RADIO'S *Complete* MAGAZINE

RADIO & TELEVISION

ELECTRICAL EXPERIMENTS Department

EASY SET BUILDING Department

RADIO CONSTRUCTION Department

MARCH OF RADIO Department

AMATEUR RADIO Department

RADIO HOOK-UPS Department

RADIO PATENTS Department

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RADIO KINKS Department

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HUGO GERNSBACK EDITOR

AMATEUR & EXPERIMENTAL RADIO AUG.

CONSTRUCTIVE RADIO ARTICLES 1940

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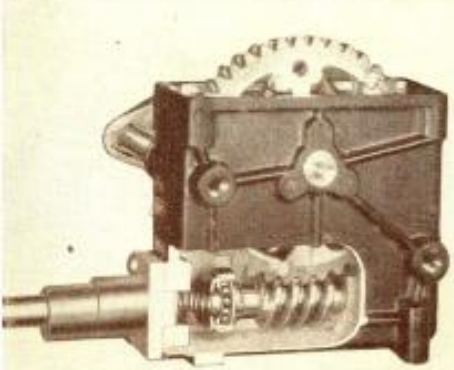

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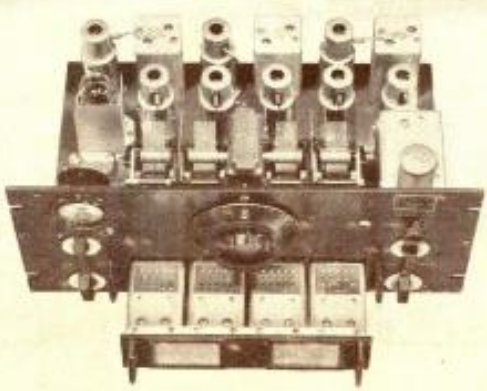

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RADIO & TELEVISION

The Popular Radio Magazine

August — 1940
Vol. XI No. 4

HUGO GERNSBACK, Editor
H. WINFIELD SECOR, Manag. Editor
ROBERT EICHBERG, Television and Digest Editor

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A Beginner's Transmitter, Part 2—by Herman Yellin
250 Watt CW-Phone All-band Xmitter by C. T. Kolz, Jr., W2BKZ
A High Quality Short Wave Converter—by Chas. R. Leutz
Volt-Ohm-Milliammeter — by Johnny Wilcox, W2CLS
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What Do YOU Think?

Our Circuits Reliable

Editor,

Here's my shack photo where I've been working for a "ticket" and your handsome VAC award. The equipment, preselectors, power supplies and receivers (except the Howard #430), and other equipment not pictured were all built from 100% reliable "R.&T." circuits.

I have been a subscriber for several years, and I find my R.&T. shelf a priceless "reference library." My favorites are: The Short Wave League and "What Do YOU Think". As to the question about the commercial phones I think it's a FB idea. Congrats to your most complete hobby mag. and 73 (best regards).

EARL TOOLE,
512 E. Locust St.,
Boonville, Indiana.

Hi! YL's 3000 Miles Distant!

Editor,

Wanted. A YL correspondent, age 18 to 20, interested in "Ham" Radio, living no closer than 3000 miles! Foreign YL must speak and write English. Will talk *Radio* and also swap stamps!

FRANK C. GUEST,
Cedarville, N. J.

LIKES OUR CIRCUITS

Editor,

RADIO & TELEVISION gives many good circuits and I learn a lot from each issue. I think that this part of the magazine is getting better. I also get help from the "Question Box" and "Radio Kinks".

A few years ago you had a contest for SWL's, in which you awarded a trophy for the most SWBC stations heard in a certain part of the world during a specified period. Why not start another contest of a similar nature, or a picture contest for SWL's similar to the one which is now being conducted for hams?

About QSL's from hams. It's been my experience that the W2's and W3's are the hardest to get QSL's from. I've sent many reports to them but have received no cards. The South American hams QSL but some of them are quite slow. Usually the DX hams will QSL if good reports are sent. I have quite a few countries verified and as soon as I get another card from Africa I will have VAC 3 times. I have your FB certificate. I have 18 states verified. I sent more reports to foreign countries than to hams in the states.

HARTVIG ROHALT,
Waverly, Minn.

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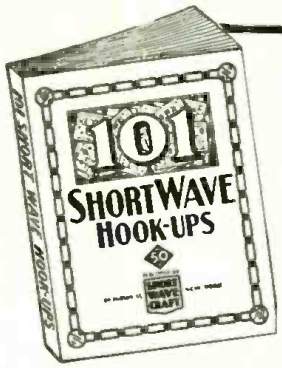
. . . . THESE OUTSTANDING SHORT WAVE BOOKS ARE *Now Available* AT YOUR DEALER!

YOU *buy* parts, tubes, kits, accessories from your local radio dealer—that's what countless thousands of short-wave fans do. Now through a nation-wide distribution service our numerous books are available at your favorite radio dealer—right where you buy other radio equipment. It's more convenient, saves time and you can inspect the books before you buy. *Ask your dealer to show you all the books advertised on this page—they're always in stock.*



101 SHORT WAVE HOOK-UPS

Compiled by the Editors of RADIO & TELEVISION

Here is a worthwhile book that every short wave listener, every short wave fan, and every short wave amateur has wanted for a long time. It gives you the 101 best short wave hook-ups which have appeared heretofore.

100 Illustrations
72 Pages

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HOW TO BUILD AND OPERATE SHORT WAVE RECEIVERS

This is the best and most up-to-date book on the subject. It is edited and prepared by the editors of RADIO & TELEVISION and contains a wealth of material on the building and operation, not only of typical short wave receivers, but short wave converters as well.

150 Illustrations
72 Pages

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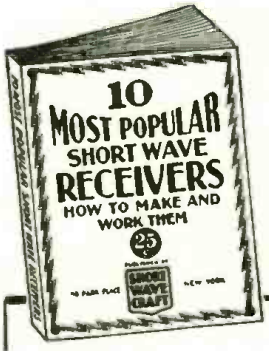

TEN MOST POPULAR SHORT WAVE RECEIVERS

HOW TO MAKE AND WORK THEM

The editors of RADIO & TELEVISION have selected ten outstanding short wave receivers and these are described in the new volume. Each receiver is fully illustrated with a complete layout, pictorial representation, photographs of the set complete, hook-up and all worthwhile specifications.

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HOW TO GET BEST SHORT WAVE RECEPTION

M. HARVEY GERNSBACK tells you everything you have ever wanted to know about short wave reception.

The author, a professional radio listener and radio fan for many years, gives you his long experience in radio reception and all that goes with it.

40 Illustrations
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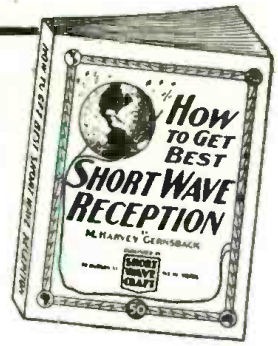

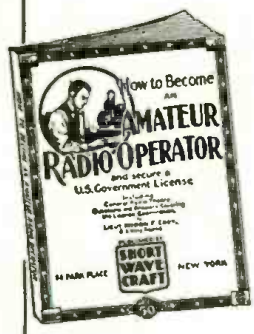

HOW TO BECOME AN AMATEUR RADIO OPERATOR

By Lieut. Myron F. Eddy, whose experience in the amateur field has made him pre-eminent in this line.

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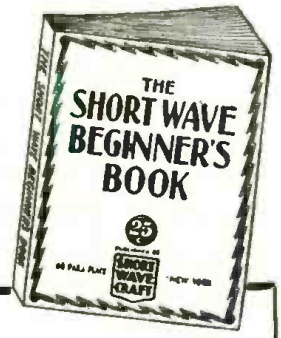

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Editorial

Radio Amateurs, Arise!

By HUGO GERNSBACK, Editor

AS America begins its huge rearmament, it is well to remember that frequently history repeats itself. In the present status of the country all signs point to the conclusion that as far as the radio amateur is concerned, history will repeat itself with certainty.

For the record and for those who were not in the last World War let us give a brief historical record of what happened in 1917, the year when the United States entered the World War. It is true that at that time radio broadcasting had not as yet arrived. It was still five years in the future. Radio amateurs, however, had been on the scene ever since 1908. Indeed, in 1917 there were already no less than 7000 radio amateurs licensed in the U.S. The instrumentalities which the amateurs were using in those days were quite different and the vacuum tube was still almost unknown as far as amateurs were concerned. Rotary spark gaps with transformers were used for transmission. We were still using mostly crystal and electrolytic detectors, etc. Yet in a general sense the radio amateur in 1917 carried on in much the same way as the radio amateur of 1940. He transmitted and received messages not only from the U.S. but frequently from abroad as well, although this was not the general thing. An amateur had to have exceptional equipment to talk with Europe in those days, but even then there were many excellent long distance records.

President Woodrow Wilson in an executive order dated April 6, 1917 closed all radio stations throughout the United States, excepting those used by the government itself. At one stroke all of the American amateurs ceased operating and they could neither transmit nor receive radio signals. This condition prevailed for the entire period of the war, until the end of 1918 when the ban was lifted.

We are rapidly approaching the time when a parallel condition will probably prevail again. Indeed, the Federal Communications Commission has already issued its first order to amateurs, to wit: That beginning August 15th all radio amateurs must cease to communicate with other amateurs *outside of the U.S.* This is the first step. With the advent of broadcasting as we now have it, it is doubtful that citizens and amateurs alike will be compelled to stop listening on radio reception. Even in totalitarian Germany and Italy, citizens are allowed to *listen in*, but they are not allowed to listen to *foreign* broadcasts. It is most doubtful whether the U.S. will take such a view and even should war come it appears reasonable to suppose that amateurs will still be permitted to listen in.

With the advent of war in 1917 every amateur understood that the closing of his station was a necessary act for the safety of the country, and there was no dissenting voice about the restriction as far as is known. Indeed, the amateurs arose nobly to the occasion and did what they could to help win the war.

At that time the writer, who had organized the *Radio League of America*, used this League to recruit American amateurs to serve their country in many ways. Amateurs by the thousand joined the Army and the Navy in their communication branches.

The writer published many messages, letters and telegrams from Army and Navy officials who asked the writer as manager of the *Radio League of America* to supply the authorities with the names of all available radio amateurs. These requests were published in *The Electrical Experimenter* throughout 1917 and 1918.

Later, the writer caused to be published the *Radio Roll of Honor* and his magazine *The Electrical Experimenter* printed the names of all radio amateurs who volunteered their services to the U.S. Government.

As a result many thousands of radio amateurs enlisted in the various branches of the government where their talents were used with maximum effect.

Now in 1940, when America is again endangered, as perhaps it has never been before, I am certain that the more than 55,000 radio amateurs will rise to the occasion and do their duty. In 1940 we need not 55,000 radio amateurs but **several hundred thousand!** In the proper defense of our country when a vast mechanization is of paramount importance, communication—and particularly *radio-communication*—is of the very greatest importance.

Whether you are in the communication department of the U.S. Navy, or in the Signal Corps of the Army, if you are in the Air Corps either above or on the ground, *you must know radio!* Now then, radio amateurs have this knowledge and are several jumps ahead of other untrained men who neither know the code, nor know how to take care of radio instrumentalities. The ordinary soldier who volunteers or who is drafted by the government, frequently knows nothing about radio. The radio amateur on the other hand is already trained technically and is, therefore, first in line for the more important commissions. In times such as these radio technicians are in great demand and will be called upon to do their duty when the appointed time comes.

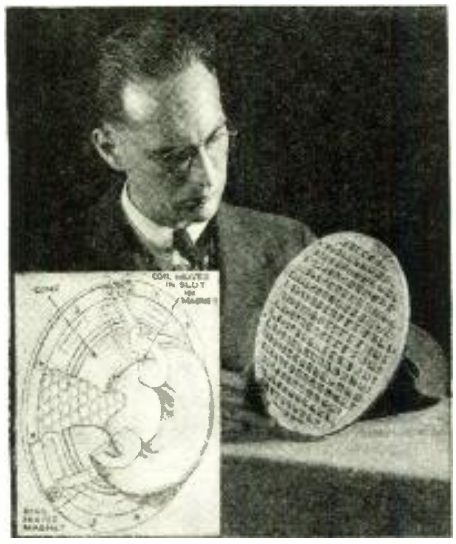
But there are, also several hundred thousand embryo radio amateurs who have as yet not become licensed and of whom the F.C.C. knows nothing because they have not made any application for a license. The 55,000 licensed amateurs are far too few for the work that is to be done in the defense of our country. For this reason it is necessary that all those qualified who have not made application for a radio amateur license as yet should lose no time in doing so.

Therefore if you are qualified to become a radio amateur—if you know how to build and operate radio instruments—you should immediately make application for a license. You should also know that a radio amateur, due to his special technical knowledge, is usually entitled to a different classification than the ordinary private. While the radio man in the Signal Corps of the Army, or in aviation does not hold any soft jobs his work usually carries great responsibility and he frequently is in a position for more rapid advancement than the non-technical man.

I again urge all those who have the necessary qualifications to communicate immediately with their Supervisor of Radio in the Inspection District where they live. This list is found on page 256 of this issue.

IMPROVED LOUD SPEAKER

Relatively flat frequency reproduction from 60 to 11,000 cycles is obtained with a newly developed Western Electric loud speaker. This unit is of the direct radiator type, using no horn. The diaphragm is so



The new loud speaker—and a diagram showing its construction.

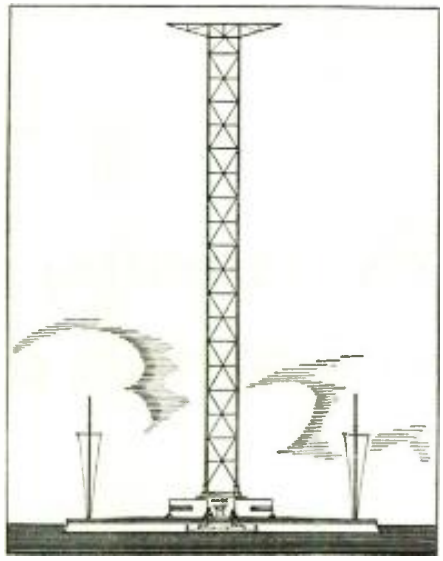
designed that it moves as a complete unit for lower frequencies, but not all parts move in unison when higher frequencies are reproduced. A formed metal diaphragm, 8" in diameter, is actuated by a 4" voice coil moving in the field of the permanent magnet. Best reproduction is had within an angle of 30 degrees in front of the speaker.

DAVID SARNOFF HONORED

In recognition of the services which Mr. David Sarnoff, president of RCA, has rendered in the advancement of the science and industry of radio, from which France, as well as other nations of the world, has benefited, the President of the French Republic has conferred upon him the high decoration of Officer of the Legion of Honor, elevating him from the rank of Chevalier which he has held since 1935.

NEW CBS KEY IN N.Y.C.

A *new* 50 kw. transmitter for WABC, the New York key of CBS, is, the F.C.C. willing, to be erected on filled in ground off Little Pea Island in Long Island Sound near New Rochelle, N. Y. According to plans the antenna will be a self-supporting structure 350 feet high and 25 feet wide with its base in the building, which is to be 75 feet square. On top of the antenna will be an airplane beacon and the steel structure itself will also act as a guide to radio direction-finders on vessels navigating Long



Island Sound. Little Pea Island, which is now merely a few rocks, will be enlarged to 200 feet square.

DU MONT TELEVISION PROGRESSES

Will Baltin, since 1932 radio and motion picture editor of daily and Sunday papers in the city of New Brunswick, N. J., has been appointed program director of television station W2XWV, now under construction in New York City by the Allen B Du Mont Labs. Baltin has written television scripts and has a number of features ready for production.

LET'S READ THEIR MAIL!

More oddities from the F.C.C.'s mail bag:

A letter from Waterloo, Iowa, asks the Commission to order the discontinuance of war dramas on the radio. A New Yorker wants the Commission to impose restrictions on the amount of broadcast advertising talk. A Portsmouth, Va., woman would confine Sunday broadcasts to programs "appropriate to the Sabbath."

Under the law, the Commission is without authority in such matters, being expressly denied the power of censorship over program material. On the other hand, the Commission advises an Ellet, Ohio, resident that there is no provision in the Communications Act or the Commission's own rules and regulations to prohibit a church-sponsored program from soliciting gifts and contributions from the listening public.

A Philadelphia taxicab concern is under investigation for using radio to dispatch its fleet without having proper authority to do so. An Illinois undertaker is getting a *going-over* for having an ambulance follow up police calls to accidents for the purpose of soliciting business. A chap in Beverly, Mass., is told that his plan to organize and sell a radio program service over amateur stations is contrary to law.

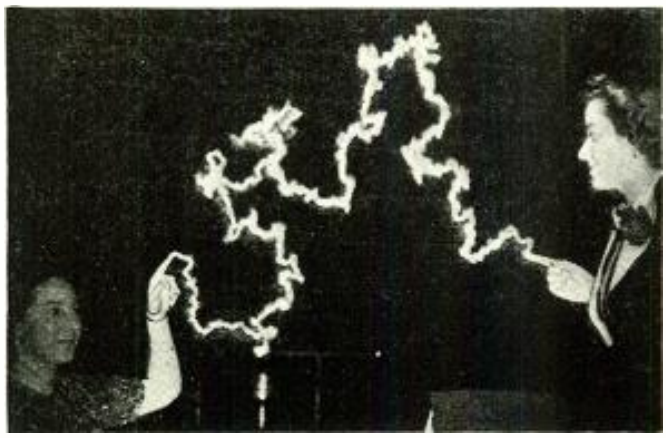
For instructions on a thrilling electrical experiment, see Page 232.

BRITAIN INCREASES SHORT WAVE SERVICE

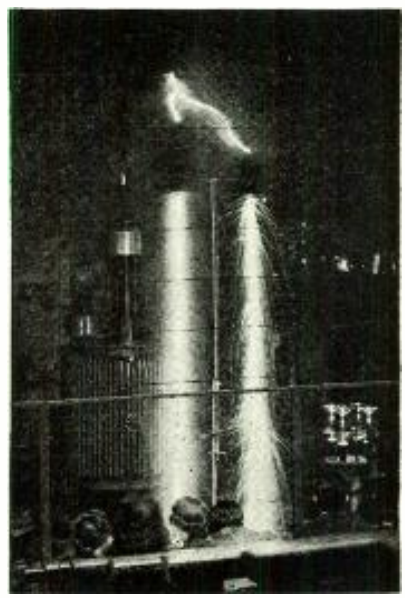
With her shores threatened by Nazi invaders Britain has increased rather than curtailed her broadcasting activities. Her leading speakers are being featured on a 24 hour broadcast schedule in 22 languages, and much of the material is aimed directly at the U.S. and Canada. The new schedule has added 30 minute periods at 12 noon, 5:45 and 8:30 p.m. and 12 midnight with news summaries at 9:15 a.m. and 4:50 and 10:45 p.m. Transmissions take place on the 16, 19, 25 and 31 meter bands.

Sensational Electric Displays at N. Y. World's Fair

A *striking* new demonstration in *Steinmetz Hall* at the General Electric Exhibit in the New York World's Fair holds audiences spellbound, as bolts of artificial lightning shatter strips of fine wire into brilliant showers of white hot metal. This startling performance is illustrated herewith. Also shown is a fake photograph in which two girls appear to hold the leaping flames of a 1,000,000 volt arc at their fingertips. This voltage at the current and frequency used would kill them instantly. But if you haven't seen these gigantic sparks, by all means do so!



At left is a composite picture showing how man-made lightning would look if it were produced by the electric personalities of two charming girls. At right is an electric fountain made by putting high current through fine wire.



Connecticut State Police Adopt F.M. System for Cars

F.M. police equipment installed in luggage compartment of radio car.

The Connecticut state police department, always progressive, has adopted *frequency modulation* for the first time in police history. The system being installed is under the direction of Prof. Daniel E. Noble of the University of Connecticut, a pioneer in F.M. In this work, which is expected to be complete by September of this year, with 250 2-way mobile units in operation, Prof. Noble has been assisted by Police Radio Supervisor Sydney E. Warner and Officer E. A. Shieler.

For the first time in state police work, the high frequency band between 30,000 kc. and 40,000 kc. is being used for complete coverage. Connecticut is divided into ten barracks areas, each of which will have its own 250 watt transmitter operating on 39,500 kc. Each of these stations will be remotely controlled from the barracks and thus each patrol area can handle its own local traffic. By the use of a receiver tuned to this same frequency located at each receiving point, it is also possible for barracks to communicate with each other as well as with the mobile units. Local traffic can be handled by each individual station and routine state-wide traffic coordinated through the teletype system. Emergency contacts will be made through the use of barracks-to-barracks contact, such use being taken advantage of in holdups, blockades, riots and similar disturbances.

Through the use of *phase modulation* the tests have shown that the average transmission distance for two-way service has been approximately *doubled*, when compared with existing *amplitude* modulation installations.

Engineering tests have shown that two-way service for distances of 25 miles are readily obtained, and greater distances can be secured through the choice of transmitting locations by mobile units. In this connection contacts have easily been made up to 50 miles.

In using this new system of operation, it has been possible to obtain an output of 30 watts from the car transmitter, the battery drain being about 25 amperes. This compares with approximately the same drain in the amplitude modulation case giving only 15 watts output.

To the uninitiated in this mode of transmission, it would appear that the operation of all stations in the same frequency would cause severe interference. Here again frequency modulation has made such an installation possible, because in this type of transmission *the stronger of the two signals predominates!* Thus if two stations go on the air simultaneously, the mobile unit will hear the *stronger* of the two, *to the exclusion of the weaker signal.* Due to the shielding of hills, this might represent an interference problem in some cases, but this may be eliminated by the dispatch routine being such that transmitters in adjacent barracks areas will not operate simultaneously. It is possible, however, to have two transmitters on the air not in an adjacent territory and the mobile unit in the home territory will only hear its own transmitter. Were it not for such a *signal discrimination* due to the frequency modulation adaptation, the interference problems would be magnified many times.

Cost is slightly higher than existing amplitude installations. However, the operating costs are considerably reduced because of the remote control operation of the ultra-high frequency stations, thus eliminating transmitter attendants. Also,

(Photos courtesy F. M. Link.)

At top police F.M. transmitter; below it, the corresponding receiver.

the tube complements, transmitter parts, etc., are all of small size and therefore do not represent a costly maintenance problem.

PUBLISH FACSIMILE NEWSPAPER

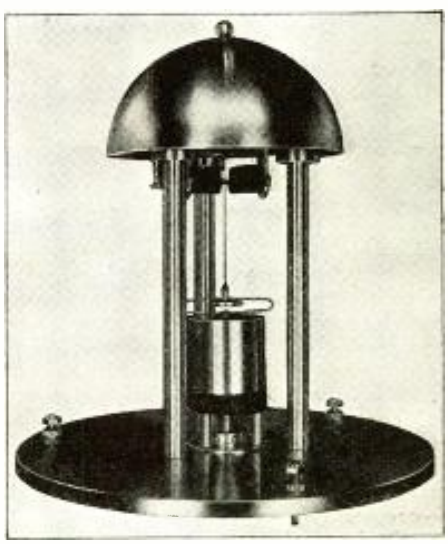
A *feature* of the RCA exhibit at the New York World's Fair is a facsimile transmitter which sends an 8½" x 12" newspaper to receivers located nearby. The New

A facsimile paper being received. Inset at top, the transmitter.

York *Evening Post* has assigned two rewrite men, a compositor, and a special makeup man to putting together the paper. Proofs are pulled at the newspaper plant and rushed by special messenger to the exhibit at the Fair. According to the newspaper's general manager the demonstration "gives the public a glimpse into the future, when newspapers may be printed in the home by radio." The time required to transmit a single sheet is 10 minutes.

Vibrating Wire Clock Is Super-Accurate

The most accurate clock in the world is, of course, the earth, and the pendulum clock has long run it a close second. Thirty years ago a vibrating quartz crystal clock was made which was also highly accurate. Now a new clock invented by H. E. Warren makes use of two connected metal wires which have opposite temperature co-efficients of elasticity. Vacuum (radio type) tubes regulating electrical and mechanical means of controlling the rate of vibration of this wire keep it within extremely precise limits. So accurate is this new clock that it is being used to control an astronomical telescope on Mt. Palomar, keeping the optical device always aimed precisely at the object being observed regardless of the earth's rotation. As the apparatus need measure only about 16" high it is well adapted for use in ordinary electric clocks, although it is so new that no such application has been made as yet.



Measuring Nervousness with the Integrating Neurovoltmeter

Nervousness as well as muscular tenseness (including what is popularly called the "jitters") have for the first time in history been measured accurately in the Laboratory for Clinical Physiology, Chicago. This was first announced by Dr. Edmund Jacobson in December, 1939, at Columbus at the meeting of the American Association for the Advancement of Science. The apparatus has gone through three stages of development of which the latest and perfected form is the Integrating Neurovoltmeter.

Very fine platinum wires, less than one half inch long, are inserted without discomfort in the muscle or nerve the activity of which is to be measured. The circuit includes a complicated switchboard and a transformer coupled amplifier, the output terminals of which are connected with the input terminals of the Integrating Neurovoltmeter.

At left: A scientist seated at the controls of the integrating neurovoltmeter measures his patient's nervousness. Below: A patient with electrodes inserted in the eye muscles.

Whenever a muscle or nerve is active, as is well known, that activity manifests itself in electrical discharges at low frequencies per second. Dr. Jacobson has shown that during complete relaxation in a muscle or in a nerve, such discharges are absent altogether. In nervousness and muscular tenseness, such as is shown in every day life, the potential differences present in the wires (called electrodes) inserted in the tissues often are less than one millionth of a volt. For this reason amplification is required. In the Integrating Neurovoltmeter the alternating currents are rectified and accumulated on a condenser. By pressing a button at regular intervals such as a minute, the operator discharges this condenser periodically and reads the magnitude of deflection on a wall-type fluxmeter. After proper corrections and standardizations have been made, a graph is made showing the extent of nervousness or of muscular activity during a period of measurement such as an hour.

Radio in the World War

When the Nazi bombers made their big raid on Paris, the French high command was not asleep. Technicians were waiting with recording equipment to make a permanent record of the sound of planes and the whistle of falling bombs. These records were later played over the short wave station *Paris Mondial* so that the world could see what France was up against. While this did not bring down any German planes it was good propaganda to arouse sympathy for the French.

Great Britain looks forward to developments in radio as the result of the war. The editors of *"T & R Bulletin"* believe that improvements in aerial and feeder design will be made and that short lengths of concentric pipe line may be substituted for coils. It is believed that vibrators, portable amateur equipment and tubes for ultra high frequency work will be improved as will quartz crystals. Circuit improvements are anticipated in cathode modulation and F.M.

The Germans, always masters of propaganda, have announced that their amateur stations are continuing to be permitted to communicate throughout the world. However, a keen analyst will note that a limited number of licenses have been issued. Although but ten stations have been announced at press time, it was reported that other licenses were to come. Propaganda experts in the U.S.A. see this as an indication that only staunch Nazis are being licensed, and that the German government is keeping a strong hand on amateur activities. A British publication reporting this state of affairs, comments that its observers have heard 25 German amateurs active on either 7 or 14 mc.

The accompanying illustration of a published notice shows at least one way in which British amateurs carry on their activities, while their stations are *off the air*, and they themselves are engaged in war service.

R.A.F. MEETING

A cordial invitation is extended to all members and friends located in the neighbourhood to attend a

MEETING

on

Sunday, May 19th, 1940

At The Queen's Head, Kirkby Laythorpe, near Sleaford. Meet 2.30 p.m. Tea 4.30 p.m.

Tickets and full details from Mr. N. Davies, Hon. Secretary, R.A.F. Amateur Radio Society, No. 1 E. & W. School.

F-M IN BLITZKRIEG

A *report* in the New York *Herald-Tribune* states that *frequency modulation* radio communication systems are being used by the German tanks which are scouring Europe. The use of F-M for service of this kind is particularly advantageous, in that it is so relatively free from the effects of electrical disturbances caused by the ignition systems of modern mechanized armies. There are also strong rumors that various other countries—including the U. S.—are working with F-M control for their mechanized units.

OPTIMISTIC ESTIMATE

Thos. F. Joyce, vice-president of the RCA Mfg. Co., predicts that within a year after the F.C.C. permits television stations to present commercial programs (to be paid for by sponsored products) there will be more than 25,000 television receivers sold in the New York area alone. Mr. Joyce reported that 6 television licenses had already been granted to the approximately 30 stations in 18 cities throughout the United States which have filed application. He believes that if the others are granted, 8 to 10,000,000 families (25% of our entire population) will be in television's service area. He believes that one million sets can be sold within 5 years.

(Note: At press time, 23 stations had received "tentative" television licenses.—Ed.)

For further notes on Television's progress, see Page 235.

STEREOPHONIC SOUND

In ordinary talking motion pictures, no matter where a character stands in the scene, his voice comes from a behind-the-screen horn which is in a fixed position. A far more natural effect is secured when the voice apparently comes directly from the actor, irrespective of his position on the screen. A system of this sort, known as *stereophonic* sound when demonstrated in New York several years ago, was put into commercial practice at the great Texas fair of 1938 and was again demonstrated in Carnegie Hall late this spring. This new demonstration not only gave the sound its *third dimension*, but also added volume expansion to give it complete naturalness. The volume on certain passages was extended to 100 decibels, just 20 db. below the point at which sound intensity becomes unbearable to the human ear.

FOREIGN CONTACTS BANNED

● *EFFECTIVE June 5th the Federal Communications Commission issued orders prohibiting licensed U.S. amateurs from maintaining contacts with any other amateurs outside of continental U.S. and its possessions. There is no regulation against listening to foreign stations, but amateur transmitters may not talk to other amateurs in foreign lands.*

The first night after this ban was made known a Washington amateur was listening to other operators conversing in a foreign language, according to United Press. *Suddenly station W4CYU, owned and operated by Robert Heckscher, interrupted and told them to confine their conversation to the English tongue. He then read them the new regulations. The penalty for violating these regulations may include revocation of the offender's license, confiscation of his equipment and prosecution.*

Flash—As we go to press the F.C.C. has just issued a ban on amateur operation of portable transmitters except on the ultra high frequencies above 56 mc., the range of which is extremely limited. The only exception permits the use of lower frequency apparatus in the public interest during a communications emergency. Amateurs will also be required to prove U. S. citizenship. For details, see Page 228.

COLUMNIST SCORES BEAT

On May 28th Danton Walker, Broadway columnist of the New York *Daily News*, printed a report that the Federal Communications Commission was planning a wholesale revocation of operating licenses to small radio stations, with additional restrictions upon amateurs. That same day Radio & Television wrote to the commission requesting further data, and James Lawrence Fly, F.C.C. chairman, replied: *"The statement which you quote is not based on any authorized statement* made on behalf of the Commission and is without foundation." On June 5 the F.C.C. imposed an additional restriction upon amateurs, namely forbidding conversations with other amateurs in foreign countries. Apparently Mr. Walker knew more of the Commission's plans than did its chairman.

AIN'T RADIO WONDERFUL?

A *columnist* in the N. Y. *Evening Post* retails an amusing story, as told by Chief of Radio Netherlands Indiesche in Sumatra. According to the story, a little Japanese fishing boat was wrecked on the shore and in it was found a high powered radio station. The Dutch reported this and protested to Tokyo. The Japanese, so the story goes, indignantly denied that Japanese boats ever went near Sumatra adding that none had transmitted radio messages. Therefore, the Dutch sent out a dozen war planes which machine-gunned every fishing boat within 25 miles of Sumatra. Twenty-four hours later, the Japanese government protested—and the Dutch commissioner replied that according to the Japs' own statement, no fishing boats could have been attacked, as there were none there. But the mystery still remains: if there were no transmitters on Japanese boats how did the Japanese get the news so fast?

Sunspots and Interference Co-related

Sunspots, it is known, have a distinct effect upon radio transmission for they cause changes in the ionization of the upper atmosphere. Now Bell system engineers are conducting an investigation of such effects. To do this they have established laboratories at Netcong, Deal and Holmdel, N. J. Ground potential measurements made at these points are compared with others made at Stroudsburg, Pa., and these are carefully analyzed. Graphs and record charts are made to correlate these readings with photographic observations made of the sun at the time the readings are taken. Although the severity and frequency of occurrence of periods of radio disturbance, excessive ground-potential differences, and variations in the earth's magnetic field tend to follow the eleven-year sunspot cycle, the peak of sunspot activity appears to occur about two years before the corresponding peak of radio and other terrestrial disturbances, according to the *Bell Laboratories Record*. One plausible explanation for this is that the active areas on the sun, which move to progressively lower solar latitudes during the course of the eleven-year cycle, are most effectively directed toward the earth a few years after the sunspot activity has passed its peak of intensity. There seems also to be a rather poor correlation between the appearances of particular sunspot groups and individual terrestrial disturbances. It is possible that the sunspots are merely one manifestation of some deeper solar activity, and that the terrestrial disturbance is another effect of this activity. There is some promise that useful predictions of these disturbances will eventually be possible and in searching for the key to them it is important to keep careful record of all the associated phenomena that are involved.

A technician charts the sun's spots.

ULTRA SENSITIVE METAL LOCATOR

The laboratories of the U. S. Dept. of Agriculture Forest Service have devised a *metal locator* which is so sensitive that it will find a nail imbedded in the heart of a tree trunk. It consists of an oscillator functioning as a tone source, a delicately balanced bridge circuit (one arm of which is the exploring loop) and a tuning amplifier which gives sufficient sensitivity to detect the small unbalance in the bridge produced by metal objects in the field of the exploring coil. In use, a man walks along a log, holding the coil a few inches from the surface. He has the control case slung over his shoulder and a pair of phones on his head. When a buried metal object is approached, a howl is heard in the phones, increasing in volume as the coil approaches the hidden metal, and reaching a maximum when it is centered over the metal. The larger the metal, the louder the howl. The accompanying pictures show the metal locator and the way it appears in use, although only one operator is generally required.

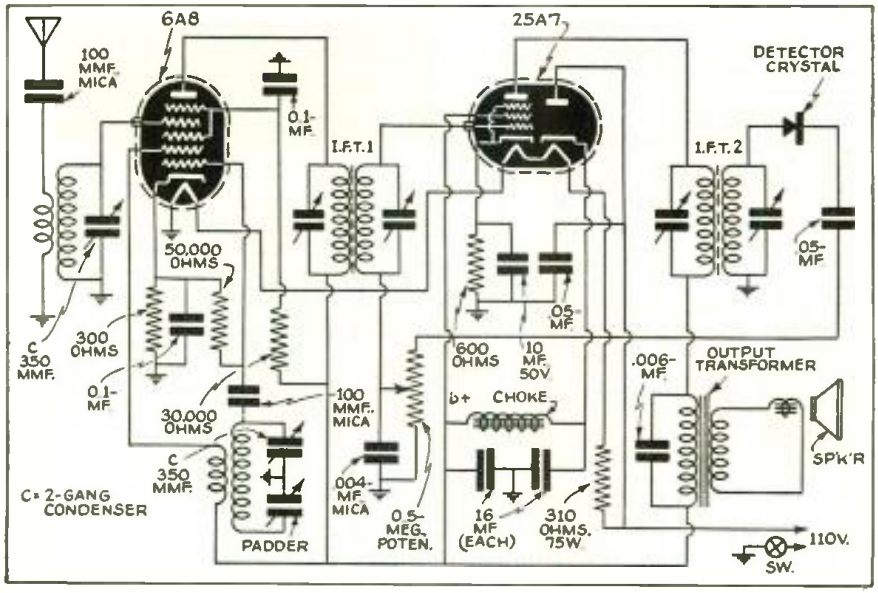
At left: Two laboratory men test a tree trunk for hidden metal. Above: A closeup of the metal locator.

BUOY TELLS SHIP'S DISTANCE

A *new combination* sound and radio buoy developed by the U. S. Coast and Geodetic Survey enables ships to measure their distance from the point at which the buoy is fixed. A ship up to 100 miles away can measure its distance by setting off a small explosive charge. The current used to detonate this charge makes a mark on a moving tape. The sound of the explosion reaches the buoy and causes it to send out a radio signal. When this signal is received by the ship it causes a second mark to be made on the paper tape. As sound travels at the rate of 1180 ft. per second, the distance of the ship from the buoy can be readily ascertained by measuring the distance between the two marks on the tape. The buoy includes a microphone, a radio amplifier and a radio transmitter, most of which equipment is sealed inside a strong 50-gallon drum, according to the New York *Times*. Again Radio aids man's safety!

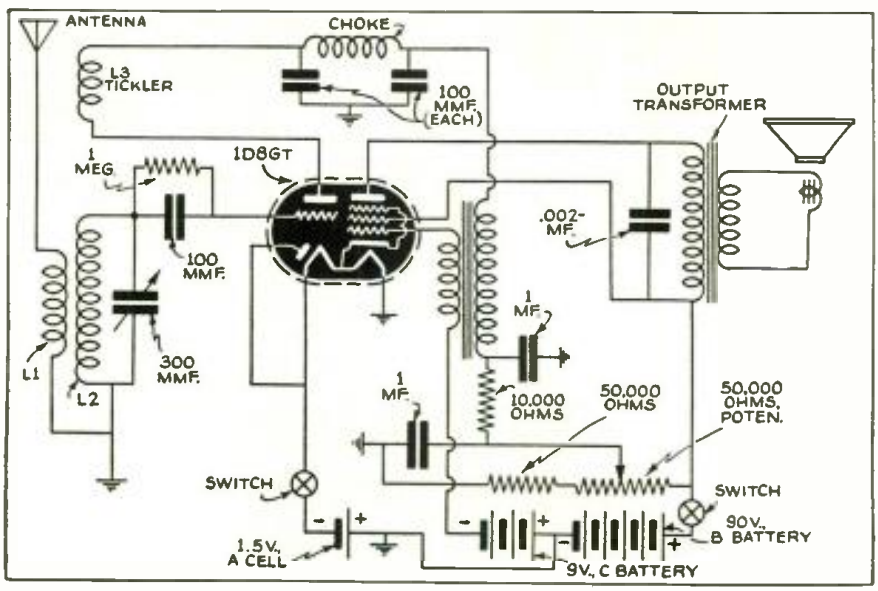
REFLEXED SUPER HAS BUT TWO TUBES!

● THE familiar reflex principle of yesteryear is utilized in an ingenious two-tube superheterodyne, the circuit of which appeared in *Radio Tecnica* of the Argentine. All values are given in the diagram published herewith; a 2 gang condenser is used, tracking being established by the usual padders. The coils likewise are a standard antenna coupling coil and an oscillator coil. It is interesting to note that one of the grids of the 6A8 is used as the plate in the oscillator circuit. The intermediate frequency transformers are likewise of standard type, chosen to operate at the beat frequency produced in the mixer. Another novel feature of this circuit is that a fixed crystal is used as the second detector. Its output is fed again through the 25A7, which also operates as I.F. stage and rectifier, and thence into the speaker transformer. The speaker has an input impedance of 4,000 ohms and a field resistance from 1,000 to 1,600 ohms.



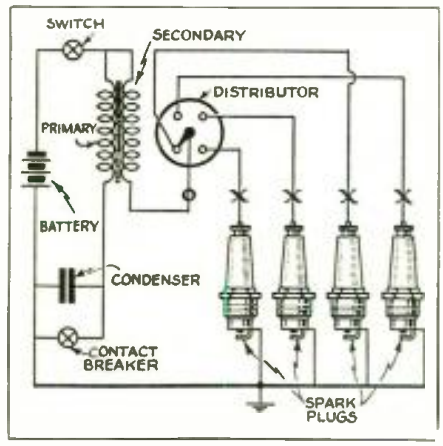
A MODERN ONE-TUBE RECEIVER

● AN ingenious circuit described in *Radio Tecnica* of Buenos Aires makes use of the 1D8GT tube to provide a regenerative detector and one stage audio amplifier in extremely compact form. In this set the antenna is coupled to the primary L1 and energy is fed inductively into the grid coil L2. The tickler L3 feeds a certain amount of energy back from the plate of the tube's triode section, thus establishing regeneration, which is controlled by the 50,000 ohm potentiometer connected in series from the B battery to the primary of the audio transformer. The secondary of this transformer is connected from the C battery to the grid of the pentode section of the 1D8GT. The plate of this section feeds directly into the loud-speaker or head phones. The circuit is extremely simple and no difficulty should be experienced in constructing it. No specifications are given for winding the coils, as the number of turns will depend on the band to be covered. They may be wound on a standard plug-in coil form, so that the receiver can be used for multi-band operation. The antenna coil L1 is wound at one end of the form and the tickler L3 at the other end, with the grid coil L2 between.



SUPPRESSING MOTOR NOISE

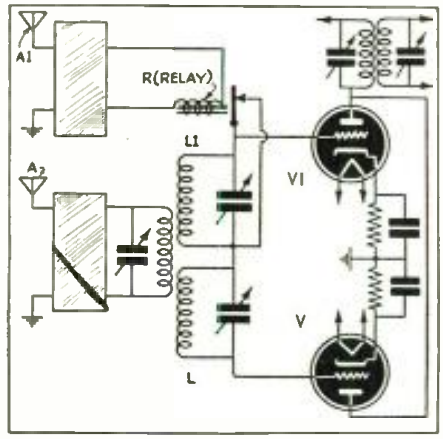
● INTERFERENCE caused by the spark plugs in automobile motors is a prolific source of annoyance to owners of short-wave receivers and television sets. Two



methods of minimizing such interference were shown in a recent article which appeared in *Wireless World* of Britain. In the accompanying diagram two alternative methods of damping the interference are shown. The X's in the connections from the distributor to the spark plugs show where a separate 5,000 to 10,000 ohm resistor may be inserted at each cylinder. Of course, if a motor has more than 4 cylinders more than 4 resistors are used. Instead, a single resistor may be connected at the point O between the spark coil and the distributor; this resistor should have a similar value. And still another method—each resistor may have half as great a value but resistors may be used at O as well as at X.

INTERFERENCE BALANCED OUT

● IN A NEW Hungarian method of interference elimination, the signals are received on antenna A which is coupled in push-pull to the grid circuits L and L1 of



two amplifiers, V and VI. When no interference is being received, L1 is short-circuited by means of relay R, so that the tube V is the only one feeding the following stages. When local interference reaches sufficient volume to be disturbing, the voltage it induces in antenna A1, in addition to antenna A, causes the relay R to open. Thus the signal, plus the interference from aerial A, and the interference signal from aerial A1, are then fed in push-pull through the amplifiers V and VI and so cancel out the interference. This was reported in *Wireless World* of Britain.

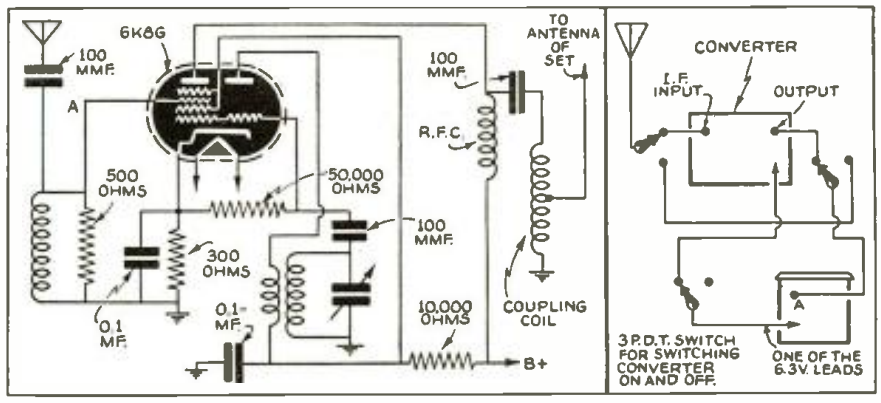
"A" BATTERY ECONOMY

● EXPERIMENTERS who use 1½ volt dry cell batteries as radio A batteries or for other purposes can take an economy hint from *The Australasian Radio World*. When the battery has run down it is usually due to drying of the paste electrolyte. This can be remoistened by punching a dozen or so nail holes through the outer paper wrapping and zinc can, being careful not to drive it too deeply into the sack of chemicals contained therein. If the zinc is corroded almost entirely away, a sheet of zinc or heavily galvanized iron must be wrapped around the sack to form a new negative terminal. In either case the battery is then immersed in an earthen jar containing a saturated solution of common salt or, better, salammoniac and water.

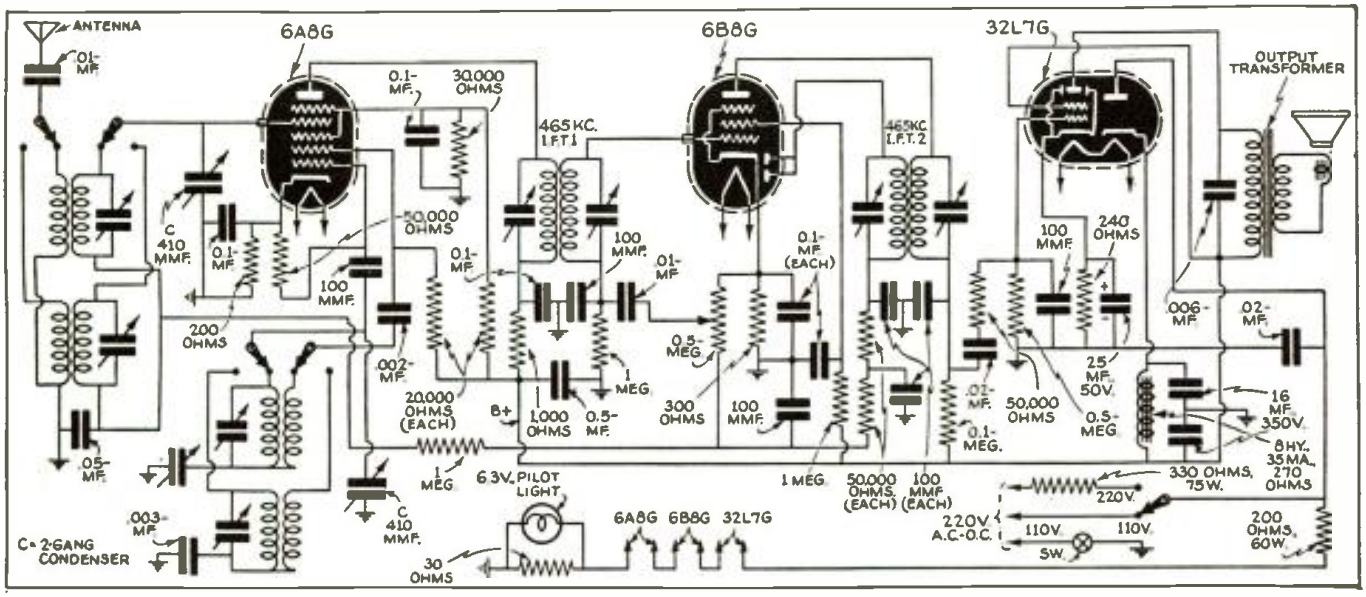
3-TUBE SUPERHETERODYNE

● A TWO-BAND superhet with 465 kc. I.F. stages and employing but three tubes for loud speaker operation can be operated from 110 v. AC/DC according to *Radio Tecnica* of Buenos Aires, S.A. Low cost is but one of the features of this receiver, portability being another of its more desirable adjuncts. It employs, of course, the familiar reflex principle, the 6B8G amplifying at both intermediate and audio frequencies. Careful filtering and the use of short leads make this possible. ▼

1-TUBE SHORT-WAVE CONVERTER



● NOW that all the warring nations are on the air with bulletins direct from their capitals, a short-wave converter of the type described in the *Australasian Radio World* will prove invaluable to any owner of a broadcast receiver. This converter is as simple as possible, for the antenna and grid coil is roughly peaked at about 25 meters and is broad enough to cover everything from 14 to 40 meters. The oscillator is sharply tuned by means of a single .00014 mf. variable condenser. The oscillator coils may be any of the standard types as generally used in converters; the output coil and coupler coil are to be home-wound and it will be necessary to experiment with the number of turns needed in the latter, in order to secure the best match to the antenna for the receiving set with which it is to be used. All the resistors are of the one watt type. The antenna coil may be the grid winding on any standard plug-in coil for the wave band which is desired. The power for the tube is drawn by tapping the power supply of the receiver. The receiver is tuned to about 550 kc. when the converter is used. A simple switching system is shown in the insert.



Can YOU Answer These Radio Questions?

1. On what Island, near New York, is CBS contemplating locating its new WABC transmitter? *See page 198.*
2. Will an F-M receiver select the weaker or the stronger signal where two stations cause interference? *See page 199.*
3. How does the integrating neurovoltmeter measure the degree of nerve exhaustion? *See page 200.*
4. A new metal locator for detecting nails in logs about to be sawed works on what principle? *See page 201.*
5. Name two ways in which to suppress radiation from automobile ignition systems. *See page 202.*
6. How is the loop tuned in a portable receiver? Give an advantage of an external loop. *See page 206.*
7. What is the main difference between amplitude and frequency modulation? *See page 218.*
8. How is a 5 and 10 meter converter connected for use with a standard receiver? *See page 220.*
9. Can a tree be used as an aerial for portable sets? How? *See page 230.*
10. What type of tube is used in making a speed flash apparatus to take photos in 1/100,000 second? *See page 232.*
11. Can outdoor views be televised with the new RCA Amateur type iconoscope tube? *See page 235.*
12. Can an electric motor be operated from the electricity collected from falling drops of water? *See page 248.*

2-Tube "Globe Girdler"

For Beginners

L. M. Dezettel*

Neat, efficient and flexible! This 2-tube set will please beginners.

The range of this 2-Tuber is 16 to 550 meters. Regen. detector and audio amplifier. 115 volt A.C.-D.C. operation.

● IDEAL for the beginner, short wave stations from all over the world can be received with clarity and volume on this "easy-to-operate" 2-tube receiver. Beam power output provides loud speaker performance on the stronger stations. The use of a new dual purpose bantam tube with 70-volt heater eliminates all batteries and separate power supply. The entire receiver (except speaker) is mounted on a chassis measuring 5" x 8".

A new type 12SJ7GT bantam tube is used in a stable electron coupled oscillator, grid leak detector circuit. *Smooth regeneration* control is accomplished by varying the screen grid voltage. The regeneration control knob also controls the power switch for turning the receiver on and off. A type 70L7GT double-function bantam tube contains a diode rectifier providing "B" voltage, and also a 1.8 watt beam power amplifier tube.

Wavelength Range 16 to 550 Meters

Four separate plug in coils are used for *short waves,* giving continuous wave length coverage from 16 to 195 meters. Two additional factory-wound coils are used to cover the *police* and *broadcast* bands between 190 and 550 meters.

Front panel controls are: main tuning condenser (adjusted with a smooth acting vernier dial), regeneration control and switch in one, and—a new idea—antenna loading control, which provides accurate antenna loading for each band and, therefore, greater sensitivity.

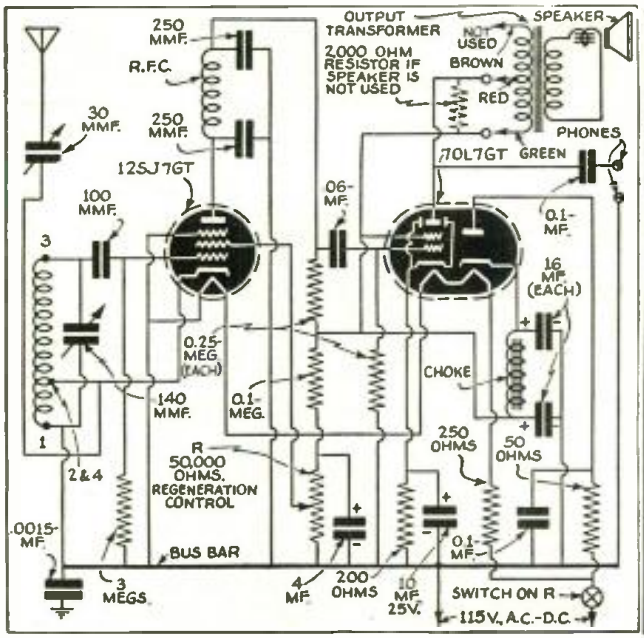
After the chassis is drilled and put together, mount all large parts (not the fixed resistors and condensers) as shown in the pictorial diagram. Be sure that sockets are mounted with guide pin slots facing in the directions shown. The pictorial diagram shows placement of parts and wiring as viewed from the bottom of the chassis; that is, with chassis turned upside-down. Do not forget to use fiber insulating washers when mounting the antenna trimmer, as this condenser must be completely insulated from the chassis. Fixed resistors and condensers are wired later and are supported by their own leads.

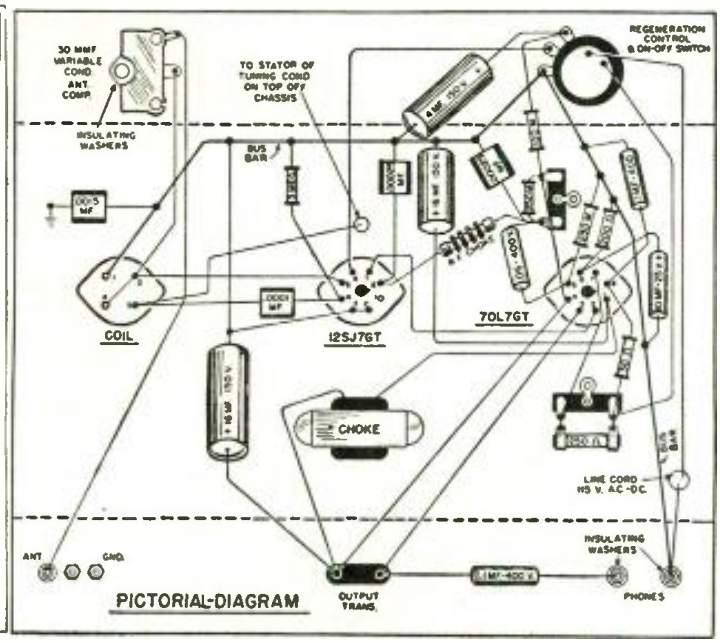
Wiring the set is simplicity itself. The layout of parts provides short connections without any crowding. A heavy bus wire, running from one terminal of the coil socket to the potentiometer and phone post is used as common ground. This "ground" is bypassed to the chassis at one point only. It is a good idea for the novice to follow both the schematic and pictorial diagrams together to become acquainted with the reading of schematic diagrams. Mark off each connecting wire on the pictorial and schematic diagram as each connection is made. This will aid in preventing duplicate wires and oversights. After the wiring has been completed, *check your work once more,* this time using only the schematic.

For headphone operation, be sure to connect a 2,000 ohm, 10 watt resistor to the two speaker terminals, on the outside of the chassis, plugging the headphones into the pin jacks provided. If a speaker is used, remove the 2,000 ohm resistor and connect the primary of a matching transformer to these speaker terminals.

*Engineer, Allied Radio, Chicago.

You will find it easy to build this 2-tube receiver, with the aid of these diagrams.





Testing the Set

Now let us try the receiver for the reception of signals. It is best to begin by using the *broadcast* coils. Plug one of the coils into the 4-prong socket. Connect the lead-in of your aerial to the *antenna* binding post. Run a wire from the *ground* binding post to a cold water pipe. Plug the power cord into a 110 volt A.C. or D.C. power socket (if D.C. is used, it is sometimes necessary to reverse the plug in the outlet to obtain the right polarity) and turn the regeneration control knob a little to the right. You will immediately hear a click as the switch snaps on. Wait a few seconds for the tubes to warm up. If no dull red glow is seen at the top of the tubes, the filaments are wired incorrectly and the wiring should be rechecked carefully.

If everything looks all right, advance the regeneration control until a thud and a hiss are heard in the earphones. This is the critical point of oscillation. Adjust the antenna trimmer for maximum amount of capacity possible, while yet maintaining the critical oscillating point over the entire tuning dial. This critical point is the setting for greatest sensitivity. Music and speech are received best with the regeneration control set just below the critical point of oscillation and code (C.W.) stations are best received with the control just above this point. Tune for a station with the main tuning dial, at the same time maintaining this point of highest sensitivity. After the signal is heard, re-adjust the regeneration control for clearness.

On short waves, tuning must be done very carefully, as the signals received are very sharp and occupy but a small amount of space on the dial. The procedure for tuning S.W. is the same as given above, but the tuning is done more slowly. For best results at night, tune around the 49 meter region. In the daytime, tune around 25 meters.

With a good high antenna 75 to 100 ft. in length, this receiver should literally "girdle the globe," bringing in stations from the four corners of the world, as well as the major stations of the United States.

Parts List
Knight 2-Tube Receiver

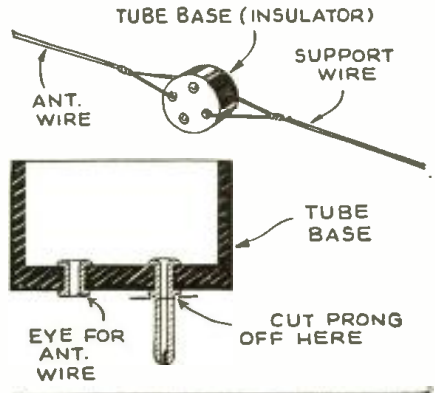
1—5 x 8 chassis base
1—Panel—7 x 9
1—Black phone pin jack
1—Red phone pin jack
1—2-terminal speaker output connector
1—"Ant-Gnd." twin binding post terminal
1—3" Kurz Kasch vernier dial
2—Round knobs
1—30 mmf. variable condenser
1—140 mmf. variable condenser
2—.1 mf. 400 volt condenser
1—.06 mf. 400 volt condenser
2—.00025 mf. mica condenser
1—.0001 mf. mica condenser
1—.0015 mf. mica condenser
2—16 mf. 150 volt electrolytic
1—4 mf. 150 volt electrolytic
1—10 mf. 25 volt electrolytic
1—50,000 ohm regeneration potentiometer
1—ON-OFF switch for potentiometer
1—50 ohm, ½ watt resistor
1—250 ohm, 10 watt resistor
1—100,000 ohm, 1 watt resistor
1—200 ohm, 1 watt resistor
2—250,000 ohm, ½ watt resistor
1—3 megohm, ¼ watt resistor
1—2½ mh. R.F. choke
1—25 henry filter choke
1—Line cord and plug
2—2 lug wiring insulators
Hardware as follows:
14—6/32 hex nuts
3—⅜"—32 hex nuts
1—½" rubber grommet
14—6/32—½" RH. machine screws
1—ft. bus wire
3—ft. hookup wire
1—ft. solder
2—⅜" shoulder washer
2—Octal sockets
1—Four prong socket
1—2,000 ohm, 10 watt resistor

Accessories

1—Set of 4 coils, 16 to 195 meters
1—Set of 2 coils, 190 to 550 meters
1—12SJ7GT tube and 1 70L7GT tube
1—5" P.M. speaker and output transformer
1—Pair 2,000 ohm headphones.

Antenna Insulator

Wishing to put up an antenna in a hurry and having no insulators handy I took some old tube bases and sawed off the prongs as close as possible. I then threaded the supporting wire through one of the eyelets thus left in the base, and the antenna wire through another eyelet as far away as possible from the first. This insulator has worked satisfactorily for some time.—*Russell Scalf.*



3-Tube "Loop" Portable Receiver

Charles R. Leutz

This loop receiver is unique in that six tube results are obtained with only three tubes, thanks to the new 1D8G which performs several functions. Actual tests showed excellent quality of reception, plus the features of light weight and excellent DX.

● A RECEIVER circuit including *diode detection, automatic volume control, voltage audio amplification* and *power audio amplification* does not represent anything new in itself; but here we have a circuit wherein all these functions are performed by one tube, the new and versatile 1D8GT. By the simple addition of two more tubes, a 1A7G Converter (really two tubes in a common envelope) and a 1N5G Pentode intermediate radio-frequency amplifier, a very complete and efficient superheterodyne circuit is formed, ideal for a really capable portable receiver. Operation is obtained from a 1½ volt "A" battery and 90 volts "B".

Portable receiver design involves two problems, which so far, have been generally neglected. First, if maximum results are to be obtained at poor receiving locations or over fair distances, the loop field should be removed from close proximity to apparatus or batteries. Secondly, the instrument should be weather-proof.

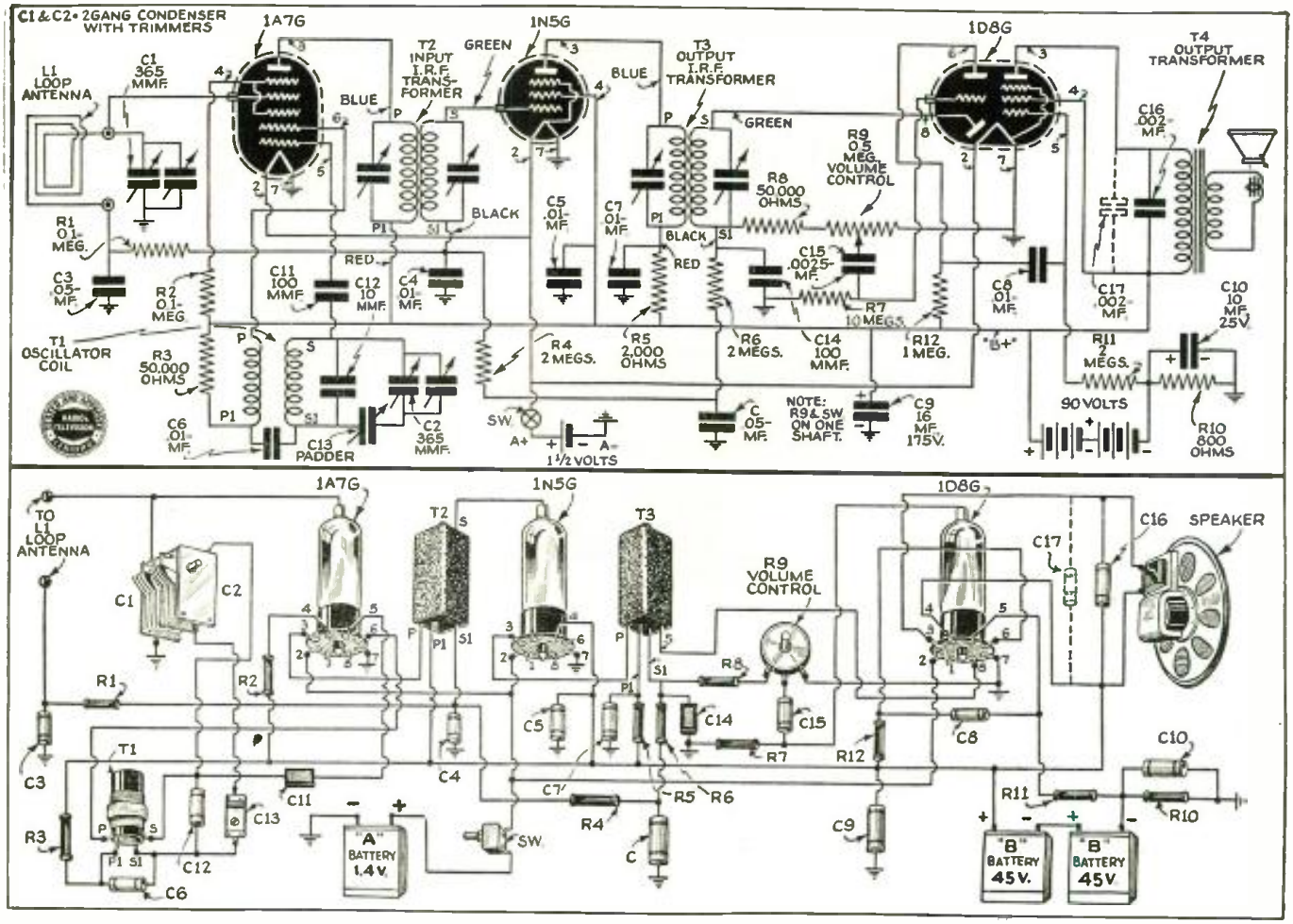
Movable Loop Reduces Interference: In this design, the loop is removable and ordinarily carried within the receiver cabinet. During operation, the loop (mounted on a phone plug) fits in a jack mounted on the cabinet lid. This feature not only places the loop "in the clear," but permits rotating the loop to secure maximum response from desired stations and minimum response from possible interfering stations. This function is important as it often enables eliminating adjacent channel interference. Furthermore, due to the bi-directional characteristic of the loop, at least 50% of all possible local noise interference is eliminated. This receiver is also suitable for service as a low-cost direction finder or *homing device* for small pleasure craft.

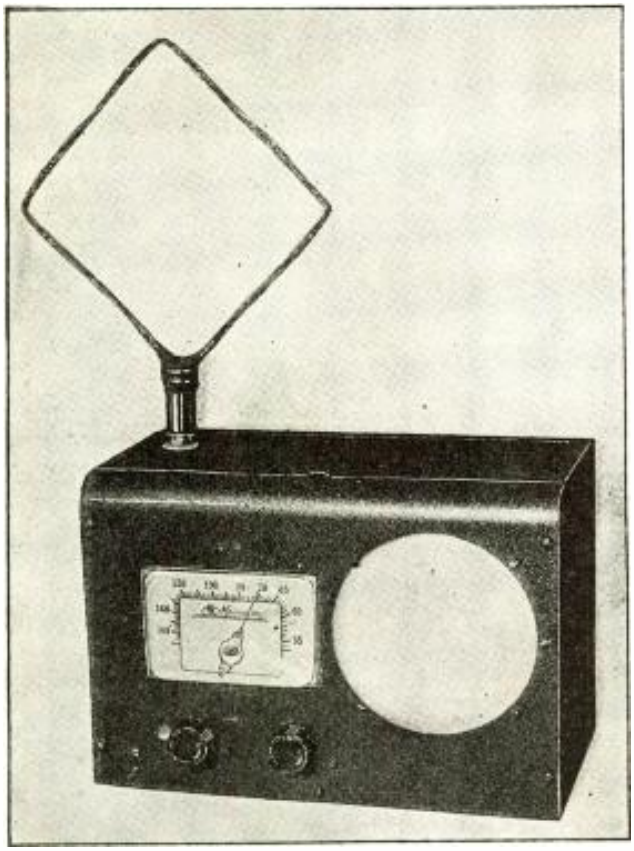
The problem of weather-proofing is solved by providing the complete instrument with a "zipper" carrying bag which is made of water-proof cloth. This effectively excludes moisture, rain and dust besides protecting the receiver external surfaces.

One of the photos shows a view of the complete receiver and also shows the loop in operating position. The chassis-panel assembly is shown in the second photo. The cabinet is a standard unit supplied with a blank panel ready for drilling. The chassis, while special, is simple and readily worked from soft sheet aluminum to the required constructional details.

Examining the schematic wiring diagram it will be noted that this superheterodyne circuit consists of a loop input and oscillator directed to the 1A7G converter tube. The converter output is amplified at 456 kc. by the 1N5G pentode. The intermediate radio

Complete wiring diagrams, both schematic and picture, for the 3-tube portable battery receiver are given below.





The loop antenna on this portable is removable. It was designed to plug into a jack fitted on the lid of the receiving cabinet, so as to get the loop away from the shielding effect of the cabinet, and thus increase the DX range of the receiver.

frequency output is fed to the 1D8GT diode for detection and A.V.C. From the diode, the audio frequency output is first amplified by the resistance-coupled triode section and that output in turn coupled to the pentode section input—and further amplified. The 5-inch permanent magnet dynamic speaker is coupled to the pentode by a transformer. Volume control is obtained by means of a 500,000 ohm potentiometer in the diode output circuit. By running the "B" negative lead through an 800 ohm resistor to the chassis, the voltage drop across this resistor provides the proper bias value for the pentode control grid and eliminates the need of a bias battery or cell.

Wiring the Set

The assembly and wiring are quite simple. All the various parts can be mounted on the chassis including the sockets, oscillator coil, input I.R.F. transformer, output I.R.F. transformer, volume control and the padder condenser. The flexible leads protruding from the intermediate transformers should be connected first, cutting same to length and carefully checking the correct colors. Connections to ground can be made at socket lugs or to soldering lugs placed under any chassis holding screw. Do not attempt to solder to the aluminum chassis. After wiring the filament leads, the remaining connections can be carefully added, using insulating tie lugs to mount one or both ends of the different condensers or resistors, as required. Where possible, mount one end of either a condenser or resistor directly to the socket lug or oscillator coil terminal involved, as indicated in the schematic diagram. As each wire is soldered into place, check against the wiring diagram and mark same off in red pencil.

The flexible leads for the tube grid clips and battery leads can now be added. When all chassis wiring is completed, mount the chassis to the front panel using the two 1½" screws and spacers. The speaker is now mounted on the inside of the front panel and connected. A piece of speaker grille cloth is fixed across the speaker opening.

The loop can be wound using solid No. 20 B&S magnet wire, either double silk or cotton covered, or, an equivalent litzendraht wire. The turns are wound at random, cemented together with Amphenol 912 coil dope, to form a square coil of circular cross-section. The winding form is 5" x 5" and may be either cardboard or wood. The loop is removed from the form after the coil dope has hardened.

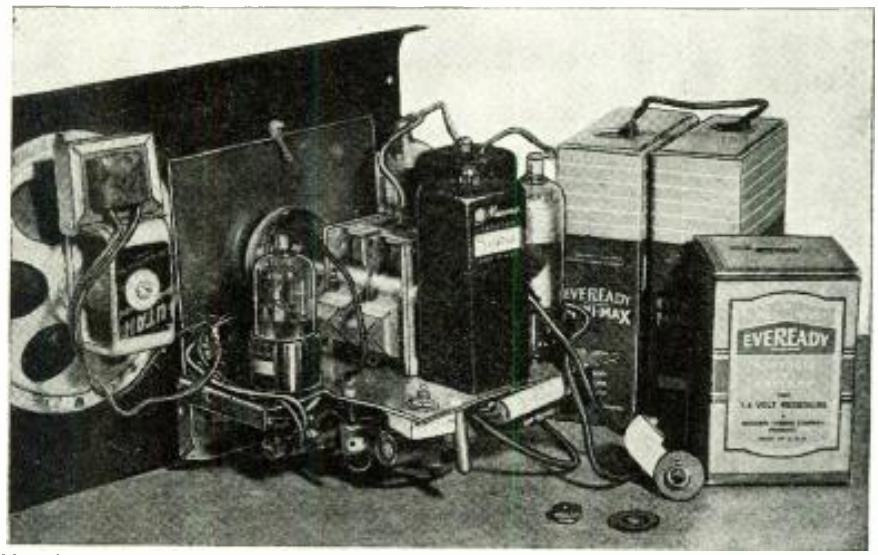
Before inserting the tubes, turn the volume control "on" and measure the "A" voltage at each socket (contacts No. 2 and No. 7); the reading should be about 1½ volts. For a no-load condition and using a high resistance voltmeter, approximately full 90 volts should be indicated at each of the tube plates and at the 1A7G anode grid (socket contact No. 6). In a similar manner the screen grid voltages can be checked.

Assuming all voltages check, the loop can be connected temporarily and the tubes inserted. The full load plate, anode grid, screen grid and bias voltages can now be checked if desired.

Alignment is simple and can readily be accomplished without any test instruments as the intermediate radio frequency transformers are accurately factory adjusted to 456 kc. First be sure the tuning dial pointer is set properly in relation to the condenser rotor plate position. Then set the dial to some local broadcast station of known frequency in the vicinity of 1,400 kc. A higher known frequency can be used if necessary, for example 1,500 kc. Under the above condition, with the set turned on, adjust the oscillator trimmer condenser first (C-2),

until the station of known frequency is received at maximum intensity. The loop condenser (C-1) is then adjusted. Assuming these adjustments give the desired result, the trimmers on the intermediate R.F. transformers can be checked. Due to the connecting leads, some slight readjustment may be in order, however, the adjustment should not require more than a fraction of one turn of the regulating screw. Never change any alignment adjustment without an audible signal to note the effect. During these operations, use the volume control and keep the signal strength low to secure accurate settings of alignment.

After aligning the high frequency end, turn the dial pointer to a local station of known frequency at about 600 kc. and adjust the padder. For each padder adjustment, always retune the gang condenser adjustment (main tuning control). Repeat this operation until maximum response is obtained.



Here is a view showing all the parts, including the batteries, for building the portable 3-tube receiver, which does the work of 6 tubes.

After the padding adjustment has been completed, the alignment operation at 1,400 kc. can be repeated for a final check.

When loops are hand-made, there is bound to be a wide variation in inductance values. Accordingly when aligning at 1,400 kc., if the loop trimmer (C-1) cannot be increased enough in value, it is of course an indication that the loop inductance is too small, and one or more turns must be added until resonance is obtained. On the other hand, if the trimmer cannot be adjusted to a small enough capacity, one or more turns of the loop must be removed as required.

The loop jack must be insulated from the cabinet lid, using insulating washers.

From a suburban receiving location, this portable gives a daylight range of approximately 150 miles while at night a range of 1,000 miles is not at all unusual. At more favorable receiving locations, the range will be proportionately greater.

Parts List

SOLAR
1—.00001 mf. mica condenser, C-12
1—.05 mf., 200 volt paper condenser, C-3
5—.01 mf., 200 volt paper condensers, C-4, C-5, C-6, C-7, C-8
1—10 mf., 25 volt dry electrolytic condenser, C-10
1—16 mf., 175 volt dry electrolytic condenser, C-9
2—.0001 mf. mica condensers, C-11, C-14
1—.0025 mf. mica condenser, C-15
2—.002 mf. mica condensers, C-16, C-17

MEISSNER
1—2 gang 365 mmf. compact variable condenser, No. 21-5214
1—Tuning dial for above, No. 19-531
1—Rectangle cro-glass dial crystal for above, No. 19-535
1—Oscillator coil, T-1, No. 9914
1—Input I.R.F. transformer, 456 kc., T-2, No. 16-5741
1—Output I.R.F. transformer, 456 kc., T-3, No. 16-5743
1—Padder condenser, C-13, No. 22-7008

I.R.C.
1—500,000 ohm volume control with switch, R-9, No. D-13-133 and No. 41 switch
2—100,000 ohm, ½ watt resistors, R-1, R-2
2—50,000 ohm, ½ watt resistors, R-3, R-8
1—10 megohm, ½ watt resistor, R-7
3—2 megohm, ½ watt resistors, R-11, R-6, R-4
1—2,000 ohm, ½ watt resistor, R-5
1—1 megohm, ½ watt resistor, R-12
1—800 ohm, 1 watt resistor, R-10

PAR-METAL
1—Cabinet, CA-100, 7¼" x 10½" x 6", black wrinkle finish

UTAH
1—5-inch P.M. dynamic speaker and transformer

NATIONAL UNION
1—1A7G tube
1—1N5G tube
1—1D8GT tube

NATIONAL CARBON
1—Eveready No. 742 1½ volt "A" battery
2—Eveready Min-Max 45 volt "B" batteries

AMERICAN PHENOLIC
3—Octal sockets, No. 88-8
1—2 oz. bottle Amphenol 912 coil dope

MALLORY
1—No. 701 jack (for loop)
1—No. 75 phone plug (for loop)

CINCH
3—Double insulating tie lugs
1—5 contact insulating tie lug
1—Double contact plug for "A" battery
1—Triple contact plug for "B" battery
3—Grid clips

MISCELLANEOUS
45 Feet insulated wire for loop (see text)
¼ lb. rosin core solder
10 Feet No. 22 push-back hook-up wire
11—No. 6-32 rd. hd. brass screws, ½" long
2—No. 6-32 rd. hd. brass screws, 1½" long
24—No. 6-32 hex. brass nuts
18—No. 6-32 lock washers
12—Soldering lugs
4 Feet No. 18 flexible rubber-covered wire for battery leads
1—Aluminum chassis made to drawing
3—Insulating washers for jack
1—Piece grille cloth, 5¼" x 5¼"

The *loop* can be wound using No. 22 B & S double covered cotton or silk insulated copper wire or equivalent Litzendraht. A total of approximately 26 turns are required, wound on a form 5" x 5" square. The turns are wound at random, cemented together with Amphenol 912 Coil dope, to form a square coil of circular cross-section. The loop can be removed from the cardboard form after the cement has hardened.

A "Den" Listening Post

for the Short-Wave Fan

Charles R. Leutz

The range of this regenerative receiver is 9.5 to 200 meters . . . it has its own full-wave power-supply "built in" . . . the tube line-up consists of a regenerative detector, a first audio stage, and an output stage . . . the first and second audio are handled by a 6C8G twin triode.

● SINCE the present war started, a new crop of *short-wave* listeners has sprung up. People find direct foreign news broadcasts interesting and often more timely than some of the domestic news releases. For the listener who stays up late at night, operation of a large receiver may disturb other members of the family and a small set exclusively for short wave operation and headphone reception is in order.

A receiver of this type, having a world-wide range and ideal for a "den" installation, is described in this article. While headphone operation is suggested, the output is more than ample to operate a 5-inch permanent magnet dynamic speaker.

In arriving at an efficient tube arrangement, at first thought it appears possible to simplify matters by using a "transformerless" circuit. Unfortunately, especially for short wave work, circuits wherein the tube filaments are in series with the A.C. line, are invariably subject to serious "hum" difficulties. For a small set, a transformer adds less than a dollar to the total cost and is well worth while.

Tube Line-Up

The completed receiver is shown in Fig. 1 and a separate view of the chassis-panel assembly illustrated in Fig. 2. From the schematic wiring diagram shown in Fig. 3, it will be noted that the circuit consists of a regenerative detector (using either a 6SK7 or 6SJ7), a first audio stage (resistance coupled), and a second audio stage. The first and second audio circuits are handled by the 6C8G *twin triode* which is equivalent to two separate 6J7 tubes. A 5W4 rectifier tube is used in the full wave midget power supply.

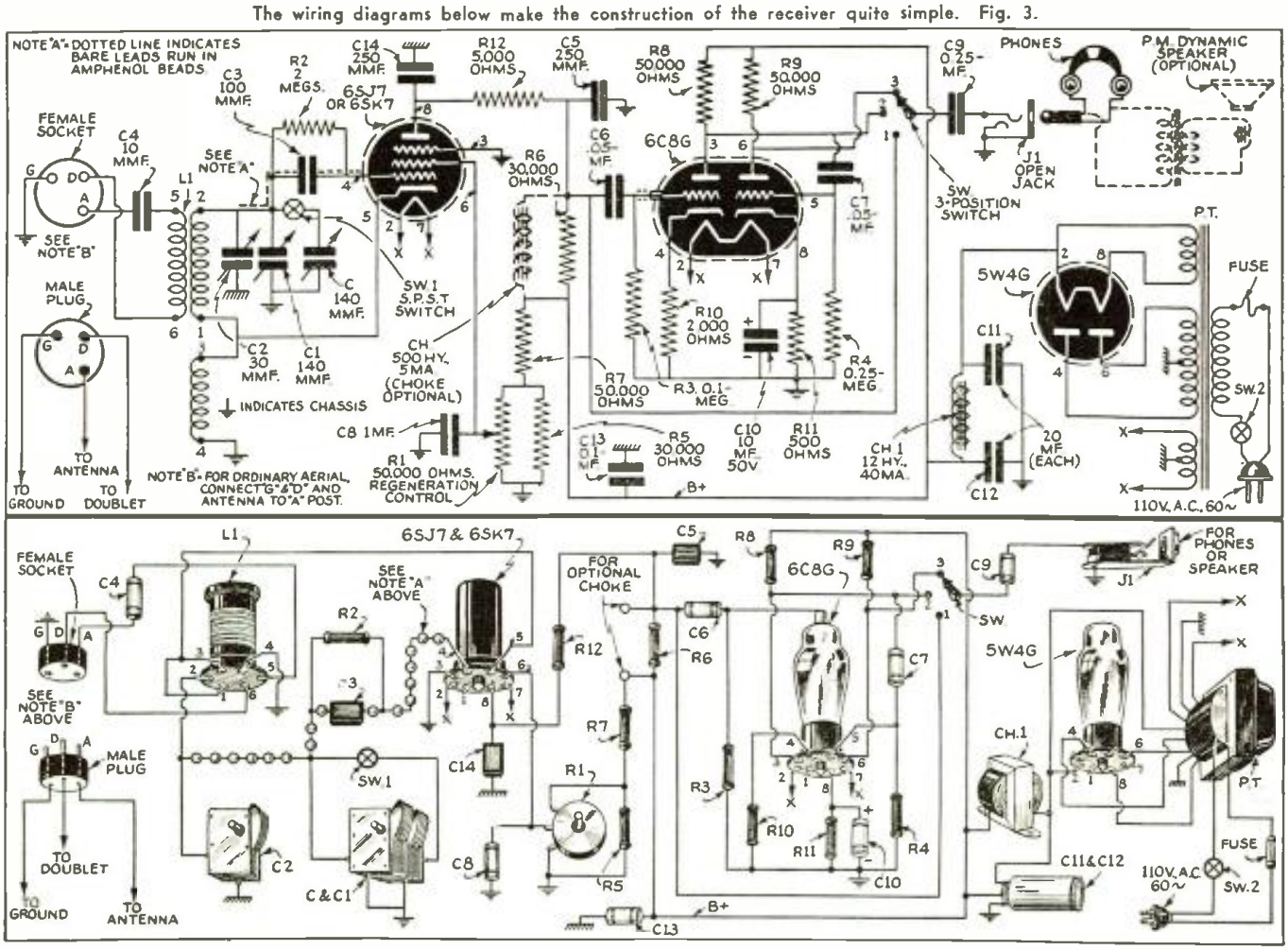
Regeneration in the detector is controlled by varying the detector screen grid voltage through the 50,000 ohm potentiometer control (R-1).

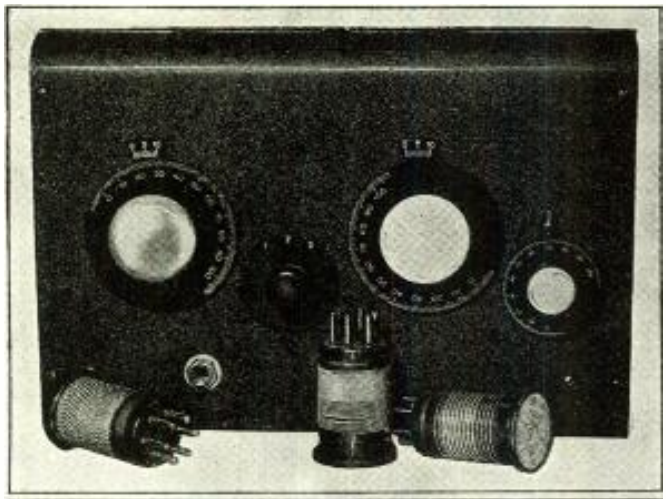
Fig. 4 gives the drilling dimensions of the front panel and Fig. 5 shows the drilling and cut out dimensions of the chassis. The standard cabinet and chassis suggested are made of soft steel and easily drilled and cut as required.

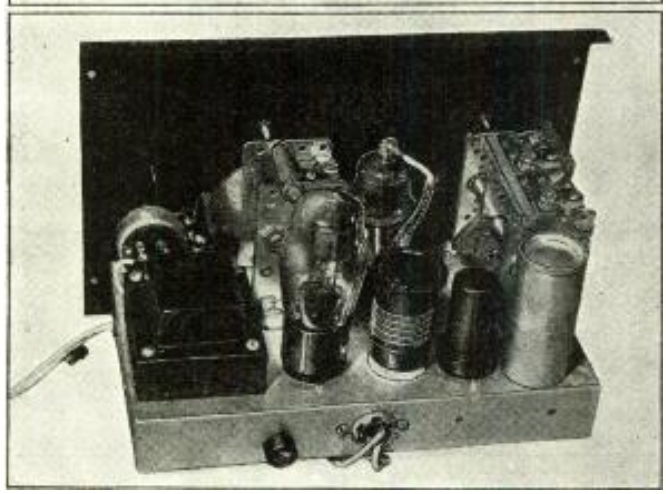
Assembly and Wiring

The assembly and wiring are relatively simple. On the chassis, the transformer, filter choke, sockets, filter condenser, antenna terminal socket, tuning condensers

The wiring diagrams below make the construction of the receiver quite simple. Fig. 3.







Figs. 1 & 2

Photos at left show front and rear view of the "Den" listening post receiver. It has smooth operating controls and very neat and distinctive appearance. The original is fitted with red and white dial knobs, which enhance its beauty considerably. Provision is made for the use of a doublet or the usual single-wire straight antenna.

and fuse extractor post are mounted in place. The phone jack is left loose as it is finally fastened by a front panel nut. The 50,000 ohm potentiometer and stage switch are mounted on small brackets to line up with the front panel holes indicated. The wiring can now proceed, first taking care of the filament leads and carefully twisting these wires. Keep filament wires away from grid or plate leads subsequently added. The R.F. leads shown in the diagram with a supplementary dotted line are covered with low loss Amphenol 912 beads. Instead of using an inductive R.F. choke in the detector plate circuit, a filter is substituted, consisting of a 5000 ohm resistor and the two .00025 mf. mica condensers shown. The performance of the detector circuit is substantially improved by using a 500 henry, 5 ma. iron core choke in parallel to the plate coupling resistor (R-6).

The first audio grid lead, which is to the cap of the 6C8G, is covered with a small piece of copper braid, which is *grounded*. The multi-stage switch permits connecting the phones to the detector output, first audio output or second audio output.

Regarding the Coils

Care must be taken to connect the coil socket leads exactly as shown. Experimenters who prefer to wind their own coils are referred to any of the standard handbooks which list this data. The standard coils here suggested tune down to 9.5 meters. Extra coils can be wound for shorter wavelengths, following the design of the standard coils, but of course with fewer turns. The cathode tap in each case should be approximately at 1/3 the total grid-to-ground or secondary turns. The antenna coupling coil can have about the same number of turns as the ground-to-cathode tap.

A doublet or all-wave spider aerial, together with an efficient transmission line or co-axial cable lead-in, is suggested for maximum results—the leads of a doublet being connected to A and D, and a separate ground connected to G. For an ordinary aerial the lead-in is connected to A, and then D is connected to G and to ground. The sensitivity is very high! European broadcast *short-wave* stations can be picked up with excellent audibility using an indoor aerial only a few feet long. However, if local noise conditions are severe, an aerial removed from the noise source and connected by an efficient line or cable will be substantially more satisfactory.

In completing the wiring, simplification can be obtained by mounting one end of component parts (such as condensers or resistors) directly to the socket contact or other terminal involved, as shown in the diagram. The by-pass condenser ordinarily across the first audio cathode resistor, R-10, has been purposely omitted to reduce hum.

Checking and Testing

While making connections, check same off against the wiring diagram in red pencil. This gives a continuous check on progress, preventing mistakes and omissions. Do not check voltages without the tubes in place. Upon completing the wiring, the chassis assembly can be tested prior to final panel and cabinet mounting. Plate, screen grid and bias values can be checked and will be approximately the same as recommended for these tubes in the standard tube manuals.

After satisfactory tests have been secured, the front panel can be mounted to the chassis, using the two holding screws and spacers. The jack is then permanently installed. The large dials are for the main tuning condenser (C-1) and *band-spread* or fine adjustment condenser (C-2). The small dial is for the *regeneration control* and the single knob for the "stage" switch.

In tuning, ordinarily only one section of the two-gang condenser (C-1) is used and this spreads the stations well out over the dial. However, a wider frequency range per coil can be secured by connecting both sections of the two-gang condenser in parallel by closing the switch (SW-1).

There are two methods of tuning a regenerative receiver, one involves operating the detector just below the oscillating point; the other system calls for an oscillating detector adjusted for "zero" beat. The second method is less subject to hum disturbance. In the first mentioned method, the desired station signal is first tuned in with the main tuning condenser and band-spread condenser. The regeneration control is then advanced to give the volume required. For a zero beat adjustment, the regeneration control is advanced until the detector circuit oscillates and then the main tuning control and band-spread dial are adjusted until the desired voice or musical reproduction is obtained free from distortion or beat whistles. In other words, the oscillating detector tuning is adjusted to exactly the same frequency as that of the desired signal.

Parts List

PAR-METAL
1—Cabinet #CA-100 7¼" x 10½" x 6", black wrinkle finish
1—Chassis #C-4500, 5½" x 9½" x 1½", chrome finish

UNITED TRANSFORMER
1—Power transformer type R-6 (T-1)
1—Filter choke type R-14 (Ch-1) 12 Hy. 40 ma.
1—Plate impedance type R-22 (Ch-2) 500 Hy. 5 ma. (optional)

R.C.A. (Tubes)
1—6SJ7 or 6SK7 detector
1—6C8G twin amplifier
1—5W4 rectifier

MEISSNER
1—Coil kit #18-3898 (9.5 to 200 meters)
1—2 gang tuning condenser, 140 mmf. each section (C-1), #21-5220
1—Single condenser 30 mmf. (C-2) #21-5218; stock 140 mmf. condenser altered to one rotor plate

CANNON
1—Pair cannon-ball master headphones

AMERICAN PHENOLIC
1—#54-8 super-mip detector socket
1—#SS6 steatite coil socket
2—#88-8 octal sockets, rectifier and amplifier
25—#73-1 amphenol 912B beads
1—#S4S contact socket and 1 #MPM4S contact plug

UTAH
1—5" P.M. dynamic speaker (optional)

MALLORY
1—#3223J 2 circuit 3 position switch (S-1)
1—#K12 50,000 ohm volume control and switch (R-1)
1—#FPD234 20-20 mf. 450 volt condenser (C-11, C-12)
1—.0001 mf. mica condenser (C-3)
1—.00001 mf. mica condenser (C-4)
2—.00025 mf. mica condensers (C-5, C-14)
1—#701 open circuit jack (J-1)
1—#75 phone plug
2—.05 mf. 400 volt paper condensers #TP426 (C-6, C-7)
1—1 mf. 400 volt paper condenser #TP422 (C-8)
1—10 mf. 50 volt dry electrolytic condenser (C-10)

1—.25 mf. 400 volt paper condenser (C-9)
1—.1 mf. 400 volt paper condenser (C-13)

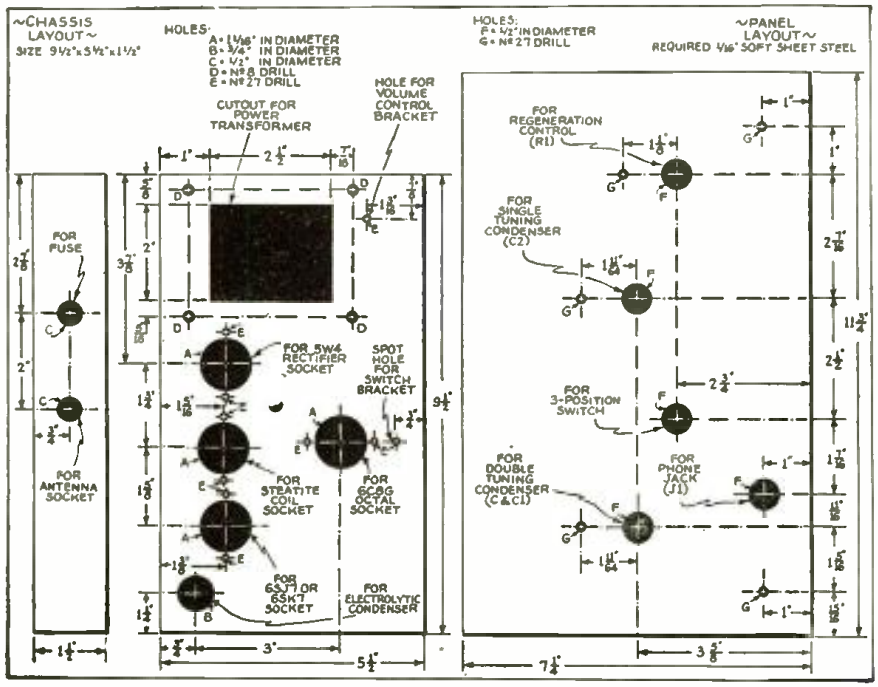
CROWE
1—#6180 dial and knob
1—#6184 dial and knob
1—#6172 dial and knob
1—#6129 knob

LITTELFUSE
1—#1075 fuse extractor post and 1 ampere fuse (F-1)

I.R.C. (Resistors)
1—2 mehogm. ½ watt resistor (R-2)
1—100.000 ohm, ½ watt resistor (R-3)
1—250.000 ohm, ½ watt resistor (R-4)
2—30.000 ohm, ½ watt resistor (R-5, R-6)
3—50,000 ohm, ½ watt resistor (R-7, R-8, R-9)
1—2,000 ohm, ½ watt resistor (R-10)
1—500 ohm, ½ watt resistor (R-11)
1—5,000 ohm, ½ watt resistor (R-12)

CLAROSTAT
1—50,000 ohm potentiometer with switch (R-1. S-2)

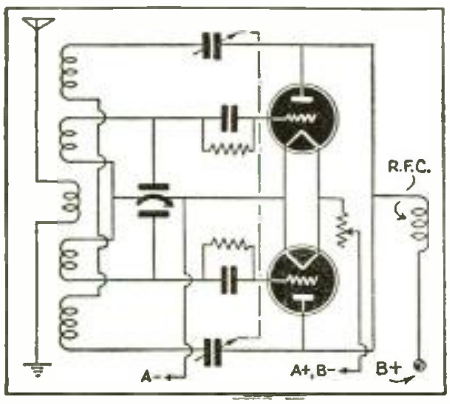
MISCELLANEOUS
1—A.C. cord and plug
10 feet #22 push back hook-up wire
¼ lb. rosin core solder
12—#6-32 rd. hd. brass screws, ½" long, with lock washers and hex. nuts
1—Piece shielded braid. ¼" dia., 4" long
1—Grid clip
4—Rubber feet. 1 rubber grommet ⅜" dia.
2—# rd. hd. drive screws 1" long
2—#6 hole spacers 3/16" long
1—Unmounted single pole single throw switch (S-1)



Layout details for the panel and the chassis of the receiver are given above.

PUSH-PULL DETECTOR

● HERE is an experimental push-pull detector circuit which seems to hold considerable promise, especially for short-wave reception. As the two tubes are capacitively in series, the total capacity is reduced to one-half that of a single tube. Aside from this fact, the circuit insures a very steady and reliable signal. The tubes used may be of whatever type the experimenter has at hand. —*R.E.*



We Will Pay

regular space rates for good construction articles giving novel and original ideas for building such simple radio apparatus as short wave converters, receiving sets, television and frequency modulation receivers, recording equipment, power supplies, simple set and tube testers, facsimile recorders, etc.

●

Address all contributions to Editor, RADIO & TELEVISION, *20 Vesey Street, New York, N. Y. Enclose stamped, self-addressed envelope if return of rejected material is desired.*

The 5, 10 and 20 meter receiver in action.

A 5, 10 & 20 Meter Receiver of Advanced Design

Harry D. Hooton, W8KPX

This receiver will appeal particularly to the Radio Amateur interested in Phone and CW reception free from QRM and noise interference. It is a superhet with 1600 kc. I.F. and a Noise-Silencer "built in." It has B.F.O. and A.V.C. and marks a distinct forward design.

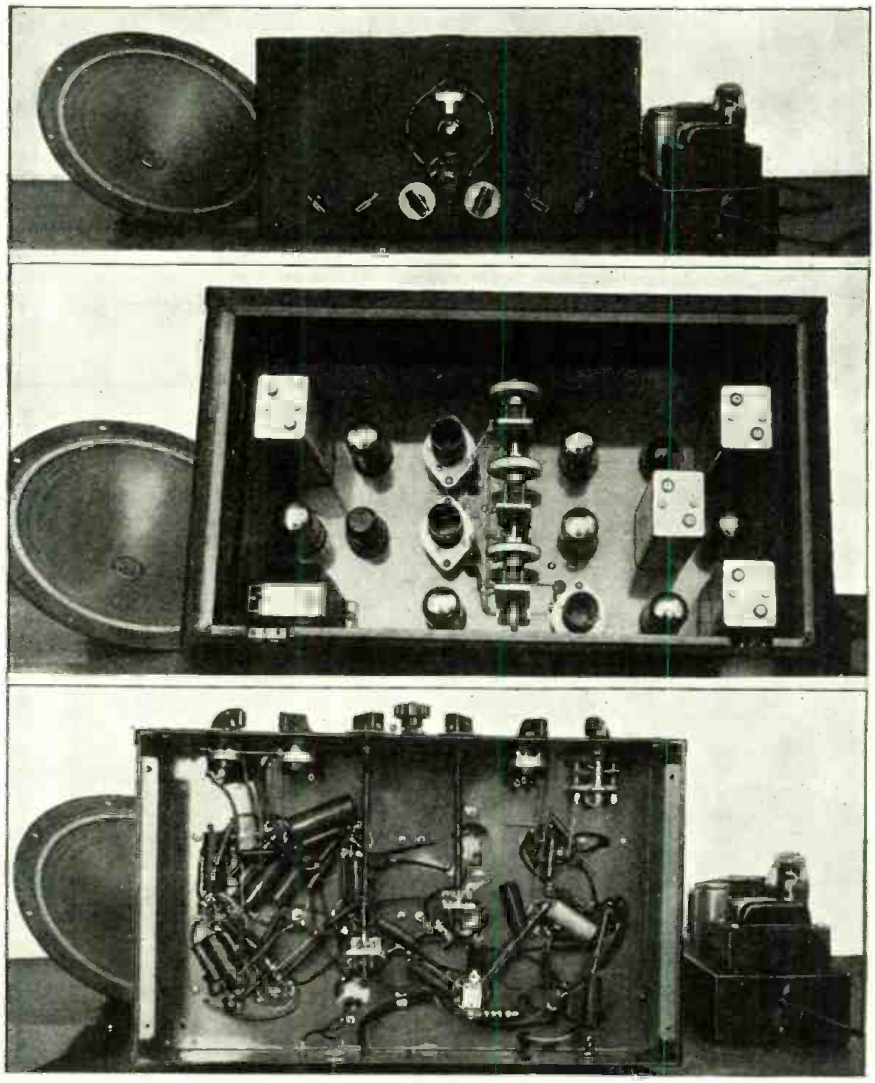
● THE problems in designing receivers for the ultra-high frequencies differ considerably from those encountered on the low-frequency bands. In the early days of 28 and 56 megacycle work, the first equipment used was adapted from the ordinary regenerative receiver and the superheterodyne. In all of the receivers the sensitivity was poor, tuning was extremely critical and difficult, and severe interference from ignition and similar noise made reception of even the strongest signals almost impossible. A big step forward was made by utilizing Armstrong's *super-regenerative* principle in ultra-high frequency receivers, which immediately provided a receiver of no mean sensitivity and a certain amount of discrimination against noise. To this circuit we pay our utmost respects because it was one of the prime factors in popularizing the ultra-high frequency bands. It was—and still is—a most extraordinary type of receiver from the point of view of maximum performance from the least possible amount of equipment.

The serious-minded amateur or listener who is primarily interested in the 5, 10 and 20 meter bands, however, will require something much better than a simple receiver. With the now established transmitter stability requirements extended to the 5 meter band, it is possible to design an effective superheterodyne circuit for these bands which will give undreamed-of results—as good or better than those encountered on the lower frequencies. The new tubes, especially the types designed for television receiving purposes, permit the construction of real high-gain ultra-high radio frequency amplifiers without the necessity of paying exorbitant prices for special tubes.

1600 Kc. I.F. Stages Employed

The receiver to be described in this article was designed especially for the amateur who is interested primarily in QRM and noise-free phone and CW reception on the 5, 10 and 20 meter bands. The I.F. transformers are of the high-gain, iron-core, air-trimmed type, tuned to a frequency of 1,600 kc. Two type 7A7 "loktal" tubes are used as I.F. amplifiers. The gain at 1,600 kc. level is extremely high—much higher than can be used practically except for the special precautions described below. The front end of the receiver starts in with a 1232 high-gain R.F. stage, which provides

Below—front, top and bottom views of Mr. Hooton's advanced design amateur receiver.



the best signal-to-noise ratio and the most gain. Both the plate and the screen circuits of the 1232 are run at rather high potentials: 300 volts on the plate and 150 volts on the screen. This is, we must admit, in excess of that recommended by the tube manufacturers, but the tube life is apparently unaffected. The difference in the sensitivity, especially on weak DX signals is tremendous. A 50,000 ohm potentiometer is placed in the screen circuit, as shown in sketch, to return the screen voltage to its normal value on signals where extreme sensitivity is not required. With the screen voltage reduced to 100 volts, the 1232 has about the same plate current as a 6K7 variable mu tube operating under normal conditions, *but produces nearly four times as much amplification.* Capacity coupling is used between the plate and grid circuits of the R.F. and mixer stages respectively, as this method is very good on the higher frequencies. Two R.F. chokes are used in series with the plate lead of the 1232, the first being a special 5 meter choke which contributes much to the R.F. gain on this band; the second is a standard 2.5 millihenry unit to permit efficient operation on the 10 and 20 meter bands.

The mixer tube is a "loktal" type 7J7 triode-hexode converter which is similar in characteristics to the older type 6K8 or 6J8G. The triode section, however, is not used as the high-frequency oscillator; another loktal type 7B7 is triode-connected and serves as an excellent oscillator. The oscillator R.F. output is fed to the coupling grid of the 7J7 through a small 50 mmf. mica fixed condenser. The mixer tube is also run at rather high screen potential—about 125 volts. This gives much greater conversion gain on the higher frequency bands and, so far as we have been able to observe in two months of actual operation, does not appreciably decrease the useful life of the tube.

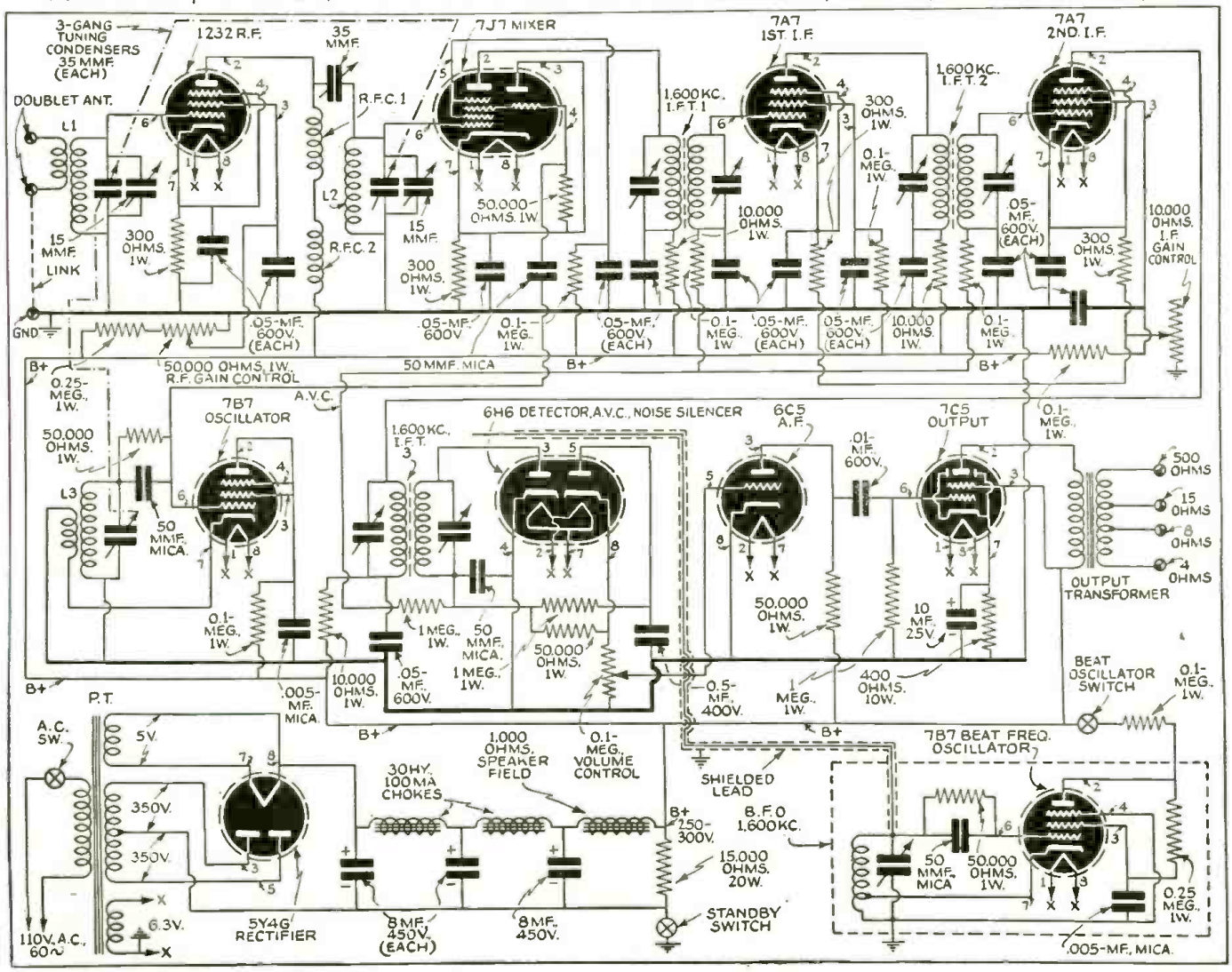
Noise Silencer "Built In"

The second detector and noise silencer tube is a metal type 6H6 although a loktal type 7A6 may be used if desired. As the diagram below shows, this portion of the circuit is extremely simple, being of the well-known automatic noise limiter type. The noise *reducing* portion really works, especially on 5 and 10 meters, where ignition noise is always encountered. The author, experimenting with the receiver at his amateur station, was able to receive numerous *weak* signals through a barrage of noise that made their reception impossible on two prominent makes of communications receivers. The A.V.C. action, taken from the detector portion of the 6H6, is applied to the two I.F. amplifier stages only. The voltage thus obtained is entirely sufficient for all normal A.V.C. purposes and, by limiting the action to the I.F. circuits only, serious detuning of the R.F. and mixer circuits on rapidly fading signals is avoided. Many hams have commented on the "steadiness" of the foreign broadcasters and others which come in with all the tone and tuning ease of local stations. A *beat oscillator*, using a 7B7 triode-connected, is provided for the reception of C.W. code signals. The output of the beat oscillator is fed to the detector portion of the 6H6 diode circuit through a small 1 mmf. capacity which is made by bringing two 1" lengths of bus wire parallel to each other and separated about ⅛". Care must be taken in adjusting the amount of coupling from the beat oscillator. If too much B.F.O. voltage is applied to the 6H6 diode, a loud hiss will be encountered; if too little is applied, difficulty will be experienced in obtaining a beat note on strong signals. It is not necessary to switch off the A.V.C. when receiving code signals; merely turn down the I.F. gain control and the effect of the A.V.C. will become negligible.

Plenty of "Gain" in A.F. Stages

A 6C5 or a 7A4 is used as the first audio frequency amplifier, being resistance-capacity coupled to the 7C5 output tube. The 100,000 ohm volume control must be a good one, because there is a small D.C. current

Here's the hookup for the new 5, 10 and 20 meter receiver, which, with its noise silencer, provides very quiet and reliable reception.



flow through the resistance element at all times during operation. Inexpensive "bargain page" controls are *out,* as these will soon become very noisy in a circuit of this type. Bias for the 6C5 stage is supplied by the 6H6 diode voltage.

The receiver is built in a National "HRO" cabinet approximately 16¾ by 8¾ by 10 inches in size. All of the cabinet space is utilized for the receiver circuits, the power supply being a separate unit built on a 5 by 2½ by 13 inch steel black crackle finish chassis. Figs. 2 and 3 show the layout of the various parts on the chassis. Care should be taken to mount every part in the exact position shown, as the design is the result of much careful experimental work in eliminating any tendency toward self-oscillation. The photographs and drawings should be studied carefully before making any attempt to wire the circuits.

Wiring the Set

Wiring the set is quite simple. First run a piece of tinned bus wire to each and every *center terminal* of the loktal sockets and ground this to the chassis *at one point only.* Run another bus line to the rotor plate terminals of the tuning condensers; ground this to the chassis and the socket ground line at *one* point only. In wiring in the various bypass condensers, lay these along the ground bus wire as close as possible to the circuits they bypass. In the original model receiver there is no bypass condenser or resistor in any part of the circuit that has a lead over *one inch* in length. If these precautions regarding short, direct wiring and careful layout are observed, no trouble from oscillation at the R.F. or I.F. levels will be experienced. Solder all joints carefully with a clean, hot, well-tinned iron and resin-core or radio solder. All wiring in the R.F. circuit is done with No. 14 round tinned copper bus wire; the I.F. and A.F. circuits are wired with the usual "push-back" hook-up wire.

Nine coils of the plug-in type, wound on 1", 5-prong low-loss forms, are required to cover the range from 70 to 10 megacycles (70,000 kc. to 10,000 kc). The range may be extended down to and including the 160 meter amateur band, if desired. For the frequencies lower than 10 mc., however, the coils should be wound on the regular 1½" forms which will permit the necessary padders and trimmer condensers to he placed right inside the coils themselves. When a new coil is plugged in, the proper value of padder and trimmer capacity will automatically be inserted in the circuit. Complete data for the coils will be found in the table at the end of this article.

Antenna

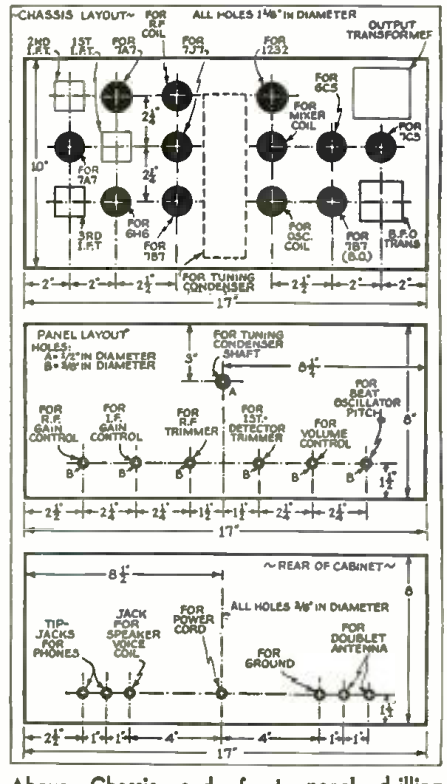
Almost any kind of antenna can be used with the set. For best reception, however, a *doublet* with a noise-reducing lead-in wire is recommended. If you use a beam antenna for transmitting excellent results will be obtained when it is used with this receiver. The author uses a simple beam antenna consisting of two half waves in phase, fed by a matching stub and 600 ohm line for 10 meter work. Comparisons between this beam and a good doublet antenna prove that signals barely perceptible on the doublet jump up to R3 to R6 when the beam is switched in. This antenna, together with its various coupling methods, will be described in connection with the W8KPX companion 5, 10 and 20 meter Cathode-Modulated Transmitter, which is scheduled for an early issue.

The author will be interested in hearing from those who build this receiver and to learn of the results obtained with it. All letters will be answered if a 3-cent stamp is enclosed for reply. Address all correspondence to the author in care of RADIO AND TELEVISION.

Coil Data

Band	Osc. Grid	Osc. Cath.	Mixer	R.F.	Antenna
56 mc.	3½	2	4½	4½	2
28 mc.	6	3	7½	7½	2
14 mc.	10½	4	12	12	3

All the above coils are wound on 1", 5-prong forms. The wire used on all coils is No. 22 enameled. The oscillator coil windings are spaced to occupy a length of 1⅛ inches; the mixer and R.F. coils occupy a space 1½ inches long. The antenna and



Above—Chassis and front panel drilling dimensions.

This transmitter, operating on the 2½ and 5 meter bands, will appeal to the average amateur, as it incorporates highly efficient circuits, while the cost of building the rig is very nominal.

C4. From the stator connection to the other side of C4 solder the coil L1. R3 and S1 are connected in series on the coil side of C4 and then to R8.

C6 is connected from the B plus side of L1 to the second grid, from which an R.F. choke and R1 is connected to ground. Plate two is connected in the same way as plate one, except that no voltage dropping resistance is used.

From the B plus side of L2, by means of the leads of the coupling condenser C7, the 6E6 tube is connected to the grid of the 809, not forgetting the R.F. choke and R4 to ground.

The audio system is very simple; first start by connecting the grids of the 6Z7G to R5 and the plates to the primary of T2, the B plus lead going to R8. The secondary of T2 connects to the grids of the 6N7G; the center tap of the transformer and the cathode of the tube go to ground. The plates connect to the primary of T3. The high voltage for the 809 is taken from the 4.500 ohm tap of T3. (This is the red wire.) The common is connected to R7.

In the audio section, all grid circuits were shielded to prevent R.F. feedback and any A.C. pick-up. The modulation transformer T3 has several taps. best results were obtained when the 4500 ohm winding was used.

The transformer T1 is connected in the conventional manner with the primary side going to an open-circuit jack, the grid side of the secondary to R5, and the other side to ground.

The 110 volt A.C. line to the power transformers is connected by first putting both primaries in parallel; one side of the 110 volt line is connected to the switch No. 1 and then to one side of the transformers; the other side of the line goes to the other side of the transformers.

If care is taken in the construction of this transmitter, you can later use it as a basic exciter for a higher powered "rig" by simply omitting the modulation for the 809, then coupling the 809 to a larger tube and adding a stronger modulation system.

The antenna used for testing was a matched single wire, strung across the room. Reports were R9 from as far as 20 miles away.

The receiver used was a converter designed by Herman Yellin (described in a previous issue of RADIO & TELEVISION) and used in conjunction with an R.C.A. Victor broadcast set.

Coil Data

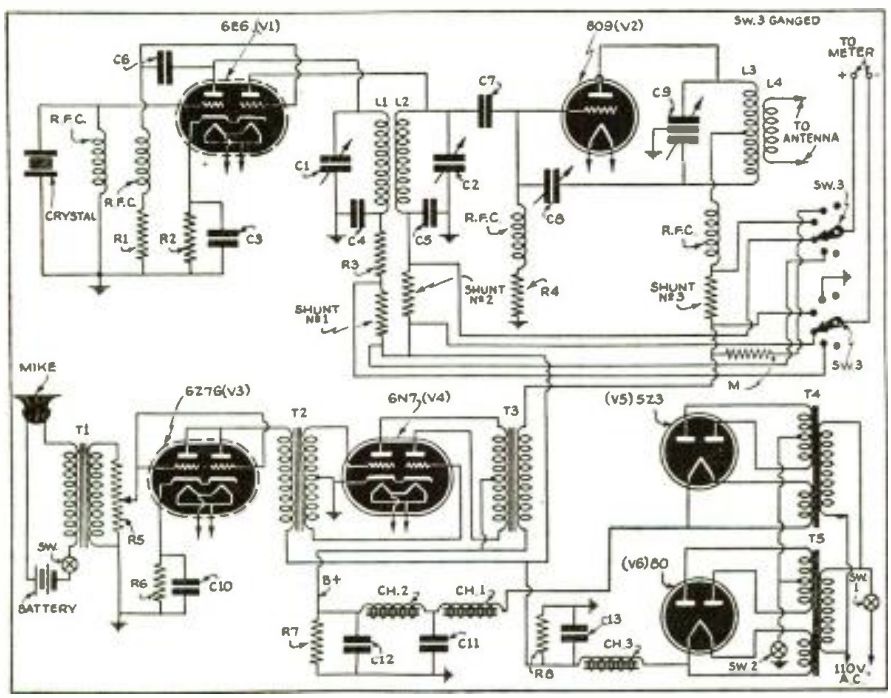
L1—9 turns No. 14 En. wire, ¾" dia. (10 meters)
L2—7 turns No. 14 En. wire, ½" dia. (5 m.)
L3—7 turns No. 14 En. wire, ½" dia., C-T (5 m.)
L4—7 turns No. 14 En. wire, ½" dia. (5 m. Ant.)
L3—3 turns No. 14 En. wire, ½" dia., C-T, spaced over 1" (2½ m.)
L4—3 turns No. 14 En. wire, ½" dia., spaced over 1" (2½ m.)

En.—Enameled.
C-T—Center-tapped.

Tuning up is not at all difficult; in fact, simpler than the majority of lower frequency multi-stage rigs. The oscillator plate condenser and coil is tuned to ten meters observed through the standard plate current dip, while the doubler plate circuit is tuned to the five meter band. Depending on whether output is desired on either five or two and a half, the proper final plate coil is inserted and the plate circuit tuned for resonance as indicated by a dip in plate current. If operating on five meters, the neutralizing condenser C8 is adjusted and the antenna connected. The small pickup coil is ideally suited for use with an antenna using a low impedance transmission line such as a twisted pair line. If the line is more than a few feet long, the writer would strongly advise the use of a concentric line, using copper tubing or a higher impedance line (500-600 ohms), employing spaced feeders. The losses of a twisted pair line are quite high on the higher frequencies and since it is always desirable to put as much power into the antenna as possible, a transmission line having a minimum of losses should be used.

The neutralizing condenser must be revamped by removing all plates but one rotor and one stator plate; then spread rotor plate slightly. The tank of the final must be neutralized when changing from one band to the other.

Hook-up of the transmitter.



Parts List

HAMMARLUND MFG. CO.
1—C1 50 mmf. condenser, MC50M
1—C2 35 mmf. condenser, MC35
1—C8 35/35 mmf. condenser, MC35SX dual
1—C9 15 mmf. condenser, HF15
1—S7 socket
1—XS 2 crystal socket
4—RFC CH-X chokes

I.R.C. (Resistors)
1—R1 30,000 ohms, BT1
1—R2 400 ohms, BT1
1—R3 2,000 ohms, BT½
1—R4 5,000 ohms, BT2
1—R5 .5 meg. potentiometer
1—R6 2,000 ohms, BT1
1—R7 25,000 ohms, DG
1—R8 25,000 ohms, EPA

RCA (Tubes—All Glass)
1—6E6
1—809
1—6Z7
1—6N7
1—5Z3
1—80

TRIPLETT
1—321 0-1 D.C. milliammeter
2—25 ma. shunts—S1, S2
1—150 ma. shunt—S3
1—½ meg. multiplier, M

BUD
Panel 1254A
Cabinet 694
Chassis 660
Insulators 931 (6)
Stand-off insulators 435 (4)
Dials 711 (5)

THORDARSON
1—T58A37
1—T17M59
1—T67D47
2—T74C29
1—T16C07
1—T70R78
1—T92R21

BLILEY
1—HF2 unit 28128 kc.

CORNELL-DUBILIER
1—C3 .002 mf. condenser
1—C4 .02 mf. condenser
1—C5 .02 mf. condenser
1—C6 .00005 mf. condenser
1—C10 .5 mf. condenser
1—C11 12 mf. condenser (dual)
1—C12 12 mf. condenser
1—C13 16 mf. condenser (dual)

MALLORY
2—Circuit, six-position switch, SW3—3226J
2—SPTS snap switches, SW1, 2

AMPHENOL (Sockets)
1—RSS4 steatite socket
2—RS8 sockets
2—RS4 sockets

Principles of Frequency Modulation

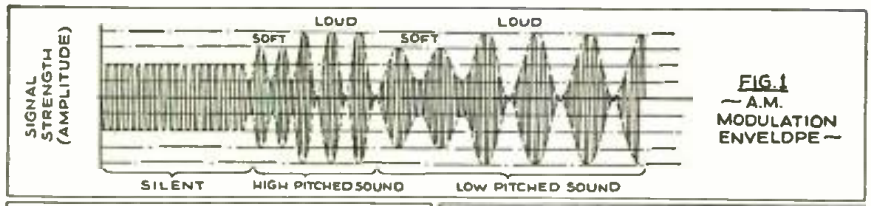


FIG. 1 — A.M. MODULATION ENVELOPE —

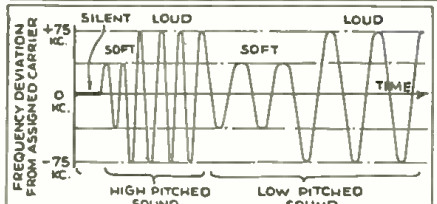


FIG. 2 — FM FREQUENCY DEVIATION —

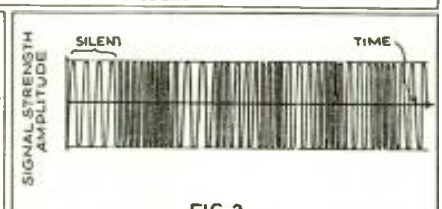


FIG. 3 — F.M. MODULATION ENVELOPE —

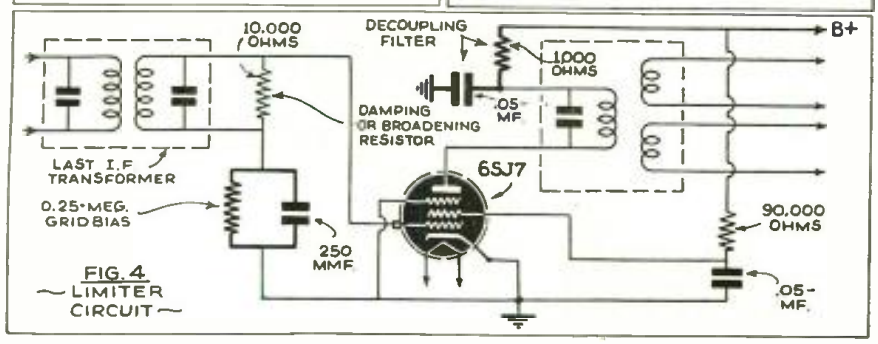


FIG. 4 — LIMITER CIRCUIT —

The difference between frequency and amplitude modulation is readily apparent by looking at the graphs.

● ***Basic Principles.*** The essential difference between the common radio transmission of today and the new F-M transmission is in the method of modulating the carrier wave. All the well-known principles of radio are applied to F-M transmission and reception. The differences between the new F-M and the older systems are relatively small. These differences are, however, important ones.

As you already know, the common system in use today makes use of *amplitude* modulation of the carrier wave. Reference to Fig. 1 shows how, as the volume of sound to be transmitted increases, the amplitude of the modulation envelope increases. As the frequency of the sound transmitted increases, the rate at which amplitude changes take place, increases. Naturally the reverse is also true: that is, softer sounds decrease modulation envelope amplitude and lower pitch sounds decrease the rate at which amplitude changes take place.

In the new Frequency Modulation system, the carrier transmitted is always of the *same amplitude*. We will see, in a moment, wherein lie the advantages of this modulation system and what "tricks" it makes possible in the receiver vastly to improve reception.

Let us refer to Fig. 2 and note how the transmitted frequency is made to vary more, away from steady unmodulated carrier frequency, for louder sounds than for softer ones. A high pitched sound will cause these excursions of carrier frequency to take place at a more rapid rate, in proportion to the sound pitch. The *modulation* envelope is shown in Fig. 3. Note in Fig. 3 that silence is transmitted as the undeviated carrier frequency and at exactly the same amplitude as the rest of the signal.

To summarize then: in *frequency modulation* the amount of deviation from carrier frequency is governed by the loudness of the sound to be transmitted; and the number of times that the frequency will be deviated that far during each second is governed by the pitch or frequency of the original sound.

A close study of Figs. 1, 2 and 3 at this time will repay you richly in understanding what is to follow.

The F-M Receiver: Having studied and understood the basic principles of F-M radio broadcasting as outlined above, we are now in a position to take up that which concerns us the most—the F-M receiver. Most of us will need to know about the F-M receiver (not the transmitter) and it is just as easy to take it up before studying the transmitter—so why not?

We find that all the F-M receivers so far marketed are superheterodynes. A tuned radio frequency F-M receiver can be made, but it would require such a clumsy multi-gang tuning condenser as to be expensive and difficult to build.

The superheterodyne principle, as applied to F-M receivers, is the same as you are already familiar with in the common radios of today. The only differences are to be found in the band pass characteristics. The F-M receiver is conventional, except for wider band pass, up to the last I.F. stage. This last I.F. stage acts as a *noise limiter.* It is in effect an *amplitude gate,* yielding a constant amplitude output—but more of that later. The limiter I.F. stage is followed by the *discriminator* stage. The discriminator stage takes the place of the conventional second detector and translates the frequency excursions of the carrier back into audio frequencies of the conventional type, with which you are already familiar. The discriminator stage is followed by a conventional high-fidelity audio amplifier and loud-speaker.

Receiver Band Pass Characteristics: Since the *frequency modulated* wave experiences excursions or deviations of as much as 75 kc. from the central carrier frequency (both + and —) the R.F. mixer, and I.F. circuits must have a fairly flat response over a band width of 150 to 200 kc. This is no problem in the R.F. circuits because, at frequencies between 42 and 50 mc., R.F. circuits employing conventional tubes and components are that broad inherently. In the circuits operating at I.F. it is more of a problem, but it is solved in practice by closer coupling in the I.F. transformers. Actual flat response is not essential for perfect reproduction because the limiter tube will iron out all amplitude distortion caused in the I.F.'s, provided it is not too bad and provided ample signal is available at the limiter. So, you see, the I.F.'s don't have to be "flossy," expensive jobs to give *perfect* reception. The *limiter* actually irons out all the distortion as indicated above.

The Limiter Stage: The function of the limiter is to "iron-out" all signals fed to it to the *same amplitude.* The limiter reduces noise, which is all amplitude modulated, to a negligible strength; this includes man-made and natural static interference; it also eliminates any fading. The limiter must have a strong signal fed to it in order to function (about 5 volts).

It may be truthfully said that the whole "reason for existence" of the F-M system is the function performed by the limiter. No corresponding action is possible with the old A-M system. The dream of radio engineers for two decades—a static eliminator—has been born!

The circuit of the limiter (see Fig. 4) resembles very closely the conventional I.F. stage. The values of plate and screen voltage are low (70-80 v.) and no initial control grid bias is applied. The limiter tube will overload very easily in one direction and will reach plate current cut-off just as quickly in the other direction. Thus strong signals of varying amplitude fed to it are put out at constant amplitude. Fig. 5 shows the action of the limiter in removing noise pulses and ironing out amplitude distortion introduced by fading or the I.F.'s.

Written Expressly for the Amateur, Serviceman and Experimenter Already Familiar with Amplitude Modulated Radio.

Ricardo Muniz, E. E.*

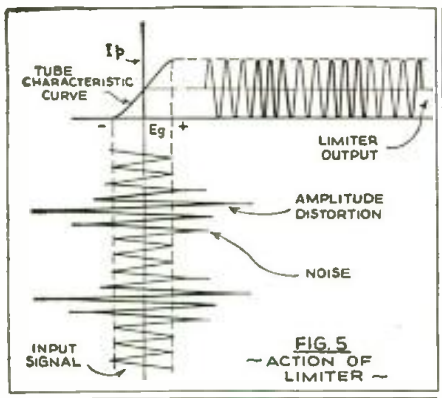


FIG. 5 —ACTION OF LIMITER—

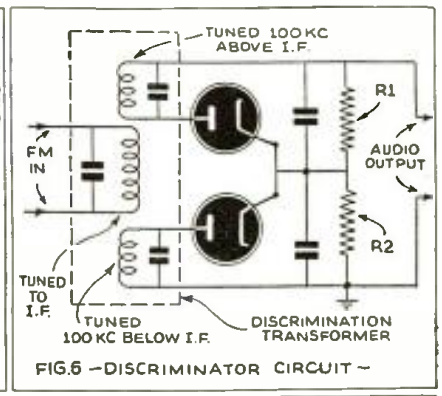


FIG. 6 —DISCRIMINATOR CIRCUIT—

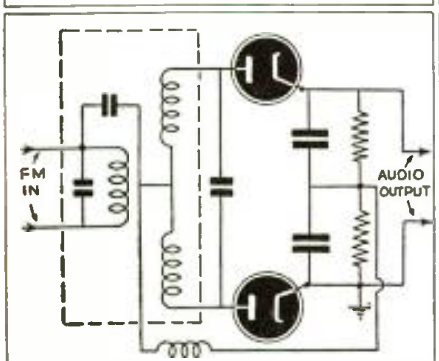


FIG. 7 —DISCRIMINATOR CIRCUIT—

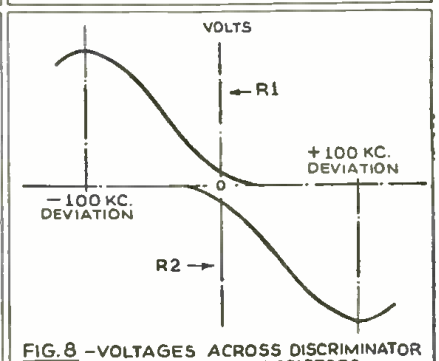


FIG. 8 —VOLTAGES ACROSS DISCRIMINATOR DIODE LOAD RESISTORS—

The action of the "limiter" is shown in Fig. 5. Typical "discriminator" circuits are shown at Figs. 6 and 7, and Fig. 8 shows the voltages across discriminator network.

The Discriminator Stage: The function of the discriminator stage is to translate the frequency excursions or deviations of the carrier, due to modulation, back into conventional *audio* frequencies. Two discriminator circuits are shown in Figs. 6 and 7. The one shown in Fig. 7 is a very common commercial type. Fig. 6 is one simple to explain, and is used in the R. & T. "F-M" adapter and receiver described by the author in the June and July issues of RADIO & TELEVISION.

Referring to Fig. 6, we see that two staggered tuned circuits are used. The primary of the discriminator transformer is tuned to the I.F. One secondary is tuned 100 kc. above the I.F. and the other 100 kc. below the I.F. At any one instant only one frequency exists in the system. The voltage developed across the diode load depends upon the magnitude of the difference between this frequency and the center-carrier frequency. In other words, as the frequency approaches the resonant frequency of the staggered tuned circuit, more voltage is built up across it and therefore more voltage appears across the corresponding diode load.

A plot of voltage across the diode load resistors with different deviations from center-carrier is shown in Fig. 8. As the frequency swings become greater, the voltage across the load resistors is greater. Thus frequency changes or modulation are translated into amplitude voltage changes.

The explanation of the action of the discriminator circuit, shown in Fig. 7, involves a complex consideration of phase relationships. The resulting voltages across the diode load resistors are the same, however, and the function is one of translation from F-M to audio, the same as above. The reader is referred to any of the recent books, for servicemen, on F-M* for a detailed explanation if it is desired.

The Audio Amplifier: The transmissions over F-M stations are pre-distorted. The higher audio frequencies are emphasized to further improve the signal-to-noise ratio in reception. The audio amplifier is usually preceded by a corresponding distorting network. Its function is to cut *highs* in a manner corresponding exactly to the emphasizing which took place at the transmitter. The result is "flat" audio. This flat, or "high fidelity," audio is then fed to a high-quality audio amplifier of conventional design. Usually a better than "run-of-the-mill" loudspeaker is supplied—one with adequate high response and with sufficient acoustic loading (baffle) to ensure reproduction of *lows*.

F-M Transmitters: Next month the author will endeavor to explain the operation of several types of F-M transmitters. Various systems of *modulation* are now being employed to obtain the frequency modulated wave. A system suitable for *amateur* use will be included.

*Engineer WNYE (41.1 mc—500 w.) the Board of Education Station at the Brooklyn Technical High School. Teacher Applied Electricity at Brooklyn Tech and faculty adviser Television Club.

*See Rider's "F-M for Service Men."

Building a Good MOBILE 5 & 10 Meter Converter

F. J. Gaffney*

● THE circuit diagram of the Converter is shown in Figure 1. A 6K8 tube is used as the converter, it having been found to give the most satisfactory high frequency response. A Colpitts oscillator circuit is used, the feedback voltages being developed across mica condensers in series with the coils. The use of a single tube minimizes drain on the automobile receiver vibropack[1] and, with a moderately sensitive receiver, provides adequate sensitivity on both 5 and 10 meters. A 4 pole double throw switch is used for change-over on both oscillator and antenna coils. This switch is of the single wafer type having 12 contacts. This type of switch takes a minimum of space and in addition allows very short leads to the points being switched. A DPDT wafer type switch is used for antenna change-over. The filament switch is a small snap type switch mounted on the rear of the cabinet. Both tuning and trimmer condensers are Isolantite insulated air condensers thus affording a maximum of stability as well as minimum losses. Coils are wound on low-loss hard rubber coil forms and are rigidly mounted. So that the receiver may be tracked on any intermediate frequency (that is with the receiver set at any frequency from 550 kc. to 3 mc.) the antenna trimmers are brought through the cabinet to adjusting knobs.

*Browning Laboratories, Inc.

[1] This 5 and 10 meter converter is particularly well suited to mobile operation, but in localities where police departments or other municipal, county, state or federal agencies have regulations governing the use of mobile receiving equipment, special authorization must be secured from such agencies before equipment of this sort is installed.

The construction of the Browning 5 and 10 meter converter starts with the mounting of the band switch, the coils and condensers. These are all mounted on the right side of the cabinet. The band switch is mounted in the vertical center of this side and located 3¼" back from the front panel. Two double terminal strips are mounted about ½" from the front and rear of the cabinet, and the coils are mounted between these terminal strips and the switch. One exception to this is the 5 meter oscillator coil which is mounted between the terminal strip and the trimmer condenser for the oscillator section of this band. The reason for this is to keep the 5 meter oscillator coil at right-angles to the 10 meter oscillator coil in order to prevent interchange of energy between the two circuits. The trimmer condensers are mounted on flat metal strips which are then fastened by self-tapping screws to small brackets spot welded to the cabinet. The antenna trimmer for the 5 meter band is located directly above the band switch, while that for the 10 meter band is directly below the band switch. The two oscillator trimmers are positioned 1¼" to the left of the antenna trimmers. A completed coil and trimmer assembly is shown in Figure 2. This picture also shows the antenna throw-over switch mounted on a flange on the left side of the cabinet.

A common ground connects the rotors of all condensers together and to a single point on the chassis. The feed-back condensers for the two oscillator coils are connected from the lower end of the coils to this bus bar ground. No. 18 solid wire should be used for all connections and lead lengths should be kept at an absolute minimum.

When the mounting and wiring of the coil assemblies has been completed the next step in the assembly is to wire the connections to the 6K8 tube and its associated components. Nearly all of the components other than those mentioned above are mounted on a sub-panel which is then assembled to the bottom of the cabinet by means of two self tapping screws. The sub-panel is in the form of an L-shaped bracket, a drawing of which is shown on Figure 3. This bracket serves to mount the tube socket and its associated components on the rear, while the front of the bracket supports the front end of the tuning gang. A rear view of the wired sub-panel is shown in Figure 4. Two double terminal strips are mounted on this sub-panel. The antenna is fed to one of these connectors while the output of the converter is fed from the other connector to the antenna connection on the receiving set. All lead lengths are to be kept to a minimum.

The tuning gang consists of two 28 mmf. Isolantite insulated air condensers coupled together by means of a flexible coupling. The condensers are mounted on the front of the cabinet and the sub-panel respectively and held in place by 4-36 flat-head mounting screws. Two screws are used to mount each condenser. Before mounting the

Fig. X—The completed 5 and 10 meter converter. Fig. 5—Interior view of converter. Fig. 1—Diagram of converter.

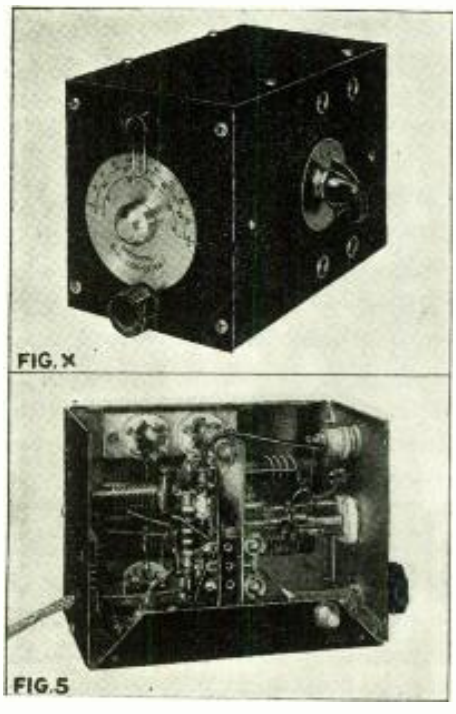
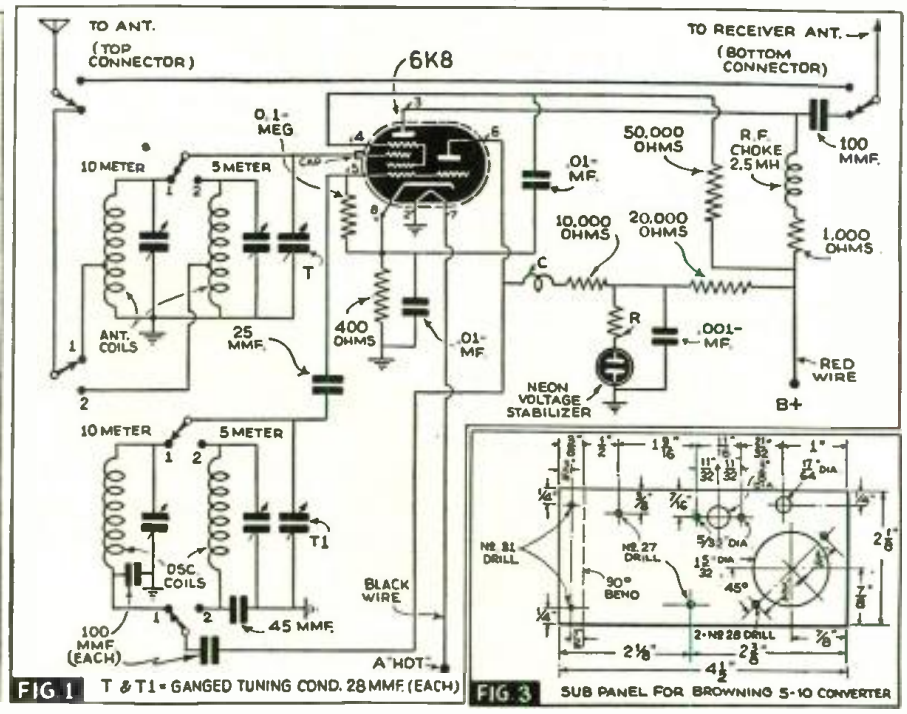


FIG. X

FIG. 5



condensers the tails of each condenser shaft must be adapted to take the ¼" inside diameter flexible coupling. This is done by reaming two ¼" spacers to fit the tails of the condenser rotors and sweating these spacers on to the tails of the rotors. The condensers are then mounted as indicated above, the flexible coupling being slid on to the rotor of the oscillator section before the antenna section is mounted on the front of the cabinet. The coupling is then fastened with both tuning condensers set at maximum or minimum capacity. The rotors of the two condensers are then connected together and to the bus bar ground and the stators are connected to the proper points on the band switch.

The oscillator stabilizing neon bulb together with its dropping resistor are then connected in series across a 1000 mmf. mica condenser of the postage stamp variety and are affixed to the same by means of sealing wax. This condenser is then mounted between ground and lower end of the 20,000 ohms dropping resistor which feeds from +B to the oscillator plate circuit. Two double terminal strips are mounted on the base of the cabinet just behind the subpanel to carry the 20,000 ohm resistor.

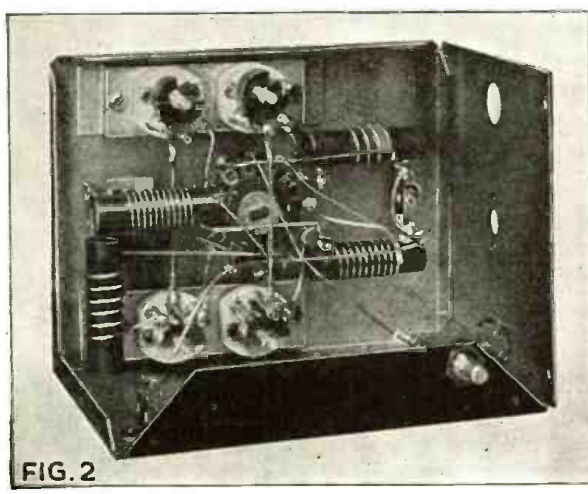
The shielded lead that carries the +B and filament connection is then connected through a rubber grommet in the back of the cabinet. The shield is connected directly to ground, while the +B is connected to the appropriate point on one of the terminal strips. The filament connection is made through the snap switch which mounts on the rear panel to one filament pin of the 6K8. The other filament pin is grounded.

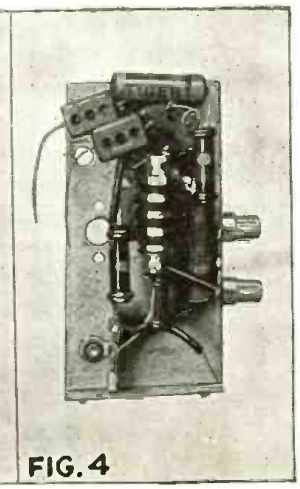
The dial is set so that the low frequency end of the bands coincides with the position of the tuning condensers at maximum capacity and is locked in place by means of the set-screw in the hub.

The antenna is changed from the input to the regular receiver to the Converter input, while the output of the Converter is plugged into the antenna input of the short wave receiver.

To operate the Converter, the oscillator trimmer of the 5 meter band is set about half way in, while that of the 10 meter band is set about one-third maximum. So that the positions of these condensers will be known, it is convenient to paint a small red dot on the adjusting screw of each condenser before the unit is assembled in such a position that when the dot is at 3 o'clock the condensers are fully in mesh.

With the antenna connections made as described above and with the throwover switch in such a position that the Converter is operative, the antenna trimmer on the band being worked is varied until maximum hiss is heard in the loud speaker, the dial is rotated until a signal is heard and the antenna trimmer on the band being worked is adjusted for maximum signal.





Another interior view and a close-up of the wired sub-panel.

Planning the AMATEUR Transmitter

Edwin F. Dillaby, W1DWY* and Vinton K. Ulrich*

● WHEN planning to build a transmitter, the radio amateur generally has a difficult time to select desirable circuits and tubes because of the multitude of designs. Further complications are encountered since it is generally desirable to plan the first transmitter in such a manner as to utilize the original parts and tubes in later designs.

The purpose of this article is to show the amateur how he can start off with a simple design and gradually increase the power and flexibility of his transmitter, so that the ultimate design will incorporate all parts previously purchased. Specific circuit details in most cases are being omitted purposely, since individual "Hams" have certain ideas that they wish to adopt in their designs. In addition, current radio magazines and radio handbooks contain more than ample circuit information.

When planning a transmitter, that will at a later date be revised and made into a larger unit, it is essential that not only the radio frequency circuit be considered, but also the power supplies and the modulator equipment if a phone transmitter. Consequently, in many cases, excess power capability will be used in the power supply since, at a later date, this capacity will be fully utilized.

While this article has been built around Hytron transmitting types because of the writers' familiarity with these tubes, the same reasoning can be applied to other tubes. The amateur should, however, be careful that adequate driving power be allowed for when using tubes that require more grid driving power. All designs are based on *continuous-service* ratings so as to obtain full life from the tubes—the most economical procedure in the long run.

*Hytronic Laboratories, Salem, Mass.

160 Meter "Rig" for Beginners

The beginner will generally go on the air on 160 meters to begin with and for that reason, the first suggested transmitter is for 160 meters. Figure No. 1 shows the simplest design, which is a crystal-controlled oscillator coupled directly into the antenna. On C.W. the output will be approximately 15 watts when a 6L6GX transmitting type is employed. A 400 volt power supply capable of delivering at least 100 ma. is necessary. Since later designs call for a 400 volt, 250 ma. power supply (P.S. No. 1), it is advisable that the "Ham" build one of this capacity, even though for the present the full power will not be utilized. Or the high voltage supply (P.S. No. 2) may be employed with a voltage dropping resistor.

The band on which the crystal and tank circuits operate are shown above as a guide to the amateur. In Fig. 1, the designation shows that the crystal and the tank are on the same waveband, which may be 40, 80, or 160 meters.

Figure No. 2 shows the second step in this planned program of transmitter construction. The 6L6GX oscillator drives a neutralized HY3OZ, triode power amplifier. With a 160 meter crystal, a power output of approximately 61 watts is obtainable for C.W. operation on both 160 meters and 80 meters.

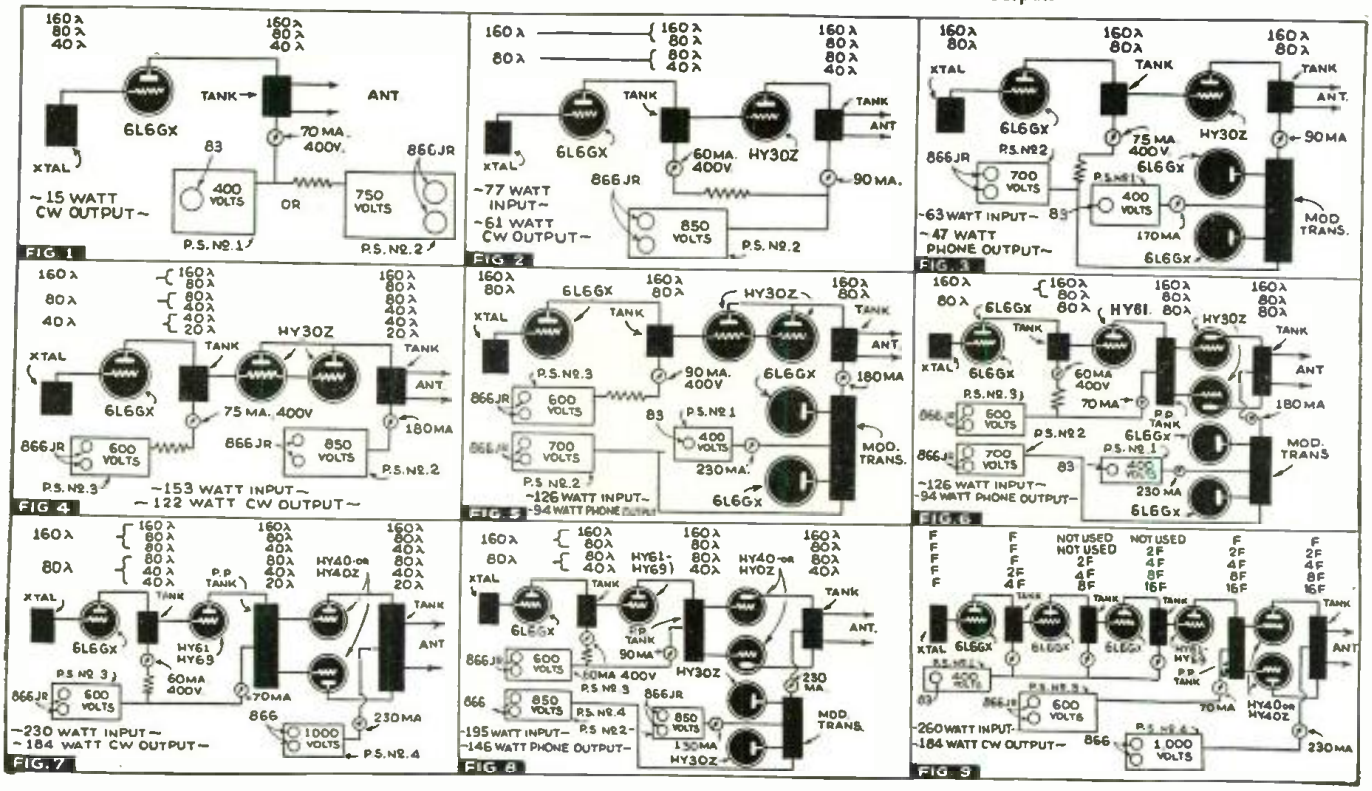
When the 6L6GX is used with the HY3OZ amplifier, it is possible to operate the oscillator from the final amplifier power-supply by using a resistor to drop the voltage down to the required value. A single HY3OZ has a maximum rating of 90 ma. but the supply should be designed to handle two tubes, since, at a later date, this addition will be made to the transmitter. With an 850 volt, 200 ma. supply, the output is more than sufficient to handle both the oscillator and the final amplifier stage.

All through these constructions, the oscillator crystal is being specified for 160 meters. Naturally, if the amateur is not interested in 160 meter operation, an 80 meter or a 40 meter crystal can be employed with outputs at higher frequencies.

After becoming acquainted with C.W. operation, the amateur very often has a desire to operate the transmitter on phone. Therefore, the addition of a modulator is in order and Figure No. 3 shows this transmitter. For a single HY3OZ tube, approximately 30 watts of audio modulator output are ample. Two 6L6GX tubes in Class AB_1 operation will deliver this power. The modulator power supply requirements are a 400 volt unit, capable of delivering approximately 175 ma.

The power supply for a 6L6GX oscillator and HY3OZ amplifier are the same as in Figure No. 2.

Diagrams below show Fig. 1—15 watt CW transmitter; Fig. 2—61 watt CW rig; Fig. 3—47 watt phone line-up; Fig. 4—122 watt CW output rig; Fig. 5—94 watt phone output layout; Fig. 6—block diagram for 94 watt output; Fig. 7—184 watt CW output; Fig. 8—a phone transmitter for 146 watts phone output; Fig. 9—CW Xmitter for 184 watt CW output.



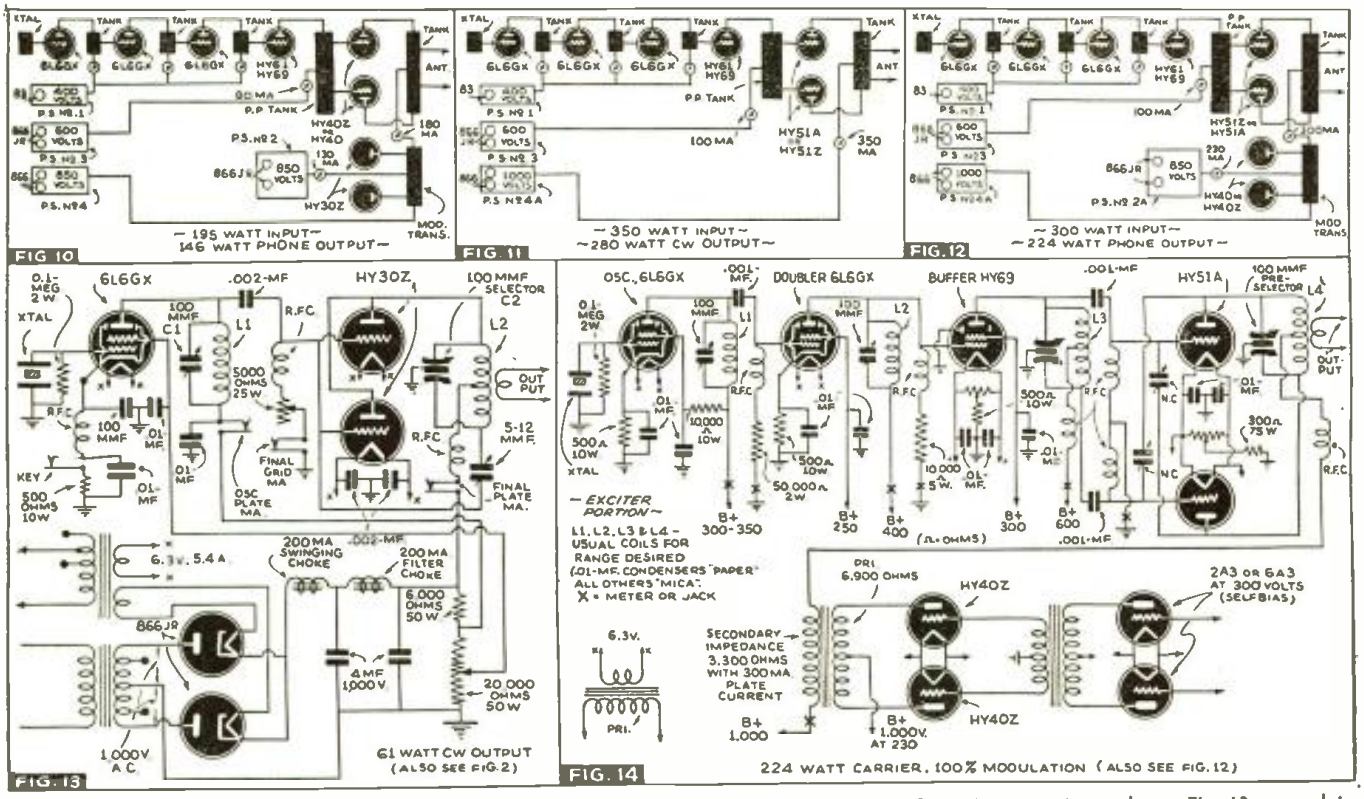


Fig. 10—phone Xmitter of 146 watts output; Fig. 11—280 watt output CW rig; Fig. 12—set-up for 224 watts output, phone; Fig. 13—complete diagram of 61 watt CW output transmitter (refer also to Fig. 2); Fig. 14—phone Xmitter of 224 watts output (refer also to block diagram, Fig. 12).

Although a 61 watt signal is ample to begin with, it is not long before the amateur yearns for additional power. When the transmitter has been designed in accordance with a definite program, it is a simple matter to take this step at a relatively low cost.

At the lower frequencies, parallel operation is entirely satisfactory and as efficient as push-pull. The logical step is, therefore, to use two HY3OZ tubes in parallel in the output amplifier as shown in Fig. No. 4. The only changes required in the transmitter are the addition of a socket and a power-supply to take care of the oscillator. Since the two HY3OZ tubes will be drawing 180 ma., it is no longer possible to take the oscillator plate supply from the 850 volt power unit without overloading it. In the next design, the use of a type HY61 or HY69 buffer-doubler is contemplated. This tube requires a total of 110 ma. at 600 volts, so by looking ahead, a 600 volt power-supply, capable of delivering approximately 200 ma., is utilized for the 6L6GX oscillator in Figure No. 4, the voltage being dropped to 400 through a series resistor or bleeder. Power supply No. 1 can also be used.

With parallel tubes in the output stage, the carrier ratings will be doubled. Therefore, for both 80 and 160 meters, the C.W. output ratings will be 121 watts.

More Power and How to Modulate It

The *phone* hound will naturally want to modulate this transmitter and the use of two 6L6GX tubes is most desirable as shown in Figure No. 5. Operated in Class AB_2, the 6L6GX tubes deliver about 60 watts audio. At this rating, 250 ma. at 400 volts is essential. With the HY3OZ's drawing 180 ma., the high voltage power supply is almost delivering full output. Likewise, full output of the 400 volt supply is needed for the 6L6GX tubes. This means that the oscillator must have a power-supply of its own, since it is impossible to put additional loads on the other two power-packs. Therefore, power supply No. 3 is used for reasons previously explained.

After a year's time, the new amateur is about ready to go on 80 meter phone, after obtaining a Class "A" amateur ticket. The designs shown so far are suitable for phone operation on the *fundamental* of the crystal only. Not wishing to discard the 160 meter crystal, the "Ham" generally considers adding a *buffer-doubler* arrangement to the transmitter. Figure No. 6 shows this circuit using an HY61 or HY69 tube between the oscillator and the push-pull HY3OZ output tubes. The power amplifier has been made push-pull since the use of a buffer makes this arrangement very practical. The type 6L6GX tubes are still utilized as *modulators*. In this design, the 600 volt power supply furnishes plate voltage for both the oscillator and the buffer stage. For 80 meter operation, the tank circuit of the oscillator is tuned to 80 meters and the HY61 or HY69 operates as a regular buffer, no neutralization being necessary since the HY61 and HY69 tubes are fully shielded for use at radio frequencies.

In Figure 6, the wavelength markings mean that a 160 meter crystal can be used with oscillator output tuned to either 80 or 160 meters and the rest of the transmitter operating on the same wavelength. Also, an 80 meter crystal can be used for 80 meter operation.

C.W. operation with 40 meters is possible even when using a 160 meter crystal. Such operation is obtained by using the type HY61 or HY69 tube as a doubler, giving output on 40 meters.

Push-Pull and Still Higher Power

As interest in amateur radio and operating increases, the desire for a more powerful transmitter manifests itself. The step from push-pull HY3OZ tubes to push-pull HY4O or HY4OZ types is not exceedingly difficult although somewhat more expensive than the previous improvements as shown in Figures No. 7 and No. 8.

Fortunately, the type HY3OZ tubes, previously used in the R.F. circuit, make excellent modulators for a pair of HY4O or HY4OZ tubes. Therefore, the type HY3OZ tubes and their power supply are moved into the modulator section of the transmitter and the 40 watt triodes are placed in the final amplifier. For C.W., these tubes require 1,000 volts at 230 ma. A 250 ma. supply is standard (P.S. No. 4) and is the one suggested for use. If HY51A's or HY51Z's are to be used later, then P.S. No. 4A should be used—also, P.S. No. 2A should be used for the HY3OZ's.

In the interests of long-life and dependable operation for phone operation, the plate voltage on the final amplifier should be dropped down to 850 volts. It is, therefore, desirable that a transformer having taps for this voltage be utilized.

184 Watts C.W. or 146 Watts Phone

As it stands, the transmitter in Figure No. 8 will deliver a C.W. signal of 184 watts into the antenna on 160, 80 and 40 meters when using a 160 meter crystal, and a phone carrier output of 146 watts is obtainable on both 80 and 160 meters. These ratings, as well as all the others, are conservative and based upon *field tests* and can be duplicated and achieved by the average amateur.

If desired, the oscillator in Figures No.

7 and No. 8 can be operated from the 400 volt, 250 ma. power-supply, thus putting it on a separate power pack.

Operation on 10 and 20 meters can be obtained through the use of 6L6GX doublers. In transmitter No. 5 and No. 6, these tubes were utilized as modulators and when transmitter No. 8 came into being, were discarded, and are now, therefore, available for use in frequency multipliers. Furthermore, the power supply used with the 6L6GX modulators is now available for use in the doubler stages and oscillator. Circuit No. 9 with its doublers can be operated on all amateur bands when suitable plug-in coils are employed. Circuit No. 10 is for phone operation and otherwise identical to No. 9. This transmitter, incidentally, makes use of all the tubes and power packs utilized in previous designs. Furthermore, all tuning condensers and tank coils are used in one way or another.

In Figure No. 9, the frequency of operation in the various stages is shown as harmonics of the crystal fundamental. Note that for final amplifier operation on F the doublers are not used, while on 2F only one doubler is needed.

The ultimate design, using the Hytron transmitting types, has a power amplifier using push-pull HY51A or HY51Z triodes. On C.W. these tubes can be loaded to 350 watts input as shown in Figure No. 11 and the carrier output will be approximately 280 watts. For radio telephone (Figure No. 12), the plate current must be reduced to 300 ma. Naturally, somewhat less power is obtainable on phone, for this reason.

For 100% modulation on the final amplifier, using HY51 tubes, a pair of HY4O or HY4OZ tubes is needed. Therefore, it is possible to still use the HY4O series in the transmitter after they have been replaced with the HY51 series in the power amplifier stage.

To fully utilize the capabilities of the HY51 series, a power-supply capable of delivering 1,000 volts D.C. at 350 ma. should be used on C.W. If this transmitter were wanted from the beginning, it would have been advisable to have built a power-supply capable of delivering these currents, even when using the type HY4O series, for later, it would be suitable for use with the HY51 series.

Then, the 850 volt power supply No. 2A could be used with the HY4O series in the modulator. With 850 volts on the plate, the type HY4O series will deliver some 145 watts audio power. To fully modulate a pair of HY51 series tubes at full output, 145 watts of audio is more than adequate.

With the exception of the changes in the final amplifier and modulator tubes, circuit No. 10 is identical with circuit No. 12.

The foregoing has shown how it is possible to start with a single tube transmitter and gradually increase its size until it is capable of delivering a power output of 280 watts on C.W., or 224 watts on phone. Both of these signals are considerably greater than the average "Ham" utilizes. Furthermore, with a good receiver and a capable operator, these powers are more than adequate for amateur communication.

Tables I and II give data on the power supplies and the units needed for each circuit. When contemplating the use of HY51 series tubes, power supplies 2A and 4A should be used at the beginning in place of 2 and 4.

In addition, it is possible to skip the in-between stages if desired. When planning on the HY51 series in the output amplifier, it will probably be best to omit the use of HY3OZ tubes and use HY4O series tubes in Figures No. 2, No. 3, No. 4, No. 5 and No. 6. Then the next step would be the use of HY51's with the HY4O series as modulators.

Plate and filament transformers having suitable ratings for the 12 transmitter circuits are available, although in some instances it may be necessary to change the primary taps as well as the secondary to get correct voltages.

POWER SUPPLY—TABLE I

Circuit	1	2	2A	3	4	4A
1-CW		x				
2-CW		x				
3-P	x	x				
4-CW		x		x		
5-P	x	x		x		
6-P	x	x		x		
7-CW				x	x	
8-P		x		x	x	
9-CW	x			x	x	
10-P	x	x		x	x	
11-CW	x			x		x
12-P	x		x	x		x

CW=Code.
P=Phone.

TABLE II

Unit	Ma.	V_1	V_2	V_3	Fil.	Fil. Rect.
1	250	400	—	—	6.3V. @ 3A	5V. @ 3A
2	200	850	700	—	6.3V. @ 5.4	5V. @ 3A or 2½V. @ 6A
2A	250	850	700	—	7.5V. @ 5A	5V. @ 3A or 2½V. @ 6A
3	200	600	—	—	6.3V. @ 2.5A	5V. @ 3A or 2½V. @ 6A
4	250	1000	850	—	7.5V. @ 5A	2½V @ 10A
4A	350	1000	850	—	7.5V. @ 7A	2½V. @ 10A

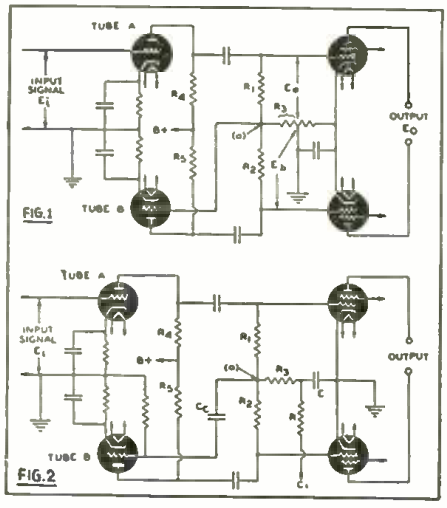
1250-0-1250 volt A.C. winding delivers approx. 1000 volts D.C. output from filter
1000-0-1000 volt A.C. winding delivers approx. 850 volts D.C. output from filter
900-0- 900 volt A.C. winding delivers approx. 700 volts D.C. output from filter
750-0- 750 volt A.C. winding delivers approx. 600 volts D.C. output from filter

A SELF-BALANCING PHASE-INVERTER CIRCUIT

● A SELF-BALANCING phase-inverter circuit that has been used in other countries for some time with good success, is shown in Fig. 1, says a recent statement of the RCA Mfg. Co. Resistor R_3 is connected between ground and point (a) and is common to the plate circuit of tube A and to plate and grid circuits of tube B. Because of this common connection, the magnitude of the signal voltage across R_3, which is applied to the grid of tube B, depends on the difference between the values of output-signal currents of tubes A and B. Hence, the effects of variations in the value of R_3 or the effects of possible variations between different tubes of the same type used in position B are very small. The circuit is degenerative, because a portion of the output of tube B is fed back to the input of tube B. It should be noted that the gain measured from the input (E_i) to tube A to the output (E_o) from the transformer's primary is only a few per cent less than that obtained from the usual circuit.

The ratio E_a/E_b cannot be made equal to unity with this self-balancing circuit by any adjustment of the value of R_3, because of the degenerative action. However, with the values of resistors ordinarily employed in this circuit, E_a/E is approximately 1.1; a 10 per cent unbalance in the push-pull output stage of a radio receiver can be tolerated easily. An analysis of the circuit shows that, as the gain of tube B is increased, the ratio E_a/E_b approaches unity.

Values and tolerances of resistors R_1, R_2, R_4, and R_5 that are usually employed in phase inverters may be used in the self-balancing circuit. The value of R_3 is not at all critical; its value may be changed by a factor of 5 with small change in overall performance.



Tests were conducted in an amplifier using a 6Q7 (tube A), a 6F5 (tube B), and two 6V6's connected in push-pull in the output stage. The amplifier was connected as shown. The values of R_1, R_2, R_4, and R_5 were 0.25 megohm each; the value of R_3 was varied from .05 to .25 meg. and corresponding values of E_i, E_a, and E_b were determined at a power output of 1 watt.

The change in gain of the amplifier and the change in the ratio E_a/E_b was negligible throughout the 5-to-1 change in the value of R_3.

Other tests of this circuit in typical radio receivers indicate that a good value of R_3 is 0.25 megohm for any of the tubes ordinarily used in phase-inverter circuits. However, it may be necessary to use a lower value of R_3 in order to satisfy recommendations for the maximum value of grid resistor for the output tubes.

The output tubes in the self-balancing phase-inverter circuit of Fig. 1 are self-biased. When the bias for these tubes is obtained from a fixed- or partial-fixed-bias source, it is necessary to couple the grid of tube B to point (a) through a suitable condenser (C_c), as shown in Fig. 2. In addition, a hum filter may be required, the data sheet states.

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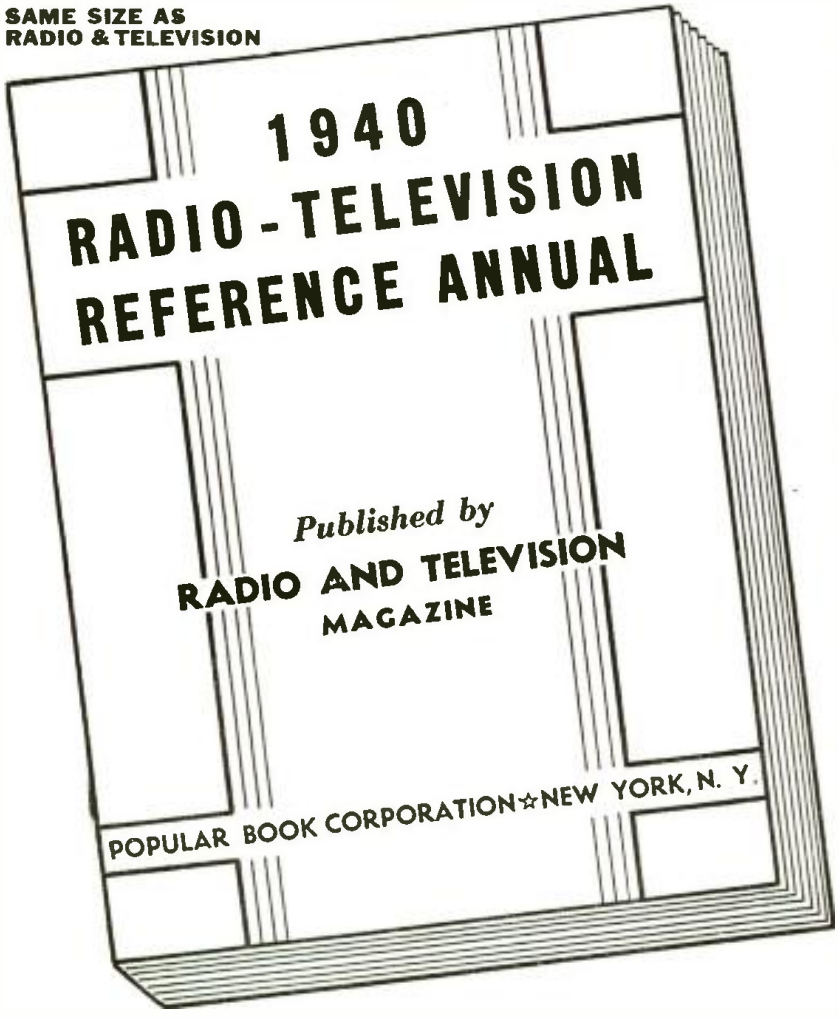

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(approximately)

45 ARTICLES

(approximately)

170 ILLUSTRATIONS

68 BIG PAGES

RADIO & TELEVISION
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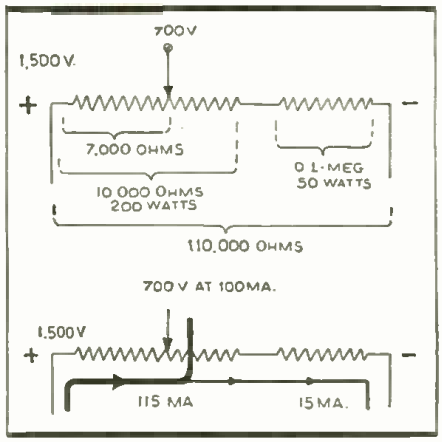
Drop Your Voltage!

● A VERY common occurrence in a ham shack when rebuilding or adding a stage like an 809, T40, T55, HK54 and similar tubes that take from 750 to 1,500 volts is



It is important to consider the current in each part of a voltage divider system.

to try to take your supply voltage for the previous stages from one common source. The usual procedure is to get a 100 or 200 watt bleeder of 50,000 to 100,000 ohms and tap it down the high end until the proper voltage for the driver or oscillator has been reached. This section will immediately proceed to get very hot and may open between the tap and the high voltage end. Brother Ham will then trade or buy a large bleeder again.

First let us see what happened to the original bleeder and voltage divider which is now in use with a few shorted sections to cross the gap where it has opened. We will assume that the resistor is rated at 200 watts and 100,000 ohms. The voltage on the final is 1,500 and we want to drop it to 700 for a buffer tube. The buffer tube is rated to draw 100 ma.

Bleeder current by Ohm's law is $I=E/R$ $=1,500/100,000=15$ ma. Now use the power formula to find wattage needed when using the resistor as a bleeder only with no taps. $W=I^2R=.015\times100,000=22.5$ watts needed, which means it should be around a 50 watt resistor. *Remember this is only when no taps are being taken off.* We use a fifty watt size to give us a good safety factor. A 200 watt bleeder used here is a waste of money, for the 100% overload allowed takes care of accidental opening of the resistor.

Now let us tap down our 200 watt bleeder at 700 volts and 100 mils. The necessary resistance from the positive side to the tap will be $R=E/I$. E is *not the voltage* at the tap but is the *voltage drop*. In this case the drop is 1,500–700, or an 800 volt drop. Now, 100 mils plus 15 mils bleeder current going through the entire resistor gives the current passing through the voltage dropping section of the voltage divider, and is 115 ma. So $R=E/I=800/.115=$ about 6,950 ohms. Seven thousand ohms will be close enough for our use. This is about 1/10 of the total resistor, or in wattage about 20 watts.

Now back to the power formula $W=I^2$ $R=.115^2\times7,000=92$ watts. Yes, *ninety-two* watts, through a 20 watt section. No wonder it opened!

To get back to the proper size voltage divider, we found that 7,000 ohms at 92 watts was required. Our 100% safety factor brings us to a 200 watt resistor with a slider. A 10,000 ohm size will be fine and will give a little variation of voltage if it is wanted. Tap a 10,000 ohm resistor at 7,000 ohms and we will have 7/10 of 200 watts or 140 watts which is well within our range. Now if a 50 watt resistor of 90,000 ohms is placed in series with the 10,000 ohm resistor at the negative end, we will have a total bleeder resistance of 100,000 ohms. In lieu of 90,000 no serious damage or change will result if a 100,000 ohms is used.

In the manner explained we have two resistors. One a 50 watt size for the bleeder current only and the other a heavy wattage resistor where it is needed.

Simple Voltage Tests

F. E. Wenger*

● A THOROUGH working knowledge of indicating instruments and circuits being measured must be had before readings can be interpreted correctly. As this article will consider voltage measurements, we will be primarily concerned with the *Voltmeter*, which is essentially a microammeter with a series resistance to limit the current flow when voltage is applied across the terminals. (Fig. 1)

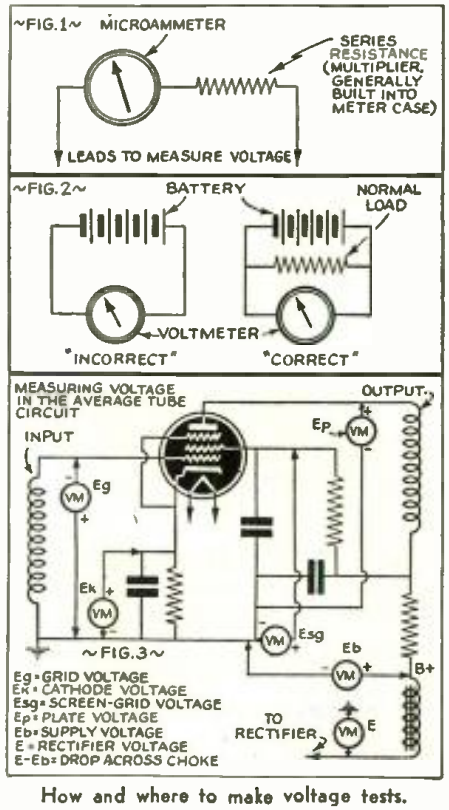
The sensitivity of an instrument is generally referred to as *ohms per volt*, and the most popular instruments in use today are either 125, 1000, 2000, 5000, 20,000 or 25,000 ohms per volt. This means that the current required to cause full scale deflection is 8000, 1000, 500, 200, 50 and 40 microamperes respectively. However, the sensitivity of the voltmeter is not as important as the ability to interpret the readings and their relation to the correct standard for that circuit.

Batteries checked without an electrical load will not give a true reading of the battery condition, as the *no-load voltage* on a used battery is higher than a *load voltage*. The modern higher resistance voltmeter can be considered as a *no-load* for batteries. Therefore, batteries must be tested under normal load, for in the absence of this load a resistive load of a proper size must be used. Fig. 2 illustrates the circuit.

When measuring D.C. voltages in a radio set, there are a number of erroneous readings that can be had, due to the current draw of the meter, especially on AVC, and resistance coupled circuits.

*Radio Engineer, The Triplett Electrical Instrument Co.

The power supply rectifies enough reserve current so that the load of the meter



How and where to make voltage tests.

will not affect the reading, but any resistance in series with a meter acts as a multiplier and decreases the meter reading in direct proportion to the value of the resistance and the sensitivity of the instrument. Therefore, a *1000 ohms per volt* meter has a multiplying resistance of 100,000 ohms and will read 100 volts full scale. If an additional resistance of 100,000 ohms is in the circuit so that it is in series with the voltmeter, the total meter reading will be 50 volts, because there will be a 50 volt drop in each resistor. If the instrument has a sensitivity of 25,000 ohms per volt, the total resistance for the 100 volt scale would be 2,500,000 ohms. If the series resistance in the circuit is 100,000 ohms, the reading on the meter will be 96 volts. On some circuits we not only have high resistance, but also the current and power are extremely small. Any additional parallel resistance, such as a meter, will lower the available voltage by consuming part of the available power, as will any of the series circuit resistances. In order to obtain a voltage reading as correctly as possible, we should use the most sensitive voltmeter available. From the above, it is seen that more accurate results may be obtained by using a very sensitive voltmeter; or if you use a less sensitive voltmeter, mathematical calculations are necessary—and even with calculations we have certain errors.

Some of the most common radio uses of the voltmeter are: (Fig. 3) To measure plate voltages, grid voltages, filter voltages, voltage drop across the resistors (by which current may be computed); voltage drop through filters and chokes, etc.

"Honor" Plaque Awarded

For Best HAM Station Photo To *Larry Shafer*, W8MSG

The first rack contains a 6L6G xtal on 10 meters, PP 207s into a 100th in the final. 500 watts input.

The second rack contains the 203Z modulators and power supplies.

Receiver is an RME69.

The first four years were spent on 160 meters, now I'm only on 10.

LARRY E. SHAFER.
Cleveland, Ohio.

Here is the new "Award of Honor" Plaque which measures 5" x 7" in size. It is handsomely executed in colors on metal, and is framed, ready to hang on the wall. The name of the winner will be suitably inscribed.

●

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Attach a brief description not longer than 300 words, describing the general line-up of the apparatus employed, the size, type and number of tubes, the type of circuit used, name of commercial transmitter—if not home-made, watts rating of the station, whether for c.w. or phone or both, etc., also name of receiver.

State briefly the number of continents worked, the total number of stations logged or contacted, and other features of general interest. Mention the type of aerial system and what type of break-in relay system, if any.

Important — Enclose a good photograph of yourself, if your likeness does not appear in the picture!

You do not have to be a reader of RADIO & TELEVISION in order to enter the contest.

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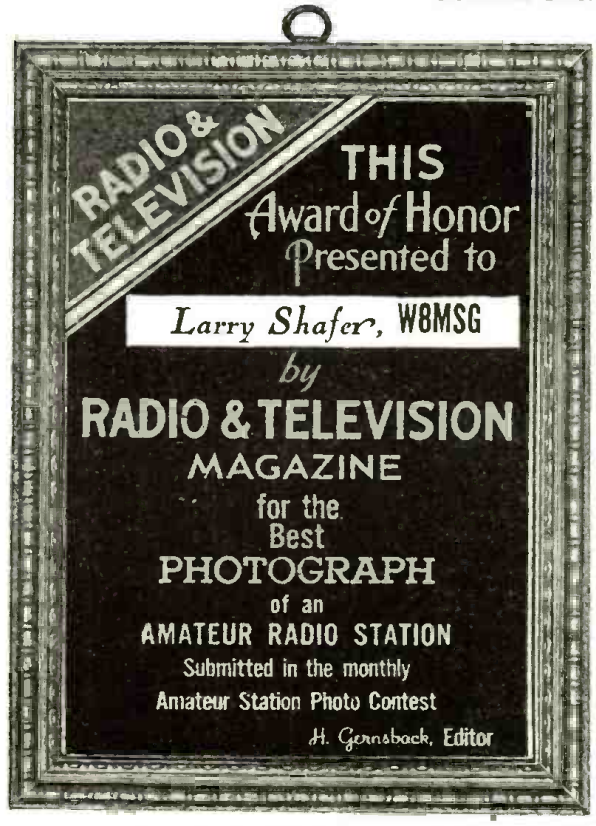


Hilarity on the HAM Bands

Jack Curry (W2MJU)

with Kitty in the background

"Jack and Kitty" in their Ham shack. ➤

•

• WELL, folks, this is a story about a couple who have a lot of fun with ham radio. To begin with, we first became interested in ham radio when we purchased our first short wave receiver. We happened to tune through the short-wave section of the receiver one day, and ran across the twenty meter amateur band. We tuned in on a very interesting conversation between two hams, who happened to be Matty (W2JDS) and Mary (W5DEW). From that time on, every night, when I came home from work, I would dash to the receiver and tune around the twenty meter band to see what I could hear. In the course of our tuning around, we ran across the "Black and Blue Network" in session—and *boy, oh, boy,* were they having fun! We got a great kick out of them. That is when the bug bit us, and we decided to see what we could do about it.

Kitty (the XYL) got the bright idea of writing to Mary (W5DEW) and telling her how much we enjoyed her contacts. A few nights later, we heard Mary and Matty in contact, and she told him that she had received "a lovely letter from a lady in New York City," who said she enjoyed listening to the conversation between them. Kitty was the lady. When it came to Matty's turn, he said that if the lady who wrote the letter was listening in, and would like to see what a ham shack looked like, she would be more than welcome to come up and visit his shack. *That was all we had to hear!* I almost broke my neck going down the stairs to reach a telephone, in order to call him up and accept the offer. Then and there we were initiated into the *ham* fraternity.

I started studying and took the examination. (During the period while waiting for the license to arrive, I wore out a pair of shoes marching up and down the stairs to the mail box.) Also during that period I assembled my station. And then the fun began! We started operations on 10 meters and our first contact was a honey. We heard Carl (W2LOL) calling CQ, and when he signed I gave him a shout. Lo and behold, he came back to my call, but told me that he could just about make me out calling him, due to the fact that the feedback on my signal was so strong.

With Carl coaching me in what to do, I finally succeeded in clearing that trouble, and we had a very nice contact. From then on Carl called me his "feedback contact," and we have had some very nice contacts with him since.

Now we'll get on to the first contact we had outside of the 2nd district. I was tuning around on the receiver one day and I heard W8DUH in Michigan calling CQ. Kitty was in another room of the apartment at the time. I gave W8DUH a shout, and when he came back to me, I nearly fell out of the chair. Kitty came rushing into the shack yelling at me, "Jack, he's calling you."

Kitty looked at me and I looked at Kitty.

I said, "Yes, I think he is. At least he is mentioning my call." Then W8DUH turned it over to me, and I threw on the transmitter.

Jack talking, "D-d-d-double U 8 d-d-d-U-H; D-d-d-double U t-t-two M J U returning."

Kitty from the background, "What are you so nervous about, Jack?"

"What do you mean I'm nervous? I'm not nervous; at least I don't think so."

From Kitty: "Gee I'm all excited; go get him, Jack!"

From Jack: "What do you mean, go get him? I've already got him."

And so on. And we had a swell contact until we both faded out of the picture.

And now on to one of our funny contacts. We have more funny ones than straight ones, I guess. We hooked up with Al (W2EUK) one night and everything was going along nicely for a while. Kitty and Al were telling bedtime stories to one another and all of a sudden Al got a bright idea. "Can you work break-in Jack? Break," said Al—and he threw his carrier off. Well, folks, if you were only here in the shack to see what happened you probably would have rolled on the floor. I had two switches to throw at the time, and what with having to hold the mike in my hand, I had my hands full. So it dawned on me to extend the mike stand and put it in my lap, and then I was going to use both hands to throw the switches. But Al had turned it over to me so quickly, and I wanted to come back to him as soon as I could, I grabbed the mike stand in my hands and pulled on it as fast as I could. And in so doing, I pulled the mike stand apart and there I was sitting in front of the transmitter, mike stand in one hand, the mike in the other, looking at the switches, and Kitty in the background having hysterics. And Al started calling me frantically: "Jack, what happened? I thought you could work break-in." Finally I went back to him and told him what happened and, boy, did we have a good laugh over that incident.

No matter with whom I come in contact, Kitty can always be heard in the background. Just as an illustration, I will try to carry on here just as it happens in the shack.

Now, say I get in contact with another station. After the greetings are over and we settle down to having a nice QSO, Kitty will butt in from the background as I am talking. And that is where most of the fun comes from.

Jack talking, "Blah, blah, blah."

Kitty comes over behind Jack and yelps into the mike, "Hello, you palooka."

Jack to Kitty: "For crying out loud, Kitty, keep quiet."

And so it goes on and on. Well, folks, it's very hard for me to put down in writing what actually takes place at W2MJU's shack. Anything is liable to happen at any time. But all in all, Kitty and I have had some wonderful contacts on the air, and also meet quite a few of the hams that we have contacted. We have made some grand friends, all through *ham* radio.

Kitty and Jack (W2MJU)

CITIZENSHIP PROOF REQUIRED OF ALL RADIO OPERATORS

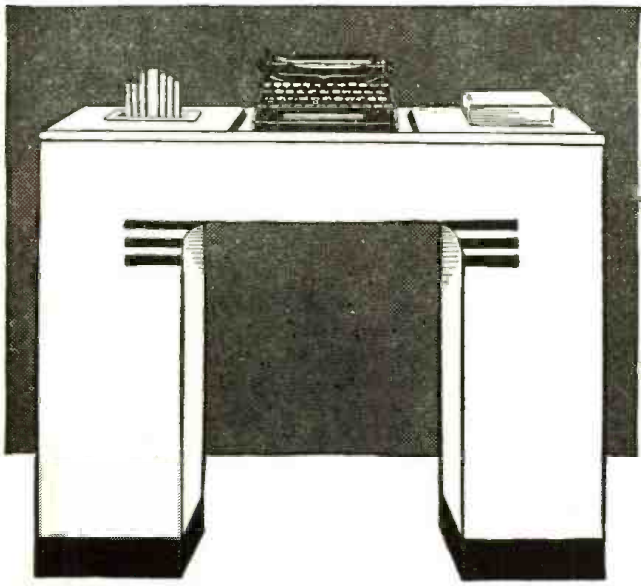
• PROOF of the citizenship of about 100,000 radio operators licensed by the Federal Communications Commission is required under a Commission order announced June 19.

This new requirement applies to *amateur* as well as *commercial* operators, and calls upon them to file such proof in the form of affidavits, fingerprints, and photographs before August 15 next.

The Commission, which licenses citizens only for all classes of radio authorizations, has heretofore depended upon the applicant's own statement as to that fact. It will henceforth require evidence of citizenship on standard forms which the Commission is now sending out as a questionnaire.

The questionnaire, which present operators and future applicants must subscribe to under oath, demands proof of citizenship by birth or naturalization, and also elicits information as to the nationality of immediate relatives, time spent by operator or applicant outside of the United States, and service with this or foreign governments.

No exception to the filing of such evidence is prescribed. However, once the holder of a license has furnished satisfactory identification he will not have to file duplicate papers with subsequent license renewals unless his status as to citizenship undergoes change. A penalty is provided for making false statements.



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Getting from YOUR

● THE average owner of a battery-powered *portable* receiver frequently finds that he can not pick up some of the weaker broadcast stations, especially when the set is located more than 100 miles or so from the station. Some of the portables do have auxiliary *aerial* and *ground* posts, so that an outside aerial wire can be connected to the set and thus increase the pickup or signal strength.

An easy way to improvise an auxiliary antenna in order to boost signals is shown at Fig. 1A. Here an antenna wire 45 to 60 ft. in length is arranged to make a one turn loop on the outside of the cabinet, so that it comes just over the loop antenna on the inside of the wooden box. The free end of the aerial wire, after making the loop, is grounded. Another way to arrange this auxiliary aerial loop is shown at B, and here the wire is simply given a one turn loop around the cabinet. Diagram C shows still another method; here a one turn loop of insulated wire is tied in place with cord over the loop antenna mounted within the cabinet. Aerial or ground posts can be connected to this "pickup" loop, and whenever the set is used in a location where reception of a desired station is weak, a ground connection may be made to the G post and an auxiliary antenna wire hooked up to the A post. The ground wire may be a piece of almost any size copper wire, and need not be any heavier than No. 20. The antenna wire may be a piece of small copper or other wire, about No. 24 gauge.

For those handy with tools and possessing a little mechanical ability, the idea shown at Fig. 1D will prove interesting. Here a couple of small brass reels carry the antenna and ground wires, and they can easily be rigged up with spiral clock springs so that whenever you are through with the auxiliary antenna you have only to unhook it and let the spring reel rewind it automatically. A small insulator may be connected at the end of the antenna wire, and a hook will be found handy at the ends of the aerial and ground wires. For a *ground*, a screw-driver or a small metal rod pushed down into moist earth will be found to improve the signal strength immensely.

Several means of rigging up a temporary antenna for a portable set are shown at E, F, etc. At Fig. E a large nail may be driven into the trunk of a live tree and in this way the tree acts as an antenna. At F we see how a stone tied to the end of a light antenna wire will enable the camper to throw the weighted wire into the air, and cause it to hook over the limb of a tree. Some might like to try the kite method of supporting the antenna and this is illustrated at G.

If you are near a telephone, an improvised antenna can be made of a piece of wire connected to the antenna post of the set, the free end of wire connected to a piece of metal such as a pie-tin, and the telephone instrument simply set on the tin. If you have occasion to use a portable set in a motor-

the Most PORTABLE

boat, it will pay you to connect a ground wire from the instrument to the engine frame. A still better pickup can be obtained if a vertical antenna wire is strung up the mast or flag pole on the launch. If there is no mast on the boat, an antenna wire may be run all around the top edge of the boat and held in place by insulated staples or else simply laid around the inside edge of the boat in the best manner possible.

Metal roofs or even metal gutters and leader pipes will help to give greater pickup for portable sets; the lead-in wire to the set may be connected to the leader or drain pipe as shown at J. The metal frame of an automobile is well insulated from the ground, resting as it does on four heavy rubber tires; the pickup of a set can be enhanced considerably by using the metal car body as an *antenna*, connecting the wire from the antenna post of the set to any point on the car frame where there is no paint. If the set is to be used near a telephone circuit, induction pickup from such a circuit may be obtained as at L.

Again, one may make use of an *antenna plug*, available in most radio stores.

If the Battery Goes Dead

Nothing is more exasperating than to have the A battery (the one that lights the filaments or supplies the heater current) go dead just when you are all set to hear the baseball scores, for example. If you are off on a picnic and suddenly discover that the set is dead, it may be the A battery (usually one cell, yielding 1½ volts—or possibly 2 of these cells, supplying 3 volts). One of the simplest ways to determine the condition of these A batteries is by means of a small battery flashlight bulb. When such a bulb is connected across the A battery it should light, even though dimly; if it will not light, the chances are that the battery is so weak that it cannot supply sufficient voltage to operate the receiving set tubes properly.

If you have tested the condition of the A battery (or batteries) by means of a lamp (or pocket voltmeter), you can then connect a fresh battery, if you have had the forethought to carry one with you. Again a temporary connection may be made from the *portable* set to the storage battery in your car. If 1½ or 2 volt tubes (the usual types employed in modern portables) are used, a connection from one terminal of the battery to one of the lead connectors joining the cells (so as to yield two volts) will do the trick. You should make it your business to ascertain whether the tubes used in your set are of the 1½ volt type or not, as this will give an overload of about ½ volt, and in this case a variable resistance should be connected in series with the circuit. If you are fairly expert at making such "emergency hookups" for battery power, the auxiliary connections can be made to the regular 6 volt terminals of the storage battery, using a suitable variable resistance of 30 ohms or more in series with the circuit as in diagram Fig. 2B.

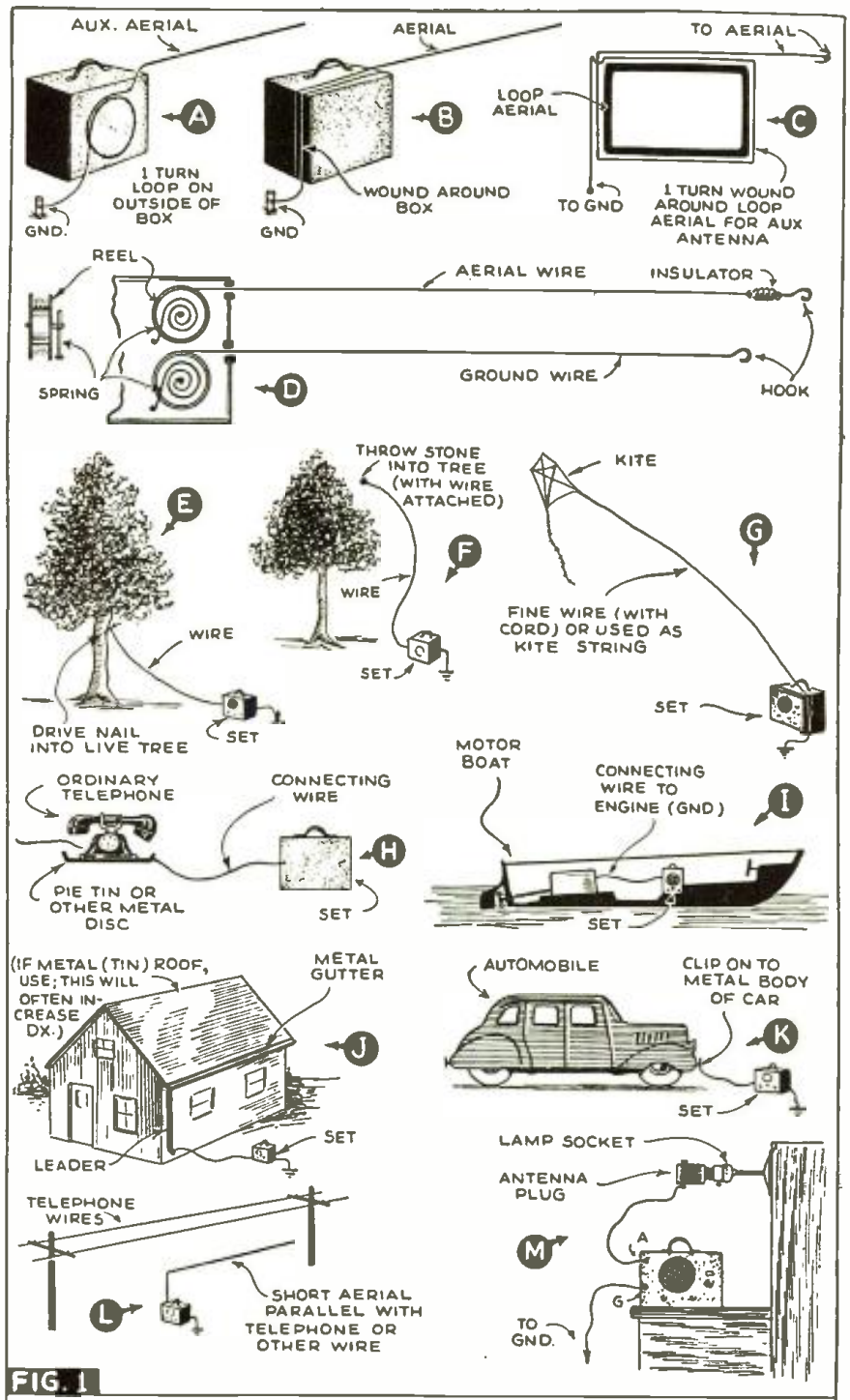


FIG. 1

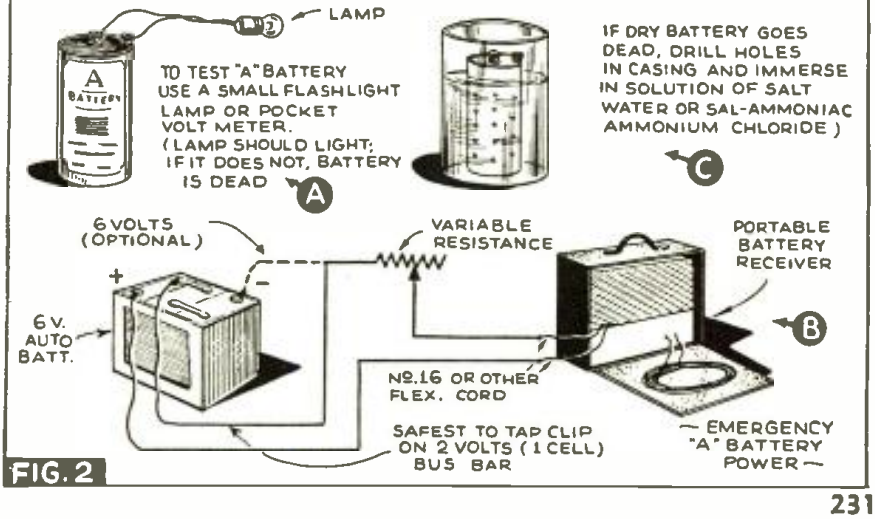
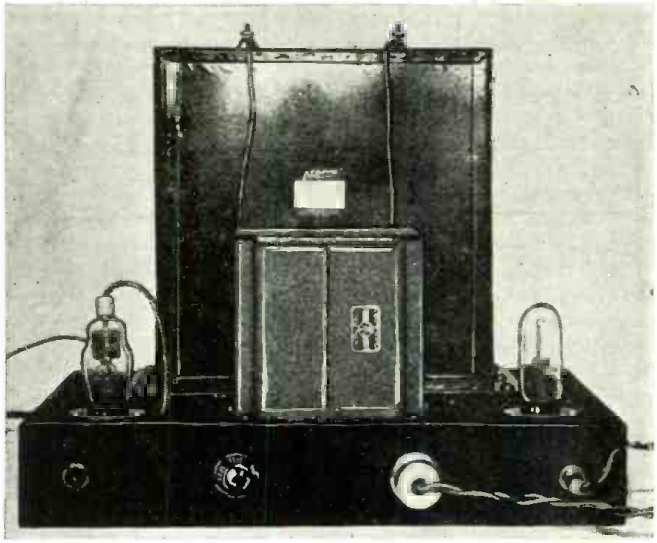
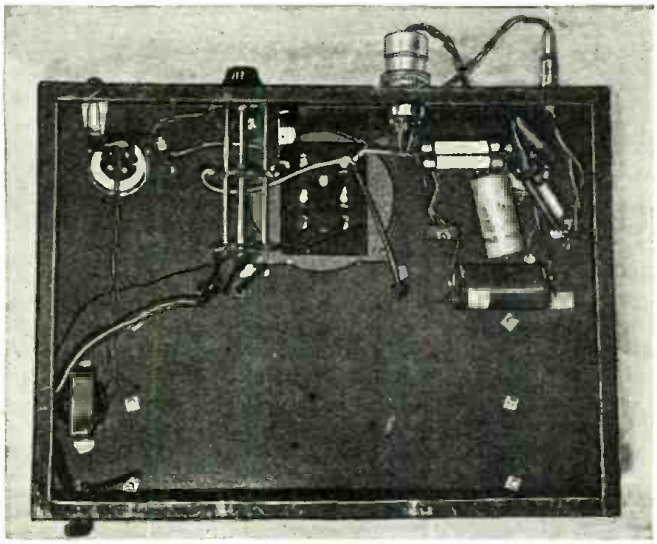


FIG. 2

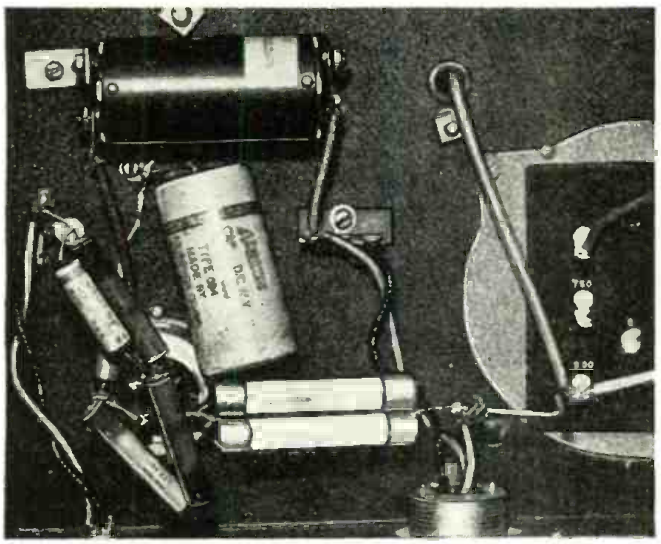
1/100,000 Second Flash!



Front view of chassis removed from cabinet.



Sub-chassis view, showing wiring and layout.



Closeup of Strobotron socket, showing resistor network.

● AS A FAMOUS camera authority recently wrote in a newspaper syndicate, the construction of a Speedlight Flash Unit is a job for the radio and electrical man rather than a photographer.

You have, no doubt, seen examples of the work produced by a unit of this sort—a golf ball being flattened by the impact of a club head, a drop of milk splashing on a plate, a bird in flight, a bullet shattering a plate of glass, and many other fascinating photos of action which occurs too fast for the eye to catch. The secret of these photographic marvels is the Speedlight Flash Unit—a piece of apparatus developed by Harold K. Edgerton and Kenneth J. Germeshausen.

It is simple to construct and, save for one condenser, is built of inexpensive parts. This condenser, marked 50 mf. on the diagram herewith, may be any capacity from 5 to 75 mf., but the amount of light obtainable from the flash tube (FA2 on the diagram) will be in direct proportion to the capacity of the condenser used. This condenser must be rated to withstand 2,000 V. D.C. and must be capable of standing up under repeated short circuit discharges. While a 650 V. A.C. motor-starting condenser might be satisfactory, the writer preferred to get a specially constructed condenser from Aerovox, for when one is experimenting with high voltage, absolute safety from the apparatus is essential.

The 879 rectifier tube is standard and can be had through RCA. It is also known as the 2X2. This tube operates with 2½ volts and 1.57 amps in the heated circuit. Its anode voltage and current are ample for the circuit for which it is to be used.

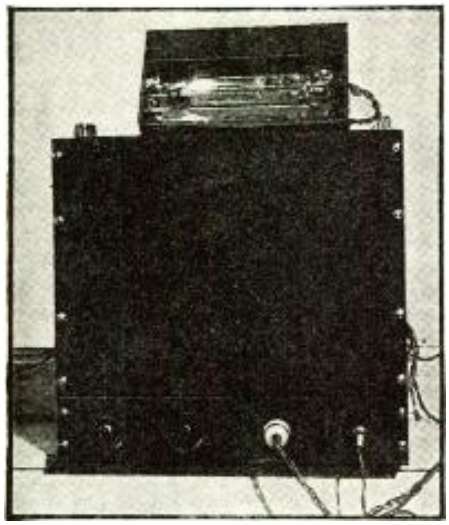
The other tube—the SN4—is specially designed for stroboscopic light and relay service. It is of the cold cathode type and operates with 300 plate volts.

CAUTION! If carelessly constructed or used, or if inadequate parts are employed, this apparatus is dangerous! Do not attempt to build it unless you have a thorough knowledge of electrical work.

A careful inspection of the circuit given in the schematic diagram shows how this tube operates. Its grid is maintained at a positive voltage through two 1 meg. resistors, which are connected in series from the grid to the high voltage line. Operation of the flash trip switch, introducing a 1 meg. resistor between the grid and the ground side of the circuit, upsets the balance of the tube, causing it to discharge through the special triggering transformer, T2, and thus causing the Argon tube to flash.

The writer, whose thought in building any high voltage circuit is for safety, devised a special switching system to short circuit the 50 mf. condenser automatically when the power is turned off. This system employs a 4 pole three gang switch with wide separation between the wafers in order to prevent any possible arc over from the condenser to the line. When the switch is turned to the extreme counter clockwise point, the line is open and there is a dead short across the condenser. When turned one point to the right, the line remains open and a 750 ohm 25 watt resistor is connected across the transformer terminals. In the third position, all switches are open, and in the fourth the line voltage switch is closed and the condenser shorting switch is open. The dead point is left in position 3 to prevent any arcing across the condenser's shorting circuit before the line circuit is completely broken. When the switch is turned OFF, the line is first opened, then the condenser is shorted through the resistor (in order to prevent too much "sock" if a dead short were used) and then is brought to the dead short position.

The components were laid out for best operation and greatest efficiency on a chassis measuring 17 x 13 x 3". The 2,000 volt transformer (which actually is 1,800 v. in the model the writer secured) was of the type which may be mounted for either sub-panel or top-of-panel connection. It was mounted with the terminals beneath the panel, a 4½" hole being drilled for this purpose, centered 3⅛" back from the front center of the chassis. The 50 mf. condenser was centered directly behind this transformer, with about ½" separation. The terminals of this condenser and the cap of the 879 are the only two leads which appeared on the top of the chassis.



The finished job—note Argon tube in reflector at top.

• • •

Robert Eichberg

photography and television expert, tells how to build this high-speed, high-voltage unit —the latest accessory for the amateur, experimenter and commercial photographer.

• • •

Two inches back from the front of the panel and 2¼" from either end, 1¾" holes were drilled to take Amphenol sunken mount sockets. This type of socket was used because it permits the contacts in the socket to project far enough below the panel to afford safety for high voltage leads. The filament transformer was mounted under the chassis, centered at the left of the 50 mf. condenser, and on the same side as the rectifier tube. Under the chassis good grounds were secured by fastening lugs to the chassis by means of self-tapping screws. These lugs were placed wherever convenient for grounding connections.

A piece of heavy brass strip was bent to an angle for mounting transformer T2, the triggering transformer, underneath the chassis. The common terminal, which is grounded, is the one mounted opposite the single terminal at the other end of the transformer. This common terminal was fastened directly to the mounting bracket to assure rigidity and a good ground.

All leads were made as short as possible, the resistors and condensers which are connected to the SN4 Strobotron tube being mounted directly on the socket contacts as far as possible. The 1 mf. condenser has its outer foil wrapping connected to ground. In this case, a standoff lug mounting strip was used to assure rigidity and to support a lead from the triggering transformer to the output connector. Other standoff terminal strips were used to support the .01 mf. condenser and 1 meg. resistor combination, and at one other point where support was necessary.

The 1 meg. resistor combination, which is made of two 2 meg., 3 watt resistors in parallel, called for special treatment. One end of this pair was soldered directly to the socket. The other end was brought to a piece of No. 8 copper wire which was formed to make a support, its other end being soldered directly to one terminal of the high voltage transformer, the other high voltage terminal of which connects to the plate of the 879. A 4-prong heavy duty Amphenol connector was used for the 10 ft. leads which connect the FA2 Argon tube to the output of the chassis, and a smaller connector of the same make was used to connect the remote flash trip switch.

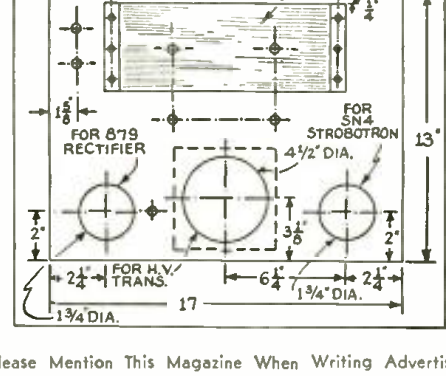
Both of these connectors are provided with locking rings so that they cannot become disconnected while the apparatus is in use. Aerovox condensers and IRC resistors were used throughout, except at the condenser shorting switch, where an Ohmite resistor happened to be at hand. The wire was a flexible type made by Cornish and insulated with a specially fine grade of rubber, covered with cambric. This wire is rated at 10,000 volts and is perfectly safe for 2,000 volt operation.

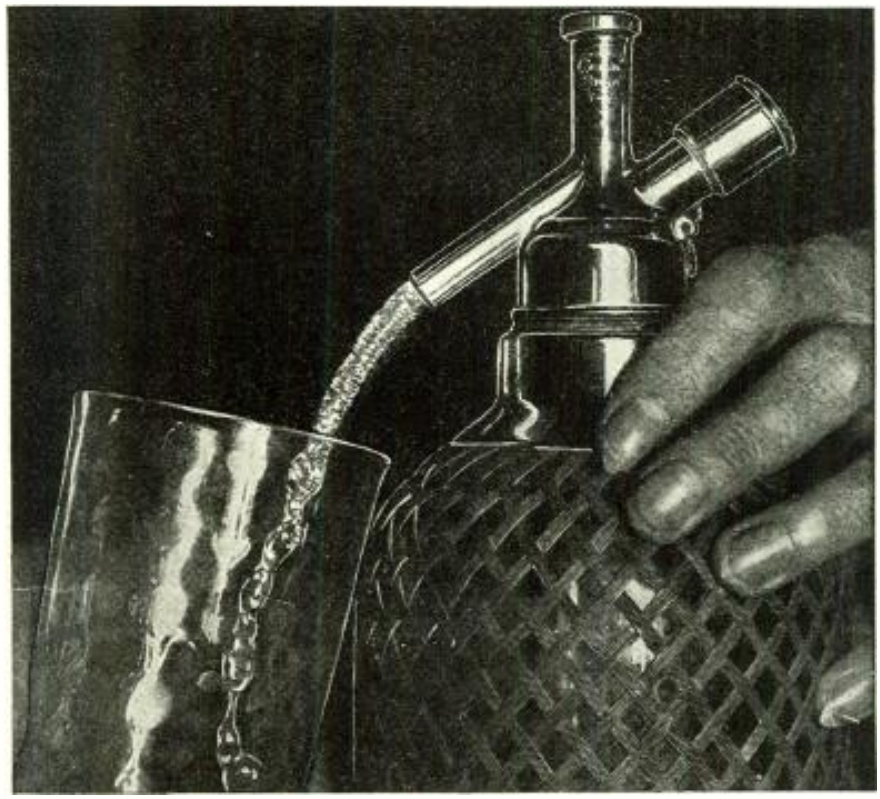
A strip of Polystyrene 1" x ¼" x 12" was used to make the mounting for the FA2. Fuse clips were fastened to this 2" from the ends, and halfway between them two ⅛" holes were drilled 6" apart. These holes are to provide for the triggering electrode which comes from the triggering transformer. It consists of 13 turns of wire spaced over the 6" distance. Polystyrene was chosen to make this mounting because its crystal clarity does not interfere appreciably with the amount of light coming from the FA2.

A reflector was made by taking a 7" disk of ¼" hard rubber; by sawing it in half, two semicircular end pieces were made. A piece of chromium plated zinc 11 x 12" was bent to fit these two end pieces, the semicircumference of the 7" diameter circle being 11". The tube mounting was cut to fit inside the end plates and pushed towards the back of the reflector until its reflection covered the greatest possible area. It was then fixed in position by means of two screws through each end-plate. The leads were brought out through a hole in the lower plate, which also was drilled and tapped to take a standard tripod screw.

A variety of switches were made for use in a remote position to afford synchronous

Chassis layout for flash unit.





The author's first speed photo, using the unit described.

tripping under various conditions but, as the camera with which this apparatus is chiefly used is of the focal plane type, the usual procedure is to work in a fairly dim light with a small stop and to open the shutter, trip the light by means of a push button, and close the shutter.

Such a light can be used in any of the ways mentioned at the beginning of this article and for innumerable other interesting experiments.

List of Parts

RCA (Tubes)
879 Rectifier

STROBOLITE CO.
1—Type SN4 Strobotron
1—Type FA2 Argon flash tube
Speed high ratio triggering transformer

UNITED TRANSFORMER CO.
900-0-900 v. special transformer
2½ v. heavy duty transformer

AEROVOX (Condensers)
5 mf. 2,000 v.
1 mf. 600 v.
.01 mf. 600 v.

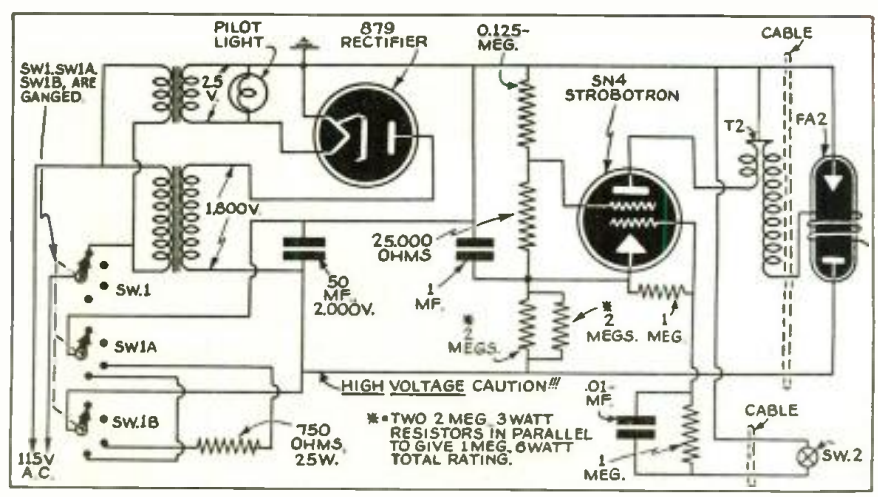
IRC (Resistors)
125,000 ohm 2 watt
25,000 ohm 2 watt
2—1 meg. 2 watt
2—1 meg. 3 watt
750 ohm 5 watt

AMPHENOL
1—4 prong heavy duty connector
1—2 prong light duty connector
2—Sunken mounting sockets
12 x 1 x ¼" strip of Polystyrene

PARMETAL
Chassis and cabinet

CORNISH
15 ft. heavy duty high voltage wire, brown covered
25 ft. heavy duty high voltage wire, red covered
35 ft. heavy duty high voltage wire, black covered

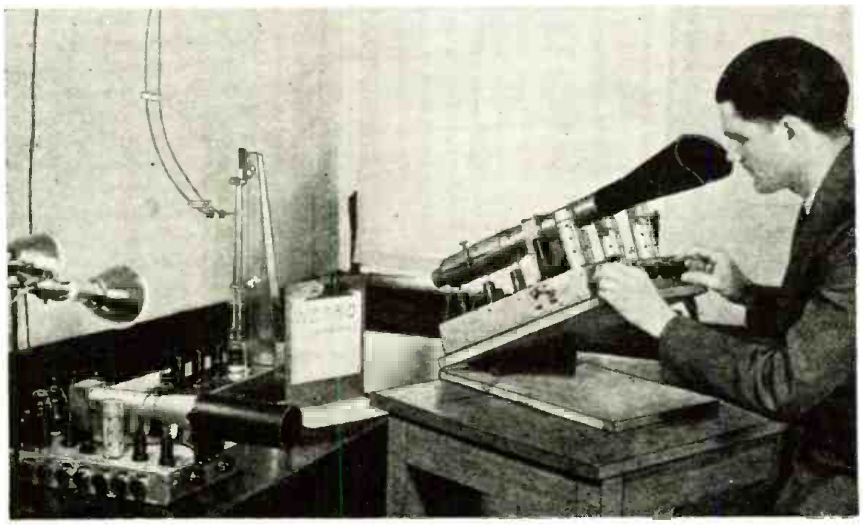
MISCELLANEOUS
1—Triple pole 4 throw switch
1—2½ v. pilot light and mounting
1—Pin jack for ground
3—2-lug insulated mounting brackets
Lugs, screws, etc.



Wiring diagram of Speedlight flash unit—insulate high voltage wiring carefully.

Amateur Television Made Practical By

New Image Pick-up Tube



New 2-inch iconoscope opens new field to the radio amateur and the electrical experimenter. Images may be sent by radio or wire.

●

Photo at left shows amateur television transmitter and receiver for 2½ meter operation. Pictures below show applications of amateur television, using the new 2" iconoscope tube. Wire transmission will appeal to the general experimenter, no license being required for such transmission.

● AN inexpensive television camera "eye" tube which opens the field of electronic television to thousands of American radio amateurs has been developed and perfected at the RCA Laboratories.

Developed in line with RCA's policy of encouraging amateur interest in television and cooperating with experimenters in that field, the new tube is actually a smaller, much simplified version of the more familiar "iconoscope" television camera tubes used in television studio cameras.

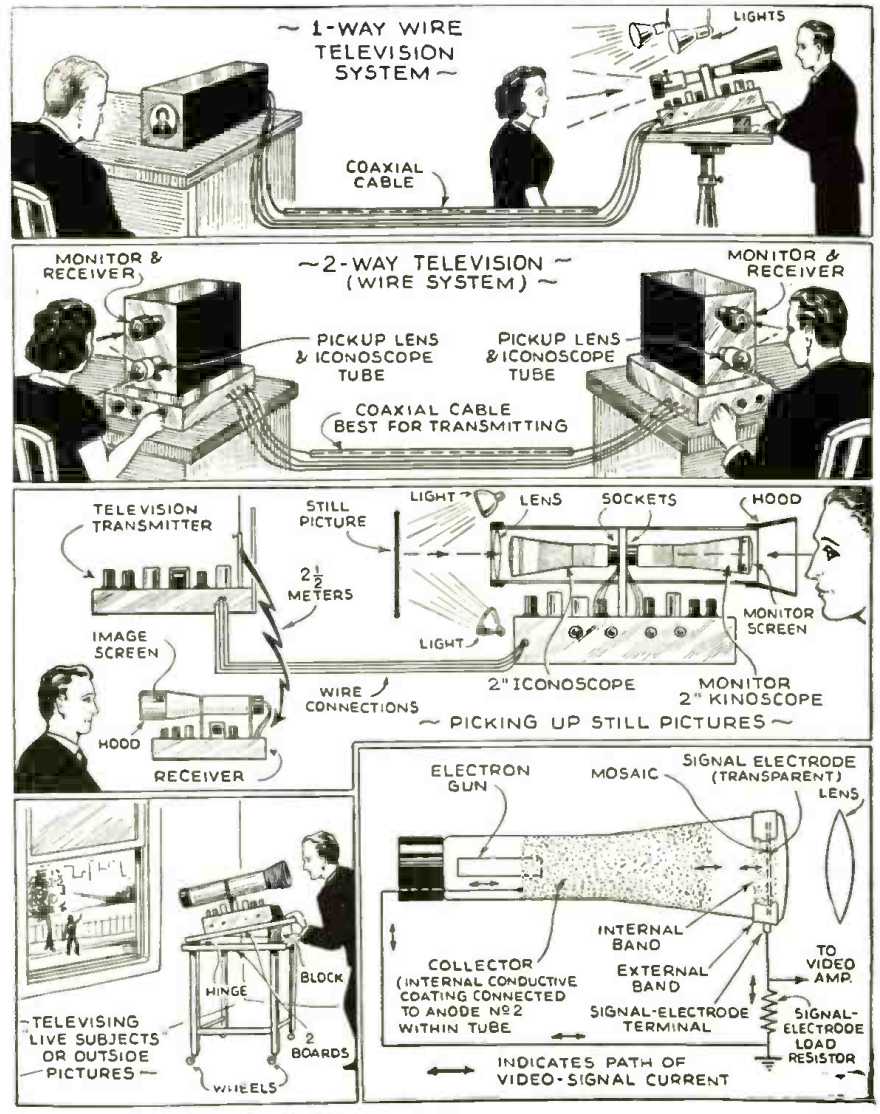
With the new iconoscope, it is practicable for the first time for the amateur to build a complete electronic television transmitting and receiving system at a cost which compares favorably with the cost of a medium-power amateur radio phone system. In fact, amateurs who now have 2½-meter transmitters will find it relatively simple to adapt them for sending television signals alternately with sound broadcasts.

Press representatives recently witnessed a demonstration of the tube in the RCA Laboratories. The 120-line, 30-frame, non-interlaced pictures transmitted by the iconoscope, while not of the same excellent quality as the 441-line television images being broadcast in New York, are remarkably clear and sharp, equivalent to newspaper half-tone reproduction. The new iconoscope transmits a television picture about 1½ inches square which may be enlarged at the receiver. In the demonstration system the receiver shows a picture having three times the iconoscope picture area.

In its research and development work, RCA collaborated with the *American Radio Relay League*, which has been seeking for several years to make it possible for the amateur radio enthusiasts to enter the television field. All the necessary equipment has been available for some time for amateurs, with the exception of the iconoscope. Television receiving tubes, or kinescopes, have been available in sizes as small as three inches.

It is believed that the opening of the electronic television field to amateurs will serve to widen existing popular interest in the new art, and at the same time accelerate

●



progress in television development. The radio industry today points to a number of important steps pioneered by American amateurs, including the development of new circuits. Radio amateurs were among the first to demonstrate the enormous possibilities of short waves, a region which at the time was not highly regarded for radio purposes.

What The New Tube Does

The iconoscope, of course, is the "eye" of television, changing light into millions of infinitely small electric impulses which are amplified and then flashed through the ether to the receiving antenna. While performing much the same function of the larger commercial iconoscope, the new tube does not resemble it in appearance. Measuring about seven inches in length as compared with the other's 20-inch length, it looks like a tapered drinking glass with the top sealed. It requires a maximum of 600 volts for operation.

In operation, the new tube is placed behind a small lens which focuses the scene upon the front surface of the mosaic. The light strikes through the transparent surface to the back surface, which is scanned by an electron gun shooting a stream of electrons across it in horizontal lines at the rate of 300 miles an hour. Scanning the mosaic a line at a time, the electrons transmit thirty complete pictures in the form of electrical impulses every second. Each picture is actually millions of tiny dots, each of which is transmitted separately.

In the demonstration transmitter built to test the new tube, a cathode-ray tube is placed behind the iconoscope to serve as a monitor—corresponding to the viewfinder on a camera. The operator sees in the monitor the same scene being televised by the iconoscope, and trains and focuses the camera at will.

As in the case of the big television transmitters, the range of an amateur television station is determined by the horizon, because of a peculiarity of the ultra-high-frequency radio waves on which the pictures must be transmitted. The height of the transmitting antenna largely determines the range of the station.

Amateurs Helped Develop Radio

The new iconoscope opens to amateurs the third step in the development of their field. The first step was the "code" stage when "hams" flashed telegraph signals around the world. Then came the 'phone stage when a microphone replaced the telegraph key, and amateurs were able to chat with each other. Now the means is placed at their disposal to add *sight* transmission. Thus, they may see each other while talking, and may train their home made television cameras on their own equipment to give the other chap a look.

It is anticipated that the unplumbed genius of the 55,000 American radio amateurs, when applied to the complex problems of television, may produce important developments. Existing amateur radio licenses permit television transmissions on the 2½-meter band and shorter waves, so that the way is already open for their participation in the new art.

[Editor's Note: While the new type 1847 iconoscope tube makes possible radio-television for the amateur, there is another great field of experimentation opened up to science students, who can now build a successful television wire *system, placing the transmitter and receiver in adjacent rooms or houses. One of the interesting features of the wire television set-up, utilizing the new iconoscope image pickup tube, is the fact that only about half the number of tubes required for radio television is necessary. With about a dozen tubes, more or less, the electrical experimenter* (and note that he will require no station or amateur operator's license) *can rig up a successful television system either for one-way or two-way transmission, at a reasonable cost.*

For receiving the image, either a 2" or 3" cathode ray tube may be used: as a monitor tube is used at the transmitter anyway, the experimenter will merely have to run a few wires from the terminals of the monitor tube socket to a second cathode ray tube, which will provide him with one-way television. If he desires two-way television, he will need two of the iconoscope tubes, together with the necessary oscillator and sweep control apparatus, and two receiving tubes of the 2" or 3" type. The RCA setup of the new amateur television system as demonstrated to the editors, used 120 line scanning, but the controls permit adjusting the sweep up to as high as 200 line scanning. For radio, *the transmission is on 2½ meters—one of the channels open to amateurs for television transmission.*

For experimenters interested in the wire *transmission of television images, we might point out that a piece of* coaxial cable *should be used to connect the transmitter and the receiver for best results. Of course, transmission can be carried on over an ordinary wire circuit, subject to a loss through attenuation, which causes the image to lack contrast, etc.*

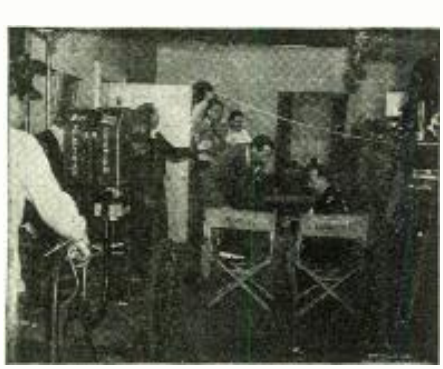
In the demonstration of this new system for amateurs by RCA it was pointed out that outdoor *images may be picked up. For televising in the studio live subjects are placed in front of the lens (before the iconoscope tube) and several fairly powerful lamps serve to illuminate the subject. At the demonstration a light reflector box was shown; this was built on the same principle as a postcard projector, a photograph being placed at the rear of the box and powerful lamps arranged at either side on the interior of the cabinet. The lens of the iconoscope camera was pointed at an opening in the front of the light box, so as to pick up the brightly illuminated image of the photo.*

A cardboard or other hood is best arranged on the end of the monitor (or receiving) tube; in this way the image may be viewed in a more brightly lighted room.

The cost of building a complete television transmitter and receiver for radio operation will run between $200 and $300, but as all of the parts and tubes used, with the exception of the new iconoscope tube for picking up the image, are standard; many radio experimenters will be able to construct the television apparatus at very reasonable cost, some of the parts and also the tubes being available from their reserve stock.]

Televise Movie Production

The production of a motion picture, *Dreaming Out Loud,* with Lum and Abner, has been televised by station W6XAO, Hollywood. Everybody wants to see pictures in process of production and through this station more than 2,000 lookers-in were enabled to witness the camera crew, electricians and prop men scurrying about on the RKO lot during the filming. They also saw the movie cameras grinding away making *takes* and *retakes,* saw *close-ups* and pauses to permit the taking of publicity stills. Sight and sound images from the motion picture lot were picked up by the iconoscopes, carried through coaxial cables to a portable transmitter and hayrake antenna on the roof of the sound stage. Thence by short wave over a six mile distance, to the station's base transmitter, from which they were re-radiated over television channel No. 1, to all receivers within a 30 mile radius. Viewers reported that the images were exceptionally clear. In the accompanying picture the television camera at the extreme left was able to include the film camera at the extreme right. When the film camera was stopped to move in or out, the television camera continued to operate, showing just what goes on in a movie studio.



Television picks-up "movie in the making."

MORE TELEVISION STATIONS COMING

Despite the fact that it put an effectual brake on television progress by its anti-commercial program ruling, the Federal Communications Commission announces—"That the way has been paved for *more television stations.*" In a published statement the F.C.C. promises full commercialization of television "as soon as the engineering opinion of the industry is prepared to approve any one of the present competing television systems." The F.C.C. is considering issuing experimental television licenses in San Francisco, Los Angeles, Chicago, Washington, Albany, Cincinnati and Boston.* The Commission reports that "a serious conflict of engineering opinion exists on the question of standards" and that Zenith, Du Mont and Philco object to the proposed R.M.A. standards and are conducting research to develop alternative

*At press time, the F.C.C. had "tentatively approved" 23 license applications and was considering 19 others.

systems for which they claim marked advantages. The commission is continuing its study of television developments and reaffirms its readiness to confer with the industry at all times. It is planning to make a further engineering inspection and survey early this autumn.

(Editor's Note: Inside industry's opinion is that Television's future depends largely on *war* conditions.)

RADIO AND AVIATION —AND TELEVISION

Speaking before the National Aeronautic Association Forum and Conference in Washington, D. C., Dr. Alfred N. Goldsmith, eminent consulting engineer, pointed out the interdependence of radio and aviation. Dr. Goldsmith said in part:

"Present world conditions . . . require immediate and extremely close cooperation between the aviation and radio industries. The fate of nations trembles in the balance, and sky power may well tilt the scales one way or another. Where civilian communication, transportation, food supply, and all other essential activities can be disrupted from the air, the utmost efficiency in defense and counter-attack is a necessity.

"This being a fundamental truth, not open to question, it is urged that now is the time for the closest possible alliance between radio and aviation. Each of these arms of national defense should place its facilities, its experience, and its personnel effectively at the disposal of the other in order to bring about the rapid improvement and expansion of radio applications in the field of aviation. Our very lives and liberties may depend upon the promptness and effectiveness of such cooperation."

Radio, Dr. Goldsmith said, is the only useful agency now known for maintaining direct communication with aircraft in flight. Of the five types of radio communication —telegraphy, telephony, teletype or teleprinter, facsimile, and television—now available to aviation in whole or in part, *television apparently holds the greatest promise*. By it, the pilot of the future, Dr. Goldsmith predicted, may be enabled to observe the ground below him, to either side of him, and in front of him in darkness, in light, and in fog and storm.

"Perhaps the ultimate application of radio to aviation is televisibility," he concluded. "This will admirably supplement direct communication, guidance, and distance determination by radio. . . . It would enable the pilot to set an indicator or pointer in any desired horizontal or vertical direction and then to see at once, by some form of television, the terrain in that selected direction just as if ordinary or optical visibility were possible along that desired direction.

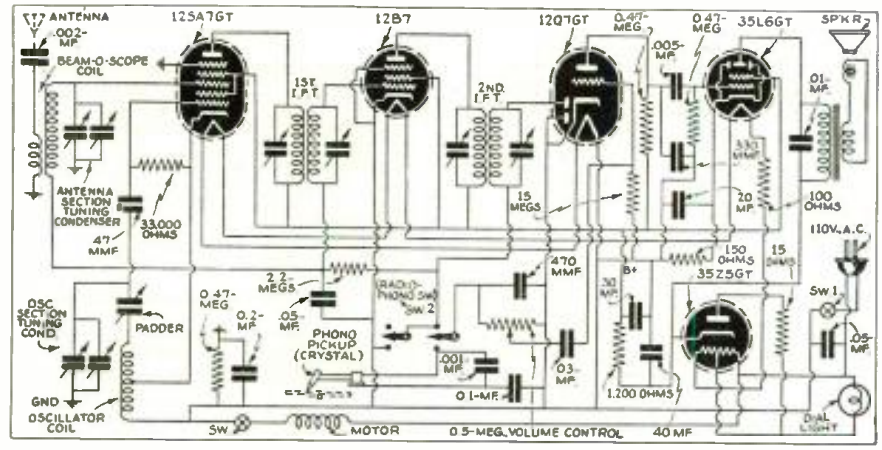
"Televisibility, in fact, would involve not only *seeing by radio* but also gaining an impression of distance by radio, and to this there might be added the possibility of telescopic or enlarged radio vision in the desired direction.

"The underlying principles governing the solution of this extremely difficult problem, with methods which differ considerably from ordinary television transmission and reception as practiced up to this time, are understood. The practical application of the new principles must await the further development of both aviation and television."

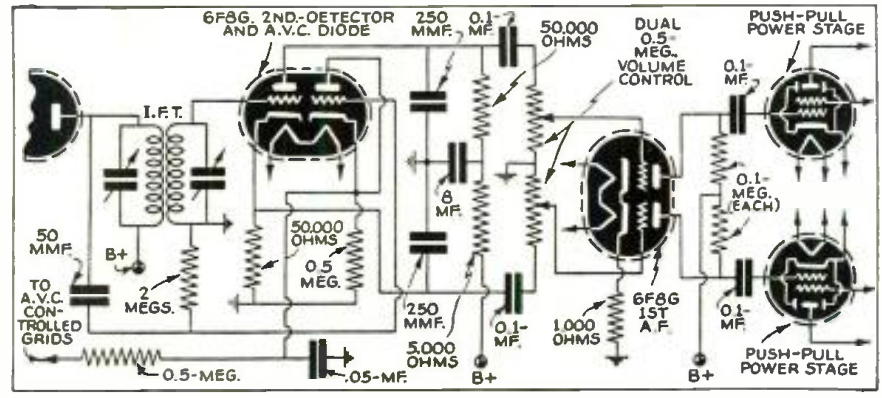
Diagrams of Interest

This is a new department. If you have a new Hook-Up, send it along; a pencil diagram will do. Be sure to include a brief description.

All diagrams and descriptions accepted and published will be paid for at regular space rates. Diagrams may be for receivers, adapters, amplifiers, etc. Send them to Hook-Up Editor, RADIO & TELEVISION, 20 Vesey St., New York City.

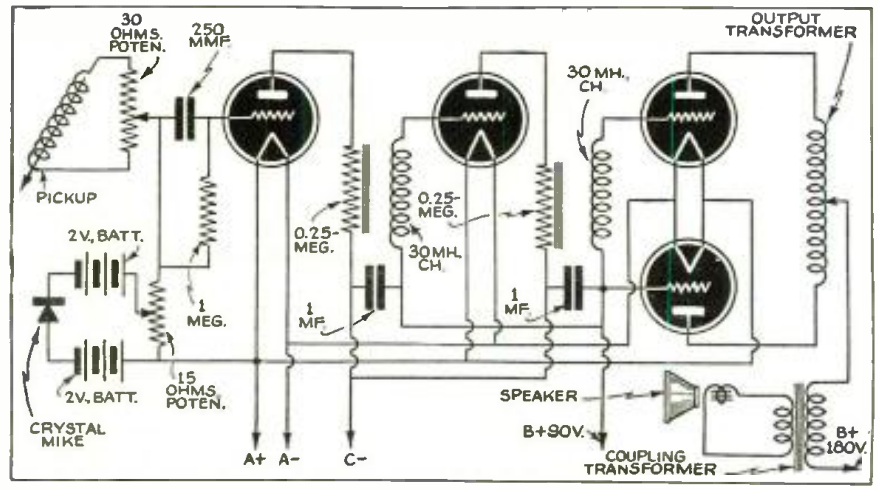


The diagram above shows the G.E. Co. model H508 portable radio phonograph combination circuit. A crystal phono. pickup is used and the circuit is adapted for operation on 115 volts A.C. The lineup of tubes comprises a superhet with one stage of I.F. amplification. Variations of this circuit will prove interesting to experimenters.



This interesting circuit was supplied by Harvey Gernsback, and shows the hook-up for an infinite-impedance second detector in a superhet receiver. Note that this circuit permits the second detector to feed the push-pull audio frequency amplifier stage, without the use of a transformer.

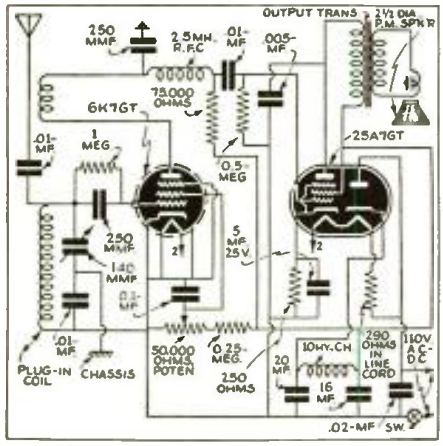
WHAT'S WRONG WITH THIS DIAGRAM?



Here's a good test for you radio diagram hounds! Allow yourself six minutes and see how many errors you can find in this diagram—and no peeking at the answers, either! After you have jotted down all of the right answers for the wrong connections, turn to page 256.

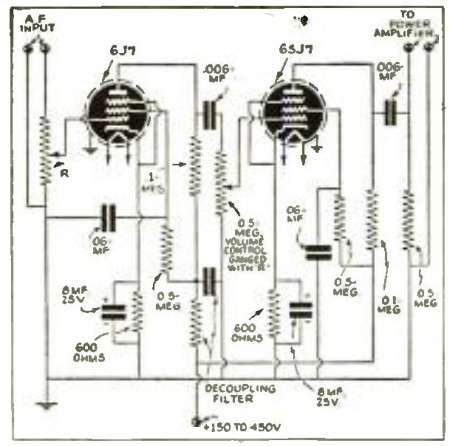
to the Radio Experimenter

2-Tube Broadcast Set



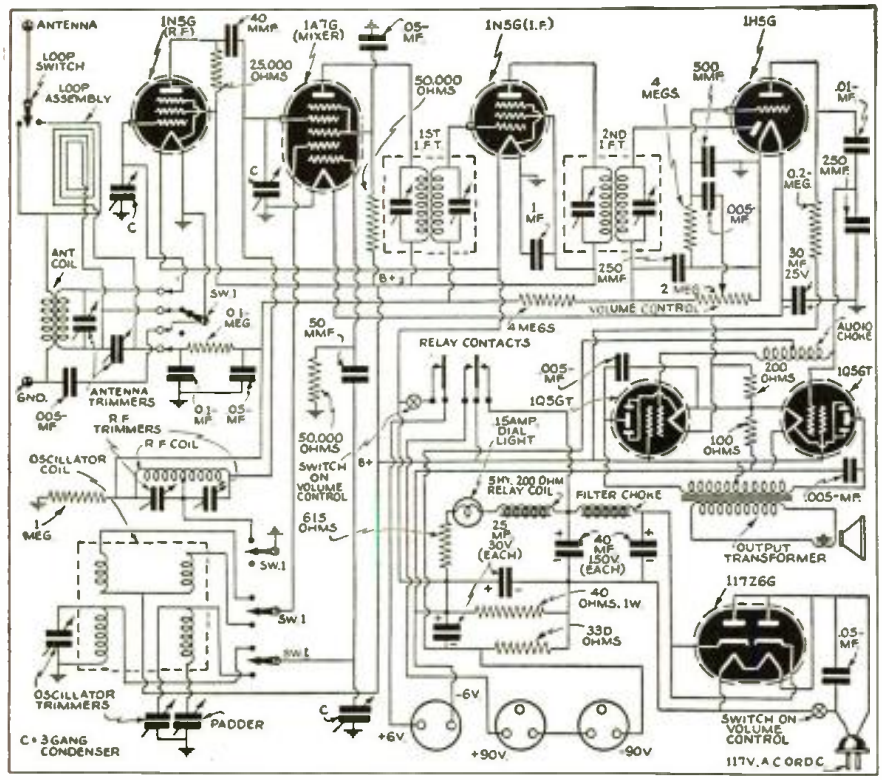
This diagram was submitted by Homer L. Davidson of Fort Dodge, Iowa, and he says in his letter that he has found it to make a dandy broadcast set of extremely small size. He uses a 2½" diameter P.M. speaker with it. Mr. Davidson had excellent DX reception using a pair of sensitive head phones in place of the loudspeaker.

Front Cover Diagram



Non-Motorboating Resistance Coupled Amplifier. Voltage gain 9,000. Courtesy of RCA (tube manual). The values of resistance chosen give a sharp low-frequency cut-off. Three or more stages (including power stage) operated from a common B supply may require a decoupling filter in the plate supply leads of one or more of the voltage amplifier stages.

At Last! Portable Set Hook-up with R.F. Amplifier



The new Pilot 7-tube portable receiver circuit appears above. As the set operates on 115 volts A.C. or D.C. or on 6 volt battery, this hook-up should prove extremely interesting to every radio student. Moreover it is quite out of the ordinary in that it is one of the first, if not indeed the very first portable hook-up to include a tuned R.F. stage, so as to boost those weak DX signals picked up on the loop antenna built into the set. For battery operation an Eveready No. 747 double A battery of 6 volts, and 2 No. 482 45 volt B batteries connected in series are recommended. Even though three tuning condensers are employed, there is but one tuning dial as the condensers are ganged. Ranges—563 to 187 and 54 to 19.1 meters.

Beginner's "Flea-Power" Transceiver

H. G. Cisin, M.E.

This inexpensive low-powered transmitter and receiver may be used for short distance "parlor" demonstrations of radio. Two of these sets will permit two-way conversation.

The flea-power transceiver in operation; it plugs into any lamp socket for its power-supply.

● THIS little two-tube outfit is a combination all-wave receiver, suitable for earphone reception, and a low-powered transmitter of the type used for phono-oscillators, mystery controls, etc. Its purpose is to give the beginner a chance to learn about transmitter operation and still stay within the rules and regulations set forth by the F.C.C. with regard to unlicensed transmitters. In order to permit the operation of remote control devices, wireless electric phonographs, etc., within the home, the F.C.C. has set up rules limiting the permissible radiation range of an unlicensed oscillator, and this device is of low enough power to come within such classification.

The Flea-Power Transceiver employs a 6C5 tube and a 6A7 tube. The purpose of the 6C5 is merely to act as a rectifier. The 6A7 is actually the "working" tube. This tube consists of a pentode and triode within the same envelope. The pentode tube is used alone when the set is employed as an all-wave receiver. When used as a transmitter, the triode is used in combination with the pentode.

The problem of obtaining suitable grid bias on both receiver and transmitter is solved by using dual grid condenser-grid leaks. The grid leak used for reception is 1 meg., with a .0001 mf. grid condenser. That used for transmission is a 10,000 ohm grid leak, with a .00005 mf. grid condenser. When being used as a receiver, the transmitter grid leak-grid condenser is taken out of the circuit by means of a switch.

The phone connection for receiving is made by a plug inserted in a closed-circuit jack. When the plug is inserted in the jack, it makes a "break" between the "B" terminal of the plug-in coil and high voltage, thus connecting the earphones in series in this circuit. When the plug is removed, high voltage is impressed directly on the tickler winding. This connection is the one needed for transmission. The triode grid used for transmission is connected directly to one of the microphone pin jacks. The other jack is grounded to the chassis. The microphone is thus ready for transmission as soon as it is plugged into the microphone jack.

The circuit used for power supply is the standard A.C.-D.C. circuit employing a filter consisting of a 4,000 ohm resistor shunted on either end by one section of a miniature type dual 20 mf. electrolytic condenser.

The entire outfit is mounted on a compact metal chassis 5" long by 2¾" deep by 1½" high. The variable condenser is mounted on a bracket. The other parts mount beneath the chassis.

The plug-in coils available for reception cover a range of from 17 to 560 meters. These same coils may also be used for *transmission*. However, when using the set as a *transmitter*, be certain *not* to use an aerial or ground even on such a low-powered rig, as this would increase the range of the set and necessitate obtaining a station license.

Complete List of Parts Required

HAMMARLUND (Condensers, Coils, Sockets)
1—19 plate 140 mmf. variable tuning condenser, type SM-140 (C2)
1—Antenna trimmer, 3 to 30 mmf., type MEX-30 (C1)
1—Set short wave plug-in coils, 17 to 270 meters, type SWK-4 (L1)
1—Broadcast plug-in coil, 250 to 560 meters, type BCC-4 (L1)
1—4-prong Isolantite coil socket, type S-4 (for L1)
2—Octal Isolantite coil sockets, type S-8 (for V1 and V2)

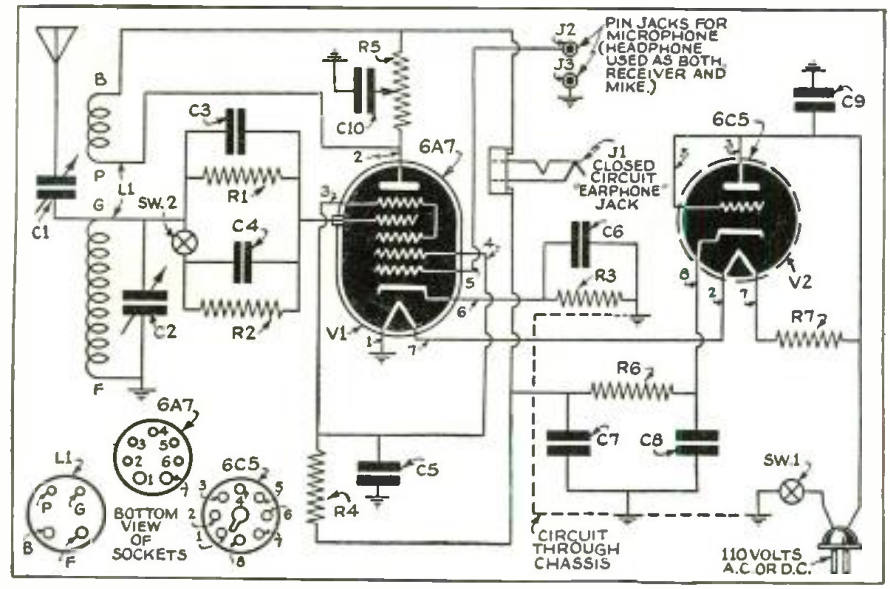
CORNELL-DUBILIER (Condensers)
1—Mica condenser, .0001 mf., type 1W (C3)
1—Mica condenser, .00005 mf., type 5W-5Q5 (C4)
1—Mica condenser, .0005 mf., type 3L-5T5 (C10)
2—.1 mf. tubular paper condensers, type DT-4P1 (C5, C9)
2—20 mf. midget dry electrolytic capacitors, type BR-2015 (C7, C8)

I.R.C. (Resistors)
1—1 meg. ¼ watt fixed resistor (R1)
1—10,000 ohm ½ watt fixed resistor (R2)
1—500 ohm. ½ watt fixed resistor (R3)
2—4000 ohm, ½ watt fixed resistors (R4, R6)
1—50,000 ohm potentiometer (R5) with switch Sw1

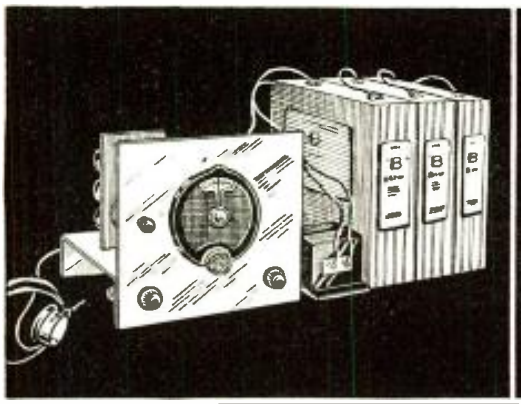
RCA (Tubes)
1—6A7 tube
1—6C5 tube

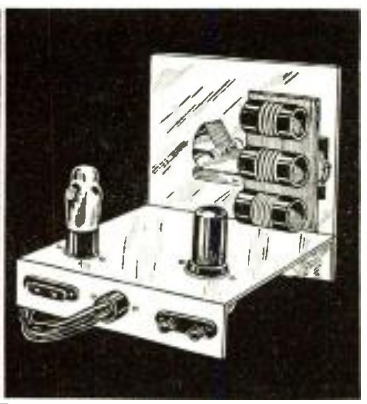
MISCELLANEOUS
1—360 ohm heater line cord (R7)
1—Toggle switch, S.P.S.T. (SW2)
1—High impedance "earphone," suitable for use *both as earphone and microphone*
1—Closed-circuit jack (J1)
2—Pin jacks (J2, J3)
1—Roll hook-up wire
1—Screen grid clip
2—Knobs
1—Dial
1—Metal chassis—5" x 2¾" x 1½"

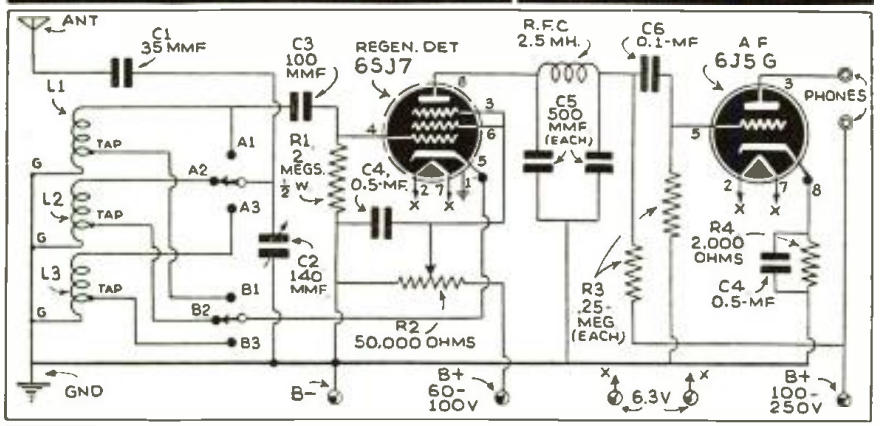
Wiring diagram of the low-power transceiver; a switch changes the circuit from transmitting to receiving.

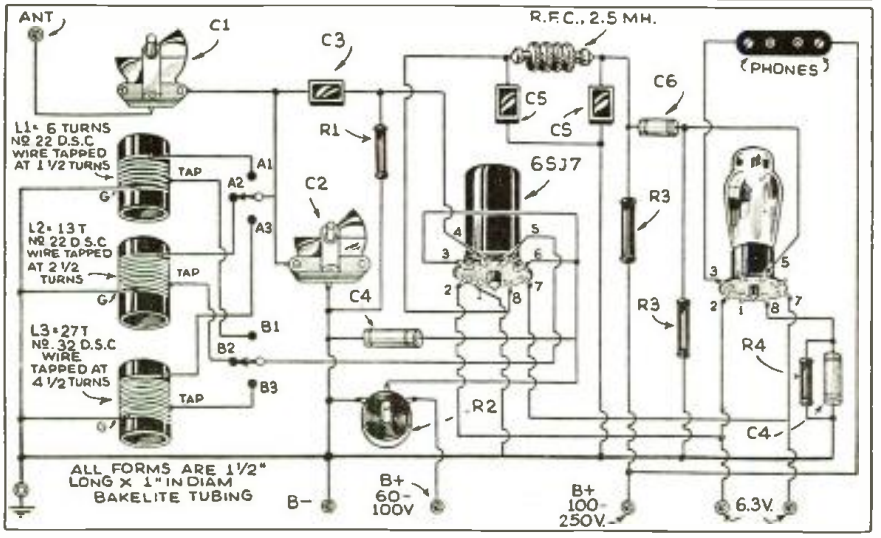


3-Band Switch-Coil Receiver









By merely turning a switch, three short wave bands (from 15 to 100 meters) are quickly and easily covered.

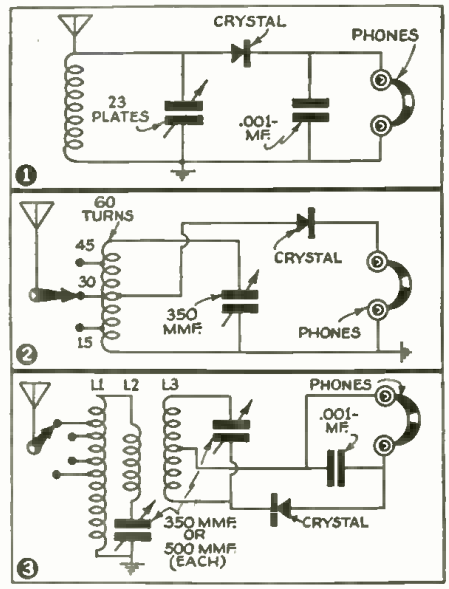
● THIS receiver covers 15 to 100 meters, without the use of plug-in coils, and may be operated from batteries. It makes a dandy portable receiver for the short-wave "fan."

The accompanying diagram shows the simple circuit of the three-band short-wave receiver, which does away with the nuisance of changing coils, and all one has to do to change the wave band is to flip a switch. A two-gang switch is employed so that both sides of the tuning circuit are switched simultaneously. The data for the three tuning inductance or coils is given in the drawing, and the coils may be wound on pieces of round wood, bakelite or even cardboard tubing. If cardboard tubing or wooden rod is used, it is well to soak the forms in paraffin wax first, so that they will not

(Continued on following page)

Three Simple Crystal Sets

● THE circuits of three simple crystal sets are shown in the current issue of the *Australasian Radio World*. Fig. 1 shows a very simple circuit which requires but a coil of wire tuned with a .0005 mf. (or 23 plate) variable condenser. A crystal, a pair of phones, a .001 mf. fixed condenser and an antenna and ground are all that are necessary to complete this set, which will give fair results when used close to a powerful station. Fig. 2 illustrates a more selective set, the coil being wound on a 2½" form 4" long, using No. 22 or No. 24 D.C.C. or enameled wire. The 60 turn coil is tapped at 15, 30 and 45 turns, requiring about 50 ft. of wire altogether. This circuit may be improved by connecting a .001 mf. condenser across the phones. Fig. 3 shows a more elaborate set in which two variable condensers and a 3-coil circuit are employed. In this circuit L1 consists of 40 turns, tapped at each 5th turn at the antenna end; L2 is 15 turns and L3 is 40 turns, all being wound on 2" tubing.



3-Band Switch-Coil Receiver

(Continued from preceding page)

absorb moisture. For the regenerative detector stage a 6SJ7 is used and for the audio frequency stage a 6J5G is employed. On strong signals a sensitive loud-speaker might be used, but this job is primarily intended for head-phone reception. By means of a simple switch placed in the output circuit of the 6J5G tube it becomes a simple matter to switch from the loud speaker to phones.

This whole receiver can readily be mounted in a large cigar box, or in one of the small, neat cases available in most novelty stores nowadays. Regeneration is controlled in this circuit by varying the voltage applied to the screen grid of the detector tube, through a 50,000 ohm potentiometer. Tuning is accomplished by means of the 140 mmf. variable condenser connected across the tuning inductance, while a 35 mmf. series antenna condenser permits the operator to readjust the set to eliminate "dead-spots." In other words, if the set goes dead and does not seem to regenerate properly, adjustment of the series antenna condenser will usually obviate the trouble. Another hint with regard to regeneration is that in some cases it may be necessary to shift the position of the tap along the inductance coils, and a greater or lesser number of turns be included between the ground connection and the tap.

If an aluminum or other sub-base and panel are used, the panel may measure about 7 x 8", and the sub-base about 6 x 8". The coil switch and the 35 mmf. antenna condenser are each mounted on a piece of bakelite bolted to the panel; the switch has its rotor isolated from the panel, in order to reduce the capacity between the contacts. The three tuning coils are mounted on a piece of bakelite 2½ by 3¾ inches. Although in some hookups of this type the *dead* coils, or those not in use at a given time, are *shorted* out by means of a switch—in this particular case it was not found necessary to short the coils out of the circuit, and they are left floating.

Double-silk covered wire may be used in winding the coils. An antenna wire about 60 to 70 feet long works very well with this set. Where this receiver is to be built and used as a *portable*, 100 to 135 volts of B will suffice, but where a power-supply unit is available, up to 250 volts may be applied to the plate of the 6J5G output tube.

Parts List

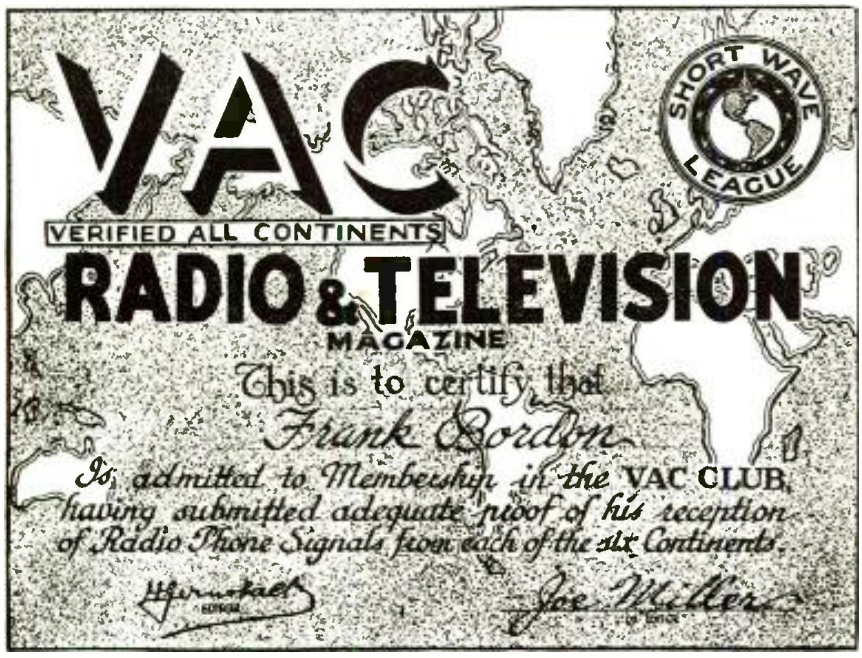
HAMMARLUND
C1—35 mmf. Hammarlund midget condenser
C2—140 mmf. Hammarlund midget condenser
4 Hammarlund isolantite sockets

AEROVOX
C3—.0001 mf. "postage stamp" mica condenser. Aerovox
C4—.5 mf. paper by-pass condenser, Aerovox
C5—.0005 mf. "postage stamp" mica condenser. Aerovox
C6—.1 mf. paper condenser, Aerovox

I.R.C.
R1—2 meg. ½-watt resistor, I.R.C.
R2—50,000-ohm potentiometer, I.R.C.
R3—.25 meg. ½-watt resistor, I.R.C.
R4—2000-ohm ½-watt resistor, I.R.C.
L1—6 t. No. 22 D.S.C. tapped at 1½ t. from ground (spaced)
L2—13 t. No. 22 D.S.C. tapped at 2½ t. from ground
L3—27 t. No. 32 D.S.C. tapped at 4½ t. from ground.
(t.=turns) D.S.C.=double-silk covered

Have You VAC?

● THE handsome 9 x 12" VAC Certificates are still available and will grace any DXer's wall. To be eligible for this DX honor, a phone QSL is needed from each of the 6 continents, Asia, Africa, Europe, Australia, North America and South America (Java and Philippines count as Asia). Send in these six QSL's with 25c for handling and costs, and, after checking, the QSL's will be returned with this fine certificate. Address *V.A.C. Editor,* RADIO & TELEVISION, *20 Vesey St., New York, N. Y.*



The Short Wave Listener

● PIPE in mouth, he draws up his chair, adjusts the "cans," and turns on the rig. The "cans" are his head-phones; the rig, his receiver. This is the short wave listener, known to his fellows as SWL. Whether his receiver be an expensive, commercial job, or a humble, home-made affair, he is mighty proud of it, for the results with which it has rewarded him during his long, patient hours of DXing.

He is well-versed on current events, gets the latest news bulletins direct from their sources, and is a wizard on geography. On the wall of his "shack" (radio room) is a large world map, into which he has inserted map-tacks, each denoting the location of that particular country which he has heard. The SWL is a friendly chap. When he hears a new station, he immediately notifies his fellow SWL's, and they, in turn, do likewise. He thinks nothing of rising at 4 in the morning to try for a rarely heard station, nor of listening for hours through static, heterodyne, and code interference, in an effort to identify a station not already recorded in his log. And will not surrender until he has positively identified it!

Of all people, he most appreciates the mailman, and patiently awaits the arrival of verification cards from radio stations to whom he has sent reception reports. Some days he receives several; then again, none for many weeks.

He is very proud of his "wallpaper," as he calls his cards. They represent the stations he has heard, and are proof that he has heard them. Beautiful or ugly, each card is a "veri," and that's the main point. They mean everything to him, and he wouldn't part with one of them for the world and its gold!

He knows the frequencies and broadcast schedules of practically every station on the air, and often recognizes a station the moment he hears the announcer's voice. He listens on all bands regularly, for changes in schedule or frequency of a station, for he likes to keep his "log" as up-to-date as possible.

"How can you hear all those foreign countries, when we can hear nothing but noise?" his BCL neighbors ask.

"Patience," he explains.

Through his hobby he has become a member of several radio organizations, at home and abroad, and has become acquainted with fellow members in various countries throughout the world. He corresponds with them regularly, and they exchange radio magazines, and other shortwave dope. They have become very good friends through correspondence, and his big ambition is to meet them all personally some day! Through correspondence he learns the latest developments in foreign radio, which makes for his 100% accurate log.

Though there is a distinction between the "ham" and the SWL, the latter has proven himself useful, though handicapped without a transmitter. In 1936, for example, a 17-year-old Austrian youth purchased a second-hand shortwave receiver. He tuned to the shipping band. Suddenly he heard, "S.S. *Lena* calling. SOS! In Distress!" Quickly the youth copied the position of the ship, and notified his local Coast Guard station. The distance between the youth and the ship was 6,000 miles, and yet three minutes after he notified local authorities, they had relayed the message to proper authorities, and all aboard the ship were rescued. The ship belonged to the Russian government, and the lad received a medal for his act.

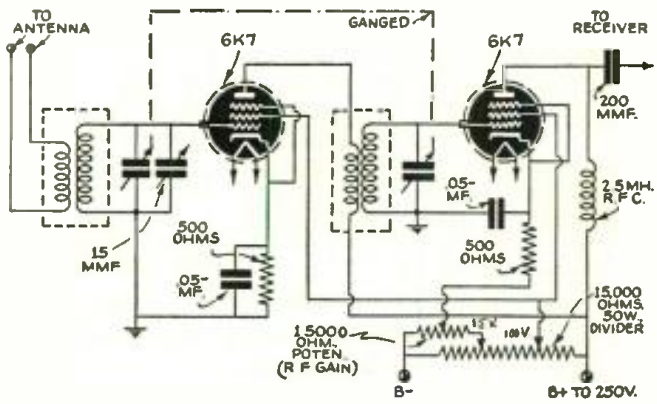
SWL's *do* serve a purpose!

Edited by Herman Yellin, W2AJL

Preselector

Please show a circuit diagram of a two-tube preselector.—W. Stumpf, Waterloo, Ontario, Canada.

A. The diagram shows a preselector using two 6K7 tubes, although 1852 tubes could also be used. Tuning condensers may be 140 mmf. each and ganged. Coils can be either plug-in or a set of the new switch-mounted type. A 15 mmf. trimmer condenser should be employed across the first tuning condenser.



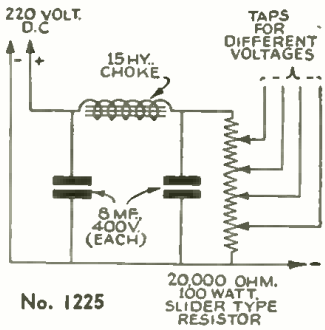
Hook-up for 2-Tube Preselector. (No. 1224)

Parts Values for "Portable"

J. Ressegive of Brooklyn, N. Y., requests values for some of the parts in the "DeLuxe Portable" described in the November, '39, issue.

A. The values of the resistors are as follows: R4, 25,000 ohms; R7, 15,000 ohms (potentiometers); R29, 1,500 ohm, 20 watt, slider type resistor; R5, 2 megohms, ½ watt; R6, 25,000 ohms, ½ watt; and R28, 1 megohm, 1 watt.

Power Supply



No. 1225

Please publish a diagram of a well filtered power-supply to operate on a 220 volt D.C. power line.—P. E. Saldana, Palo, Leyte, P. I.

A. The power-supply shown in the diagram contains a slider type resistor across the output for obtaining different voltages. The taps should be adjusted (with a load connected to them) until the desired voltage is obtained. Use a high resistance voltmeter. The choke coil should have a current carrying capacity equal to the maximum current drain of the equipment powered by this supply.

Facsimile Recorder

Please publish a simple but effective Facsimile Recorder that I could use with my HQ-120 Hammarlund receiver.—J. E. Coxon, Seattle, Wash.

A. A home-built facsimile recorder which can be constructed from materials found in the average well-equipped junk box was described in the January, 1940, issue. A certain amount of mechanical skill is necessary for its successful construction. A complete kit, partly assembled, is available commercially.

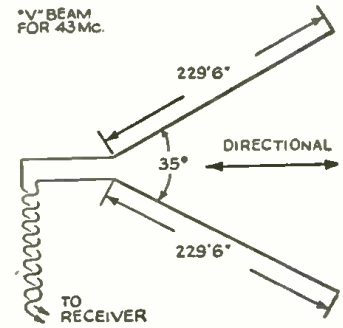
110 Vt. One-Tuber

Is it possible to have a one-tube radio using a type 30 tube and operating from the A.C. electric line?—E. Budgis, Taylor, Pa.

A. Unfortunately, it would be quite impossible to do this, since a rectifier is necessary for converting the alternating current to direct current suitable for the plate supply. The only type of single tube receiver would be a tube having a triode or pentode unit, together with a diode rectifier in the same envelope.

"V" Beam Antenna

Can you give me information on a "V" beam antenna for use in receiving a frequency modulated transmitter over 100 miles away?



No. 1226

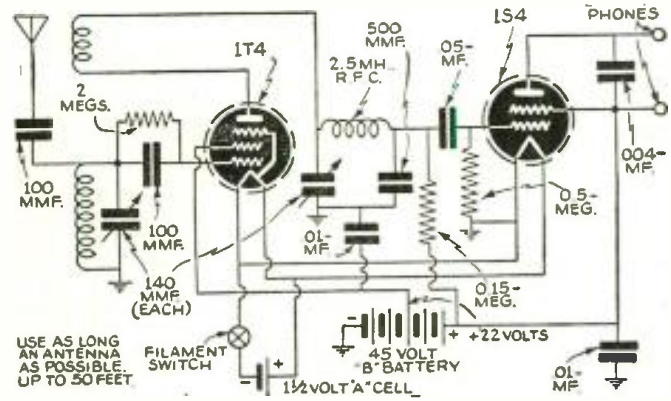
A. "V" beam antennas are quite directional and have a high gain along their line of maximum response. This is especially true where each side of the beam is of the order of 10 to 30 wavelengths long. The sketch shows the dimensions for a system, having sides 10 wavelengths long, for a frequency of 43 megacycles. Both sides of the beam should be horizontal and about one wavelength above ground. Where there is insufficient acreage for such a long antenna, a shorter one can be used, but it should be remembered that the longer the wire the greater will be the antenna "gain," which is highly important on the high frequencies where the distance is greater than the "line-of-sight" distance. Where less than 10 wavelengths length is used, the two wires of the "V" should be spread more than the 35° shown. In the following formula for calculating the length of each wire, the factor K equals the number of wavelengths for each wire.

$$\text{Length (feet)} = \frac{984\ (K)}{\text{frequency (megacycles)}}$$

Hook-up for 2-Tube Receiver

I would like a diagram of a portable 2-tube receiver using the new midget 1.4 volt tubes.—B. MacDonald, Bremerton, Wash.

A. Herewith is a simple 2-tube outfit capable of being very compactly constructed. A 140 mmf. tuning condenser is employed as



A 2-Tube Receiver for the experimenter. (No. 1227)

well as a 140 mmf. regeneration condenser. The coils can be any 2-winding plug-in units, such as the Hammarlund or Bud. On the stronger stations a small 2 or 3 inch P.M. (permanent magnet) speaker could be used.

Queries to be answered by mail (not on this page) should be accompanied by fee of 25c (stamps, coin or money order). Where schematic diagram is necessary, our fee is 50c up to 5 tubes; for 5 to 8 tubes fee is 75c; over 8 tubes, fee is $1.00. *No picture diagrams can be supplied.*

Preselector

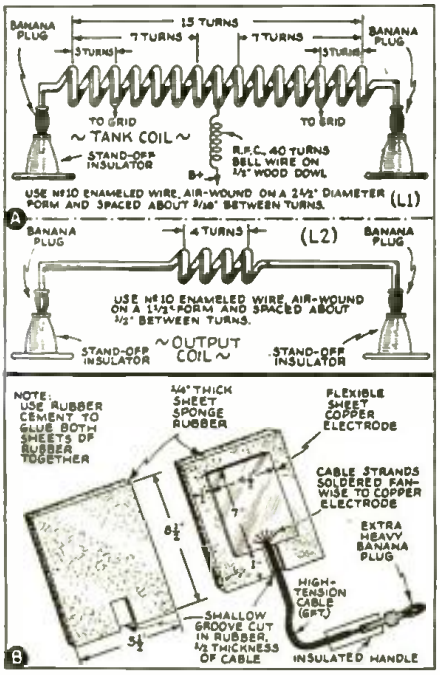
Referring to the preselector in the September, 1939, issue, the parts list specifies a 140 mmf. condenser, while a 160 mmf. condenser is referred to in the text. Which is correct? Can plug-in coils be used instead of band-switching? How many turns are on the primary windings?—Edward Sujak, Cicero, Ill.

A. A 140 mmf. condenser is correct and can be used with plug-in coils. The number of turns on the primary will depend on the type of antenna used. For a doublet, use about one or two turns more than is used between the tap and ground of the regular coil. Use No. 30 enameled wire for this winding.

Short Wave Diathermy

I am particularly interested in the short wave diathermy apparatus which appeared in the February, 1940, issue, and would like to have a drawing showing the high frequency coil construction, and also details on how to make the pad electrodes.—John Q. Smith, Buffalo, New York.

A. The accompanying drawing shows the details of construction for the high frequency tank coil and also the output coil for the short wave diathermy apparatus. The second drawing B shows the construction details of the treatment electrodes. A word of caution is in order—be sure to examine the rubber covering on those treatment pads at frequent intervals (also the heavy rubber covered cables connecting them to the apparatus), so as to be sure that there is no chance of a high voltage leak. A high frequency spark, while probably not fatal, may cause a severe burn and is liable to upset the patient's nervous system.

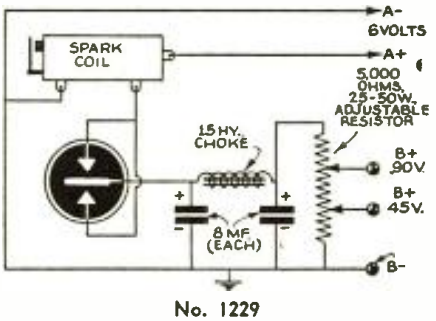


Details of short-wave diathermy coils, also construction of treatment pads. (No. 1228)

Bleeder for Power Supply

I would like information on the size of bleeder necessary to obtain 45 and 90 volts from the Vibrator Power Supply using a Ford spark coil, described in the November, 1938, issue.—Allen Phillips, Roland, Manitoba.

A. Since you do not state the current drain at these two voltages, we cannot specify the exact values of resistance to use. However, by using a tapped bleeder with slider adjustments, the sliders can be adjusted until the desired voltage is obtained under load. This method is applicable to any power-supply where the current drains are not known. The resistor should have a resistance such as to draw about 10 milliamperes, without any other load connected to the power supply. We are reprinting the diagram of this interesting power supply with the addition of the adjustable resistor.



No. 1229

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Radio & Technical Publ. Co.	Radio Textbooks	Circulars on each Book		Free	228
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Radolek Co., The	Mail Order	1940 Radio Profit Guide		Free	211
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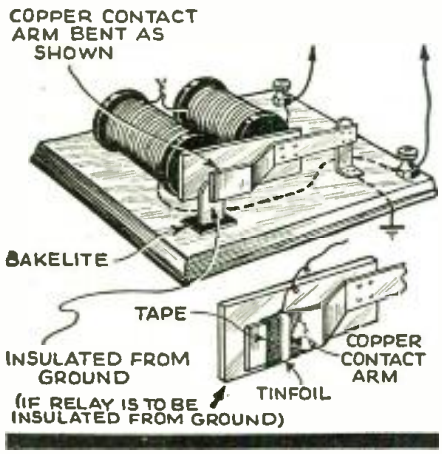
Teleplex Co.	Code Machine	Booklet	S-8	Free	219
Triplett Electrical Inst. Co.	Parts Mfr.	Catalog		Free	219
Tri-State College	Radio School	Catalog		Free	195

The Cover Kink

First Prize Winner

Keying Relay

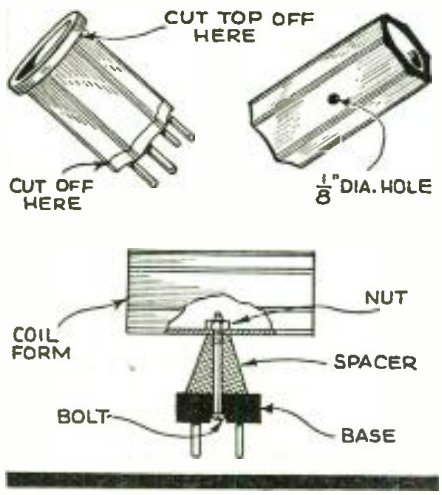
A handy relay which can be used for keying a transmitter or other purposes is readily constructed from an ordinary buzzer



of the 10c store variety. The circuit of the buzzer is changed, the interrupter being disconnected from the magnet circuit. The magnet is connected directly as the primary and when energized attracts the rebent contact, causing it to close the secondary circuit. If necessary the relay may be rebuilt to insulate the contact arm bracket from the base.—*Harry Greenberg, W2MSQ.*

Horizontal Coil Mounting

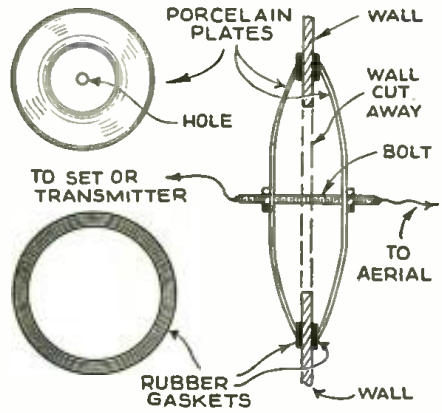
Take an ordinary 1½ inch diameter rib coil form and cut off the moulded rim at the top and the prong part at the base, making both cuts as near to the ends as possible. Drill a ⅛" hole in the exact center of the prong section and countersink it for a 6/32 flat head screw. Drill another ⅛" hole in the center of the side of the ribbed section of the coil form. Now, with a 6/32 flat-head brass bolt and nut fasten



the two parts together using the upper half of a "pee-wee" feed through insulator as a spacer. The coil must be taken apart before the wire can be wound on it and when this is done one-half inch should be left between the two windings to accommodate the top of the spacer. This type of coil is very convenient in many applications and will not cost much more than 25 cents.—*E. J. Rohrig.*

Oversized Lead-In Insulators

Mammoth high efficiency insulators suitable for use in low power transmitters or high frequency receivers can be made at a minimum cost from porcelain plates. First secure a flat block of wood and drive a large nail into it letting the nail head protrude a little so as to bear against the center of the plate preferably. Then place the plate right side up on the block and center it over the nail. Fill the bottom of the plate with turpentine and with a hand drill and



a good steel bit not over ¼ inch in diameter you can bore a neat hole. Be sure to keep the nail directly under the center of the plate where you are drilling.—*Alton Larpenteur.*

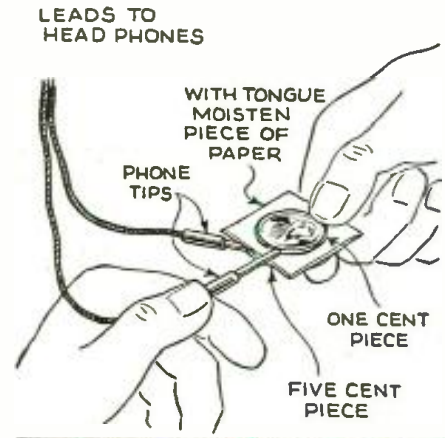
Low Cost Call Letters

Wishing to display my call letters on the front and rear of my car, I went to the local hardware store and bought my call in aluminum letters at a cost of 5c each. I then visited a nearby auto junk yard and

obtained two last year's license plates. I bolted the letters to the plates on the blank side and painted them my favorite colors. The same set of letters can be used for other applications, even on the panel of the rig.—*Frank Courtney, W4FDX.*

Flea-Power Battery

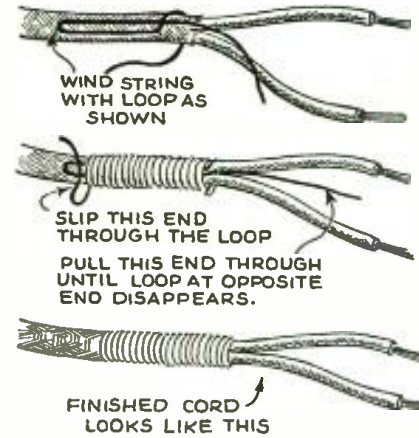
When it is necessary to test a pair of phones and no source of current is available, a "flea power" battery can be made in a few seconds by using a one cent piece and a five cent piece separated by a piece of soft, absorbent paper, such as news-



paper. This paper must be thoroughly moistened with saliva, which serves as electrolyte in the tiny battery. Touch one phone tip to the nickel and start tapping the penny with the other. If the phones are in working condition a faint click will be heard when the penny is tapped.—*James Halusz-czak.*

Keeping Cord Neat

Many radio set builders wind the insulation on lamp cord with string to keep it from fraying and becoming unravelled, but few know how to wind the wrapping so that it will be neat and free from knots. First make a large loop of the string and lay it along the lamp cord, as shown. Then wind on the remainder of the string, and bring its end through the loop you have formed. Next, pull the free end of the loop, to bring the loose end under the wrapping. Finally cut both ends as close to the wrap-

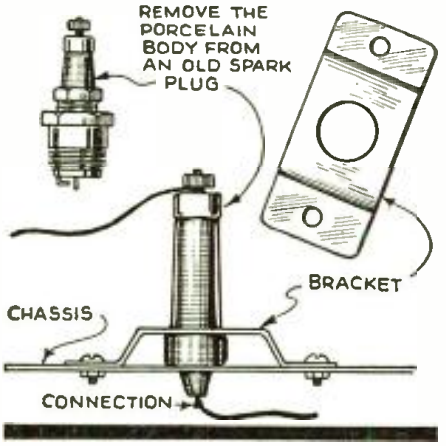


ping as possible. The cord will be firmly secured, and no knots or loose ends will remain.—*Steve Liska.*

RADIO KINKS published on these pages will win their senders 8 months' subscription to RADIO & TELEVISION. The *best* kink published each month will win a *2 years'* subscription. Read these kinks; they will be of real use to you, besides indicating what is wanted. Send a typewritten or ink description with sketch of *your* favorite to the Kink Editor

Feed-Through Insulator

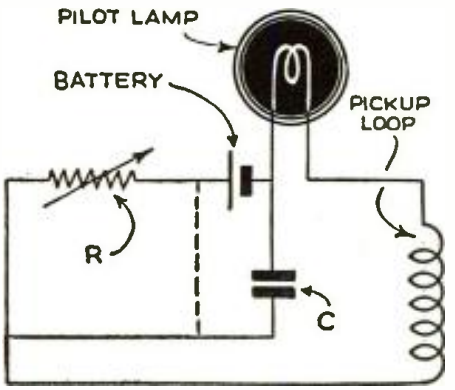
A cheap, efficient insulator can be quickly made by utilizing the porcelain from a discarded spark plug. A hole is drilled in the chassis as shown in the accompanying sketch. This hole must be big enough to take the lower end of the porcelain without permitting the flange to pass through. A piece of strap metal is bent and drilled as illustrated to bear on the other surface of the porcelain flange. This clamps the spark plug firmly to the chassis. One wire may be attached by means of a bolt at one end of the plug and the other soldered to the other end of the wire which runs through the



center of the plug. If space permits the mounting bracket may be installed underneath the chassis.—*Richard Krogman.*

Transmitter Tuning Aid

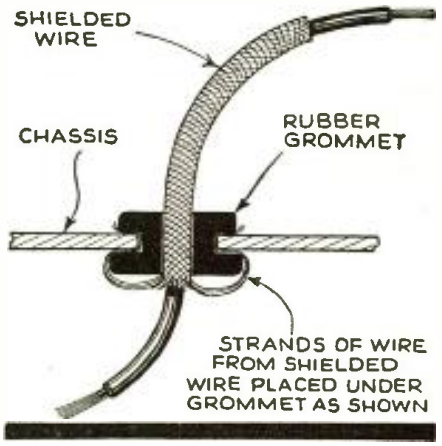
When attempting to use an ordinary pilot light and pickup loop to tune the R.F. amplifier of a low-power portable rig, very tight coupling is necessary. As a result of such tight coupling and insufficient indication, poor neutralization and resonance are often obtained. As it takes 70% of the energy supplied to a pilot light to heat it up to a dull red glow, a 30% increase in



energy will increase its brilliance from dull red to dazzling white. The 70% of the energy is supplied by a small battery and variable resistor in series with the bulb and coil as shown in the diagram. Resistor R is adjusted until the bulb glows dull red. Condenser C may be any small condenser which is available. The pickup coil is now loosely coupled to the transmitter circuit. If a two volt .06 amp. pilot bulb is used, no resistor is necessary since 1.4 volts, obtainable from a small flashlight cell, is approximately 70% of the two volts needed to light the filament.—*Albert T. Herrmann.*

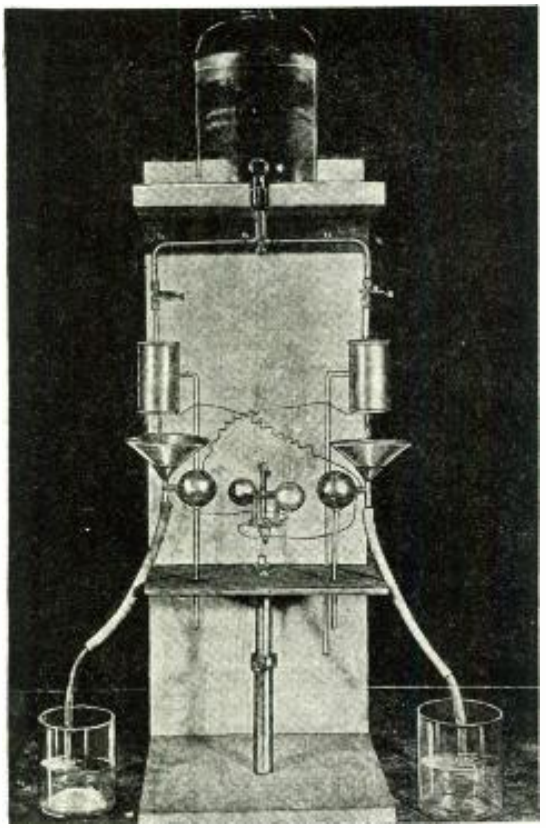
Anchoring Shield

When it is necessary to bring a shielded wire through the chassis, I untwist about ½" of the shield and pass the wire through a rubber grommet. I then turn the unraveled shield over the outside of the grommet and press the metal threads tightly into the groove of the grommet. I then push this grommet into the hole drilled in the chassis to accommodate it. The accompanying illustration shows how this is done. This method of grounding the shield not only affords a good *ground* connection but also holds the wire in place and makes a neat end on the shield.—*Oleg Mcinikoff.*



ELECTRO-STATIC MOTOR

Operates from Drops of Water



Left: The remarkable apparatus all set up—the electric charge accumulated from dropping water operates a motor.

● FOR more than half a century it has been known that a static charge is produced by the breaking up of a jet of water. Based on this, a new type of *electrostatic motor* has been developed which relies for its source of electrical energy on the static electricity generated and accumulated from two small streams of water fed by a central reservoir.

Working in the Experimental Physical Research Laboratory and in the Science Shop of Stuyvesant High School, Emil Gaynor and Howard Kapner designed and developed this motor, under the able guidance of Mr. Gustave Weidemann, head of the Research Laboratory and Mr. John W. Radu, instructor in the newly equipped Science Shop (of the Stuyvesant High School, New York) where most of the precision work was done.

The electrical charge built up in this device is quite considerable, making possible visible discharges up to three-sixteenths of an inch, indicating a potential of over one thousand volts.

Following is a description of the actual construction of the "Rain Motor" pictured in this article. Anyone with a reasonable knowledge of laboratory techniques, and some mechanical ability, can easily construct a similar model.

The general placement of parts can be seen in the schematic diagram. As the first jet is turned on so that the water falls in a stream, breaking up about an inch from the end of the nozzle, a small electrostatic charge is formed. As the water falls on the funnel below, the charge is collected, part staying on the ball and part being transmitted to the charging cylinder surrounding the other nozzle. As the water is turned on in this nozzle it acquires a charge, by induction, opposite to that on the first cylinder. This water, now carrying a charge opposite to that of the water in the other jet, strikes its funnel and again the charge is divided between this funnel and the opposite charging cylinder, as before. This continuous charging action keeps building up a potential, until it reaches a point where some of the water dropping towards the funnels is actually flung back against the oppositely charged can, or goes flying all over the parts of the device.

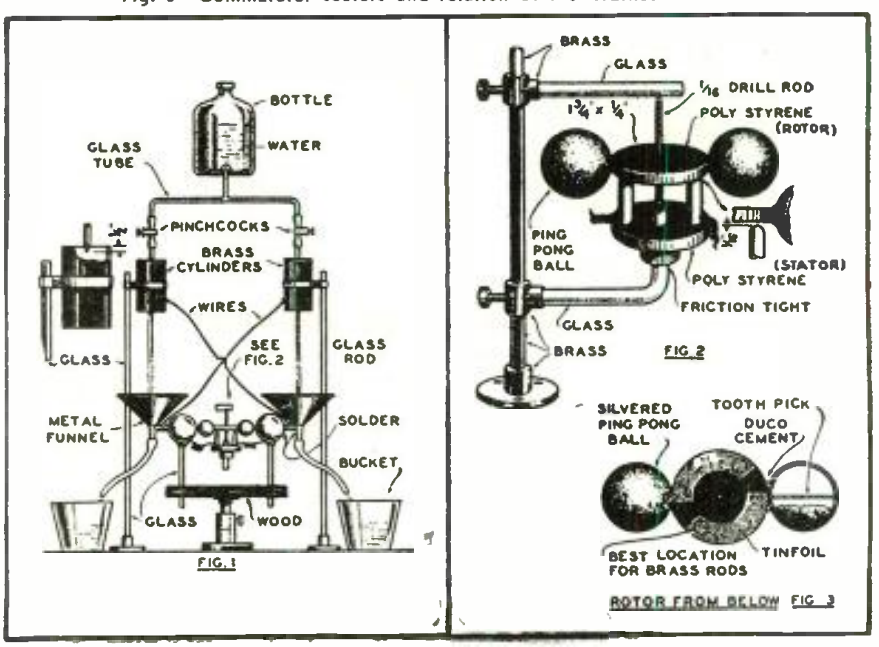
The rotor consists of two ping-pong balls held to a polystyrene disc by toothpicks cemented into place with Duco cement. The disc is mounted on a 1/16" drill-rod shaft with 60° pivot points and is tempered just below glass hardness to prevent wear on the glass bearings. The supports for the rotor are two ¼" glass rods mounted on an adjustable brass standard. The pivot holes are drilled in the glass at required spots using a diamond drill, or a triangular file sharpened to the proper cutting angle. The hole is finished by using a brass rod turned to the angle desired in a lathe and then charged with a paste of fine carborundum and water; this is used to polish or fine-grind the bearing holes in the glass rods. The ping-pong balls are painted with a standard aluminum or bronzing paint and two commutator segments are painted on the underside of the polystyrene disc, one touching each ball (or use tinfoil).

Two pieces of brass rod are mounted 180° apart on another disc of polystyrene an inch and a half below the rotor disc. The ends of these inductors should come within 1/16" of the commutator segments.

In action an electric charge is developed as described previously and the rotor, if well balanced and nearly frictionless, will begin to rotate of itself except when it is exactly between the stationary balls.

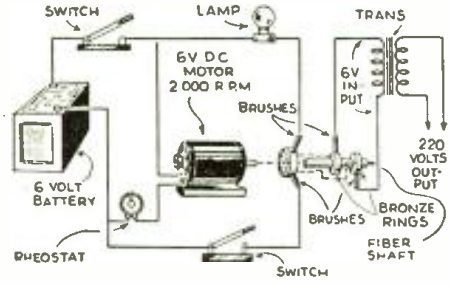
When the full charge has been developed one of the balls will be charged positively and the other negatively. One inductor is connected to the positive ball, the other to the negative ball. The inductors charge the rotor balls by induction through the commutator segments, producing polarities on the ping-pong balls similar to the nearby stationary balls thereby causing repulsion and rotation.—*Courtesy Science Observer.*

Fig. 1—Complete assembly of "dropping water" electric generator and the motor.
Fig. 2—Details of the motor—the rotor unit.
Fig. 3—Commutator sectors and relation of the brushes to them.



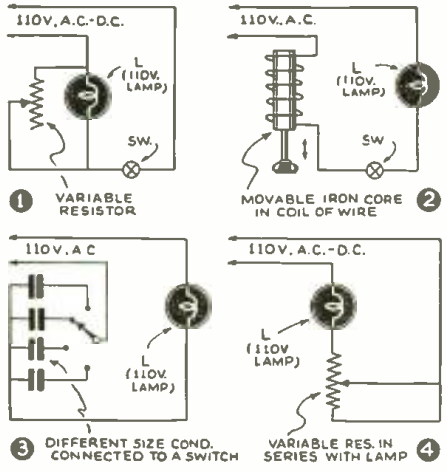
AC FROM A BATTERY

● A 6 VOLT motor rotates a commutator arrangement, provided with a pair of slip rings and brushes. The brushes may be of the woven wire type or simply spring brass strips. A variable resistance or rheostat in series with the motor regulates the speed and when it is rotating at 1800 r.p.m. the A.C. produced will be equivalent to 60 cycle frequency. At each quarter revolution of the commutator and slip rings either a positive or negative impulse is fed into one side of the transformer primary winding. The transformer may be of any desired ratio of voltage amplification, and if a 6 volt battery is used as a source of supply then of course the primary winding of the transformer should be of sufficiently low impedance to operate on 6 volts, says *Ciencia Popular.*



LAMP DIMMER

● FIRST, an adjustable resistance of a few hundred ohms may be connected across the lamp socket terminals as shown in Fig. 1. As the resistance is decreased the lamp becomes dimmer and vice versa. An adjustable choke coil for use on A.C. circuits is shown at Fig. 2. The coil may comprise several layers of No. 16 or No. 18 insulated copper wire and through the center of the coil an iron core is arranged to slide. This core should be made of iron wire or else stampings from an old transformer core (or plain strips of sheet iron or even tin will do if nothing else is available).

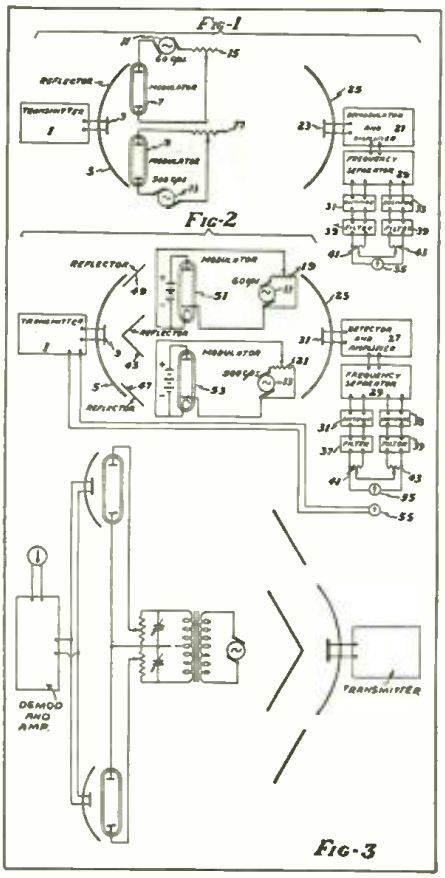


If you have a number of condensers of different capacity lying about, several of these may be connected to a switch as shown at Fig. 3; the lamp will light the brightest on the large size condensers, and dimmer on the smaller capacity condensers. One of the usual ways of dimming a lamp is to connect a variable resistance in series with it as shown in Fig. 4.

DIGEST OF RECENT RADIO PATENTS

RADIO BURGLAR ALARM

● A RADIO beam system especially designed for protective use has been patented by Irving Wolf of Merchantville, N. J., and assigned to RCA. This invention makes use of a system which is independent of the radio transmitter and so avoids giving false alarms in case of transmitter failure. It provides means for modulating two portions of an ultra high radio frequency beam with different audio frequencies, or different phases of the same frequency, and to receive such modulated beam on a single receiver which includes demodulating, frequency separating or phase-balancing means, and a balanced alarm. It also provides a radio beam protective system with two different modulating frequencies or phases, and means to balance these frequencies or phases at a receiver and indicate unbalance by an alarm. Figs. 1 and 2 show two ways in which the system may be designed, while Fig. 3 shows how single-frequency two-phase modulation of the protective beam may be secured. (No. 2,203,807)



Alarm independent of transmitter.

SYNCHRONIZING SIGNAL

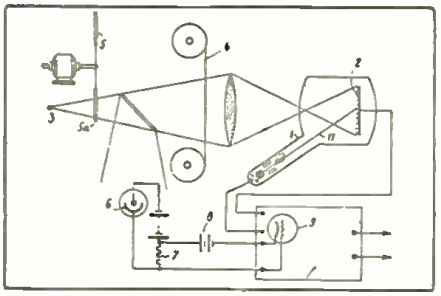
● AN element for producing the synchronizing signal in a cathode-ray television transmitter tube is covered by patent No. 2,196,375, issued to H. H. Wolff (assigned to Loewe Radio). Alongside the photo-electric screen on which the image is thrown, and parallel to its edge, is an electrode, which the ray touches through a slit in a shielding diaphragm. Each time the ray makes contact with the electrode, the synchronizing signal is sent out.

SELECTIVITY CONTROL CIRCUIT

● AN interesting patent has been issued to Garrard Mountjoy (No. 2,194,566) for a receiver selectivity control circuit. This circuit comprises at least 3 cascaded resonant circuits with means for varying the selectivity of the 3rd one of the circuits. Means are also provided for electrically coupling this third circuit with the first two circuits so as to vary the selectivity thereof as a unit. Additional facilities for adjusting the two circuits in successive relation are provided.

TELEVISION FILM SCANNER

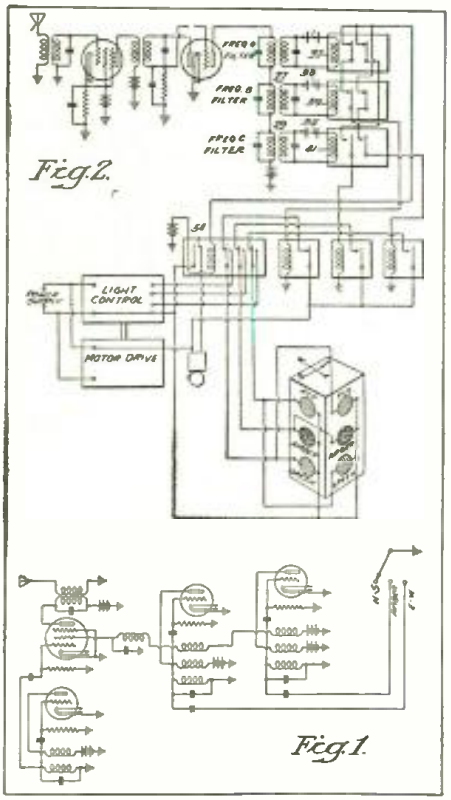
● FLICKER when televising motion-picture film is to be eliminated, according to patent No. 2,199,608, issued to René Barthelemy (assigned to Cie. pour la Fabrication des Compteurs, &c.), by a procedure which moves the film by jerks, scanning each picture several times while at rest. The method is stopping the projection of the film "for a time equal to the previous stoppage and such a number of times that the beginnings of two successive stoppages are separated by the duration of a scanning of the photoelectric surface, and continuously scanning the screen while the film is projected and while it is obturated."



Film scanning method.

RADIO TRAFFIC CONTROL

● A NEW system of traffic control, in which each car equipped with certain apparatus will automatically control traffic lights, has been invented by Winfield R. Koch, of Merchantville, N. J., and assigned to RCA. In his patent application, Mr. Koch proposes to equip ambulances, fire trucks, police cars and other emergency vehicles with apparatus which will automatically turn traffic lights red for cross traffic when such emergency vehicles approach an intersection. His system also permits traffic signals to be controlled selectively from mobile vehicles and automatically prevents unauthorized interference with the controls. The diagrams show a transmitter and a receiver for use in this system. Another feature of this traffic control system is that it permits the usual automatic control of STOP and GO lights when emergency vehicle signals are not being received. (No. 2,203,871)



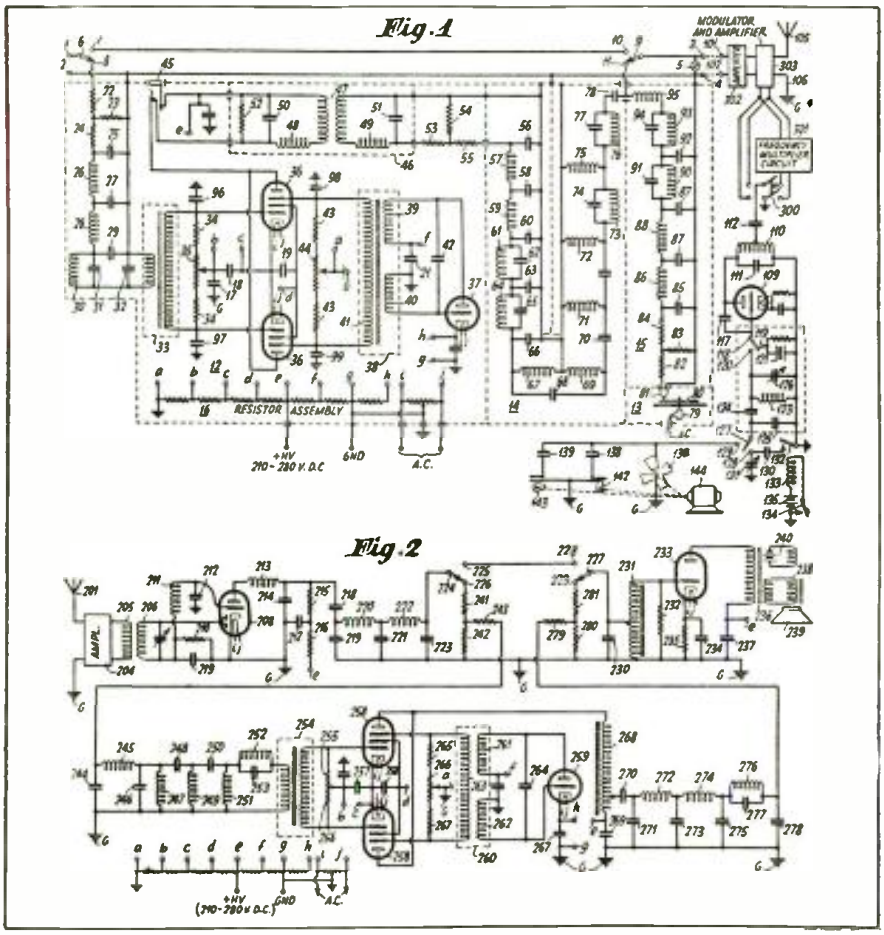
Emergency traffic control system.

TELEVISION TRANSMISSIONS

● PATENT (No. 2,189,135) has been issued to Fritz Schroeter of Berlin, Germany, a unique system of television transmission and this particular patent covers a scheme for the use of motion picture film. Means are provided for moving the film past an optical system, arranged in connection with a suitable photo-cell circuit, the latter serving as a light translating device for producing currents of varying intensity, corresponding to light and dark areas in the pictures on the film. The scanning is carried out by means of a cathode-ray tube arrangement.

SECRET SIGNALING SYSTEM FOR RADIO TELEPHONY

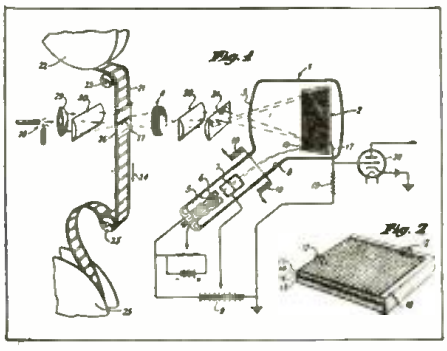
● HERETOFORE there did not exist a private system of telephony which did not give some indication of the fact that telephony was in progress, says Ellison S. Purington of Gloucester, Mass. Therefore he invented a new system in which the true message is concealed by means of a false telephonic message on the same carrier wave as the privacy message, thus masking the true signal. This is achieved through the use of duplex transmission, at the same time converting the speech frequencies of the true signal to a band of frequencies outside the band used by the masking signal and also modulating the radio carrier by the modified frequencies. If necessary, the carrier is also varied at a low rate of speed so that a normal receiver can not be maintained in tune with the transmitted frequency. A receiving system to pick up these signals has also been included in the patent which is assigned to John Hays Hammond, Jr. The transmitting system is shown in Fig. 1 and the receiving system in Fig. 2. Such a secrecy system will prevent unauthorized "listening in." (No. 2,204,050)



Top:—Transmitter of new system. Bottom:—The accompanying receiver.

TELEVISION PICKUP MORE EFFICIENT

● Willard H. Hickok of Bloomfield, N. J., has patented and assigned to RCA an invention wherein an iconoscope should operate at a more efficient portion of its response curve, be more sensitive to light and have a higher output for a given light input. Mr. Hickok's tube has a novel mosaic electrode capable of developing and storing an electrical replica of an optical image of an object focused on the electrode, which image is distorted or expanded in a unilateral direction whereby a more effective electrical storage, a more sensitive system for given light input, than is customarily used in conventional systems may be obtained. In the accompanying illustrations, Fig. 1 is a combination schematic and perspective diagram showing the principal details of the new tube and system, while Fig. 2 is a perspective sectional view of a portion of the electrode structure of the tube shown in Fig. 1. The number *11* designates a sheet of insulating material, its front surface being coated with a photo-sensitive mosaic structure (*12*), each element of which extends all the way across the sheet. (No. 2,204,250)

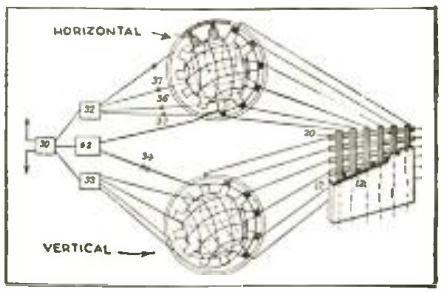


New mosaic in pick-up tube.

On the Cover

LARGE SCREEN TELEVISION

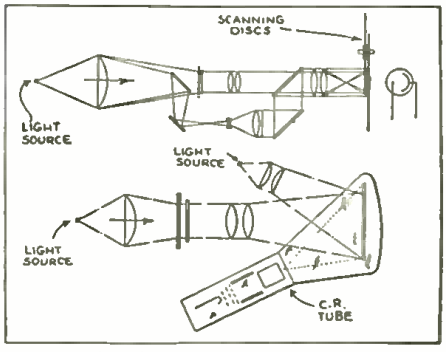
● IN an invention recently patented by Pierre Marie Gabriel Toulon of Puteaux, France, large screen television is secured by employing a frame with a multiplicity of electro-optical light diffusers which form the viewing screen, individual connections being made to each element and a unilaterally conductive device. The screen is illuminated with daylight or artificial light, and the incoming signal impressed through commutators which afford horizontal and vertical scanning. In this way the signal controls the amount of light being reflected by the screen and thus causes images to be formed, in accordance with the wave being transmitted by the broadcasting station. (No. 2,201,066)



Control for large screen.

TELEVISION SYNCHRONIZING

● A NEW method of producing a synchronizing pulse has just been patented by Rolf Möller of Zehlendorf, Germany, and assigned by him to the Fernseh Aktien-Gesellschaft. Mr. Möller simplifies the system by eliminating the use of supplementary P.E. cells and succeeding amplifiers. He obtained synchronization by providing supplementary illumination of constant value for the photo-emissive surface of the image pickup tube which, however, is only effective during the duration of the image signals and which is ineffective during the period of the synchronizing impulse. The accompanying illustration shows at the top an application of the new system for mechanical scanning, while the lower portion shows the system as applied to a cathode ray tube. (No. 2,204,427)

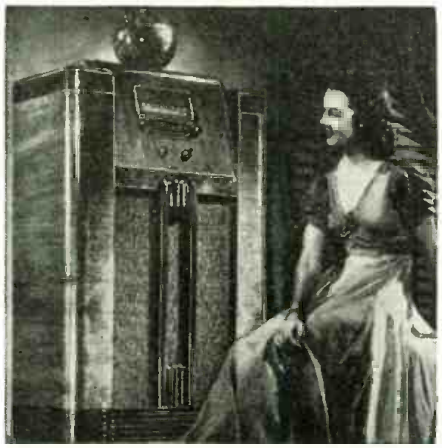


Simple synchronizing system.

New Radio Apparatus of Interest

7-Tube 2-Band A.C. Superhet

●THIS new Knight 7-tube 2-band console radio is housed in a cabinet built of selected matched walnut veneers and featuring an inclined instrument panel. The cabinet is hand-rubbed to a rich, lustrous finish and has gracefully curved ends.



Features include: 8-inch electro-dynamic speaker; continuously variable tone control; A.V.C.; individual coils on each band; push-button tuning on 6 stations; "Air-Magnet" aerial (eliminates outside aerial and ground); 3 watts output; phono and television-sound attachment, etc. Tunes two bands, 545-1550 kc. and 5.8-18.1 mc. Incorporates a superhet circuit licensed by RCA and Hazeltine, using the following tubes: 6A7, 6D6, 75, 76, 2—41, and 80.

This new 7-tube 2-band set is supplied by the Allied Radio Corporation.

Model 670 A.C. Ammeter

● THIS handy little tester has extensive uses in countless fields. One of a new series of matched instruments available in single units or in combination to answer practically every servicing or electrical analyzing problem. Included in the entire line are A.C. and D.C. Milliammeters, A.C. and D.C. Ammeters, A.C. and D.C. Voltmeters, D.C. Microammeters, Ohmmeters, Volt-Ohm-Milliammeters and Battery Testers. Completely self-contained. All incorporate large three-inch Triplett instruments with long scales having the Red●Dot Lifetime Guarantee against defects in materials or workmanship. Red molded cases, 3 1/16" x 5⅞" x 2⅛". Panels are ivory with red markings and trim.

Model 670 has a self-contained current transformer permitting measurements on these ranges: 0-1; 0-2.5; 0-5; 0-10; 0-25. A.C. amperes. (For use on 60 cycles.)

New Midget Relay

● WARD LEONARD ELECTRIC CO. is now marketing a new midget relay designed for use on either A.C. or D.C., and available with contacts arranged for single pole, normally open, normally closed or double throw.

The relay is rated to handle approximately one horsepower and is furnished with coils for operation on standard voltages, either A.C. or D.C. up to 110/115 volts at standard frequencies. It is small enough to mount in the familiar wall type push-button box.

New Receiving Antenna Matcher

● HERE is the new Meissner Signal-Splicer, which is especially designed to enable the radio amateur to get maximum results from his receiver while using his transmission antenna.

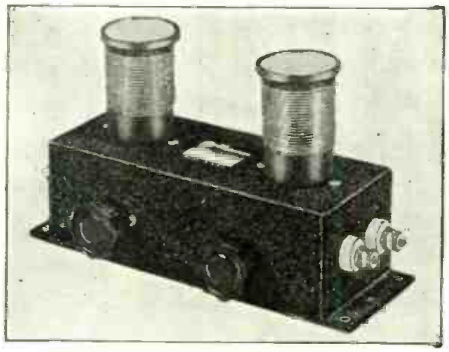
It is the contention of Meissner engineers that the large majority of Hams operate in this manner, taking great care to match the antenna to their transmitters but entirely neglecting the receiver in this respect.

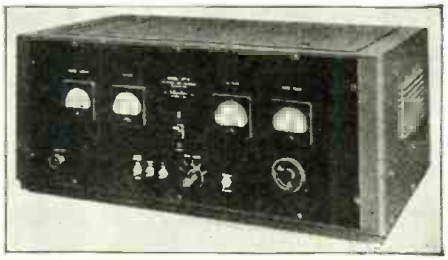
First—they found signal strength improving as they approached the point of impedance match. Great improvement was noted with a condition of perfect match! Frequently, from two to three "R" points gain was encountered and weak signals, completely unreadable before, were easily copied when the antenna and receiver were tuned to match.

Next—high signal gain with a decided decrease in stray noise pick-up was noted.

A substantial improvement in image rejection was also found and on receivers having a poor image-ratio, interfering image signals could be eliminated, in many cases, by adjusting the matching network to peak value!

The set of coils supplied with the "Signal Splicer" will usually cover the majority of amateur frequency ranges. Additional coils, if required, are available at reasonable cost.





New Hallicrafters Ham Transmitter

● HALLICRAFTERS, in their new HT-9 "ham" transmitter, provide a striking example of highly refined design and sturdy construction combined with price economy made possible by the growing demand for ready-built transmitting equipment.

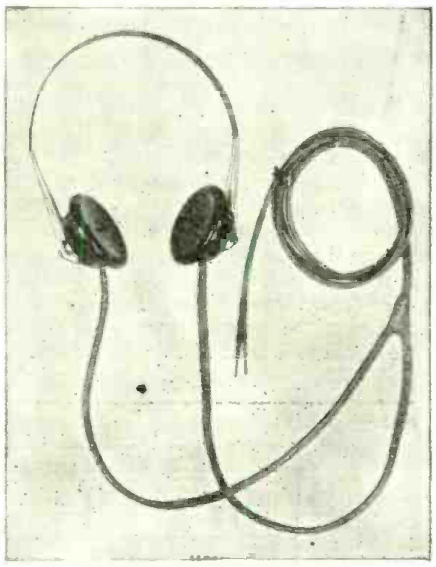
Five band-switched channels are provided for operation on any frequencies in any bands between 1.7 and 30 megacycles. These channels are set-up by means of plug-in coil units, each of which contains its own tuning capacity and is pre-tuned to the desired frequency on installation.

Rated *carrier* power is 100 watts on c.w., 75 watts fully modulated on phone. The R.F. line-up consists of a 6F6 oscillator, 6L6 doubler and 814 power amplifier with automatic provision for using the 6L6 as oscillator when working straight through on the crystal frequency. The audio end employs a 6J7 input amplifier, 6J5 voltage amplifier and push-pull parallel 6L6's coupled to the 814 through a special 3-winding transformer for properly proportioned simultaneous modulation of screen and plate. Four built-in power supplies provide separate supply sources for the R.F. exciter, R.F. final, audio voltage amplifiers and 6L6 screens, and plates of the 6L6 modulators.

Three meters provide a continuous check on all circuits. The HT-9 is completely self-contained in a 28" x 18½" x 11½" steel cabinet with interlock safety switch on cover.

New D.C.-A.C. Converters

● AMERICAN TELEVISION & RADIO CO. announces a new line of midget phonograph inverters, for operation on 110 volts D.C., inverting same to 110 volts A.C. 60 cycles at an output of 15 watts. They are available in three models, with and without filters.



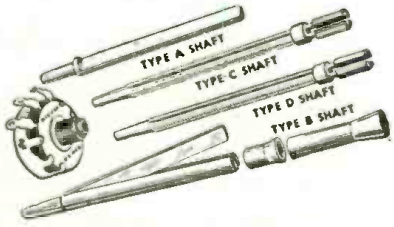
Aircraft Headphone

● UNIVERSAL MICROPHONE CO. is now ready for distribution of its new aircraft headphone. It will be in addition to the firm's catalog of aircraft microphones for land stations, dispatchers' offices, private and transport planes and other aircraft.

Black bakelite cases house the phones, an adjustable steel band covered with black lastex, and five feet of waterproof cord are included in the assembly.

A ball and socket joins at the back of the case to automatically fit the phones to the ears. The earphone elemen. uses Alnico magnet, high permeability iron structure and one piece coil bobbin "Tropic" sealed.

The low impedance model matches lines of 200-600 ohm impedance.

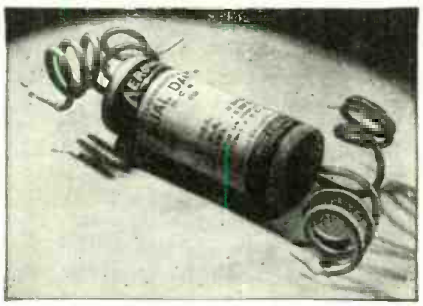


Midget Controls With New Plug-in Shafts

● WITH the addition of a complete line of plug-in shafts by the International Resistance Co., IRC Midget Controls are recommended for universal use in practically every control replacement. The new plug-in shafts assure easier installations and mean that fewer special controls at higher prices will be required by the serviceman. A comparatively small stock of the most popular midgets will handle the big majority of jobs.

Small Dual-Section Electrolytics

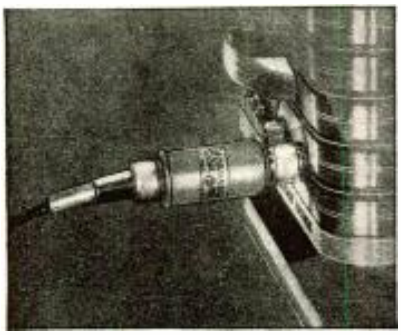
● STILL smaller dimensions and two independent sections with four leads distinguish the new PRS Dual Dandees just added to its already extensive line of midget-can electrolytics by the Aerovox Corporation.



The new dual PRS 450 8-8 and the PRS 250 16-16 measure 1 x 2½", while the new PRS 150 20-20 measures 1 x 2¼". These dimensions are believed to be the smallest for any dual midget electrolytics of corresponding voltages and capacities now available. The units have two entirely independent sections and four leads, permitting the independent use of either section and either common positive or common negative connections.

Microphone Cable Transformer

● A NEW type of microphone cable transformer makes it possible to couple low impedance dynamic or velocity mikes to amplifiers which have



only high impedance input circuits. This handy piece of apparatus which connects between the microphone cable and the amplifier input connection is available in two types. One provides for voice coil connection of dynamic mikes, as it has a primary impedance of 30 to 50 ohms; the other is a 200 to 250 ohm unit for dynamic or velocity mikes which have self-contained line output transformers. Both types are magnetically shielded to reduce hum pickup. Mfd. by Thordarson.

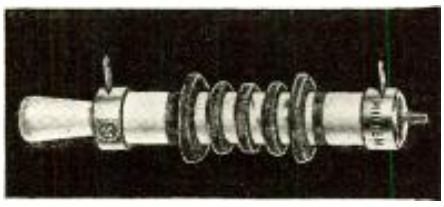
Pilot's New Line

● THE new line of twin-set portables manufactured by Pilot Radio Corp. has many attractive features. One of these is the addition of a stage of TRF which necessitates the use of a 3 gang condenser in the superheterodyne circuit. Another feature is that a marine band (covering ship-to-shore, coast guard, emergency, weather, aviation,

foreign and marine signals) has been added to a special marine portable for boat owners. These sets are designed to operate on A.C., D.C. or battery and have an automatic switch-over for use on self-contained or house-line power. Ranges 563 to 187 and 54 to 19.1 meters.

New Iron Core R.F. Choke

● A NEW 500 ma. iron core R.F. choke having extremely high impedance over a wide range of frequencies has just been announced by the James Millen Mfg. Co. for use on all amateur bands between 30 mc. and 1.6 mc. However, the extremely high impedance developed over this wide range of frequency has made this choke, the cata-



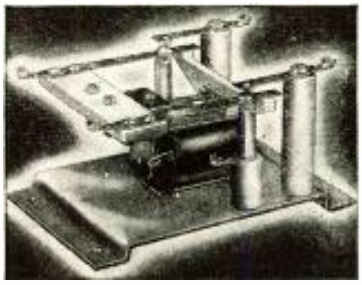
log number of which is 34150, well suited for any commercial application. Its unique mounting, comprising die-cast end terminals with threaded stud inserts, makes it extremely easy to use.

Wood Antenna Towers

● THE new Premax Products wood tower is 10 feet in height, 24" square at the base and 9" square at the top. Horizontal and cross bracing insures perfect rigidity and maximum strength. The vertical corner posts are of well seasoned timber, 1⅝" square. All parts are cut to exact length and drilled for assembly. For protection each piece is given two coats of weather-resistant paint.

New Antenna Relay

● A NEW antenna switching relay has just been added to Meissner Mfg. Co.'s rapidly increasing line of amateur parts and accessories. It is designed to transfer the antenna automatically from the transmitter to the receiver in ham operation, but may also be used as a D.P.-D.T. high-frequency switch in any other application. The contacts are large and wide opening, to handle the output of transmitters up to 1 kw. without arcing or burning. The transmitter connections are at one end and the antenna at the other, to provide straight-through feed. All insulation is of Alsimag 196, to permit operation on frequencies as high as 60 mc. without noticeable loss. The standard unit is provided with a coil for 110 volt A.C. operation.



Radiator Type Tube Connectors

● A NEW series of connectors designed to radiate heat away from the grid and plate connections of transmitting tubes has recently been announced by Bud Radio, Inc. These tube connectors have a distinct advantage over the usual type of wire and cap connectors as they readily radiate all heat present at the tube connections due to internal heating and contact resistance heating. This feature protects the glass seals of the tube, eliminating the possibility of tube failure due to this cause. Connectors come in four sizes to accommodate both large and small wire leads and large and small cap leads. Their new catalog gives the complete data on all BUD lines and is free for the asking.

New Million Tube Tester

● THIS new instrument, produced by Million Radio and Television, tests emission of all tubes, including 117 volt tubes, and provides a neon short or leak test with the tube hot. In addition to the tube tests, it checks by-pass condensers for shorts and leakage, and gives polarity and

leakage tests on electrolytics. It uses a 3" D'Arsonval meter with "Good-Bad" scale and comes in a compact carrying case.

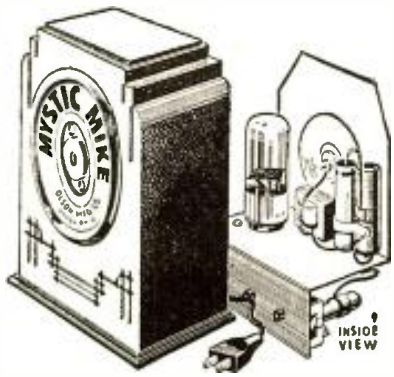
Hermetically Sealed Crystal Units

● GENERAL ELECTRIC has announced two new hermetically sealed crystal units for radio service, Types G18 and G19. Protection of the crystal and electrodes from atmospheric effects such as moisture and dust is provided by the hermetic sealing, which is accomplished when the crystal unit is encased in a weld-sealed shell and then successively evacuated and filled with dry air or gas. The operating range of the new units is −40 C to +60 C—and in some cases greater.

The units have a metal tube type shell, insulation within them is provided by glazed low-loss ceramic material. Both units fit standard octal sockets.

X-ray orientation, employed in the manufacture of these crystals makes it possible to produce crystals whose frequency remains constant to less than 0.0001 per cent per degree Centigrade temperature change.

Fun with Mystic Mike



● THE Mystic Mike now appears in a de Luxe Model in addition to the Little Marvel set first produced. The new unit, housed in a bakelite cabinet with built-in supersensitive microphone, may be hooked up to an attachment for playing phonograph records. The Olson Manufacturing Company has designed this unit for clear, natural tone quality and trouble-free performance.

This device consists of a modulated oscillator with tube and microphone; it plugs into any electric socket and transmits to nearby receivers without any electrical connections. With variable frequency control, it radiates a signal within the tuning range of all types of broadcast receivers. Speech or music is picked up by tuning to the frequency of this oscillator. Either an A.C. or D.C. light circuit is practical for the purpose.

D.C. Trouble Shooter

● A POCKET-TYPE trouble shooter which is extremely inexpensive, yet performs a wide variety of functions, is being offered by Radio City Products Co., Inc., in their Model 432.

The case is only 5⅛ x 3 x 2 inches and the overall weight 24 ounces.

The meter is an 0-1 ma. D'Arsonval type, accurate within 2%, equipped with a multi-scale with a separate scale for the low ohms. In addition to the ohmmeter zero adjustment there is also a mechanical zero adjustment on the meter itself. The ranges provided are: D.C. volts, 0-5/50/500 and 1,000; D.C. milliamperes, 0-1/10; ohms, 0-500/50,000/500,000. Self-contained batteries provide for all ohmmeter ranges and test probes need not be in the circuit for balancing the ohmmeter. All test probe connections are made by means of tip jacks. The Model 432 is described in Catalog No. 121, copy free on request.

500 Watt Adjustable Link Coils

● THE adjustable link coils here illustrated have been developed by Bud Radio, Inc. The outstanding feature of this new series of inductances is the adjustable spiral winding link. This type of winding enables one link to be used for all bands, without restricting the coils to one diameter, thus permitting the proper form factor to be maintained on all bands.

240 Watt Phone Output R.F. Power Amplifier

● THE purpose of the Cardwell "AFU" R.F. amplifier plate-tank foundation is to provide a simple yet efficient layout, which permits advantageous use of modern tubes of latest design such as 812s or T40s, as well as circuit improvements which allow the highest possible input to be used for a plate tank capacitor of modest size and cost.

The "AFU" consists of a 3000 V. 100 mmf. dual Midway condenser, mounted "stator up" by means of a pair of type "M" brackets. Across the stators special brackets are mounted, which are specially designed to fit a Barker and Williamson type "B" jack bar. When B & W type B. B1 or BVL coils are plugged in, the brackets holding the jack bar, become the *leads* from the ends of

the plate coil to the respective stators. Further elimination of leads is accomplished by a pair of special brackets (type "BWZ") which mount two type "ZS-7-SS" "Trim-air" neutralizer condensers on diagonally opposite sides of the respective MT-100-GD stators, the transmitting tubes being arranged on diagonally opposite sides of the tank tuning condenser.

The complete elimination of leads in the plate tank circuit and the minimization of stray capacity, results in one of the outstanding features of the "AFU," i.e., *five-band coverage (5-80 M. inclusive) with stock coils*, using the same condenser for all bands. The P.A.-240, when operated with 812's fully modulated, will require a 1250 V. 250 ma. power source, with a 6.3 V., 8 amp. filament supply.

Measures Radio Interference

● AN instrument for the accurate measurement of radio noise and interference has been developed by the RCA Mfg. Co. and is known as Model 312 *Radio Noise Meter*. Its principal uses include measuring noise levels on transmission lines, electrical apparatus, and field strength of radio signals in comparison with noise levels. Adapted for use in both the field and the laboratory, it may be equipped with a loop antenna to indicate the direction from which the interference is coming. Fundamentally it is a superheterodyne receiver with a short vertical antenna and an output metering system. It employs a self-contained calibrating source. Three types of auxiliary networks are available as accessories, for measuring disturbances on single-phase two-wire, and three-phase or single-phase A.C. electrical apparatus.

New Loop Antenna

● A NEW "Shielded Align Loop Antenna" has just been announced by The Radex Corporation. This unit, for use with any test oscillator or signal generator to align loop antenna radio receivers, is furnished complete with dummy antenna and shielded generator leads.

New Tubes

● RCA 929 is the new RCA high vacuum photo tube utilizing a new type of caesium photo-surface of extraordinarily high sensitivity to light sources in which blue radiation predominates. Although the 929 is not infra-red sensitive, it has a sensitivity of 45 microamperes per lumen to light from a tungsten filament operated at 2870° K. To daylight, its sensitivity is several times greater; to light from a high-pressure mercury arc, many times greater.

In addition to its exceptional sensitivity, the 929 features excellent stability and consistent spectral response. Because of these features, it is well suited for measurement and relay applications.

The cathode window area is .6 square inch and direct interelectrode capacitance 2.5 mmf. The tube operates with a maximum anode supply voltage of 250 and an anode current of 20 microamperes, when a sensitive cathode area ½" in diameter is used. The D.C. resistance of the load is 1 megohm, and the tube sensitivity at 3750 Angstroms is .04 microamp./microwatt.

New Transmitter Tube: RCA 829 is a new push-pull beam power transmitting amplifier having a total maximum plate dissipation of 40 watts. One of these tubes operated in push-pull class C telegraph service can handle a power input of 120 watts with less than a watt of driving power, at frequencies as high as 200 mc. (1½ meters).

Heater voltage of the new tube is 6.3 per unit and the trans-conductance for a plate current of

60 ma. is approximately 8500 micromhos. The grid-screen mu-factor is 7. The tube may be used as grid modulated push-pull R.F. power amplifier in class C telephony, as plate-modulated push-pull R.F. power amplifier in class C telephony, or as push-pull R.F. power amplifier and oscillator in class C telegraphy. A complete description with characteristics, applications, diagrams and charts appears in an 8 page booklet published by the manufacturer.

BOOK REVIEWS

THE PAGEANT OF ELECTRICITY, by Alfred P. Morgan. 364 pages, illustrated, size 5½x8½", published by D. Appleton-Century Co., New York, N. Y.

Mr. Morgan has been an electrical engineer for more than 30 years and has written many books and articles. He also has been active in the radio industry, designing short wave equipment, gun-fire control, etc.

In this book Mr. Morgan traces electricity from its first manifestations in static form, through magnetism, galvanic electricity, and one of the earliest commercializations, when Samuel F. B. Morse invented the electric telegraph. Mr. Morgan discusses Thomas A. Edison's contributions to electricity, the birth and growth of the telephone, the invention of dynamos and A.C. generators and the application of electricity to industry. He writes of electronics, X-rays, radio and devotes considerable attention to the activities of Radio Amateurs. All sixteen sections of the book are freely illustrated with line drawings and reproductions of photographs. An index and chronology are provided for the serious student.

FREQUENCY MODULATION, by John F. Rider, 136 pages, John F. Rider, Publisher, New York, N. Y.

Mr. Rider one of the best known writers in the radio field, gives a broad view of the difference between **frequency modulation** and **amplitude** modulation as applied to transmission and reception. He also discusses servicing F.M. sets and gives useful pointers on the necessary oscillators and other intruments to be used. A section is devoted to the important problem of antennas for receivers of this type. The book with its liberal supply of charts and diagrams will be of extreme value to anyone engaged in servicing or experimenting with F.M. apparatus.

SAFETY RULES FOR RADIO INSTALLATIONS, 30 pages, 7½x5", published by U. S. Dept. of Commerce (National Bureau of Standards Handbook H35).

This booklet should be in the hands of every one who owns or operates a radio receiving or transmitting station; it gives clear and explicit safety rules for all radio installations. It tells what size wire should be used for antennas of varying spans, what types of supports and insulation should be used, and under what condition lightning arresters may be omitted. It explains how to bring in the lead-in and how to install and protect the ground connection. It also states under what conditions the power supply lines may be used in place of antenna or ground.

CHARACTERISTIC CHART AND SOCKET CONNECTIONS OF RCA RECEIVING TUBES. 12 pages, 8½x11", published by RCA Mfg. Co., Inc.

The first two pages of this useful book classifies RCA tubes according to their cathode voltages and their functions, in order to assist the tube user with identifying tube type numbers and in choosing a tube type for each application. The final two pages are devoted to socket connections. The remainder of the book is given over to the standard characteristics chart.

RADIO AT ULTRA-HIGH FREQUENCIES. Published by RCA Institute's Technical Press, New York. 448 pages, size 6x9, illustrated.

This volume consists of technical papers by RCA Engineers and deals with the propagation, transmission, relaying, measurement and reception of radio waves above 30 mc. It is edited by Lewis M. Clement, Ralph R. Beal, Dr. H. H. Beverage, Robert S. Burnap, Dr. Alfred N. Goldsmith and Chas. W. Horn. The first section of the book consists of papers published in full, dealing with ultra high frequencies below 300 mc.; this is followed by data on ultra high frequencies above 300 mc. The balance of the book—some 18 pages—is devoted to summaries of papers covering these subjects. The book is illustrated with photographic reproductions, mats, graphs, circuits, etc.

WE PRESENT TELEVISION, edited by John Porterfield and Kay Reynolds. 6x9, 298 pages, illustrated, published by W. W. Norton & Co.

This book collects into one convenient volume the writings of a number of persons well known in the television industry. Among these are Waldemar Kaempffert Science Editor of the New York *Times*, Alfred H. Morton, NBC Vice President in charge of television, Donald G. Fink, Managing Editor of Electronics, O. B. Hanson, NBC's Vice President and Chief Engineer, Thomas H. Hutchinson, Program Manager of NBC Television Department, Thomas S. Riley, an NBC television production man, Earle Lorimore, an actor, Chas. E. Butterfield, Radio Editor of Associated Press, Harry R. Lubcke, Director of Television of the Don Lee Broadcasting System, J. R. Poppele, Chief Engineer of WOR, Benn Hall, *Radio Daily* staff writer, and Robert Edmund Jones, noted stage designer.

The book gives an outline of the television situation and is remarkably up-to-date. There is of course a certain amount of bias due to the fact that many of the writers are so closely engaged in actual television work that they are unable to see beyond their immediate problems. It is also unfortunate that the editors have apparently fallen for a few publicity stunts. Most surprising is that the book fails to stress the legal and economic implications of the television situation. All in all, however, the book has considerable merit and should be read by every thorough student of the subject.

GETTING ACQUAINTED WITH RADIO. By Alfred Morgan, 285 pages, size 5x8, published by D. Appleton-Century Company, New York, N. Y.

This book, which is illustrated by the author, is one of the finest books for the beginner that has yet crossed this reviewer's desk. It gives the fundamentals of radio and electricity in extremely simple, non-technical language which the novice should find easy to master. The book is intended for the beginner only, and, while it may not enable him to become a radio expert, it will at least give him a basic groundwork in an understanding of radio. The book makes no pretense of giving thorough coverage of the more technical aspects of the art—indeed, its only reference to television is a single sentence in the section dealing with transmitters, C.W. and phone. This reviewer likewise takes issue with the formulas given for condensers in series and resistors in parallel. However, the book is well worth its price for the man who wishes to get a general background of radio knowledge.

New HAM Guide

● THE new 8½ x 11" *RCA Ham Guide*, issued by RCA Mfg. Co., contains 48 pages, devoted to data, diagrams, specifications and illustrations of transmitting tubes. There are also sections on general transmitter data, and detailing (with diagrams and parts lists) the construction of several RCA transmitting units. Among the tubes described are the 802, 806, 807, 808, 809, 1623, 810, 811, 812, 813, 828, 829, 832, 834, 866, 866A, 872, and 872A. Price 15 cents.

NEW CATALOGS

Two New Thordarson Catalogs

● THORDARSON ELECTRIC MFG. CO. has just issued two new 8½ x 11 catalogs. 500-E deals with broadcast transformers in the Tru-Fidelity line. Among the items covered are AF, multi-shield AF, Bantam AF, incher AF, and major AF transformers, also driver and modulation transformers, filters and line equalizers, modulation and filter reactors, current-limiting filament transformers, plate and power transformers, etc.

The other catalog 600-E describes the Thordarson amplifier line and several interesting accessories, among which is a combination amplifier speaker case, a microphone cable transformer, and a selection of carrying cases. A wide range of amplifiers for all purposes are fully described and clearly pictured in this handsome catalog.

Technical Tube Manual

TECHNICAL MANUAL published by Hygrade Sylvania Corp. 271 pages, 9¼x4½, illustrated.

This convenient volume, which has a spiral binding for the user's convenience, adds for the first time a new idea which makes it still easier to use as a reference manual. This consists of eight cardboard index tabs that serve to identify the various sections of the book. The fundamental properties of vacuum tubes, a classification of amplifier types, a dictionary of definitions and a section on general tube and circuit information, comprise the first section of the book. Standard receiving tubes are then considered in great detail, full characteristics and a working diagram of each being given. Succeeding sections deal with a GT tube chart, special tubes and their characteristics, panel or dial lamps and finally the dimensions and outlines of various tubes. This tube manual is a great convenience for anyone engaged in radio, either for pleasure or profit.

Two New Solar Sheets

● TWO sheets just issued by Solar Manufacturing Corp. describe the condenser quick check and bridge, and the new red cap condenser series. The "quick check" gives instantaneous indication of whether a condenser is *good* or *bad* under actual operating conditions or separately. In addition it measures capacity and indicates power factor. This apparatus comes in two models, both of which are described in the four-page sheet. Models are available with and without a bridge. The red cap condenser series is made up of 12 different midget units, which range from ½ to 5/16 inch in diameter; all are 2 3/16" long. Capacity ranges from 4 to 40 mf. and working voltages from 25 to 450 volts.

Condenser Catalog

● CORNELL-DUBILIER ELECTRIC CORPORATION has just published a special catalog (No. 180X) describing its high-voltage capacitors for heavy-duty X-ray and impulse or surge-generator applications. These units are especially suitable for use in technical research and university laboratories.

Correction Notice

In the article on the Frequency Modulation Converter by Ricardo Muniz in the June issue, we failed to credit the following company for the parts supplied:

THORDARSON

L4 and L5, 30 hy. 150 ma. filter chokes.

Transformer T1; T13R14—0A4, 300-300 volts, 150 ma.

6.3 volts 4 amp.

5.0 volts 4 amp.

COMMERCIAL NOTICES 10¢ A WORD

Under this heading only advertisements of a commercial nature are accepted. Remittance of 10c per word should accompany all orders. Copy should reach us not later than the 10th of the month for the second following month's issue.

AGENTS WANTED

300% PROFIT SELLING GOLD Leaf Letters for Store Windows; Free samples. Metallic Co., 446 North Clark, Chicago.

CODE MACHINES

AYERS ALL ELECTRIC CODE Practice Machines. Low monthly rental. 50,000 words practice tapes. World's Champion code machine designed by T. R. McElroy, World Champion telegrapher. Write N. C. Ayers, 711 Boylston St., Boston, Mass. Dept. C.

CORRESPONDENCE COURSES

USED CORRESPONDENCE Courses and Service Books. Bought, Sold, Rented, Exchanged. Catalog Free. Vernon Exchange, Henagar, Ala.

DIATHERMY MACHINES

DIATHERMY, SHORT-WAVE Therapy, and ultra short-wave therapy machines custom-built by radio engineer at considerable saving over commercial machines; 6 meters, 16 meters or any other frequency specified can be furnished. Machines substantially built with high patient safety factor, 250-300 watts output. Neat professional appearance. Automatic safety time switches. All necessary pads and electrodes. For sale only to physicians, hospitals, and sanatoriums. Prices from $195.00 to $300.00. Not for sale to the general public. Write for further information giving your own specifications and requirements. Allan Stuart, 1015 Wilson Ave., Teaneck, N. J.

INSTRUCTION

$15.00 STEAM ENGINEERING Course—8 vols. $4.50; Radio and Electrical text-book bargains—get list. Life of Napoleon, 3 de luxe volumes $3.00. $10.00 New Cyclopedia of Science, 1300 pp. $4.50; Hopkins "Experimental Science," 2 vols. $3.50. Harry Ackerson, Box 322, Ramsey, N. J.

PATENT ATTORNEYS

INVENTORS — PROTECT YOUR rights before disclosing your invention to anyone. Form "Evidence of Conception"; "Schedule of Government and Attorneys' Fees" and instructions sent free. Lancaster, Allwine & Rommel, 486 Bowen Building, Washington, D. C.

SWL—CARDS—QSL

SWL'S—QSL'S. COLORFUL, ECOnomical. W9KXL, 819 Wyandotte, Kansas City, Mo.

200 SWL CARDS $1.45 SAMPLES. SWLCO, 16 Sanger, Medford, Mass.

FOR SALE (NON COMMERCIAL) 3¢ A WORD

Under this heading we accept advertisements only when goods are offered for sale without profit. Remittance of 3c per word should accompany all orders. Copy should reach us not later than the 10th of the month for the second following month's issue.

DON'T BUY A RECEIVER UNTIL you get my free list of reconditioned, Guaranteed Receivers! Practically all models at money saving prices. Trade-ins. Time Payments. Send for list. W2AVA, 12 West Broadway, New York.

NATIONAL RADIO INSTITUTE course, radio servicing, sound pictures, public address, text books. Triplett 1175A tester, consisting of signal generator, AC DC voltmeter, ohmmeter, milliammeter. Triplett 1166A Free Point tester. Radio City tube tester, model 307. Complete $50.00. Box 28, Campgaw, N. J.

PHILCO MODEL 088 SIGNAL GENerator with tube and cables less batteries $6.00. M. G. Armstrong, Sunray, Texas.

BRAND NEW HALLICRAFTER SKY Champion 3 mo. old. Twenty dollars, need cash. Wm. Merman, 715 Lincoln Ave., Bellevue, Ky.

RECONDITIONED GUARANTEED receivers. Nearly all models of Nationals, Hallicrafters, Hammarlunds, RME's, etc., cheap. Ten day free trial. Terms. Write for free list. W9ARA, Butler, Missouri.

BARTER AND EXCHANGE — 1¢ A WORD

NO ADVERTISEMENT TO EXCEED 35 WORDS, INCLUDING NAME AND ADDRESS

Space in this department is intended solely for the benefit of our readers, who wish to BUY or EXCHANGE anything in the Radio, Television and Photographic fields for Radio, Photographic and other merchandise; therefore we charge only 1c a word. Each word in a name and address is counted. Remittance should accompany order.

Only one advertisement can be accepted from any reader in any one issue.

Copy should reach us not later than the 10th of the month for the second following month's issue.

We cannot accept responsibility for any statements made by the readers.

All dealings MUST be above board. Remember you are using the U. S. mail in all these transactions and therefore you are bound by the U. S. Postal Laws. Describe anything you offer accurately and without exaggeration. Treat your fellow men the way you wish to be treated.

We welcome suggestions that will help to make this department interesting and helpful to our readers.

WANT TO BUY A GOOD WESTON test oscillator or any other good make and a complete set of either Gernsback's or Rider's manuals. Give full description and price in first letter. James Notaris, Ambler, Pa.

WANTED: USED COMMUNICAtions receiver, typewriter, set of Rider's manuals. Have electric relay unit, 12 watt amplifier, 0-1 ma. meter, speakers, 110 volt D.C. 90 amp. generator. Raymond Glasnapp, Armstrong, Iowa.

WANTED: ARRL HANDBOOK AND d.c. and a.c. set analyzer. Trade mechanical drawing set, B&S 4 cyl. engine, stamps U.S. Kenneth Merlan, Healdsburg, Calif.

WILL BUY RADIO COURSES, analyzer, testing equipment, manuals. Describe fully. Cheap. Wesley Kay, 319 Main St., Niagara Falls, N. Y.

WANTED FOR CASH, ANTIQUE radio transmitting and receiving instruments. No home made jobs. Only those in (good) condition wanted. Send list. State least offer accepted. George C. Starry, 210 N. Ligonier St. (Rear), Latrobe, Pa.

TRADE—RADIO MAGAZINES, MIDget radios, Philco 90 console, spare parts, etc., for ultra-high transceiver or receiver, portable typewriter, record player, or? Swap swap lists. John A. Ladue, 225 West Park, Long Beach, New York.

HAVE COMPLETE MECHANICAL drawing outfit, like new. Want radios, telescope, tenor saxophone, clarinet, anything. Walter Bartell, 2135 Lyndale, Chicago, Illinois.

HAVE 300 WATCHHOLDERS, holds any watch on auto dash board. Also wall model. Originally sold for 25c each. Trade all 300 for a V.O.M. Radio City Products Co. preferred, or others. Archie Penquite, Marshalltown, Iowa.

HAVE AUTO RADIO, RECORD player, mikes, oscillator, camera, enlarger, Red Seal records, books. Want photo goods, 16mm films, swap lists. M. Epstein, 2953 Ruckle, Indianapolis, Ind.

TRADE ALMOST NEW SUPERIOR Channel Analyzer for good obsolescence-proof tube-tester of well known make, complete with accessories and tube charts. R. V. Mosher, Schell City, Mo.

HAVE COMPLETE AMERICAN School of Photography's course. Will exchange for a Sky Champion or any good Hallicrafters s.w. receiver. Wm. H. Hart, 711 Highland Ave., Carutherswille, Missouri.

HAVE 1280 SUPERIOR TUBE AND set tester, A.R.R.L. Handbook and phonograph motor. Want record changer. Alpha Gilmore, 146 Hawthorne, Belmont, N. C.

WILL TRADE—$17.50 Movicmatic motion picture camera (Practically new). Takes 16 mm. movies, also snapshots, and movie books. Wanted—record player, servicing equipment, or what have you. All replies answered. Robert Jones, 201 Walnut Street, Westernport, Maryland.

WANTED: TELEVISION EQUIPment, transceiver, 5 and 10 meter transmitter and wireless phonograph control. Steve Novota, Jr., 406 S. Plum St., Moweaqua, Ill.

WILL TRADE PHILCO CIRCUIT tester model 025-A 1000 V. A.C.-D.C. output meter, mills 0-150 ohm 15,000 V. 1½ meg. ranges, and capacity meter for amplifier of equal value. Cost new $39.50. E. Wooster, Feesburg, Ohio.

SWAP 25,000 OHM, 100 WATT RESistor, Hoyt 0-300 milliammeter. 83 tube—all unused—for V.O.M., crystal mike or? A. Dembie, 1630 East 41 St., Cleveland, O.

HAVE EIGHTEEN METERS, TUBE checkers, analyzers, s.w. parts, speakers, relays, rectifiers, pickups, magazines, micrometers, fence charger, etc. Want old coins and all classes of goods. Roby, 6303 Kenwood, Chicago.

WANTED—NEW OR USED PARTS for experimental television receiver. Will pay cash or trade for. No junk please. Louis B. Booth, 75 Campfield Ave., Hartford, Conn.

WANT PORTABLE RECEIVER OR? Have small new S.W. and broadcast receiver and transmitter and neon tester. Gerald Pirsig, Route 2, Blue Earth, Minnesota.

SWAP 7 TUBE 3 BAND MEISSNER radio new, no cabinet, for photographic equipment. Good enlarger preferred, anything photographic considered. All letters answered. Stanley Galaski, 232 54th Street, Brooklyn, New York.

WANTED—ONE PAIR OF USED crystal headphones in good condition. Will pay cash. All letters answered. Roger Crabill, 1116 Staples Street, North East, Washington, D. C.

SWL EXCHANGE

This department is for the benefit of all short wave listeners who wish to exchange SWL cards and correspondence. Remittance of 1c a word for each word in the name and address should accompany order.

UNITED STATES

LEE CAMP, JR., 1053 Springbrook Ave., Moosic, Penna.

BOB LARSON, 618 North June Street, Hollywood, California.

MIKE MORRISSEY, Sharpsburg, Ky.

GEO. M. RADENHEIMER, W9K3, Box 162, Excello, Ohio.

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(While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.)

What Do YOU Think?

(Continued from page 195)

Likes Television Articles

Editor,

I have been a reader of RADIO & TELEVISION for two years and I have yet to find a mag like it. Your Television articles are also good and some day I hope to build one of the telly sets described in R. & T. Now about these SWL crabs who are always hollering about not receiving QSL's. The South Americans are about the best heard in the United States, along with the Cubans.

The SWL yelps about not receiving a QSL from some Ham, say in Chile. But did it ever occur to this SWL that possibly 200 or more fans might have sent him cards, and that is a pretty tough job for any Ham? I myself receive a lot of disappointments from Hams in foreign countries. But the U. S. Hams QSL pretty good with me. I will close now, saying that I will QSL 100% with any SWL. I am getting new cards made.

73, good DX and keep up the F.B. work.

VICTOR POLITI,
1024 Mill Plain,
Fairfield, Conn.

How to Improve R. & T.

Editor,

Your magazine is, on the whole, very good, but there are a few suggestions I would like to make on how to improve it. Describe more sets as you did back in 1934–35, some 2-tube supers and regenerative sets, so that the beginner can build them. The type you used in the January, 1938, issue was better than that used in recent issues. I think you should go back to the original style, and print some simple 2- or 3-tube, 10-meter receiver hook-ups with plug-in coils. There are many fellows who would like to go down on 10, but most of the sets have some tricky coil and shielding arrangement that makes them rather difficult to build.

Your articles on television are O.K. except for one thing; they are too technical for most of the fellows.

Well, aside from these "trifling things" (hi!) that's about all I can say against your magazine.

ROBERT WINSLOW,
Box 172,
Wykoff, Minn.

(Thanks, Robert, and we'll do our best to apply the ideas you have suggested.—Ed.)

ANSWERS TO "WHAT'S WRONG WITH THIS DIAGRAM?"

1. Pickup fader is of incorrect value.

2. Pickup fader is incorrectly connected to pickup and circuit.

3. No batteries should be used with a crystal microphone.

4. Even if mike were carbon, the additional battery bucks out the one shown correctly.

5. First tube is connected not as an amplifier but as a detector.

6. Iron cores in interstage couplings are shown at resistors instead of at chokes.

7. Iron core chokes should be used in plate circuits; resistors in grid circuits of impedance coupled amplifier.

8. Values of coupling condensers are higher than customary, and these condensers should be connected at other ends of chokes and resistors.

9. Wrong values are given on resistors and chokes.

10. No push-pull action would be had on output tubes.

11. Air core transformer cannot be used successfully for output.

12. Coupling transformer is incorrectly connected.

13. Plates should be supplied with positive B voltage instead of negative C.

14. Grid should be supplied with negative C voltage instead of positive B.

15. No connection is shown for minus B and plus C.

16. Mike fader control is of too low value.

List of Radio Inspectors' Districts

(Continued from page 197)

The required forms may be obtained from the office of the Supervisor of Radio in the Inspection District where you live. The correct local address may be found in the telephone books of the cities shown in parentheses below. Look under U. S. Government, Federal Communications Commission. Be sure to write the supervisor of the correct district, as given herewith:

First District: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut. (Supervisor of Radio, Boston, Mass.)

Second District: New York (New York City, Long Island, and the counties on the Hudson River to and including Schenectady, Albany, and Rensselaer) and New Jersey (counties of Bergen, Passaic, Essex, Union, Middlesex, Monmouth, Hudson and Ocean). (Supervisor of Radio, New York, N. Y.)

Third District: New Jersey (all counties not included in Second District), Pennsylvania (counties of Philadelphia, Delaware, all counties south of the Blue Mountains, and Franklin County), Delaware, Maryland, Virginia, and the District of Columbia. (Supervisor of Radio, Baltimore, Md.)

Fourth District: Alabama, Tennessee, North Carolina, South Carolina, Georgia, Florida and the territory of Puerto Rico. (Supervisor of Radio, Atlanta, Ga.)

Fifth District: Mississippi, Louisiana, Texas, Arkansas, Oklahoma, and New Mexico. (Supervisor of Radio, New Orleans, La.)

Sixth District: California, Nevada, Utah, Arizona and the Territory of Hawaii. (Supervisor of Radio, San Francisco, Calif.)

Seventh District: Oregon, Washington, Idaho, Montana, Wyoming and the Territory of Alaska. (Supervisor of Radio, Seattle, Wash.)

Eighth District: New York State (all counties not included in the Second District), Pennsylvania (all counties not included in the Third District), West Virginia, Ohio and Lower Peninsula of Michigan. (Supervisor of Radio, Detroit, Mich.)

Ninth District: Indiana, Illinois, Wisconsin, Michigan (Upper Peninsula), Minnesota, Kentucky, Missouri, Kansas, Colorado, Iowa, Nebraska, North Dakota and South Dakota. (Supervisor of Radio, Chicago, Ill.)

This subject is thoroughly covered in the chapter, "Getting Started," in "The Radio Amateur's Handbook," obtainable from The American Radio Relay League, Hartford, Conn. The prospective "ham" should write to the Government Printing Office, Washington, D. C., for a copy of "Regulations Governing Radio Communication" (10c per copy); and "The Radio Law of 1927" (5c per copy). Further procedure is explained on the forms, which are obtainable gratis.

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Hot Off the Press

Here's the Guide you've been waiting for—the most genuinely helpful, complete and practical volume of its kind RCA has ever issued. Written specifically for the amateur, it contains 48 pages filled with timely technical information on transmitter construction, transmitting tube circuits and complete data on amateur radio's finest line of tubes.

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Available through RCA Power Tube Distributors, or send 15c direct to RCA Commercial Engineering Section, Harrison, N. J.

● 48 Pages Chock Full of Timely Circuits, Photographs, Construction Features and Data on Amateur Radio's Finest Transmitting Tubes. 15c Amateur Net.

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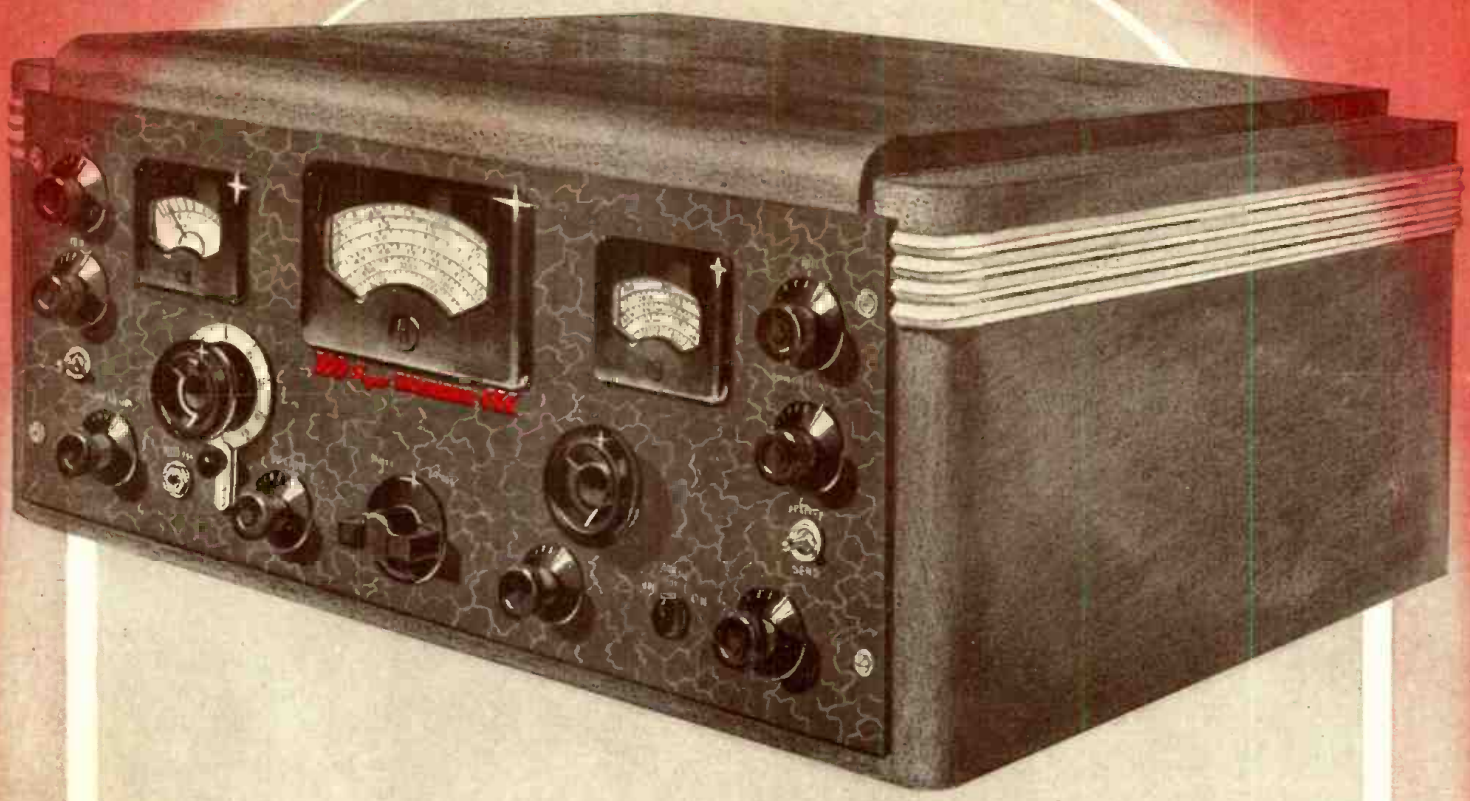

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