, 7-pin and 8-pin metal tubes. This is accomplished by equally dividing the 360-degree pin circle by 8, making the angular separation of the pins exactly 45 degrees or multiples of 45 degrees. With this arrangement, a 7-pin "metal tube" will fit into the 8-contact socket, leaving one contact blank; a 6-pin "metal tube" will fit into the same socket, leaving two blank spaces, and so on down to the minimum number of pins.

This design feature of the new metal tubes will greatly simplify the use of testing equipment, and all of the advantages of this new socket design are incorporated in the tester described here, for "free reference point" analyzing.

Each of the analyzing circuits is provided with a circuit-breaking twin jack which keeps the circuit closed until two pin plugs are inserted. The use of such jacks eliminates the necessity for using push-button switches to open the circuits for current measurements, thereby enabling automatic current measurements. The terminal arrangement enables the connection of other elements, such as "pick-up" devices, microphones, headphones or grid leaks, for numerous special tests.

The flexibility of the open switchboard arrangement of the circuit terminals is illustrated in the elimination of the use of troublesome adapters for output measurements, as it is only necessary to connect the desirable a.c. voltmeter range across the plate and cathode circuits, with the analyzing plug inserted in the power output stage of a radio while the tube is placed in the proper analyzer socket. The capacitor C1 (in Figure 3) effectively blocks the d.c. plate potential so that the meter registers only the a.c. component of the output signal.

By the use of a .5 mfd. (or larger) capacitor, which is installed in the analyzer between "top cap" and cathode circuits, a by-passing effect is provided to prevent the setting up of an oscillatory condition in sensitive circuits. A careful study of Figure 6 indicates that the cable conductors, pin-jack terminals and switches are designated according to the new simplified pin numbering system and that, when the analyzing plug is inserted in a radio socket, the circuits of that socket are extended to the analyzer panel for any measurement desired, so that it is unnecessary to remove or dismantle a radio chassis in order to gain access to the circuits for point-to-point tests, as is necessary with the usual multi-purpose meter.

Power Output

(*Continued from page 740*)

characteristics for the tube under consideration. Once the three curves are obtained, find the operating point on the $E_g = E_c$ curve. This is the point, on this curve, where E_p and I_o intersect. Call this point "q."

From the discussion in Part I, we know that the next step is to find the load line. We know, furthermore, that the load line will pass through q. There are an infinite number of lines answering this requirement, so we must find a method of eliminating all except the one whose slope gives the optimum load resistance.

Following Figure 2, we can set down certain general conditions for this line. It will be a straight line, passing through q and sloping to the right. We can assume that if it is extended to the left of q, it will cut the $E_g = 0$ curve at some point which we will call x. We can also assume that as it is extended to the right of q, it will cut the $E_g = 2E_c$ curve at some point which we will call y. These points, x and y, correspond to I_{max} and I_{min}, respectively. The slope of this line determines the value of the load resistance. We must find the slope that will give a load resistance for maximum power output and not more than 5% second harmonic distortion. One possible way would be by following a "cut-and-try" method, but this is very tedious. A further analysis of the requirements will help simplify the process. The total length of the load line will be xy. It can be shown that for 5% distortion, $\frac{xq}{qy} = \frac{11}{9}$.

It remains, therefore, for us to find a straight line, xqy, such that $xq = 1.22$ qy.

The best practical way to do this is to make a "power output rule" or "distortion rule." Such a device consists essentially of a double-scaled ruler with a zero near the center. Both scales are marked off in arbitrary units from 1 to 10. The units on the left scale are 1.22 as large as the units on the right. If such a rule is not available, you can make one following the outline in Figure 3.

To use the rule, place the zero point on q. Then rotate the rule in a horizontal plane until a position is found such that the distance xq and qy reads the same on each scale. (Be sure to have the *longer* scale to the *left* of q.) When such a position is found, draw the line xqy. This is the load line for 5% distortion.

To find the value of R_L, extend the load line to the point where it cuts the current and voltage axes. Divide the voltage on the zero current axis by the current on the zero voltage axis. This gives R_L. It should be noted that this is the a.c. value of R_L. If R_L is a pure resistance, the a.c. and d.c. values are the same. If R_L is the primary of an an output transformer, the value of R_L, obtained from the above method, is the impedance the transformer should have over the frequency range concerned.

In practice there is one condition which slightly limits the universal use of the method outlined above. The value of E_p chosen should not exceed the recommended maximum plate dissipation of the tube. If the value of I_o chosen indicates that the plate is being overheated, this value should be arbitrarily lowered to a safe value by increasing the grid bias. The R.C.A. engineers point out the fact that such a readjustment of the grid bias will be found necessary for the 45 and 2A3 type triodes when used above 180 volts.

The Oscillator

(*Continued from page 741*)

good reading is obtained on the output meter. (In the case of automatic volume control receivers, the lowest signal possible should be used, so that the operator will be sure he is working below the a.v.c. level.) Then, using an insulated screwdriver, the trimmer condenser on the detector stage section of the variable condenser is adjusted for a maximum reading on the output meter.

The trimmer on the preceding condenser section is then adjusted in the same manner. This procedure should be carried out step-by-step back to the first radio-frequency tube with constantly increasing output indications. If the output meter goes off scale, the oscillator attenuator should be adjusted to lower this reading. The receiver volume control should be kept at a maximum to obtain the most accurate results. After adjusting all the trimmers, it is wise to go back and again readjust each trimmer for exact resonance.

The receiver dial should next be rotated to approximately the 1000 kilocycle position and the oscillator tuning control again adjusted until a maximum reading is indicated by a peak deflection on the output meter. Using a piece of fibre rod or similar device, the sections of the slotted end plates that are in mesh with the stationary plates on the detector gang section of the tuning condenser should be bent in or out and the deflection on the output meter noted. These slotted sections are provided for alignment adjustment at intermediate points on the broadcast band and should be adjusted for maximum output at this point. This procedure should then be repeated on each of the gang sections, working back to the first radio-frequency tube.

This same procedure should be repeated at approximately the 600-kilocycle setting on the dial, this time bending the additional slotted sections of the end plates that have moved into mesh due to the rotation of the receiver dial. Again the trimmer condensers should be left untouched, as they have little effect at this point. When this procedure is followed with reasonable care, using insulated tools to eliminate body capacity, the set should be well aligned and ready for service.

Many receivers of the tuned-radio-frequency type also have neutralizing adjustments. These adjustments have an important bearing on the operation of the receiver, and should in all cases be made *after* the trimming of the condenser gang. To neutralize the receiver, the antenna and ground terminals of the radio set should be connected respectively to the high output and ground posts of the oscillator. The output meter should be connected as before and both the oscillator approximately 1000 kilocycles.

The first radio-frequency tube should then be removed and either a dummy tube (one with the filament burned out) should be placed in the socket, or, if the receiver is an old one having bayonet type sockets, a slip of paper wrapped around one of the filament prongs of the particular tube used in this socket so that it will not heat up when replaced. With the oscillator and receiver controls at maximum settings, a signal should be indicated on the output meter, but of course it will be a low value, due to this particular tube not functioning. The neutralizing trimmer associated with this tube is then adjusted to show a zero or minimum signal on the output meter. This adjustment will be most critical with the set full on.

When the first tube has been put in working condition again, the same procedure should be carried out with the second radio-frequency tube.

O. J. MORELOCK, JR.,
Radio Engineering Division,
Weston Electrical Instrument Corp.

S.W. Reception

(*Continued from page* 745)

There has also been in the past a great room for improvement in coil-changing devices and although the past few months have seen some great strides on perfecting this purely mechanical device, some of them still seem to have a tendency to eventually become noisy, or inoperative. For real DX, many of the dyed-in-the-wool DX'ers and amateurs still prefer plug-in coils, which give really satisfactory service, but at the best are a nuisance when it is desired to make a rapid change from one wave-band to another. Eventually we will see perfected coil-changing devices generally adopted which will at one time make all plug-in coils obsolete.

Most all-wave receivers now employ some kind of a device for locating the exact peak of an incoming signal. This sometimes takes the form of a neon shadow which moves as the dial crosses an incoming signal. Others appeal to the ear instead of the eye and are in the form of beat oscillators which produce a whistle which becomes low pitched or vanishes entirely as the exact peak or point of resonance is found. This is a big help in locating new stations but it also has its disadvantage and it is often difficult to distinguish a weak signal above the noise level of the set. Many of the visual indicators are all right in principle but are not sufficiently sensitive to operate on a weak station where you need them most. There are exceptions to all of these statements but I am writing critically or where I think improvements will be made. The all-wave set of the future will, therefore, automatically tune an incoming signal to the exact peak desired. Two or three years ago it was said that no all-wave receiver could be calibrated over the entire range of frequencies with any degree of satisfaction. What should have been said was that it "Had not been done—Yet," because at the present time several receivers really show a good degree of calibration over the entire spectrum which is adequate for ordinary use. However, not far in the future we shall see all-wave receivers that will possess such a degree of exact calibration *that any known frequency will be located almost instantly with a very small percentage of error!* Easy location of important short-wave stations on a receiver will do much towards making for a universal popularity for the high frequencies.

Very definite progress has been made in the way that short-wave signals are received under fair conditions. Short-wave reception in the past was a difficult proposition at best and never really enjoyable for entertainment purposes. Now short-wave programmes can be really enjoyable all the way through, with good tone quality, little fading and almost perfect understandability. In the future foreign reception will be almost as reliable as local reception and only limited by such especially adverse weather conditions that no signals can be received at all.

A Tri-Band Set

(*Continued from page* 731)

it will be necessary to cut the lead between the grid resistor of the first audio stage and the ground, and insert a 1½, 3 or 4½ volt bias on the 19 tube.

Switch S2, when closed makes a potentiometer out of the regeneration control. When the switch is open, the control becomes a series variable resistance. The set will work both ways but one method may give slightly better results than the other. When turning off the receiver, this switch should be opened so as not to place a drain on the B-batteries.

The receiver described above is not intended to be used with a doublet antenna system. The resistor "T" pad in the antenna circuit is designed especially for the elimination of "dead-spots" and body capacity effects and is effective only when used with the grounded antenna. The doublet type can be used, however, if a suitable method of coupling is utilized. An "H" pad, or better still a coupling coil, will do this effectively.

The author would be interested in hearing (in care of RADIO NEWS) from readers who build the little receiver and to learn of the results obtained with it.

List of Parts

C1—Hammarlund Midline Midget variable condenser, 80 mmfd.
C2—Sangamo fixed condenser, 100 mmfd.
C3—Sangamo fixed condenser, 2000 mmfd.
C4—Small adjustable condenser, neutralizing type
C5—Bypass condenser, 1 mfd. paper type
C6, C8—Cartridge condensers, .01 mfd. 400 V. type
C7—Sangamo fixed condenser, 250 mmfd.
L1, L2—Grid and tickler coils. (See Figure 2)
R1, R2—Fixed resistors, 300 ohms
R3—400 or 500 ohms
R4—3 megohms
R5, R9—75,000 ohms
R6, R10—1 megohm
R7—15 ohm rheostat
R8—Potentiometer, insulated shaft type, 100,000 ohms. (If potentiometer has switch attached the p.p. switch illustrated is not required)
SW1—3 point inductance switch (see Figure 2)
SW2—s.p.s.t. switch (see R8 above)

One 6-prong Eby isolantite socket and one 5-prong wafer type bakelite socket.

One piece sheet aluminum, size 6 by 10½ inches (for panel)

One piece sheet aluminum, size 7 by 14 inches (for chassis)

One piece 1-inch bakelite tubing, 2¾ inches long

Dial, tubes, knobs, batteries, necessary hardware, etc.

V. D. Calculations

(*Continued from page 738*)

but an easier method is at once obvious. We draw a vertical line through P, giving us point S, and connect S with U, then TR = VW. The proof is as follows: $\frac{VW}{UO_1} = \frac{PW}{PO_1} = \frac{SR}{SO_1} = \frac{TR}{UO_1}$. The first and last expressions show that VW = TR. Therefore, if we make the line TR equal 5 milliamperes, or simply draw a horizontal line through 5 milliamperes, intersecting the line US in the point T, the abscissa $O_1R = 56$ volts of point T will give us the voltage across R_1 and across the load; $O_2R = 144$ volts the voltage across R_2, $WR = 7$ milliamperes the current in R_1 and $VR = 12$ milliamperes, the current in R_2; every question is, therefore, answered.

We had chosen 5 milliamperes as an example, but it is obvious that the construction holds true for any value of load current, so that the line US can justly be called "load characteristic" of the voltage divider R_1R_2. As a further example, the diagram shows that for a load current of 10 milliamperes, for instance, the voltage across R_1 or the "load voltage" would be 32 volts, the current through $R_1 = 4$ milliamperes, the voltage across $R_2 = 168$ volts and the current through $R_2 = 14$ milliamperes.

If the line US is extended downward, it crosses the vertical through O_2 in the point Z. It is then $O_2Z = O_2Q$, because

$$\frac{O_2Z}{PS} = \frac{UZ}{US} = \frac{O_1O_2}{O_1S} = \frac{QO_2}{PS}$$

The "load characteristic" of a voltage divider R_1R_2 is therefore very simple to find: make O_1U equal the current that resistor R_2 would pass if connected alone across the supply voltage; in a similar manner, O_2Z, the current that R_1 would pass under the same condition; then UZ represents the "load characteristic," giving all corresponding load voltages and currents. If besides the load characteristic the individual currents through R_1 and R_2 are of interest, the two lines for R_1 and R_2 must be drawn, and in that case it is recommended to find the point S rather by projection of intersection point P than by drawing O_2Z downward. With the first-mentioned construction, better use can be made of the available amount of cross-section paper, thus increasing the accuracy.

The advantage of this solution of the voltage-divider problem is its extreme flexibility, combined with the fact that it shows the influence of all factors at once. We had started out to find the load characteristic of a given pair of resistors, but we can now reverse the problem. From the construction it is apparent that to every load characteristic belongs a certain pair of resistors.

Let it be required, for instance, to find a voltage divider across 250 volts to supply the screen voltage to three a.v.c. controlled 58 type tubes and that it has been established that the combined screen currents fluctuate between 3 and 9 milliamperes. With 3 milliamperes the screen (or load) voltage should not exceed 100 volts, and with 9 milliamperes it has been found permissible that the voltage drops to 85 volts. The two points, namely, 100 volts, 3 milliamperes and 85 volts, 9 milliamperes establish our desired load characteristic. (See Figure 4.) This gives us points U and S; we connect now point U with the 250-volt point on the voltage scale, this line representing the resistance R_2; this resistance must be such as to pass 43 milliamperes ($= O_1U$) at 250 volts $= 250/.043 = 5820$ ohms. To find resistance R_1 we could extend US downward, but since we like to know the individual currents, we establish point P by going perpendicularly up from S until it intersects the line UO_2. Now draw the line O_1P, which intersects the vertical through O_2 at 57 milliamperes; R_1 is therefore $250/.057 = 4390$ ohms. By drawing verticals through the original points of the load characteristic, we see that with a 3-milliampere load the currents through R_2 and R_1 will be 25.8 and 22.8 milliamperes respectively, with the desired voltage of 100 volts across R_1; at 9 milliamperes load current and 85 volts, the currents through R_2 and R_1 will be 28.4 and 19.4 milliamperes respectively. 28.4 milliamperes will also be the maximum current drawn by the divider.

The construction can, of course, also be used if the maximum current that can be spared for the voltage divider is given and it is desired to find the voltage regulation. This simply means that the line for R_2 and one point on the load characteristic is given. This establishes point S and therefore P and R_1.

On ¾ Meter

(*Continued from page 733*)

plates. The stator was then cut in two with a pair of shears leaving an eighth inch gap between the two stator plates. Each was connected with a very short pig-tail lead to its corresponding socket lug, the rotor being left free, as in 1(D). Although, at first appearance, this method seemed satisfactory, the tuning range was not linear and it was found that, over a part of the range, the frequency *increased* instead of decreasing! The condenser was then moved to the tube end of the socket lugs, as in 1(E) which seemed to cure the trouble. It must be noted that the length of the lugs is a large part of the oscillating circuit.

Figure 2 shows the circuit of the complete receiver. The r.f. circuit is of the same dimensions as the transmitter. It is necessary to use less antenna coupling, however, or the super-regenerative action will cease. The transceiver to be described in a later issue makes use of an antenna switch so that optimum coupling is possible in both transmit and receive positions.

Because the power outputs are so small and because it is very convenient at this frequency, directional antenna systems are resorted to in order to raise the field strength in a given direction. Power step-ups of the order of 100 times are theoretically possible, the simple arrangement of Figure 3 of the Yagi type effecting a gain of possibly ten times. The elements are made of No. 12 hard drawn copper wire or, better, brass rods. They are press-fit into a thin piece of hard wood impregnated with wax for outside use. The "Y" type impedance match is used between the transmission line and the antenna although other types of match are equally good. It is extremely important to have the antenna exactly resonant to take full advantage of the directional effect. A sensitive r.f. milliammeter (100 ma. will do) made resonant by attaching the proper lengths of wires to its posts (5 to 5½ inches for a 3-inch meter) serves to check on the antenna output and will read when held near the antenna or directors. Violent overmodulation with i.c.w. (for it must be steady) will increase the output many hundred percent for measurement and checking purposes. Watch the plate current carefully during the overload period, which should be of short duration.

A directional antenna at the receiver is equally effective and should be used. It may be made identical to the transmitting

INDEX OF ADVERTISERS

antenna. Note photograph of the antenna on roof of car.

No story is complete without mention of results obtained. Arrangements are being made for some experiments from New York office buildings which we hope to tell about later. The weather has prevented any elaborate tests to date. However, a series of test runs were made by the author with the receiver in a car and an automatic key controlling the transmitter on the roof of the "shack." These signals were audible 3½ miles. Voice was heard at about 2 miles. The transmitting antenna was 30 to 35 feet above the ground, the transmission taking place at Bellmore, L. I., in a residential district. House to house transmission should result in quite an increase in range over these house to car tests because of the greater elevation of the receiving antenna thus made possible.

*Amateur Station W2BRB.

A Tube Checker

(Continued from page 743)

never start by turning the drill forward. Run it backward a few revolutions first and then forward, using light pressure until the drill is well started. After the holes are drilled, counter sink them to double their diameter at the panel face. This makes the most easily entered socket known. The countersinks act like funnels. Trim the sockets to the same round pattern and drill out their exact centers for mounting. As a final step put a thin coat of vaseline on the prongs of a tube and insert in the sockets to lubricate them. Do this every time the sockets get so dry the tubes push and pull a little hard. Put a ¼-inch washer under the nut of the mounting screw to give additional bearing to the bakelite wafer. Those who try to use the discarded top of the bakelite wafer as a drilling template needn't be surprised if the holes are out of position. Obey the above instructions unless a top of panel socket is used. (In which latter case the automatic switch described will be unworkable.)

Direct-Coupled Amplifier

(Continued from page 736)

was made with the value of R1 changed to 100,000 ohms and no self-bias. R2 was 4500 ohms. In Curve E, R2 was changed to 3500 ohms, leaving R1 100,000 and employing no self-bias. This is the steepest curve (highest amplification) obtained with this outfit.

Curve F was obtained by employing self-bias in combination with the values of R1 and R2 as in Curve E.

The amplifier seems very well adapted to its purpose, that of a photocell amplifier controlling a magnet, and should prove useful in other applications, where relays have to be tripped, etc.

War of Words

(Continued from page 725)

Short-Wave Time-Table. Thanks to your monthly tips and lists, I have been able to listen to stations in the United States, France, Germany, Spain, England, Argentina, Brazil, Italy, Japan, Indo-China, Holland, Colombia, Ecuador, Costa Rica, Panama, Guatemala, Cuba, Morocco, Canada, Hawaii, Australia, China proper, Java, Sumatra, Belgium, Philippine Islands, Norway, Switzerland, Venezuela, Africa (Nairobi, Kenya), Peru, Malaya (Singapore), U. S. S. R., (Moscow), Mexico". We have been receiving thousands of such letters from enthusiastic readers, written in this same vein, and we know that our new readers can get the same kind of results.

So, if you would "keep up" on Europe, listen-in on your short-wave set and follow diverging continental national views and policies and form your own opinions, without having to rely on rewritten news items that are bound to be re-interpreted if not censored.

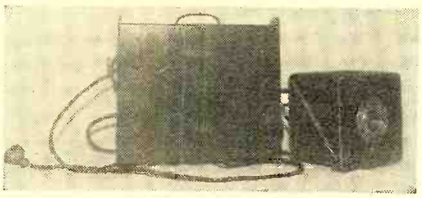
A.C. Pre-Amplifier

(Continued from page 737)

may, of course, use longer or shorter cable as circumstances may require. It is well to bear in mind that the leads carrying the filament current should be not smaller than No. 18 wire and where the cable length exceeds 25 feet, should be preferably No. 16, or better still No. 14 wire. To facilitate quick connections, it is desirable to equip this cord with a 5-prong plug and to mount a corresponding 5-prong socket on the case of the power supply unit. Some may prefer, however, to equip the cord with plugs at both ends and mount a corresponding socket on each unit.

The electrical output of this pre-amplifier unit is sufficiently high to eliminate the need for an output tube to line transformer on cable runs up to 200 feet providing ordinary shielded antenna wire or its equivalent is used. The writer's experience indicates that this equipment will operate nicely, with a single stage power amplifier consisting of two type -47 tubes in push-pull.

Referring to the photographs a good idea of the assembly details will be obtained.



COMPLETE A.C. OPERATED CONDENSER MIKE EQUIPMENT

The two tube pre-amplifier is shown removed from its case. The upright frame provides convenient means for mounting the 7½ volt C battery. In another view the complete equipment is shown with the covers removed. In this view parts for the power supply are, from left to right, at the top, a double filter choke and the audio transformer employed as the third choke. At the right are the 'phone jack (for the output cable) and the power cable socket. Along the bottom of the box, at the extreme left, is the voltage divider, to the right of which appears the power transformer, the type -80 rectifier tube and the four section, 32 mfd. electrolytic filter condenser. Although an output transformer (tube to line type) is not necessary under ordinary conditions, the writer has included one in the pre-amplifier shown in the photographs, for use where the output cable is excessively long. This transformer is mounted directly behind the type -56 tube and may be seen in the photograph of the pre-amplifier assembly.

A FAIR DEAL TO ALL . .

RAYTHEON'S New Price Plan effective April 1st, 1935 is built upon this keystone: "A Fair Deal to All"—consumer, dealer, service man and jobber. Its need was never more acute—a sixty-five million dollar replacement tube market slashed during the last five years to twenty-four million dollars—reduced prices and profits—loss of public confidence.

THE AVERAGE list price per tube on January 1st, 1930 was $2.63; the average price per tube on April 1st, 1935 was $.80 and no increase in consumer sales. An $.89 price will sell no more tubes than a $1.00 price.

RADIO TUBES are service items, not ordinary shelf or counter merchandise; tubes must be tested and installed; purchasers require information and advice, service questions arise; and for all this work the trade must be fairly compensated.

RAYTHEON'S new selling plan was built after weighing these factors; it incorporates the answer the trade is seeking and includes the only tube distinctly different in design—4-Pillar Construction—unexcelled quality, consumer acceptance and competitive trade prices—not price-slashing lures, but profit-building list prices. All 4-Pillar Tubes bear the Raytheon name; the story is easy to tell—the 4-Pillars are plainly visible to the consumer. Reputable dealers and service men everywhere recommend, endorse and sell them.

Ask your Jobber for complete details of Raytheon's plan, or use the coupon.

RAYTHEON PRODUCTION CORPORATION

30 East 42nd Street, New York
55 Chapel Street, Newton, Mass.
445 Lake Shore Drive, Chicago
555 Howard Street, San Francisco

RAYTHEON PRODUCTION CORPORATION,
Dept. D-6, 30 E. 42nd Street, New York:
Please send ☐ Details New Price Plan ☐ Display Material
*NAME*__________
*ADDRESS*__________
*CITY*__________

FOUR PILLAR RAYTHEON RADIO TUBES

1543

Now!

MALLORY

REPLACEMENT VIBRATORS

are available for Every Auto Radio

and...*Get This!*...at no greater cost than ordinary vibrators

Mallory Vibrators are the standard. Over half the automotive radio sets in operation are equipped with Vibrators made by Mallory. Mallory has led the way to better and more efficient auto radio performance—Mallory continues to pioneer each new development.

Now Mallory has Replacement Vibrators available for every set in every make and model.

As the vibrator is the unit in the auto radio set that naturally is subject to the most wear, vibrator service becomes increasingly important. Just as Mallory equipped auto radio sets give the finest performance, so Mallory Replacement Vibrators will give the greatest satisfaction.

Use Mallory Vibrators. Order from your jobber today.

MALLORY
PARTS TO PERFECT THE WHOLE
in RADIO, AUTOMOTIVE AND ELECTRICAL, INDUSTRIAL FIELD
© P. R. M. CO.

Every Radio Service Man should be a member of the Institute of Radio Service Men

P. R. MALLORY & CO., Inc.
INDIANAPOLIS INDIANA