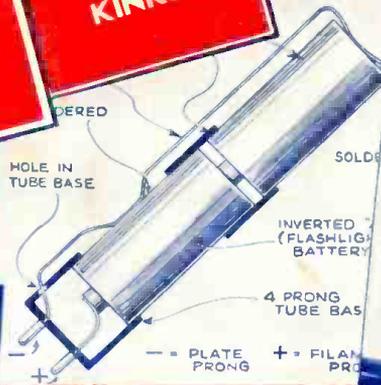


RADIO & TELEVISION

RADIO KINKS



ELECTRICAL EXPERIMENTS



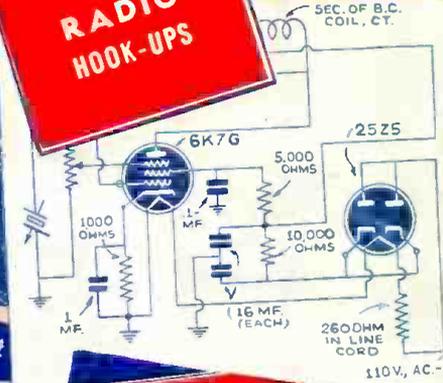
EASY SET BUILDING



AMATEUR RADIO



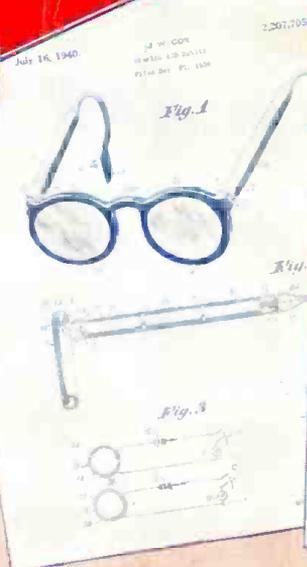
RADIO HOOK-UPS



TELEVISION NEWS



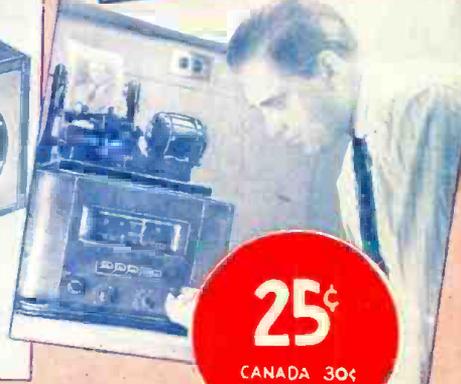
RADIO PATENTS



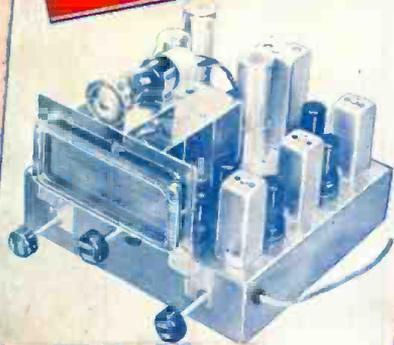
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HUGO GERNSBACK
EDITOR

AMATEUR & EXPERIMENTAL RADIO

OCT.

CONSTRUCTIVE RADIO ARTICLES

1940

NC-44



HIGH PERFORMANCE CIRCUIT

The NC-44 Receiver employs seven tubes in an advanced superheterodyne circuit which provides unusually fine performance.

ACCURATE TUNING

A separate bandspread condenser is used in addition to the main straight-line-frequency condenser. This combination plus the full vision direct-reading dial and the linear bandspread scale makes accurate tuning easy. Both condensers have an inertia type drive.

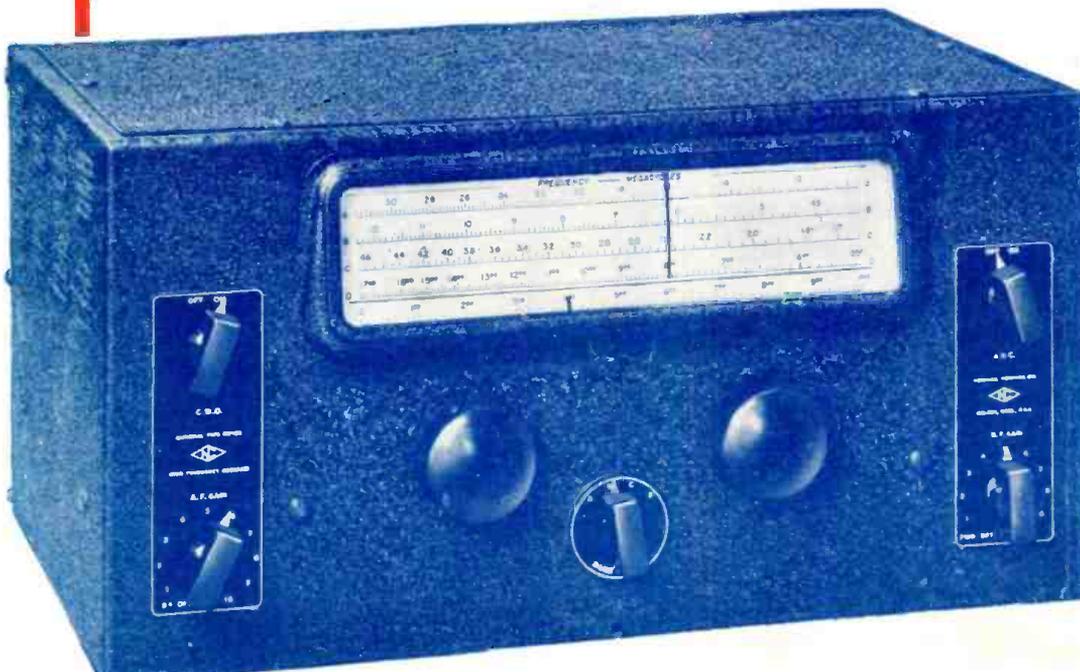
CONVENIENT CONTROLS

Separate controls for RF and Audio Gain are brought out to the front panel, together with switches for the CW oscillator and AVC circuit. A coil switch below the tuning knobs selects the four ranges from 550 KC to 30 MC.

ECONOMY

The NC-44 Receiver gives most per dollar. Low in first cost, long-lived and trouble-free, it gives the kind of performance one associates with much more costly receivers. Made in three models, for 115 V. AC, for 115 V. AC-DC, and for battery supplies. List Price, any model, \$82.50 with tubes and speaker housed in a separate cabinet.

NATIONAL COMPANY, INC., MALDEN, MASS.



List Price
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Any Model



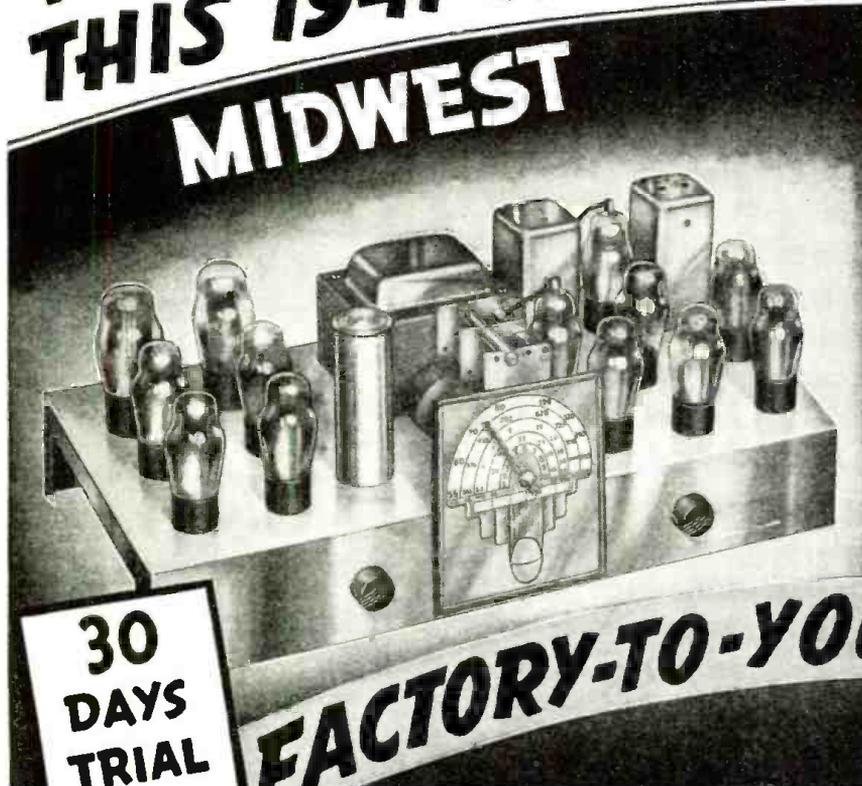
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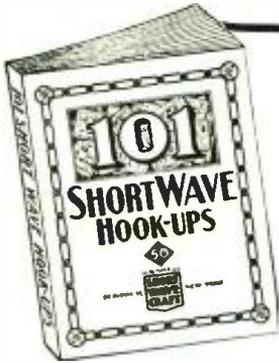
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Compiled by the Editors of RADIO & TELEVISION

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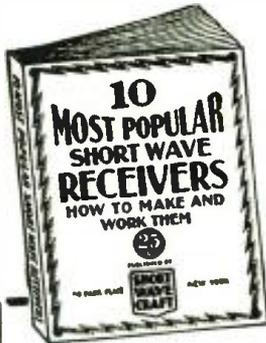
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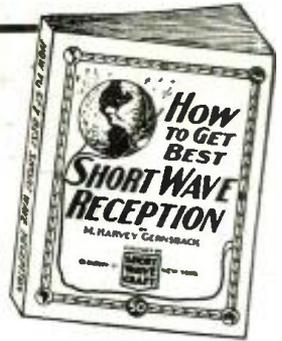


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M. HARVEY GERNSBACK tells you everything you have ever wanted to know about short wave reception. The author, a Professional radio listener and radio fan for many years, gives you his long experience in radio reception and all that goes with it.

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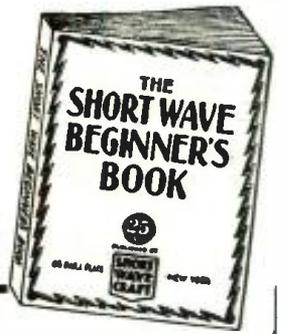


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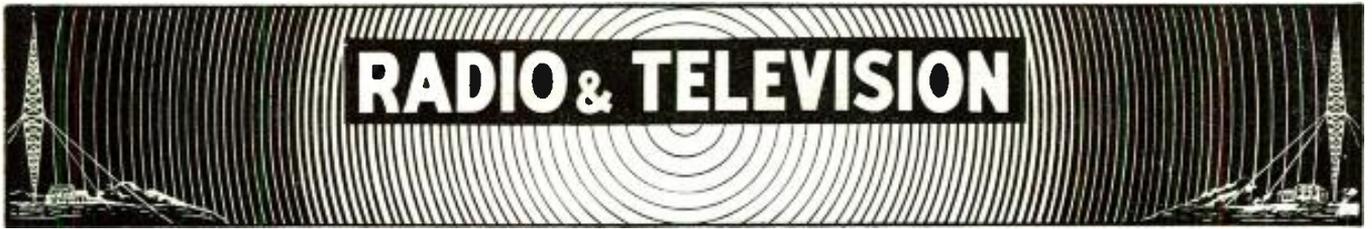
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Editorial

FUTURE RADIO AMATEURS

By HUGO GERNSBACK, Editor

It is always interesting to speculate on what the future developments may be in any branch of science, and one of the most interesting ones is, no doubt, radio amateurism.

Frequently, we seem to forget how fast radio progress has been in the past, but if we judge the future by the past, we may be certain that progress will be much more rapid in time to come. Even the wildest predictions which have been made in the past have often proved exceedingly tame twenty or thirty years later, and for this reason, the few predictions which I venture to make should be considered in this light.

When in 1908 I wrote an editorial in *Modern Electrics* (part of which became the Radio Law in the 1912 Radio Act), there was a great deal of amusement and derision at what I had proposed at that time.

It should be remembered that at the time I wrote the editorial in the November 1908 issue of *Modern Electrics*, there was no Radio Law and every one could help himself to any wavelength he choosed to take. Chaos reigned in wireless communication and whoever could outshout the other could get his signals through. Naturally, this condition could not go on and the radio amateur was threatened with extinction. Through intensive appeal to the newspapers and bombarding Washington with letters, I succeeded in having a 200-meter wavelength set aside for the amateur. My recommendation in the editorial above mentioned—that the amateur should not be allowed to use more than one kilowatt of power—also became the law of the land.

At that time, the 200-meter wavelength was regarded by authorities as worthless. This particular band now is one of the most valuable in the radio spectrum. As time went on, the radio amateur no longer required one kilowatt and, indeed, he can span the globe with a few paltry watts today and is doing so as a matter of routine. Some years later, the amateur had to give up the now valuable 200-meter frequency only to be buffeted around from one frequency to another, but today he still carries on triumphantly. You may rest assured that radio amateurs, at least in this country, will always function, and there is no question but whatever authority there is in the land will always—now and in the future—set aside special frequencies or wave bands in which the amateurs can work. From time to time they may have to give up certain frequencies, as they have in the past, but as radio progresses, the amateur will be found to be carrying on as usual.

The radio amateurs' importance has long been recognized by all authorities, even in the totalitarian countries, where restrictions are much greater than in this country. It might also be said that the value of the radio amateur will keep on increasing in the direct ratio to his progressiveness. But it should never be forgotten that what the radio amateur has gained has not been lightly won; and only by constantly fighting for what he now has, will he survive in the future.

With all the splendid work that radio amateurs have done and have accomplished, perhaps the only fault that I can find with our radio amateur is, that they have not always made the fullest use of their ingenuity. There have been years in which the Radio

Amateur Art seemed to be, to a certain degree, stagnant.

It took many, many years for radio amateurs to take kindly to phone communication. I wrote numerous editorials during those years, urging amateurs to take up phone communication because I saw a great future in it, but still the progress was comparatively slow. Only in recent years has there been a real swing to phone communication. I predict that in due time the radio amateur will use phone communication almost exclusively, with code communication only as an emergency or when it is difficult to get phone signals through.

I have also constantly deplored the fact that amateurs have not seen fit to be more progressive in television. There is no reason at all why amateurs cannot experiment with television today, and I foresee that during the next few decades a combination "phone and television" system will be the rule with amateur communication, rather than the exception. Amateurs could do a tremendous service in the art of television, particularly at this time when commercial television is still in the future. The amateur is not hampered with commercial and sponsored programs and, for this reason, is in a very much better position to exploit television and blaze the trail for this art than even the broadcasters. Why amateurs have not devoted more time to television I have never been able to understand. Television certainly is as fascinating and important an art as code or phone communication for amateurs.

Frequency modulation is another point to which the amateur should give his undivided attention today. I venture to predict that during the next few years the amateur will be using F.M. as an adjunct to his other methods of communication.

So far, frequency modulation is an unknown quantity. While the prevailing technical opinion today seems to be that F.M. is not satisfactory when it comes to bridging distances of more than 25 miles, the radio amateur knows from experience that such opinions are apt to go by the board, and that tomorrow may very well bring surprises where F.M. on the higher frequencies may span the world. Always remember that not so many years ago, it was believed impossible to even span the ocean with a wavelength below 200 meters. Of course, we laugh at these things today and, for this reason, it behooves us never to keep our minds closed to the inevitable radio progress.

It is also quite certain that all amateur equipment of every kind will continue to change in the future as it has in the past. Already it is possible for an amateur, with his portable transceiver, to walk about yet be in communication with his fellow amateurs.

No one will doubt the statement that in years to come the amateur will walk around with his vest pocket radio transmitter and receiver, by means of which he will be able to communicate for great distances, while he walks the streets, sits in his car or paddles his canoe.

Only by doing all these things will the amateur be able to carry on and prove to his community and country, that one of the most important inventions ever bestowed upon man is his ability to be in constant communication with his fellowman no matter where he is and no matter how trying the circumstances.

RADIO ENABLES WIFE TO CHECK ON HUSBAND

When Mrs. Harriet S. Eklund got into communication with her husband Carl, assistant biologist of the expedition near the South Pole, they talked about the weather, although it was more than six



The G. E. short wave station recently linked Mrs. Eklund with her husband near the South Pole.

months since she had heard his voice. Mrs. Eklund was pleased to hear that her husband was in the midst of a heat wave—the temperature being way up to 18 above zero, as compared with the previous fortnight's temperature of 70 below! In the accompanying picture Mrs. Eklund appears worried—perhaps she fears that Carl is suffering from the heat?

\$50,000 Radio for S.S. America

The finest and most comprehensive radio equipment ever installed on an American liner has been put aboard the *S.S. America*. It was all custom built by RCA engineers and most of it was specifically designed especially for this boat. The installation comprises 8 transmitters, 8 receivers, a radio compass, a radio auto alarm and the necessary associated equipment. The ship can be in telegraphic or voice communication with all important cities of the world as well as other ships at all times.

The radio room is in charge of 5 radio officers. Here are located five radio transmitters and five radio receivers and the radio auto alarm. The frequency band and the approximate power delivered into the antennas of the 4 radiotelegraph transmitters are: 110-160 kilocycles, 1000 watts; 350-500 kilocycles, 1000 watts; 4-22 megacycles, 1000 watts, and 375-500 kilocycles, 50 watts. The same ratings for the single radiotelephone unit are 4-18 megacycles, 600 watts.

The main radiotelegraph operating controls are conveniently arranged in a specially designed console 9½ feet long. Three receivers are housed in the console and here also are the start-stop switches for the motor-generators, frequency selector switches, signal lights, and the antenna switching panel for selection of any of the five receiving doublet antennas for either of two high-frequency receivers. Then there are four loudspeakers and switches which permit a combination for monitoring by speaker or earphone. Other switches enable a connection between any of four receivers and a loudspeaker on the ship's bridge.

Still other panels contain the main radiotelephone controls. A feature of this particular equipment is a speech inverting or "scrambling" device, which establishes two-way privacy in all radiotelephone conversations.

Apart from all of the main equipment in the radio room is the emergency radiotelegraph transmitting and receiving position. This is a 50-watt transmitter which operates on emergency generators and has in reserve two sets of storage batteries, permitting communications when all other sources of power are unavailable. Also at this position are two receivers, one of which covers the frequencies from 15 to 500 kilocycles. The other one, a type B crystal receiver, operates without batteries or tubes.

Finally, in the radio room, there is the radio auto alarm, which is always alive to the emergency distress signals of other ships and automatically sounds a bell in the radio room and on the bridge when such signals are picked up.

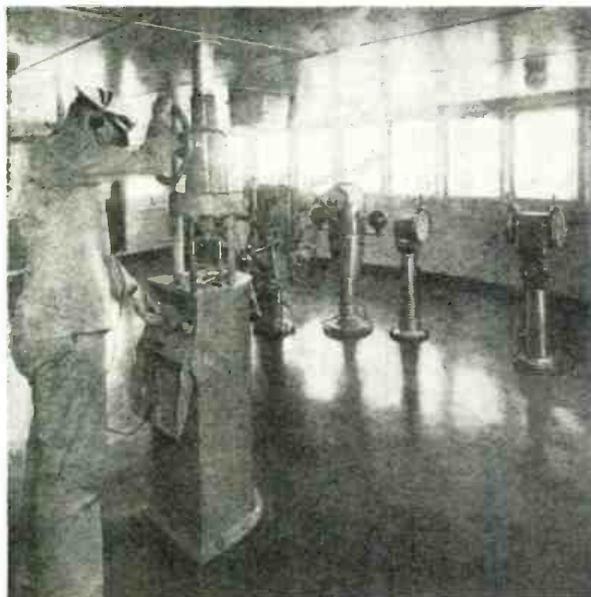
A 75-watt radiotelephone set operating on a frequency band of 2 to 3 megacycles, is installed in the ship's chart room just aft of the bridge. It is used only for shipping business such as communicating with tug boats during docking operations and with the pier and home office while the ship is in the harbor.

By means of a radio compass accurate bearings can be taken on shore beacon stations and the exact position of the ship can be determined.

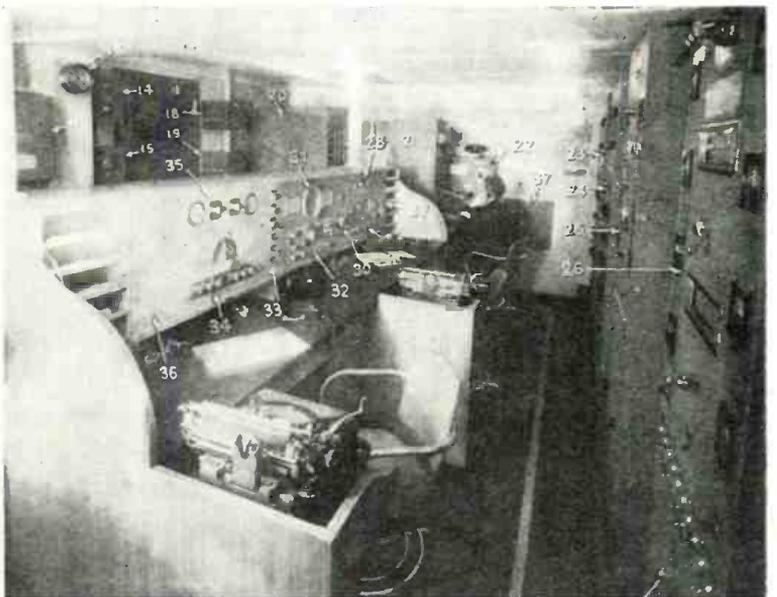
Two life boats are equipped for two-way radiotelegraph communication at 500 kilocycles. Using storage batteries as sources of power, these sets will function for many hours.

Counting the 2 life boat antennas, the radio compass loop antenna, the 75-watt radiotelephone antenna, the 5 doublet receiving antennas, the main flat-top antenna, the horizontal V and the forward inverted V antennas, there are 13 antennas aboard.

The *America's* radio installation called for more than 10 tons of equipment, 4½ tons of which were made up of special high voltage cable.



Picture at left shows the Radio Compass on the *S.S. America*, which enables the craft to determine her exact position (and those of other ships) at any time. Picture at right shows the great ship's radio room. A key to the indices follows: 11, Auto alarm receiver and selector unit; 13, Ship's time; 14, Direction finder junction box; 15, Auto alarm junction box; 18, Emergency receiver battery charging panel; 19, General purpose battery charger; 20, High-frequency radiotelephone modulator and power supply unit; 21, Radiotelephone control unit; 22, Pre-selector and noise limiter for radiotelephone receiver; 23, High-frequency radiotelephone transmitter, 600 watts, 4.1-18.1 mc.; 24, H.F. telegraph transmitter, 1 kw., 4.1-22.2 mc.; 25, Intermediate-frequency telegraph



transmitter, 1 kw., 350-500 kc.; 26, Low-frequency telegraph transmitter, 1 kw., 110-160 kc.; 27, H.F. telegraph pre-selector and doublet antenna selector switches; 28, Monitoring loud-speakers; 29, H.F. telegraph receiver; 30, Remote controls for H.F. telegraph transmitter; 31, Auto alarm clock with sweep second hand for timing the international auto alarm distress call. Also Greenwich and Eastern Standard time; 32, long-intermediate wave receiver 15-500 kc.; 33, Remote controls for telegraph transmitters; 34, Long-intermediate wave receiver 60-1500 kc.; 35, Same as item No. 28; 36, Direction finder console signal; 37, 115 volts alternating current 60 cycles for A.C. operated equipment.

—Photos courtesy of Radio Corporation of America.

Duplex Facsimile Unit Keeps Planes in Touch with Airports En Route

The Duplex Facsimile Unit for transmission reception of permanent images is now being marketed by the Finch Laboratories. A receiver which will pick up and record such images is shown on the cover and herewith. Another picture on this page illustrates the new facsimile unit which will enable an aviator flying perhaps

hundreds of miles from his home base, to sketch the terrain below and send the image back to headquarters without delay. On the receiving drum, adjacent to the transmitting drum, he may receive written instructions, weather maps—or even pictures of "Superman."

Finch is now maintaining a mobile field

laboratory and the third picture taken inside this de luxe trailer shows a 250 watt transmitter and scanning unit. Facsimile, though it has not won any great acceptance by the general public in the east, is claimed to have many good commercial and military applications, affording, as it does, permanent visual records.



JUMP STICK FOR APE ALSO WORKS ON CUTIES

The jump sticks which the American Legion popularized at their most recent convention, to the alarm and dismay of sundry cuties, has now been put to a practical use. It is used to control Toto, a 400 lb. female gorilla now resident in Havana, Cuba. Prof. Stanley B. Wiltse and W. K. Kearsley of G. E.'s laboratory, developed this 5,000 volt gadget. That the stick also has its less serious moments is shown in the other picture in which Janet Dempster demonstrates the stick to Maxine Gould.



WOR OPENS W2XOR

WOR went frequency modulation over its new station W2XOR on August 1st. The station, located in midtown Manhattan, operates on a frequency of 40.3 mc. with a power of 1,000 watts. A new Western Electric circuit using temperature controlled crystals give it a frequency stability of .0025 per cent. The station is on the air daily from 9 a.m. to midnight. One hour in the afternoon and one hour in the evening will be devoted to high fidelity programs, the balance of the material being regular WOR presentations. The accom-



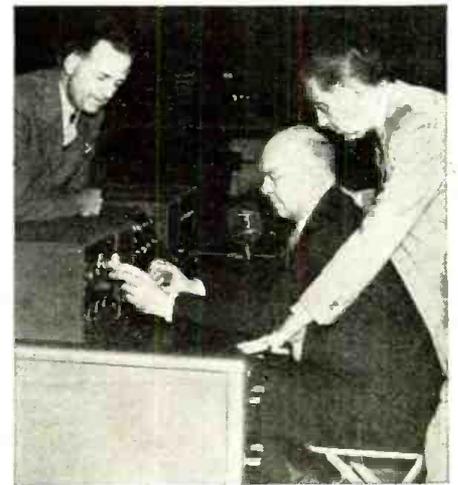
The instrument weighs four pounds, is push button operated and is so constructed that if one attempts to grab it he will receive a shock. While the voltage is high the current is low enough to prevent injury.

Dr. Paul Nipkow Dies

According to an Associated Press report published in the New York Times, Dr. Paul Nipkow, inventor of the "Nipkow disc" universally used in television until superseded by the cathode ray tube a few years ago, died in a Berlin hospital on August 24th. He celebrated his eightieth birthday two days earlier.

Dr. Nipkow had secured a patent on his "electrical telescope" in 1884, but lost it when unable to afford fees for extending it. Others capitalized on his idea.

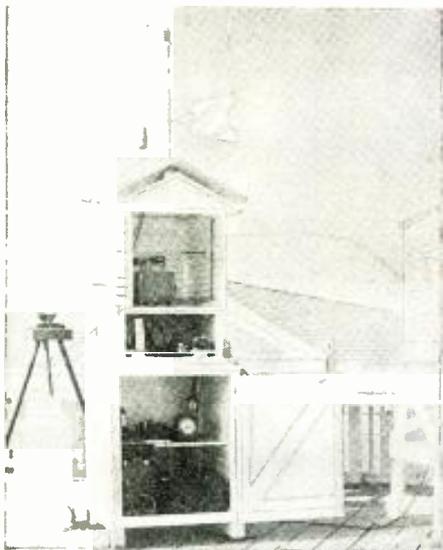
It was only six years ago that Dr. Nipkow won recognition. At that time he was made honorary president of the newly organized German Television Society.



panying picture shows left to right J. R. Poppele, chief engineer of WOR, Major Edwin H. Armstrong, inventor of F-M, and Alfred J. McCosker, Pres. of the Board of the Mutual Broadcasting System.

Automatic Weather Station Brings Reports from Remote Areas

Harry Diamond, and Wilbur S. Hinman, Jr., of the National Bureau of Standards of the U.S. Dept. of Commerce, have described the completely automatic weather station installed at such isolated stations as mountain peaks, small islands, etc. This system uses the same principle as the common radio sonde. The variation in the meteorological element is converted into a change in resistance which in turn produces a change in modulation frequency.



The essential difference lies in the use of much lower frequencies, 0.15 to 3.0 cycles per second. The low frequencies allow mechanical keying of a conventional radiotelegraph transmitter, thereby precluding the need for complicated modulating equipment. A manual counting method or simple electrical counters may be used at the receiving end for evaluating the observations. An experimental station of this type was installed at the Naval Air Station, Anacostia, D.C., on April 1, 1940, and has since been in daily operation.

The experimental station includes a 15-watt radio transmitter with battery power supply; instruments for measuring pressure, temperature, humidity, wind direction and velocity, and rainfall; means for converting the instrument deflections into corresponding variable resistances; modulating equipment for keying the radio

transmitter at a rate depending on the value of the particular variable resistance in circuit; automatic control equipment for connecting the instrument resistances into circuit in a definite sequence and for identifying the several observations by appropriate code letters; and a timing clock for starting the equipment at scheduled times.

The pressure, humidity and rain gauge instruments are of standard design, the rain gauge being of the weighing type. In each instrument a relay-operated clamping bar is added for clamping the instrument pointer against the edge of a wire-wound resistor when an observation from that instrument is desired; this provides the means for converting the instrument deflection into a variable resistance variation. The instrument pointer is thus allowed to swing freely except when an observation is made.

The temperature element consists of a glass capillary tube filled with an electrolyte having a high temperature coefficient of electrical resistance; the resistance of this device is thus a function of the ambient temperature.

The wind direction indicator (of standard type) has eight contact segments cor-

responding to the eight principal compass points. A different fixed resistor is connected to each segment and thrown into circuit when the wind vane assumes that direction.

The wind velocity indicator is a standard commercial cup anemometer with the "take-off" contacts stepped up by a factor of four so that four contacts per minute correspond to one knot. These contacts are made to key the radio transmitter directly.

The automatic control equipment is arranged to allow a warm-up period for the transmitter after starting, next to send out the station call letters, a reference frequency, and finally the several observation frequencies corresponding to the desired measurements each preceded by an identifying code. The sequence is repeated twice.

A month's automatic operation of the experimental station has shown the system to be reliable mechanically and electrically.

The receiving equipment required consists, in the simplest case, of an ordinary radio receiver, headphones, and stop-watch. Accordingly, the observations may be obtained by field crews; this is often an advantageous feature.

F-M'S GREATER SERVICE AREA SHOWN BY GRAPHS

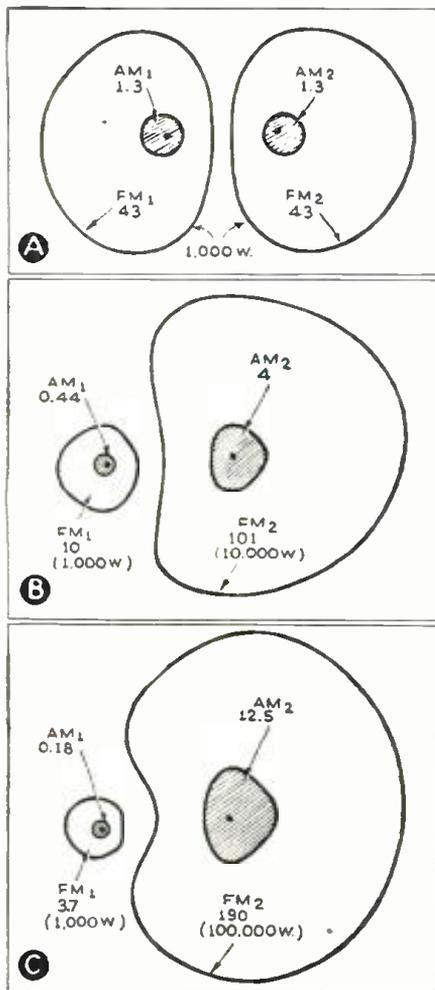
That under certain conditions the service area of F-M (Frequency Modulation) is 33 times greater than that of present A-M broadcasting is a claim made in a report of tests conducted by I. R. Weir, General Electric radio engineer. In each test 2 A-M and 2 F-M transmitters of equal power were located 15 miles apart with level ground between them. Transmitting antennas were 300 feet in the air, while receiving antennas had a 20 foot elevation. Computations made from these tests showed that the 2 1,000 watt A-M stations had equal service areas of 1.3 units each around both stations, while the area covered by the F-M stations was 43 units. Fig. A illustrates this.

Should the power of one of the A-M stations be increased to 10,000 watts, the good reception area of the weaker, or 1000-watt station, is reduced to 0.44 units, while that of the stronger increases to 4. Of two F-M stations with this 10:1 power ratio, the weaker has an area reduced from 43 units to 10, while the area covered by the stronger increases to 101 units, as shown in Fig. B.

If the power of one A-M station is raised to 100,000 watts while the other remains at 1,000 watts, the area of the weaker is further reduced to 0.18 and that of the higher-powered A-M station is increased to 12.5 units. With frequency modulation, this 100:1 power ratio results in a reduction of the lower-powered station area to only 3.7 units, while that of the stronger is increased to 190, as Fig. C indicates.

Even though the 1000-watt F-M station is reduced to 3.7 units under such adverse conditions as a power ratio of 100:1, still the good reception area of this station is 280 per cent of that possible using A-M transmitters and the most favorable power ratio of 1:1.

The tests also prove that receivers located between the service areas of two frequency



modulated stations can get either station by means of a directional antenna. Thus vast A-M interference areas can be converted into "discriminating" areas by the use of F-M, General Electric engineers claim.

FAIR POSTMISTRESS

Actress Jean Muir at the microphone has the distinction of being the only "postmistress" to date of the U.S. Antarctic Expedition. She recently read the fortnightly mail over WGEO, the General Electric short-wave station in Schenectady, to the 59 men in Little America.



Split Atom Put to Work Opening New 5 kw. Station in New England

Scientists have been splitting atoms with great gusto for 10, these many years but at last they have taken the split atom out of the ranks of the unemployed. A uranium atom, commonly called U-235, though not a submarine, did its first job for Westinghouse station WBZ (Boston,

Mass.), turning on its new transmitter.

The splitting of the uranium atom was clearly audible to the radio audience as a sharp click. Two preliminary clicks were heard as two atoms were split, to accustom the listeners to the sound. On the third click the 200,000,000 electron-volts of the split U-235 atom switched the program from Millis to the new transmitter in Hull.

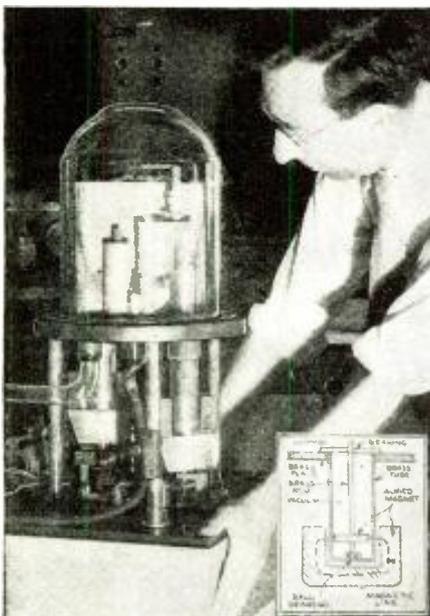
Although the new WBZ transmitter operates on the same power as previously used—50,000-watts—it sends out waves of double strength which cover a much larger area and reach more than a million additional listeners.

Picture at left is sketch of new WBZ transmitter. At right, Drs. E. U. Condon and W. E. Shoupp of Westinghouse prepare to split the atom, which is in a polystyrene chamber above oscilloscope. Below how atomic energy started the new station.

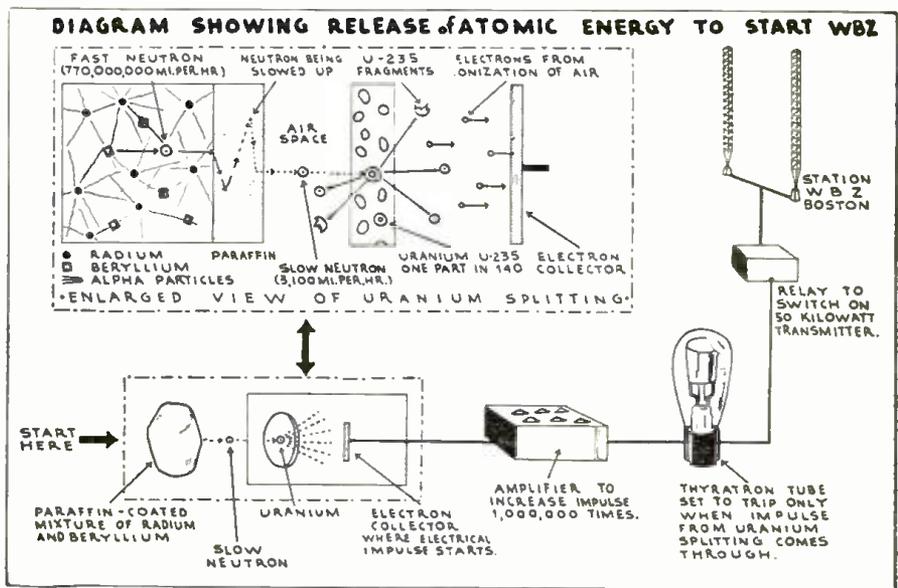


MAGNET SOLVES MANUFACTURING PROBLEMS

Finding it necessary to move some aluminum disks which were to be coated with vaporized selenium while in a vacuum. General Electric engineers under the direction of Dr. W. C. Hewlett evolved a system of magnets to solve the problem.



One of the magnets is revolved around a protruding brass tube sealed to the base of the vacuum chamber. Within the tube is another alnico magnet attached to the



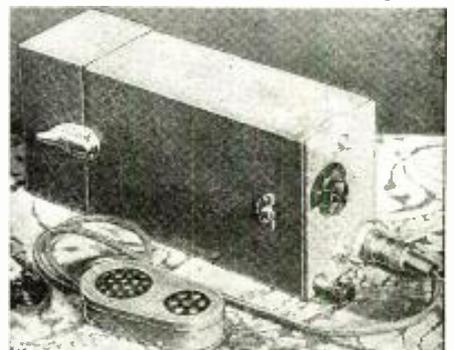
mechanism. As the outside magnet is revolved, the one within the vacuum-sealed chamber also rotates. Thus, without any shaft extending from the vacuum chamber, it is possible to control the mechanism.

Each disk must be treated separately, and the use of the magnetic "gears" has made it possible to load 100 disks in the vacuum chamber simultaneously and to treat them consecutively in the small vapor chamber within the vacuum jar. One set of "gears" raises the disks one at a time, whereupon a second set of "gears" operates the mechanism which transports the single disks to the vapor chamber, holds them there the specified length of time, and then removes them to the stack of completed disks.

A high vacuum is used for in air the selenium would be oxidized, since in a vacuum the vaporizing temperature is decidedly lowered; vaporization in a vacuum gives the operator a control in directing the path of the vapor particles. In addition to vaporizing selenium, the equipment is also applicable in vaporizing and depositing any other materials.

FOR 'CHUTE FIRE-FIGHTERS

A small radio transmitter and receiver weighing but six pounds with batteries, phone and speaker has been especially developed for use by members of the U. S. Forest Service, to be used when they are dropped with parachutes from planes

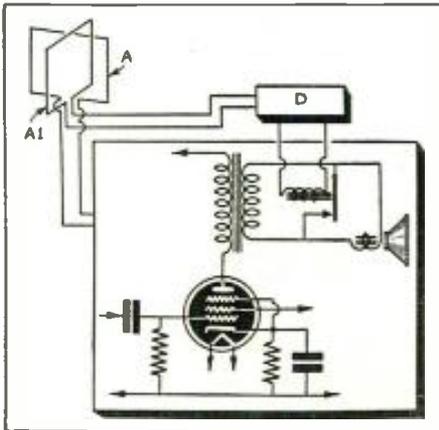


over fire-threatened areas. The set is about as big as a loaf of bread, measuring 2x4½x12", and operates on frequencies from 30 to 40 mc. with a range up to 100 miles.

Photo by N. S. Forest Service.

INTERFERENCE REDUCTION SYSTEM

● A British patent on a new system of interference elimination is described in *Radio Revista* of South America. In this system two loop antennas are used, one of

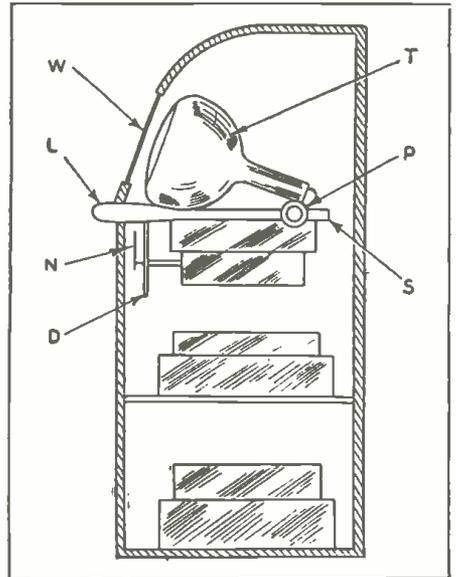


which is connected to the usual R.F. or detector stages, and the other to a detector and amplifier which operate a relay across the voice coil of the loud speaker. In the accompanying diagram antenna A feeds the

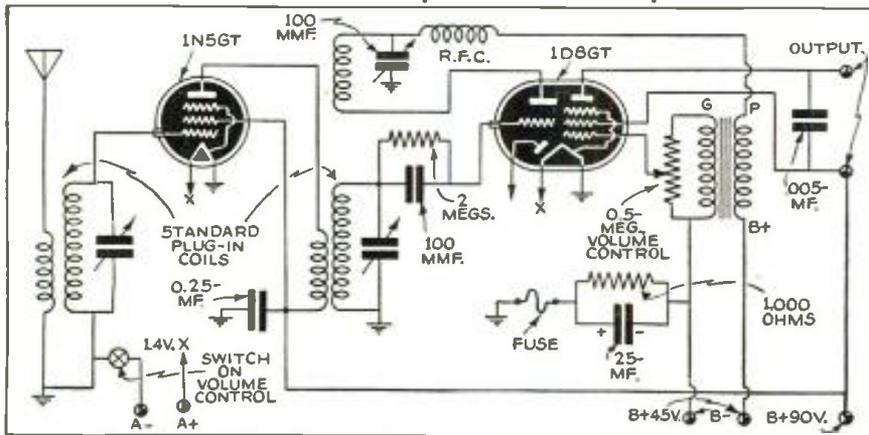
signal to the receiver, while antenna A1 is so positioned that it does not pick up the transmitted wave, but is in a plane such that it is as responsive to local interference as is antenna A. When a burst of interference is received it is amplified in the special detector amplifier circuit D, the output of which is fed into the winding of relay E. When this winding is energized it closes the contacts across the speaker voice coil, thus giving an instant of silence instead of an ear-splitting crash of interference.

DISAPPEARING C-R TUBE

● RADIO sets which are designed for both broadcast and television reception may have a new and interesting feature, according to a new idea of C. E. Lock, reported in *Wireless World* (London). As the illustration shows, the cathode ray tube T is mounted on a shelf S which is pivoted at P. When the set is used for television the lever L is depressed, bringing the tube into position behind the window W. When radio reception is desired lever L is lifted, putting the tube out of sight, making certain circuit changes, and bringing the dial D and pointer needle N into view behind the window. One of the objects of this in-



2-Tube Portable Operates Small Speaker



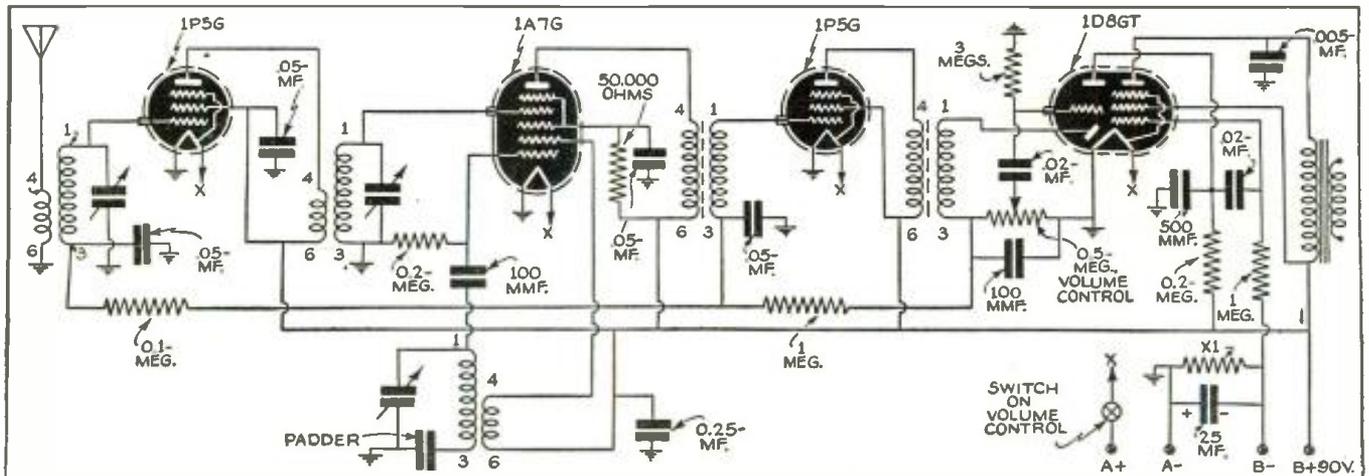
● A TRF set with regenerative detector, described in *Australasian Radio World*, has a number of desirable features, not the least of which is an automatic biasing arrangement to conserve the batteries. The set makes use of a 1D8GT which uses its triode section as detector and its tetrode as the first audio stage. A 1N5GT precedes it as the radio frequency stage. The tuning con-

trols include one two-gang variable condenser of .00035 mf. capacity (with trimmers), a .5 meg volume control and the .0001 mf. midget condenser, which provides control of regeneration. The on-off switch is built onto the volume control. The author of the article used shielded R.F. and detector coils of commercial manufacture but the experimenter may wind his own.

FOUR TUBE PORTABLE

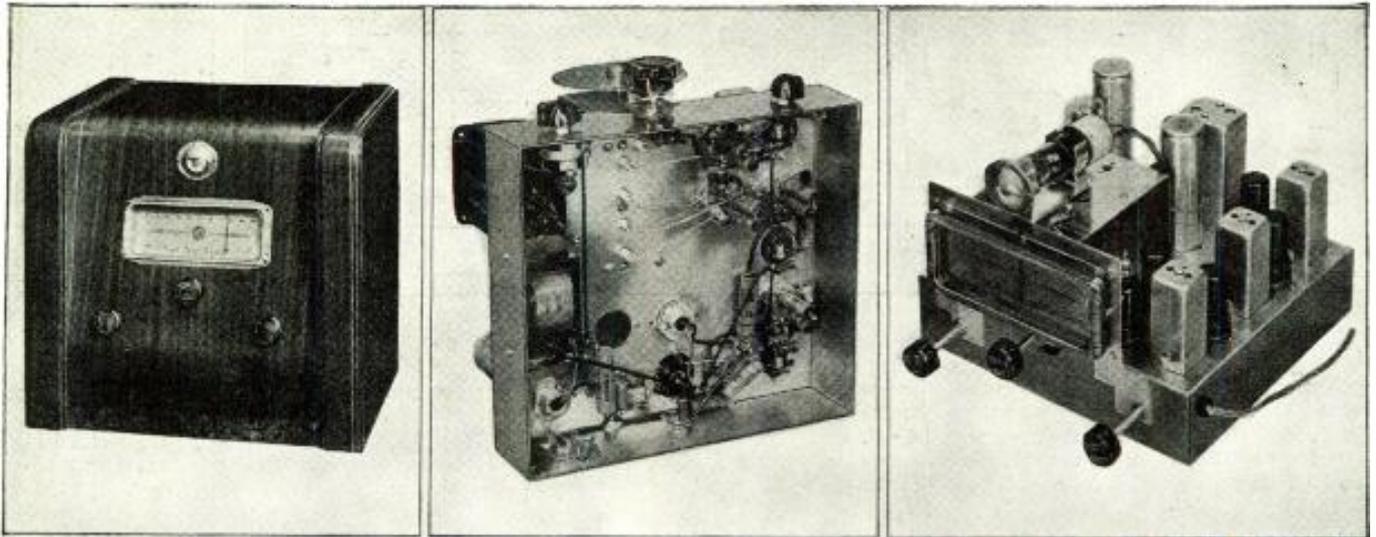
● A little Australian radio set known as the Picnic Portable made its debut last year. This year it has been redesigned and made to fit in a case 5½x6½x9" complete with batteries and loud speaker. The circuit has been further modified to provide automatic biasing, thus eliminating the need for a C battery and affording greater efficiency when the B batteries are run down.

The author constructed this receiver in a metal case, making it necessary to use an outside antenna but if a wooden case were used the grid coil of the first 1P5G might be replaced with a loop antenna. The resistor marked Q on the diagram may be from 800 to 1,000 ohms. The lower value will give somewhat better performance but the use of 1,000 ohms will still afford good reception and will cause approximately 25% less loss in the battery circuit. The author further suggests that a .25 ohm resistor be inserted in series with the A battery and the tube filaments. Note that this is ¼ of an ohm and not ¼ of a megohm. The author reports that at least one reader made that mistake in constructing the set—and then wondered why the filaments would not light.



Building the Browning Frequency Modulation Transceptor

G. H. Browning*



Front, bottom and chassis views of the FM Transceptor.

● RADIO'S most enterprising pioneer, Major Edwin H. Armstrong, has again given the art a new forward impetus with his invention of *frequency modulation* broadcasting. The result is static-free reception, bell-like clarity of tone, and remarkable dynamic range which literally brings the orchestra into your living room.

The Federal Communications Commission has already given the "go ahead" signal on *frequency modulation* and many such stations are either on the air or being constructed. The frequency band assigned by the F.C.C. is from 42 to 50 mc. allowing 40 channels 200 kc. wide for this method of *high frequency* transmission. As interference between stations as we know it today, is not encountered in frequency modulation transmission, these 40 channels will allow the operation of a very large number of broadcasting stations and it is safe to say that almost every community can have its own "interference-free" station. The advantages of frequency modulation transmission and reception are four-fold:

1. The reception is substantially static and interference-free. It makes little difference whether the static originates from natural causes or is man-made.

2. The dynamic range may be made that of the original program. By this is meant that the softest to the loudest passages may be faithfully reproduced in the home.

3. The system lends itself more readily than amplitude modulated systems to high-fidelity reception. This means that the music and speech emitted from the loud speaker is more "life-like" than has previously been known.

4. There is practically no station interference as we know it. If two F.M. stations were operating on the same frequency and if one of these stations were two or

three times as loud as the other, the receiver would automatically pick up the stronger signal and there would be practically no interference due to the weaker signal. Of course if two stations operating on the same frequency have the same signal strength there is some interference, *but there are no whistles* as would be the case with amplitude modulated stations. This

Frequency modulation is spreading rapidly over the country—hence the demand for data on building a good frequency modulation converter. Here's the Browning transceptor—one of the best designs for the purpose the editors have come across.

freedom from interference allows the operation of a very large number of transmitting stations and will allow each community to be served with numerous local transmitters.

Plugs into "Phono" Jack of Standard Receiver

It is the purpose of this article to describe the construction and operation of a transceptor (adapter) for receiving *frequency modulated* stations. It should be pointed out at the outset that this Transceptor is a complete frequency modulation receiver, less only the audio amplifier and speaker system, and is designed to plug into the phonograph jack of the ordinary high-grade radio receiver for receiving frequency modulation stations through the receiver's audio amplifier and speaker system.

The transceptor may also be used with a separate high-grade audio amplifier and speaker.

There are numerous fundamental differences between a frequency modulation receiver and an amplitude modulation receiver.

1. An entirely new type of circuit called the *limiter* is incorporated. This is designed fundamentally to keep the amplitude of the signals fed to the detection system constant in amplitude. This results in the elimination of any amplitude modulation which would cause noise. With the limiter circuit shown, acting in conjunction with the detection circuit, noise rejection up to more than 50 db. may be obtained. In fact it is possible to operate an electric razor adjacent to the frequency modulation antenna without spoiling the program in any manner. During the recent lightning storms, the writer, by means of a switching arrangement compared the noise obtained with amplitude and frequency modulation. In the case of amplitude modulated signals, static crashes would entirely obliterate the program from even a local station located only a few miles from the receiver, *while with frequency modulation no noise was encountered though the frequency modulation station being received was located some forty miles away from the receiver.*

2. The second prerequisite to a high-grade frequency modulated receiver is very high gain. This may be obtained by utilizing a tuned antenna circuit and a stage of radio frequency amplification ahead of the mixer tube, and two stages of high-gain I.F. amplification, besides the *limiter stage* which actually, on low signal levels, gives additional gain. Tube hiss, which always accompanies high gain, is entirely eliminated when the frequency modulation station is tuned in.

*Browning Laboratories, Winchester, Mass.

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3. The I.F. amplifier, instead of being very selective as is the case with amplitude modulated stations, is purposely made *broad*—having a band width of about 150 kc. Transients in the I.F. amplifier must also be damped out by means of resistors placed across the I.F. transformers.

4. The method of detecting frequency modulated signals is fundamentally different from that employed with amplitude modulated signals, for it is *changes in frequency* which produces the audio frequency rather than changes in amplitude.

With these differences between F.M. and A.M. receivers clearly in mind, we can discuss construction, alignment, and operation of the frequency modulation Transceptor. The circuit diagram of the complete Transceptor is shown in Fig. 1. Although the circuit diagram looks rather similar to the conventional superheterodyne, the I.F. frequency is much higher than that usually employed, being 3 mc. The band width of these special 3 mc. I.F. transformers is approximately 150 kc. (that is, they are so designed that there is very little attenuation at 75 kc. either side of the center frequency). The resistors placed across these transformers damp out transient oscillations which would cause fuzz frequencies in the output. The limiter circuit appears something like a third stage of I.F. amplification, with the exception that a sharp cut-off tube (6SJ7) is employed with no bias. Low voltages are employed on the screen and plate, and a resistor and by-pass condenser placed in the cathode return. The detection transformer is somewhat similar to the so-

called *discriminator* circuits employed in automatic frequency control, though its function is markedly different. This detection transformer is so designed that when the signal frequency varies at an audio rate, audio voltages are developed in the diode sections of the 6H6. The 100,000 ohm resistor and the .001 mf. condenser is a corrective network, made necessary by the fact that frequency modulation stations pre-emphasize the high frequencies in accordance with standard practice; to obtain a flat audio response curve at the loud speaker, it is necessary to compensate for this or de-emphasize in the receiver.

The Browning High Frequency Tuner

As the transmission of frequency modulation stations is from 42 to 50 mc. (approximately 7½ meters) a special type of high frequency tuner has been developed. This includes a tuned antenna circuit, a stage of radio frequency amplification and the oscillator circuit. This high frequency tuner is shown in the dotted lines on the circuit diagram. To obtain maximum performance, it is necessary that all lead lengths be extremely short and that chassis currents be reduced to a minimum. The frequency range of the tuner is approximately 41 to 51 mc. The entire unit is very compact, measuring approximately 5¼" x 3" x 2½". This unit is quite complex in its structure and the set-builder may procure it completely wired, aligned and tracked.

Construction of the I.F. Amplifier

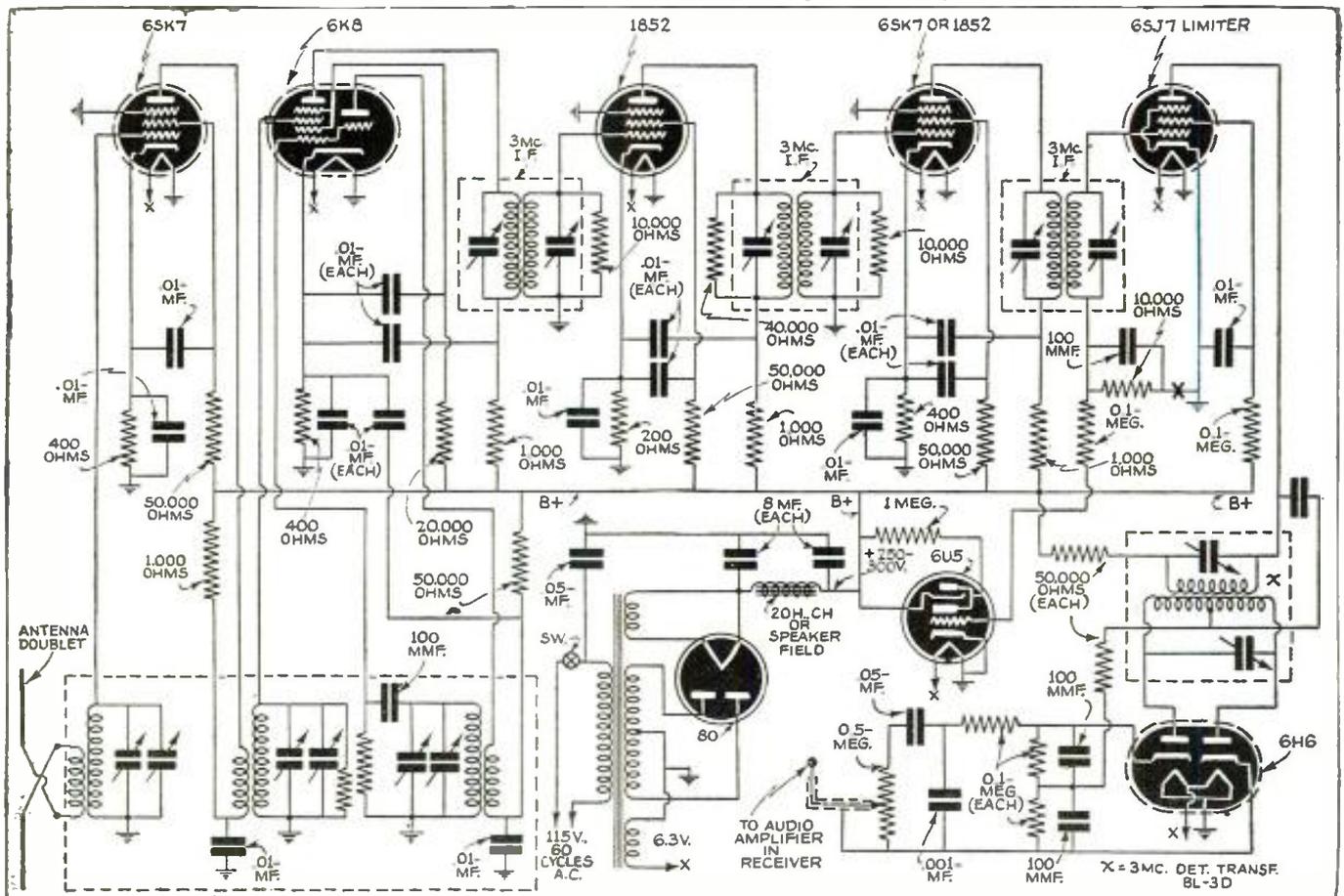
The layout of the R.F. amplifier and mixer tube, as well as the I.F. amplifier,

is shown in Fig. 2. It will be noted that the placement of parts is such that the amplifier tubes are adjacent to the 3 mc. I.F. transformers, making the lead lengths extremely short. It will be noted that each I.F. amplifier stage has a decoupling detector in the plate and screen grid circuits and that all by-passing is done to the cathode of the tube associated with the circuit.

The sockets for the various tubes should be mounted with their key positions as shown on Fig. 2, and the I.F. transformers so mounted that the green terminal is towards the rear and outside of the chassis. These mounting positions further *shorten* the leads. After the components have been mounted in their proper position, the wiring is done in accordance with the schematic wiring diagram. The by-pass condensers are mounted on their ends as shown in Fig. 3. This tends to give some shielding between plate and grid circuits and at the same time makes the leads very short. Rigid bare wire is used for all critical I.F. circuits.

The power-supply system is extremely simple and is shown in some detail in the photograph of the underside of the chassis, Fig. 3. The choke is mounted on the side of the chassis, while the power transformer is mounted in the hole provided. After all the I.F. and power-supply wiring has been done, the 40T high frequency tuner may be mounted in position and the seven connections made from this tuner to the associated R.F. and mixer tubes. Care should be taken to make gradual bends in the leads which carry high frequency current.

Hookup of the well-designed components forming the F-M adapter.



Alignment and Adjustments

After the complete transceptor has been constructed and the various connections carefully checked, the next step is to properly align the I.F. amplifier. This is done by feeding a 3 mc. signal into the grid of the 6K8, and adjusting each of the transformers in turn for maximum gain. Maximum gain is readily indicated by the 6U5 tuning eye, for as the signal strength increases due to alignment, the eye will more nearly close. It may be found that in the alignment process the eye closes and overlaps. In such case, reduce the signal output of the signal generator and re-check. When the I.F. system has been completely aligned the eye should completely close with a signal strength from the signal generator of about 1 millivolt.

The next circuit to be adjusted is the detection transformer. To make adjustments on this transformer, connect a high sensitivity voltmeter (5,000 ohms per volt or more) between the cathode No. 4 of the 6H6 and ground. If the voltmeter has a zero in the center of the scale so much the better. With a 3 mc. signal fed to the grid of the mixer tube, set the secondary trimmer of the detection transformer (secondary trimmer is on the side of the detection transformer nearest the 6H6 tube) so that zero voltage is obtained, as indicated on the voltmeter. Change the signal frequency from 3 mc. to 2.95 and 3.05 mc. alternately and adjust the primary trimmer (this trimmer is on the red and blue terminal side of the shield can housing the 3D) until equal and opposite voltages are developed as indicated on the voltmeter. Readjust the signal generator to 3 mc. and check to see if zero voltage is obtained. If exact zero voltage is not obtained, adjust the secondary trimmer slightly. Any alignment tool with even a small amount of metal cannot readily be used for these adjustments as its capacitance detunes the circuits.

Having aligned the I.F. and detector system, the next process is to align the 40T tuner for the particular antenna system being used. It is suggested that a doublet type of antenna be used as will be explained in detail under "Antenna Requirements." Having attached the lead-in from the doublet to the terminals in the rear of the 40T tuner, tune in an FM signal. With a screwdriver, adjust the antenna circuit (this is the trimmer in the rear of the 40T tuner) for maximum signal strength as indicated by the eye. Slight adjustments may be required on the R.F. trimmer (middle compartment) for maximum signal strength. No adjustments should be made on the oscillator unless the frequencies being received are not in accord with the markings of the dial.

Attaching the Transceptor to the Audio Portion of a Radio Receiver or an Audio Amplifier: A shielded lead is brought out from the 1/2 megohm volume control as shown in the circuit diagram. If the radio receiver with which the transceptor is used has a phonograph jack this lead will be connected to the tip of the phonograph jack and the shield around this lead will be connected to the base of the plug. When the transceptor is to be used with a separate audio amplifier connect the lead from

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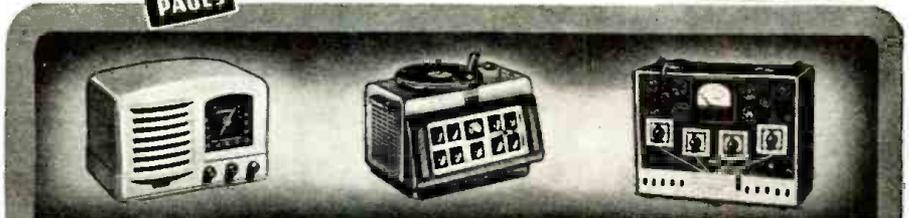
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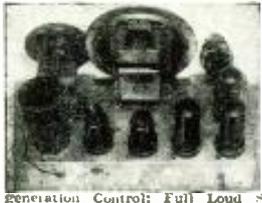


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SEVEN OVERLAPPING BANDS—825 to 2000 meters. Professional Band Spread, Beam Power, Communications Set, **POWERFUL, SENSITIVE, SELECTIVE.** Features include: Beam Power Output; Built-in Dynamic Speaker; Patented Cisin A.C.-D.C. Circuit; Band Spread on all Bands; Self-Contained Power Supply; Precision Filtering; Antenna Control; Head-phone Jacks; Dual Re-Generation Control; Full Load Speaker; Studio Tone Quality; drilled assembled chassis.

Complete Senior Space Explorer Kit of all chassis parts, drilled assembled chassis. Power Supply and dynamic speaker, built-in dynamic speaker, ready to use. **\$5.95**

Matched Metal Tubes include 1-6J7, 1-6CS, 1-25L6, 1-25Z6 rect., 1-75A Ballast, \$3.75; Four S.W. Coils 8 1/4 to 200 meters \$1; Two B'cast Coils 200 to 600 m. \$1; Long Wave Coil 600 to 2000 meters \$1.50; Wired Dynamic speaker, \$1.95; Attractive cabinet \$1.50; Wired and tested \$2.25 extra. Shipping weight 7 lbs. Send stamp for Circular. 25% deposit on all C.O.D. orders.

SPECIAL—Senior Space Explorer. Complete Assembled. Wired. Factory Tested Chassis. with all coils 8 1/4 to 600 meters, set of matched metal tubes, built-in dynamic speaker, ready to use. **\$15.35**

H. G. CISIN'S Air Scout Jr. Radios MODEL 3A-E ALL ELECTRIC SHORT WAVE SET

A powerful sensitive short-wave set. Holds wonderful records for distant reception. Also brings in police transmittant, phone and broadcast entertainment. Excellent volume. Works from any A.C. or D.C. house current. Easy set to build. Speaker mounts on attractive panel. Range 9 1/2 to 415 meters or to 1500 meters with special long wave coil.

Complete Kit includes: Earphone, broadcast coil 70 to 200 meter coil. Panel, Chassis, High Grade Variable Condenser, Potentiometer, Antenna Trimmer, Dial, Sockets, Knobs, Wire, Resistors, Condensers, and all other required parts including instructions and diagrams. **\$3.20** With Phone (Less and diagram. ONLY)

ONE-TUBE BATTERY SET—Model 1B. Satisfied owners report MARVELOUS RECEPTION. Same as model 3A-E. Earphone reception. Complete kit includes parts listed above plus 31 tube and filament phone. With tube and batteries **\$2.45** Phone (unwired)

TWO-TUBE BATTERY S.W. SETS—Model 2B. Complete kit including all parts in the 1-tube model plus parts for extra audio amplifier. **\$2.95** & Phone (unwired)

THREE-TUBE DE LUXE BATTERY S.W. SET—Model 3B. Complete kit including all parts in the 1-tube model plus parts for two extra audio stages including two 41-type tubes and 33 **\$3.45** & Phone (unwired)

Following Auxiliary Parts are available: 9 1/2 to 20 meter coil 25c; 15 to 45 meter coil (foreign) 25c; 40 to 80 meter coil (foreign) 25c; 22 1/2 volt "9A" battery 75c; Two flashlight "A" batteries 10c each; 5" Finish All Loud Speaker \$1.50; Complete Antenna Kit 50c; Wood Screw Kit 10c. Three tubes for Model 3A-E each 35c. Long Wave Unit and coil for any model \$1. Double Ear-phones \$1.30. Bandspread Attachment 75c. Any Air Scout Jr. model wired extra \$1.00.

NOTE: If you already have earphones, two extra foreign coils may be substituted in any model.

WIRELESS TRANSCASTER

This wonderful new device has hundreds of practical applications. Broadcasts voice or music from any room or floor in home, office or store to any radio in same building WITHOUT CONNECTING WIRES. Works from any lighting socket, and is easy to set up. Your favorite recordings from electric phonograph through any radio WITHOUT CONNECTIONS between radio and phonograph. Transforms your radio into an efficient public address system. Acts as an interoffice communication system. Simplifies home broadcasting. Great fun for parties, entertainments, etc. Ideal for auditions. If your neighbor's radio in same building annoys you, you can tell him so THRU HIS RADIO. Can be used as a radio nursemaid to warn of trouble in nursery. No need to go upstairs. Merely tune your radio to a pre-determined point on dial and listen in. If baby is crying, you'll hear him clearly through the radio. Also permits use of radio as a telephone. Listen to secret conversations. Impossible to enumerate many other uses in this limited space.

TWO-TUBE WIRELESS TRANSCASTER STANDARD MODEL

Two separate rectifier tube and dual purpose 6A7 tube with audio modulated triode and a high-gain pentode oscillator. Sumless 25 DB. amplification permitting use of earphone or small mag. speaker as microphone, or any high impedance microphone. **READY TO USE WITH TUBES (LESS MIKE) . . . \$2.35**
EARPHONE MIKE—95c

DE LUXE MODEL TRANSCASTER- TRANSMITTER

Powerful, high-gain device engineered so that it will transmit high-fidelity music without connection wires to remote radio set. No sacrifice of quality or power. Uses separate rectifier tube 6A7, screen grid tube amplifier, and dual purpose 6A7 modulator and oscillator. Price, complete, ready to operate . . . (less tubes and antenna) **\$4.95**

Set of 3 Matched Tubes \$1.95

Order Transcasters direct from this ad. No circulars available, but complete directions and full list of applications with every Transcaster.

H. G. CISIN, CHIEF ENGINEER
ALLIED ENG. INSTITUTE, DEPT. 5-68
85 Warren St., NEW YORK, N. Y.

the arm of the potentiometer to one input terminal of the audio amplifier and the shield around this lead to the chassis.

Tuning the FM Adapter: The left hand knob controls the on and off switch and the right hand knob is audio volume control. The center knob is the tuning control.

The cathode ray tuning indicator gives an excellent indication of signal strength being picked up from the FM station. For best noise suppression, the tuning eye should practically close. When the FM signal is not sufficiently strong to about quarter close the eye, noise may not be entirely eliminated (improvement of the antenna system may be necessary).

The cathode ray eye is a tuning indicator only.

Always tune an FM receiver for minimum noise. It will be noted that at either side of the correct tuning point a material amount of noise is obtained. When the receiver is tuned for minimum noise the eye should be nearly at the maximum closed position, but not necessarily at the exact maximum closed position.

The operator will notice that there are three points on the dial where frequency modulation signals from strong stations may be heard. This is due to the shape of the curve of the detection transformer and is general with all FM receivers. The correct tuning point of course is the center one where the eye tends to close.

Antenna Requirements

A suitable *high frequency antenna system* is mandatory. In general it will be found that a horizontal half-wave doublet (two-quarter wave sections) will be satisfactory. Each of the quarter wave sections should be between 58" and 65" long. For a lead-in, concentric cable or twisted pair may be used. As this type of antenna is directional, its best position should be determined. This is easily accomplished, since the antenna is short enough to allow a preliminary set-up to be made in the room where the receiver is to be used. The antenna should be located in a horizontal plane and rotated until satisfactory reception is obtained from the maximum number of stations. An indication of signal strength will be provided by the electric eye. The antenna may then be raised to its final location and oriented in the position which gave best results.

The lead-in from the antenna is connected to the double-terminal strip on the rear

of the high frequency tuner. If a concentric line lead-in is employed, the inner conductor should be connected to the upper terminal.

Parts List on Browning F-M Transceptor BROWNING LABORATORIES (Components)

- 1—BL-40T Tuner
- 3—3M IF Transformers
- 1—3D IF Transformer
- 1—100C Chassis
- 1—6D Slide rule dial

KENYON (Components)

- 1—KT-222 Filament and Plate Transformer
- 1—KC-20 Choke

CORNELL-DUBILIER (Condensers)

- 16—.01 mf. 400 volt paper tubulars
- 3 100 mmf. mica
- 1—1,000 mmf. mica
- 2—8 mf. 425-volt electrolytics

IRC

- (Resistors all values 1/2 watt unless otherwise specified)
- 1—200 ohm
 - 3—400 ohm
 - 4—1,000 ohm
 - 2—15,000 ohm
 - 1—10,000 ohm
 - 4—50,000 ohm
 - 4—40,000 ohm
 - 1—20,000 ohm, 1 watt
 - 4—100,000 ohm
 - 1—500,000 ohm potentiometer (left-hand taper)

AMERICAN PHENOLIC

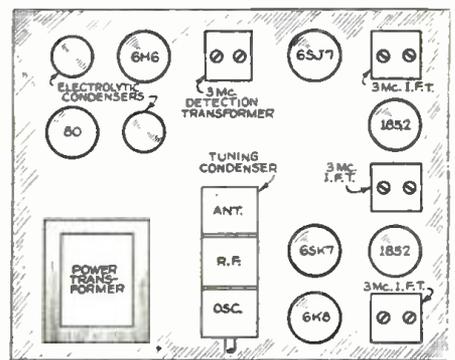
- 6—octal eight sockets
- 1—four-prong socket
- 1—Tuning eye assembly with socket

RAYTHEON (Tubes)

- 1—6U5
- 1—6SK7
- 1—6K8
- 2—18S2
- 1—6SJ7
- 1—6H6
- 1—80

MISCELLANEOUS

- 1—A-C switch with rotary type
- 10—insulated soldering terminals
- Wire—#16 bare, and various colored flexible.



Plan view of chassis, showing position of tubes, I.F. transformers, etc.

NON-COMMERCIAL EDUCATIONAL F-M BROADCASTS

● **FIRST** use of F-M (frequency modulation) broadcast in the non-commercial educational field is proposed by the Board of Education of the San Francisco Unified School District as a result of being granted a construction permit by the Federal Communications Commission for a new station at 22nd and Bartlett Streets, that city, to operate on 42,100 kilocycles with 1 kilowatt power, unlimited time.

It intends to use radio for instructional, administrative, supervisory, and other functions in the local schools. Thirteen studios are planned for high schools and colleges in that area. They will be connected with the broadcast station by means of leased wires. In this manner it is expected that a greater number of teachers and pupils will

be enabled to participate with less effort and expense of transportation.

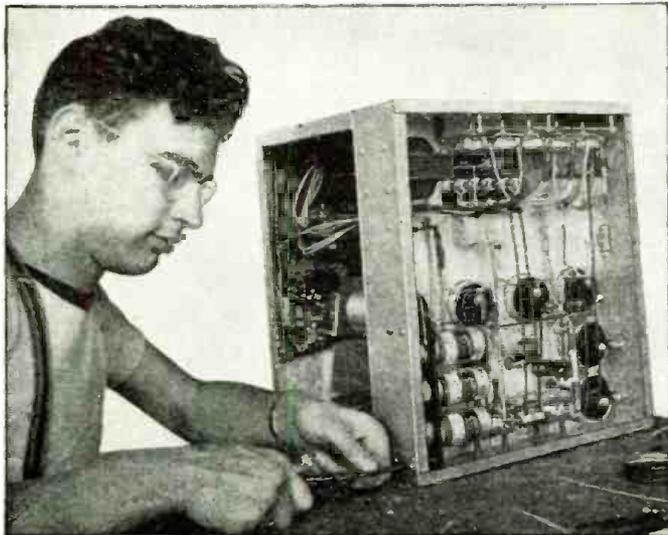
The broadcast programs will cover nearly all of San Francisco as well as the East Bay area which includes the cities of Alameda, Oakland, Berkeley, El Cerrito and Richmond. The Board of Education, which is the governing body of the San Francisco Unified School District, has allocated \$9,000 for the station, and an additional amount of \$42,000 has been made available.

Three other institutions were previously licensed to use A-M (amplitude modulation) on the channels set aside for non-commercial educational purposes. They are the New York City Board of Education, the Cleveland Board of Education, and, more recently, the University of Kentucky.

10 by 8 Inch Television Images

BY THE TELEVISION CLUB OF BROOKLYN TECHNICAL
HIGH SCHOOL

Faculty Adviser:—Ricardo Muñiz, E.E.
President:—Saul Morton Decker
Vice President:—Martin Rosenberg



The television unit is readily assembled with ordinary tools.

Here is a picture reproducing unit which will operate from the video output of any television receiver. It will reproduce large images from small television receivers—also useful as a serviceman's universal test picture reproducer.

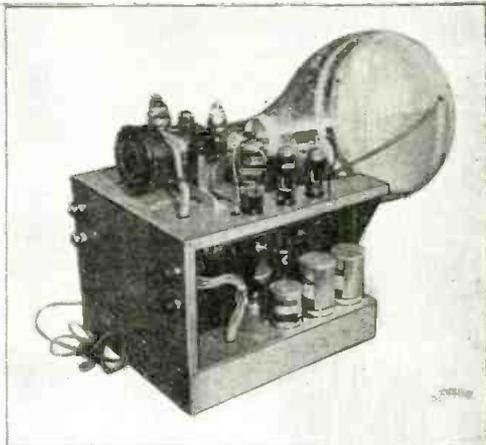
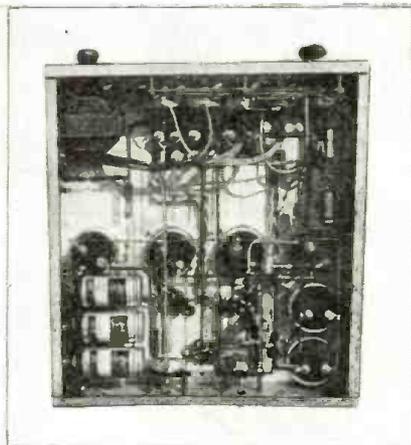
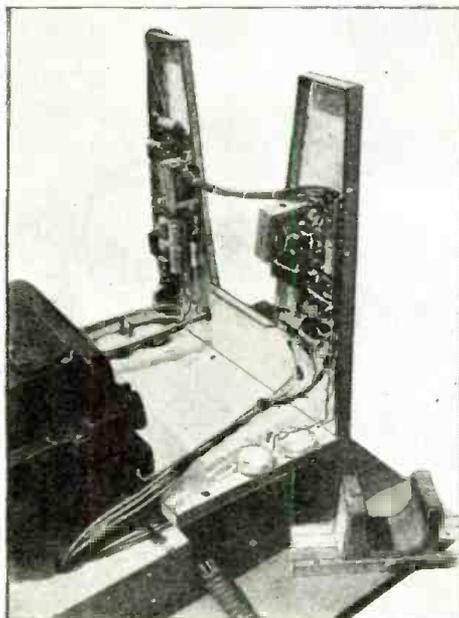
● **Large Pictures from Your Small Televisor:** This picture reproducing unit when used in conjunction with any of the Televisors described for home construction in *RADIO & TELEVISION*, or with any of the kits now on the market, will give the constructor Ten Inch by Eight Inch television pictures.

Serviceman's Universal Pix Reproducer: To the repairman or serviceman anticipat-

ing any quantity of *television* work, this unit offers all the advantages that a *Universal speaker* gives in radio servicing—plus some. Having this unit on the bench will make possible the application of *signal tracing* service methods. This unit will enable the worker to align and repair the *television receiver* portion of the Televisor with the assurance that his adjustments and tests will not be confused by troubles

located in the synchronizing separator, clipper, D.C. restorer, deflection oscillator, high voltage power supply, or picture tube. He can *concentrate* on the *receiver* itself. This **MUST** be working before troubles can be easily diagnosed in the remaining portions of the Televisor. We consider a unit of this character a **MUST** for the busy "Television-Man".

Television Experimenter's Necessity: The



Photos show—from left to right—upper deck swung back on hinges to expose wiring; bottom view—wiring under lower deck; rear view complete unit—with cathode potentiometer knobs; lower row—lower deck—power supply; complete unit ready for "big bottle."

Note front "apron."

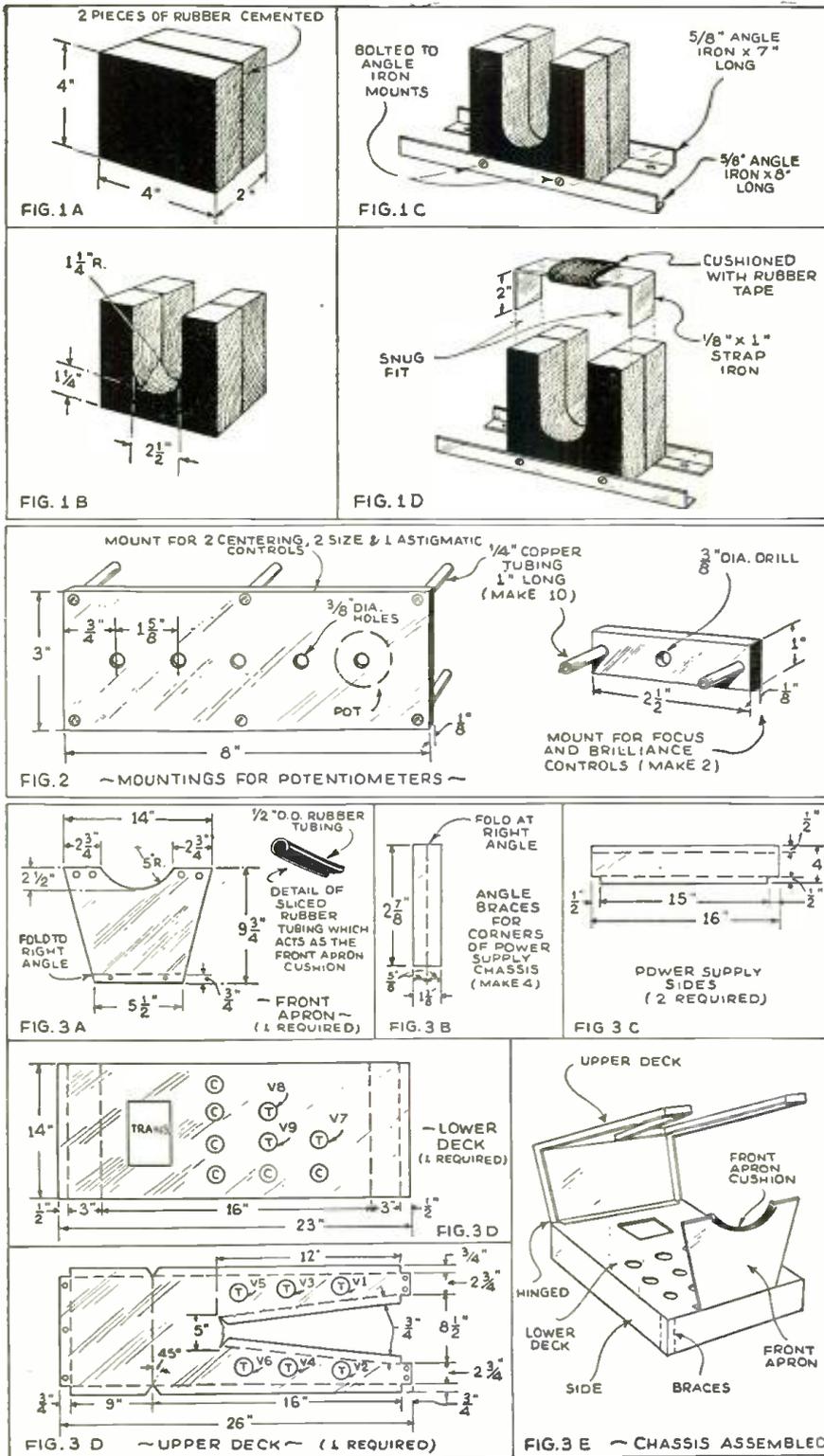


Fig. 1—Tube mounting.
Fig. 2—Mounting for potentiometers, chassis layout, etc.

television experimenter is most usually concerned with the more subtle and intriguing receiver portion of the television set. The high voltage power supply and deflection circuits are more or less routine. One of these units on the bench will leave him free to experiment with all the various types of receiver circuits, T.R.F., Super-Het, Filter type, and all the various Video amplifier circuits for producing correct amplification of the video signal, without phase shift and with equal amplification of all frequencies

in the video range. He can connect the picture reproducer to any of his television receivers with a minimum of effort. He can compare, under controlled conditions, two designs of receiver. He can use this reproducer with his amateur television receiver. (A complete amateur television system will be described in this magazine by Mr. Muñiz in the very near future.) In short, it is as necessary to the television experimenter as a loud speaker is to the radio experimenter.

General Constructional Features: It will

be noted upon viewing the photographs of the unit built by the Tech. Club that two chassis were used. The upper chassis provides mounting for the synchronizing pulse separator-clipper-amplifiers (6J7), the saw tooth deflection oscillators (6AC5G), and the deflection amplifiers (802) and their associated circuit parts.

The C-R picture tube is also mounted on this chassis by means of an ingenious arrangement which is here described. The lower chassis contains the power-supply and bleeders. Note that the heavy power transformer is braced in two places. Drawings of the necessary sheet metal work are provided herewith for the guidance of the constructor. Unless some facilities for sheet-metal work are available to you, it might pay to have the chassis bent by a sheet metal shop—it takes very little time. At Tech, the chassis was made in the school's sheet metal shop under the supervision of Mr. Hochberg of that department.

Details of Construction

1. Upper Chassis: In the drawing and photograph it will be noted that this deck has a large area cut out of its upper surface to accommodate the cathode-ray tube. This forms two "arms" of the chassis on either side of the bulb. One side is devoted to the "horizontal" circuits, the other to the "vertical." The "horizontal" includes the 6J7, 6AC5G and 802 tubes. These circuits produce the horizontal deflection or "line frequency." The "vertical" tube complement is the same, but these circuits produce the vertical deflection of the cathode-ray beam—that is the "frame frequency."

Thus six tube sockets are mounted on the upper deck besides the "moorings" of the big tube. On the under side of the deck are found the condensers, resistors and transformers which constitute this portion of the unit. These parts are grouped in the section of the circuit diagram enclosed in the single dotted line and labeled "upper deck."

It will be noted that the upper deck has a vertical portion in the rear which extends down to the lower deck. The Power Transformer, the main mountings of which are on the lower deck, is braced against this portion of the upper deck for additional support. Mounted upon this rear "apron" of the upper deck are four of the adjustment potentiometers. These are the four pots. found in the cathode circuits of the oscillator and amplifier tubes. Those in the oscillator tubes are the frequency controls, while those in the amplifier tube circuits are the size controls. More about their functions later. They are mounted directly on the chassis metal because only a small voltage difference to ground exists at this point of the circuit. All other potentiometers are insulated from the chassis and from their knobs.

The "mooring" device for the large tube may be seen in the photos and in the special sketch which shows it in detail. You will note that the Teletron tube socket is NOT anchored to the chassis. The socket has no provisions for mounting provided; the socket is supported by the tube. The neck of the tube is gently but firmly held in the rubber cushioned jaws of its "mooring." The flared portion of the big "bottle" rests upon a rubber cushioned semi-circle cut out

of the third piece of the chassis. The cushion is a piece of $\frac{1}{2}$ " O.D. rubber tubing. This third piece is designated "Front Apron" in the chassis drawings. The radius shown is correct to fit the big tube at the place which will rest there. No attempt is made to anchor the tube at this support.

All holes in the upper deck made for the passage of wire leads must be protected with rubber grommets. These grommets serve a dual purpose here. They re-enforce the insulation of the high voltage carrying leads at their most critical point, where they pass through the chassis, and they protect the lead mechanically against abrasion. It will be noted that the leads from the socket of the big tube are bunched into two groups. Each group is "laced-up" and passed through BOTH decks by means of large grommetted holes. This lacing does not detract from the performance and does improve neatness.

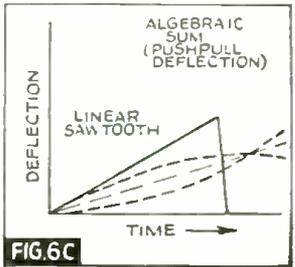
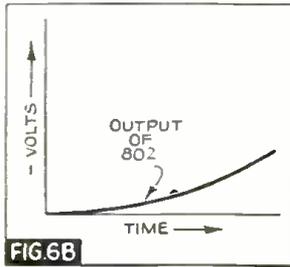
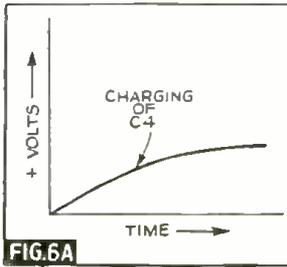
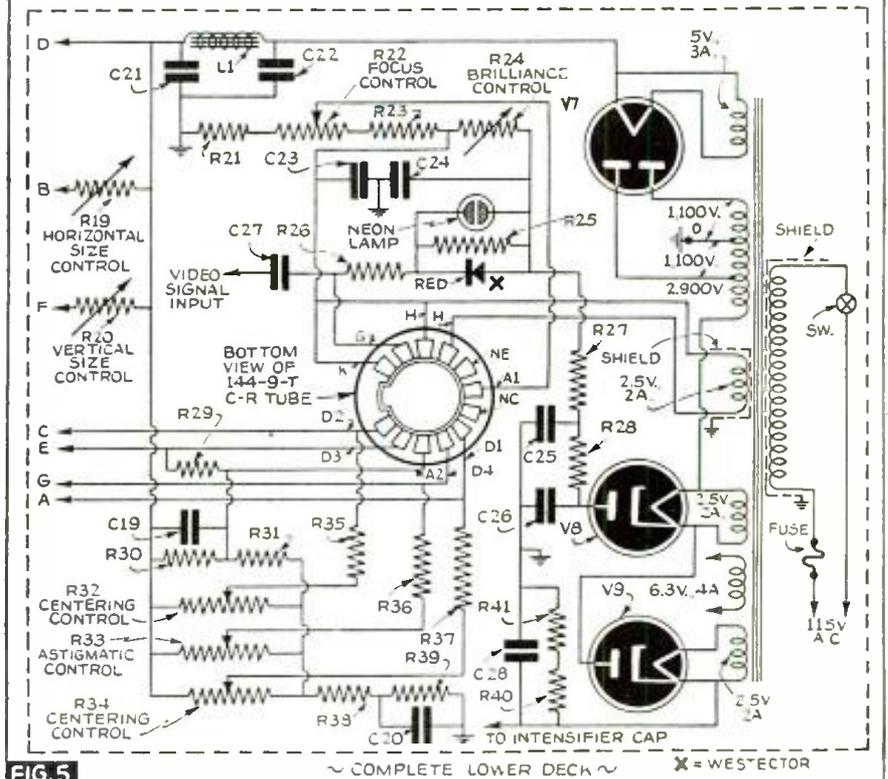
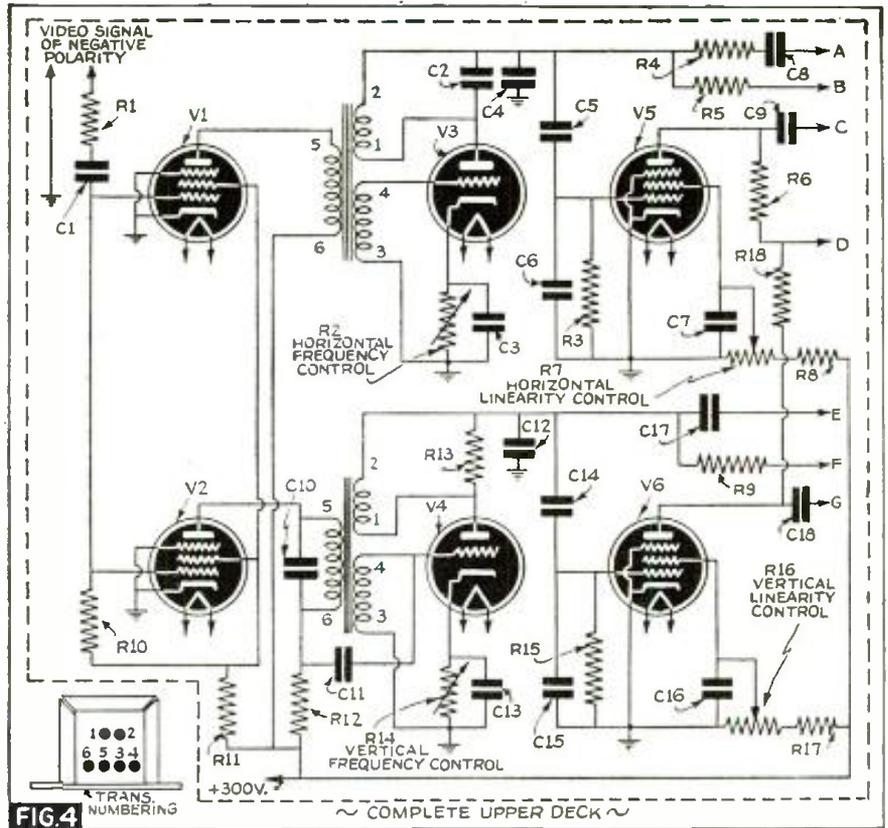
2. Lower Deck of Chassis: Mounted on the lower deck of the chassis are all parts within the single dotted line in the circuit diagram. These constitute the transformer, choke, condensers, tubes and bleeder of the power supplies. Also the potentiometers which are too "hot" to mount directly on chassis metal are mounted here on sub-panels. A detail of these sub-panels is shown in the drawings. The "pots." are supported some distance behind the back of the chassis with the exception of the brilliance and

Figs. 4, 5 and 6—Fig. 4: Diagram for complete upper deck. Fig. 5: Diagram for complete lower deck. Fig 6: a, b and c: Graphs showing push-pull deflection.

focus controls (which have to be re-set frequently) which are similarly mounted behind the front of the chassis. Insulated extension shafts (not shown) extend from the pots. out through the chassis onto knobs. Now is as good a time as any to **WARN** the constructor that the potentials used in this, and all other, electronic television circuits are **LETHAL**—that is to say **THEY KILL!** You don't get a second chance from the demon **HIGH VOLTAGE**. But with care and judgment, **NO HAZARD WILL EXIST** in using and operating this device. **BUT** when we say mount a potentiometer on an insulated sub-panel—we're not fooling!

Hinges are provided at the rear of the lower deck for mounting the rear apron of the upper deck in such a manner (see photo) that it can be swung back for servicing or experimental changes. (After unbolting transformer from it, etc.)

Explanation of Circuit: Let us start with the input to the 6J7G's. This input must be a video signal of *negative* polarity. The club obtained this from the plate of the first video amplifier in the school's Televisor. Naturally a blocking condenser was used in series with this lead to keep D.C. out of the grid circuits of the 6J7G's. These two tubes function as *synchronizing signal separators* and the outputs of their plates are applied to the synchronizing windings of the horizontal and vertical oscillation transformers. Thus the saw tooth deflection oscillators are "triggered" to keep in perfect step with the transmission. Of course the "synch" won't take control unless our



frequency of sweep is adjusted to very near the correct value with the frequency control "pot."

As an oscillator, or saw tooth generator, we use a 6AC5G. Hung on its plate circuit is condenser C_4 (considering the horizontal sweep circuit). Condenser C_4 is charged through resistor R_3 and potentiometer R_{10} . In this circuit the timing is such that C_4 reaches nearly the full 1,100 volts before it is discharged through the 6AC5G, which was held at cut-off by the charge existing on cathode condenser C_3 from a previous cycle of oscillation. This charge on C_3 is bled off by potentiometer R_2 to ground. When the charge on C_3 is low enough—the 6AC5G draws plate current. This plate current comes from the condenser C_1 . Pot. R_2 acts as horizontal frequency control. Pot. R_{10} acts as size or amplitude control.

Actually the presence of the transformer acts to decrease return time, etc.—but a longer explanation is available in the Du Mont Teletron 144-9-T Bulletin, which you can get for the asking (from Du Mont) so we won't go into the elaborate details.

Fig. No. 6a shows the signal wave appearing at the output of this tube. You will note that it is not a perfect straight sided saw tooth. This wave is applied to one of the deflecting plates of the Teletron. The other plate receives its potential from the 802 tube. The 802 input comes from the same wave through a voltage divider. The 802 is operated with such a potential on its screen grid as to obtain action similar to that observed in a volume expander circuit encountered in audio practice. The result is a voltage wave output from the 802 as shown in Fig. No. 6b. This voltage wave is applied to the other of the pair of horizontal deflecting plates in the Teletron. Since the curvature of the output wave of the 802 is opposite in direction from that of the 6AC5G the resulting deflection of the cathode-ray beam in the horizontal, or line, direction is as shown in Fig. No. 6c. Thus we have *linear* deflection.

Had we generated a linear saw tooth in the usual manner we might have gotten about 11 volts of sweep from the saw tooth generator (instead of nearly 1,100). We would then have to amplify this saw tooth in a linear manner to obtain a 1,100 volt saw tooth. This would require a very large amplifier tube capable of withstanding high plate voltages and would have increased the cost of the unit very greatly.

The vertical sweep circuit is similar in every respect.

Power-Supply Circuit: Both halves of the A.C. cycle are rectified in the 2,900 volt power-supply section. We do not obtain a full wave output, however. With ground = 0 volts we take 2,900 volts D.C. positive from the 2Y2 marked Rec. No. 1 for the intensifier electrode which accelerates the cathode-ray beam AFTER it has been deflected, thus improving picture brilliance without decreasing deflection sensitivity of the "big bottle." The accelerating anode is operated near 1,000 volts positive potential. This electrode is marked A_2 . The *modulating* electrode, that is the control grid, of the big bottle is held at 2,900 volts negative, or "below ground," by the output of the second 2Y2 marked Rec. No. 2. The control grid is marked G.

D.C. Restorer: The Westinghouse dry

rectifier Westector acts to introduce the correct bias on the modulation electrode of the Teletron, to maintain the background level at the transmitted level. The neon lamp across it protects it against surges. The control pots. will be found to have the correct range. Their manipulation is self-explanatory once they are turned, so explanation is not called for.

While all the members of the Brooklyn Technical High School Television Club contributed their share of effort in the design and construction of the unit just described, the author and faculty advisor of the club wishes to especially commend the president, S. M. Decker, and the vice-president, M. Rosenberg, for their unstinting effort. Mr. Rosenberg did much of the preliminary planning and ordering of materials, as well as some of the construction. Decker brought the project to a conclusion at Monmouth Beach, N. J., completing the assembly and wiring, checking, testing and experimental work.

Additional Notes: The service man and the experimenter will find it more convenient to add a phase inverter and voltage divider for feeding the synch. separator. This will avoid having to break into the first video stage for a negative feed.

Another convenience for these two would be an extra small, low-voltage power-supply to avoid having to tap into the vision receiver for B+ for the 300 volt supply.

In the case of some few vision receivers it might be necessary to add more video amplification, in order to swing the grid of the "big bottle" enough to get good contrast. We at Tech. did not find it necessary, however.

These possible alterations are conventional and do not, I believe, require further treatment here. The author would be glad to provide data, however, to any constructor who became puzzled about these points or any others. Address him care of this publication and enclose a self-addressed and stamped envelope.

(The circuits used in this unit were adapted from those in the Bulletin of the Teletron 144-9-T made by Du Mont. Permission was obtained to make use of this data.)

Parts List

AEROVOX CORPORATION (Condensers)

Ordering Data

4—Type 3012 .25 mf. C-23, C-24, C-25, C-26
2—Type 2089 .05 mf. C-17, C-18
3—Type 1686 .01 mf. C-8, C-9
1—Type 1684 .04 mf. C-12
1—Type 1654 .001 mf. C-27
3—Type 1510 .5 mf. C-28 (three in series)
2—Type 1505 4. mf. C-21, C-22
1—Type 1467 .0025 mf. C-10
1—Type 1457 .0025 mf. C-14
1—Type 1457 .0002 mf. C-4
1—Type 1457 .00005 mf. C-5
2—Type 1455 .0003 mf. C-2, C-6
2—Type 684 .25 mf. C-15, C-19
1—Type 684 .005 mf. C-11
2—Type 484 .1 mf. C-1, C-20
1—Type 484 .05 mf. C-3
1—Type 484 .02 mf. C-7
2—Type PR 50 25. mf. C-13, C-16

Circuit Legend (repeats above)

C-1 .1 mf.	C-15 .25 mf.
C-2 .0003 mf.	C-16 25.0 mf.
C-3 .05 mf.	C-17 .05 mf.
C-4 .0002 mf.	C-18 .05 mf.
C-5 .00005 mf.	C-19 .25 mf.
C-6 .0003 mf.	C-20 .1 mf.
C-7 .02 mf.	C-21 4.0 mf.
C-8 .01 mf.	C-22 4.0 mf.
C-9 .01 mf.	C-23 .25 mf.
C-10 .0025 mf.	C-24 .25 mf.
C-11 .005 mf.	C-25 .25 mf.
C-12 .04 mf.	C-26 .25 mf.
C-13 25.0 mf.	C-27 .001 mf.
C-14 .0025 mf.	C-28 (3—5's in series)

INTERNATIONAL RESISTANCE CO.

(Resistors)

Ordering Data

Type BT-1/2
2—10,000 ohm; R-1, R-26
2—15,000 ohm; R-12, R-39
1—40,000 ohm; R-4
1—50,000 ohm; R-13
2—300,000 ohm; R-30, R-31
2—1 meg.; R-3, R-25
4—5 meg.; R-29, R-35, R-36, R-37
1—10 meg.; R-10
Type DG
1—80,000 ohm; R-6
Type BT-1
3—100,000 ohm; R-5, R-27, R-28
1—40,000 ohm; R-8
2—200,000 ohm; R-11, R-17
1—5 meg.; Part of R-15
3—20 meg.; Part of R-15, R-40, R-41
Type BT-2
2—800,000 ohm; R-9 (two in parallel)
1—3 meg.; R-18
1—2 meg.; R-21
2—750,000 ohm; R-23, R-38

P. R. MALLORY & CO. INC. (Potentiometers)

2—5,000 ohm, E5MP, Potentiometer; R-2, R-14
1—50,000 ohm, K, Potentiometer; R-16
1—100,000 ohm, Y 100 MP, Potentiometer, R-24
1—250,000 ohm, UC 519, Potentiometer, R-7
1—500,000 ohm, UC 513, Potentiometer, R-19
2—1 meg., Y 1000 MP, Potentiometer, R-20, R-22
3—2 meg., P, Potentiometer; R-32, R-33, R-34

Circuit Legend for Resistors

(All values above are repeated here)

R-1 10,000 ohm	R-22 1 meg.
R-2 5,000 ohm	R-23 750,000 ohm
R-3 1 meg.	R-24 100,000 ohm
R-4 40,000 ohm	R-25 1 meg.
R-5 100,000 ohm	R-26 10,000 ohm
R-6 80,000 ohm	R-27 100,000 ohm
R-7 250,000 ohm	R-28 100,000 ohm
R-8 400,000 ohm	R-29 5 meg.
R-9 400,000 ohm	R-30 300,000 ohm
R-10 10 meg.	R-31 300,000 ohm
R-11 200,000 ohm	R-32 2 meg.
R-12 15,000 ohm	R-33 2 meg.
R-13 50,000 ohm	R-34 2 meg.
R-14 5,000 ohm	R-35 5 meg.
R-15 25 meg.	R-36 5 meg.
R-16 50,000 ohm	R-37 5 meg.
R-17 200,000 ohm	R-38 750,000 ohm
R-18 3 meg.	R-39 15,000 ohm
R-19 500,000 ohm	R-40 20 meg.
R-20 1 meg.	R-41 20 meg.
R-21 2 meg.	

AMERICAN PHENOLIC CORP.

(Amphenol)

- 5—MTP8 sockets
- 2—M1P7L sockets
- 2—M1P4 sockets

NATIONAL UNION RADIO CORP.

- 2—6J7G Tubes V1, V2
- 2—6AC5G Tubes V3, V4
- 2—2Y2 Tubes V8, V9
- 1—5X4G Tubes V7

RCA MANUFACTURING CO., INC. (Tubes)

- 2—802 V5, V6

CORNISH WIRE COMPANY

- 1—Line Cord & Plug

INSULINE CORP. OF AMERICA (I.C.A.)

- 5—Cat. No. 2436 Terminal Strips
- 11—Cat. No. 2439 Terminal Strips
- 1—Cat. No. 1230 Switch

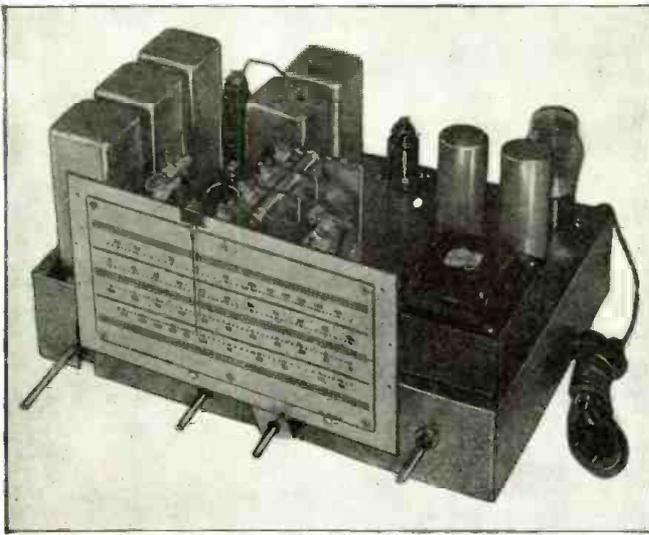
Other Parts Used in Construction

- 1—Power transformer made to following specification:
 - Primary:—110 volts 60 cycles; surrounded with electrostatic shield
 - Secondary:—1100—0—1100—2900 volts the 1100 at 30 milliamperes the 2900 at 2 milliamperes
 - two—2.5 volt filament at 2 amps each
 - one—2.5 volt Cathode Ray tube filament at 2 amps with electrostatic shield
 - one—5 volt filament at 3 amps
 - one—6.3 volt filament at 4 amps
 (This transformer was made up and delivered to Club for \$12.50)
- 1—Filter choke; 15 henrys, 60 milliamperes, 5000 volt insulation.
- 1—Picture tube 144—9—T (Du Mont) & socket
- 1—Horizontal Oscillation Transformer & socket—Du Mont
- 1—Vertical Oscillation Transformer & socket—Du Mont
- 1—Copper Oxide High Voltage Rectifier (for D.C. restorer) 3,000 v. (Club used British-made Westinghouse unit sold by Du Mont)
- 1—3000 v. Neon Lamp
- 100 ft. Automobile lighting type cable for high voltage wiring.
- Soft sheet rubber for tube mooring.

6-Tube All-Wave Superhet Receiver

L. M. Dezettel*

A receiver that will appeal to the "short wave" fan. It covers a range of 16.6 to 2,142 meters or 140 kc. to 18 mc.



The finished receiver — range 16.6 to 2,142 meters.

● THE advanced radio builder will enjoy constructing this six-tube all-wave super. What appears to be a complicated circuit, difficult to wire, really is not. It is straightforward, with no trick circuits and is especially easy to "get going" because the Gen-Ral four-band coil assembly used is supplied all assembled and wired to the rotary band switch. The trimmer and padding condensers are wired in and aligned, so that all that is necessary is to connect ten leads into the rest of the circuit and you are ready to go.

Unique also in this receiver, is the fact

that one of the ranges is below the broadcast band in frequency (above in wavelength). The long waves have many interesting stations that some folks seem to overlook. This receiver tunes from 140 kc. to 18 mc. in four bands (2,142 to 16.6 meters).

A 6K7 is used as an R.F. amplifier or preselector. A 6A8 is the combined oscillator-converter stage. A 6K7 stage of I.F. is used at 456 KC. A 6R7 tube combines the functions of diode detection, automatic volume control, and first stage of audio amplification. Finally a 6F6 pentode is used

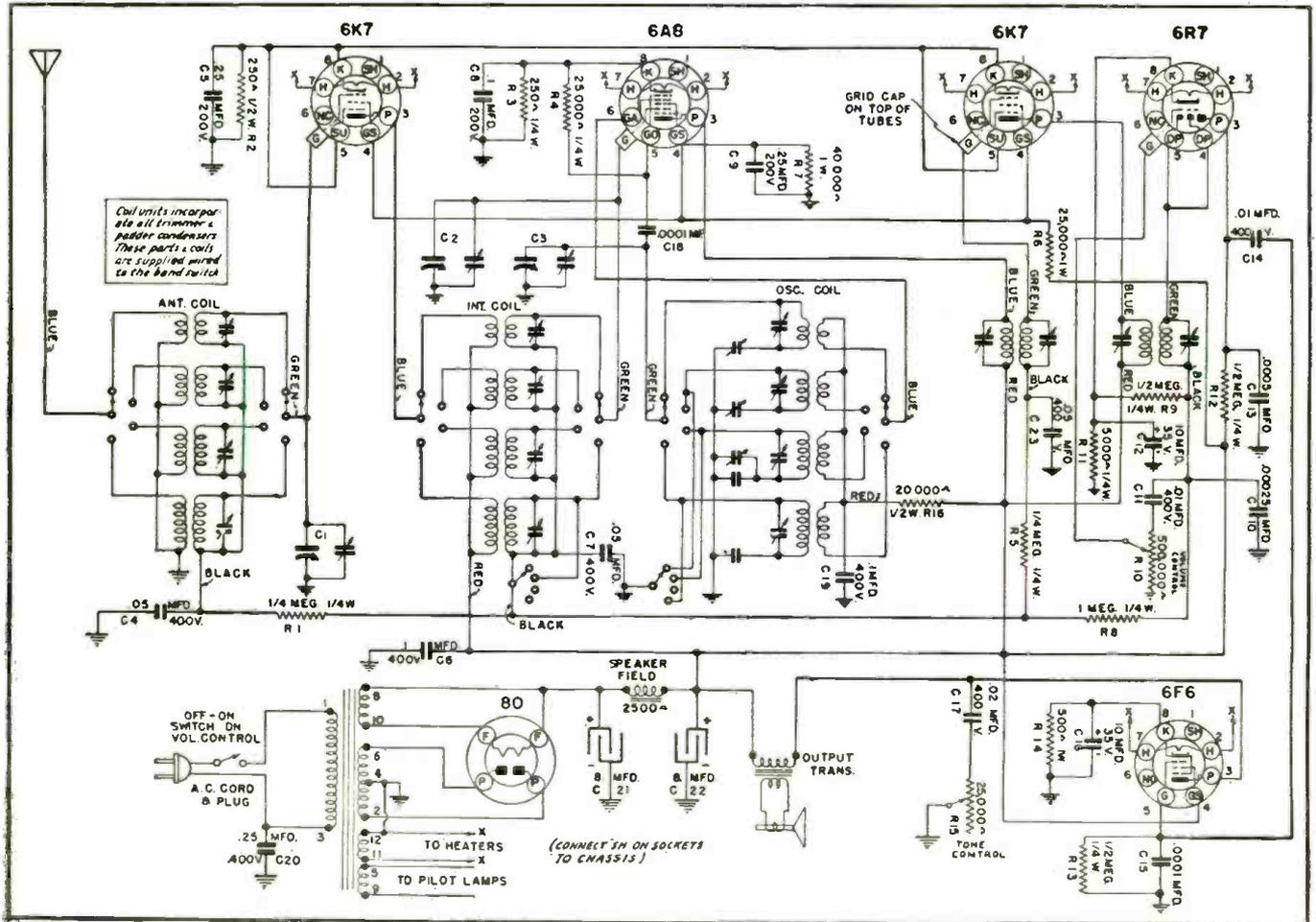
for the power output stage as indicated. This set works on AC voltage only (105-125 volts) an 80 tube being used for full-wave rectification in the power-supply circuit.

The chassis measures 14"x10"x3". If you form and drill your own, follow the layout as shown in the pictorial diagram. Use Electroalloy material—it is much more easily drilled than steel. Needless to say, a good mechanical job on the chassis and secure mounting of parts is important towards good stable operation of the receiver.

Except for a few precautions, which would apply to any receiver, wiring will be found to be comparatively easy for a de Luxe type of receiver such as this. Be sure that socket terminal numbers are care-

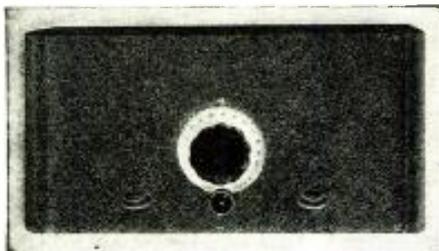
*Engineer, Allied Radio Corporation.

Wiring diagram of the 6-tube 4 band receiver.



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CLEVELAND, OHIO

fully observed; this is the spot where mistakes are most generally made. It is important that all connections are made as *short* and *direct* as possible. Keep wires close to the chassis. Connections to plates and grids of tubes should be well separated from each other. The object is to prevent any "backward" plate to grid coupling in an R.F. or I.F. stage, which would cause oscillations. Solder all connections securely, and use solder lugs under mounting nuts for grounds; or solder directly to chassis for ground connections. Be sure that polarity of by-pass condensers, especially electrolytics, is observed and checked carefully.

How about alignment, you say? Ah, that's the beauty of this job. The coil assembly is factory-aligned and matched with the I.F. transformer. *No alignment is necessary on your part!* Any difficulty with operation can be blamed on only one thing—failure to follow the wiring diagram carefully.

While a single wire antenna will work very well with this receiver, one of the all-wave doublets will improve its performance considerably.

Parts List, 6 Tube Superhet

- 1—3-gang 420 mmf. condenser
- 1—slide-rule Airplane dial
- 1—Gen-Ral four-band assembly, includes all coils, trimmers, band switch, and two I.F. transformers
- All of following items, between asterisks, of Knight brand
- *3—.05 mf. 400 volt condensers C4, 7, 23
- 2—.25 mf. 200 volt condensers C5, 9
- 2—.1 mf. 400 volt condensers C6, 19
- 1—.1 mf. 200 volt condenser C8
- 2—.01 mf. 400 volt condensers C11, 14

- 1—.02 mf. 400 volt condenser C17
- 1—.25 mf. 400 volt condenser C20
- 2—8 mf. 450 volt condensers C21, 22
- 1—.00025 mf. mica condenser C10
- 1—.0005 mf. mica condenser C13
- 2—.0001 mf. condensers C12, 16
- 2—10 mf. 35 volt condensers C12, 16

RESISTORS

- 2—250,000 ohm 1/4 watt resistors R1, 5
- 1—250 ohm 1/4 watt resistor R3
- 1—25,000 ohm 1/4 watt resistor R4
- 1—250 ohm 1/2 watt resistor R2
- 1—25,000 ohm 1 watt resistor R6
- 1—40,000 ohm 1 watt resistor R7
- 1—megohm 1/4 watt resistor R8
- 1—5,000 ohm 1/4 watt resistor R11
- 3—500,000 ohm 1/4 watt resistors R12, 13, 9
- 1—20,000 ohm 1/4 watt resistor R16
- 1—500 ohm 1 watt resistor R14
- 1—500,000 ohm potentiometer R10
- 1—25,000 ohm potentiometer
- 1—Switch for above potentiometer
- 1—power transformer
- 2—4 prong tube sockets
- *5—octal tube sockets

Accessories

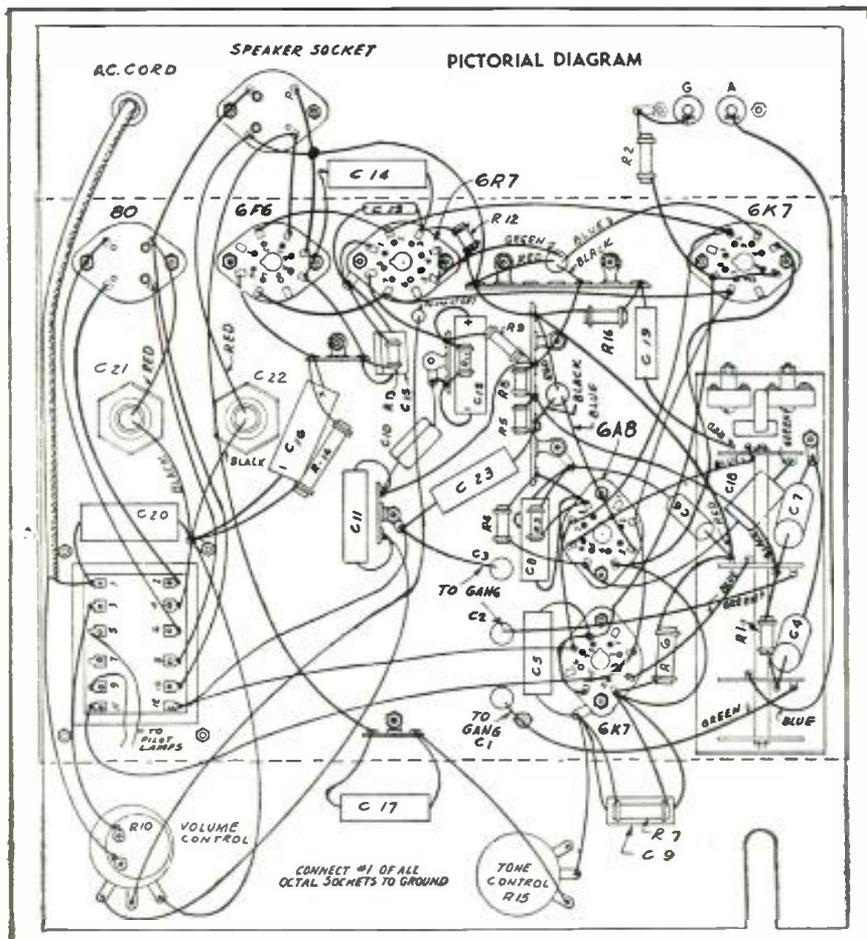
R.C.A.

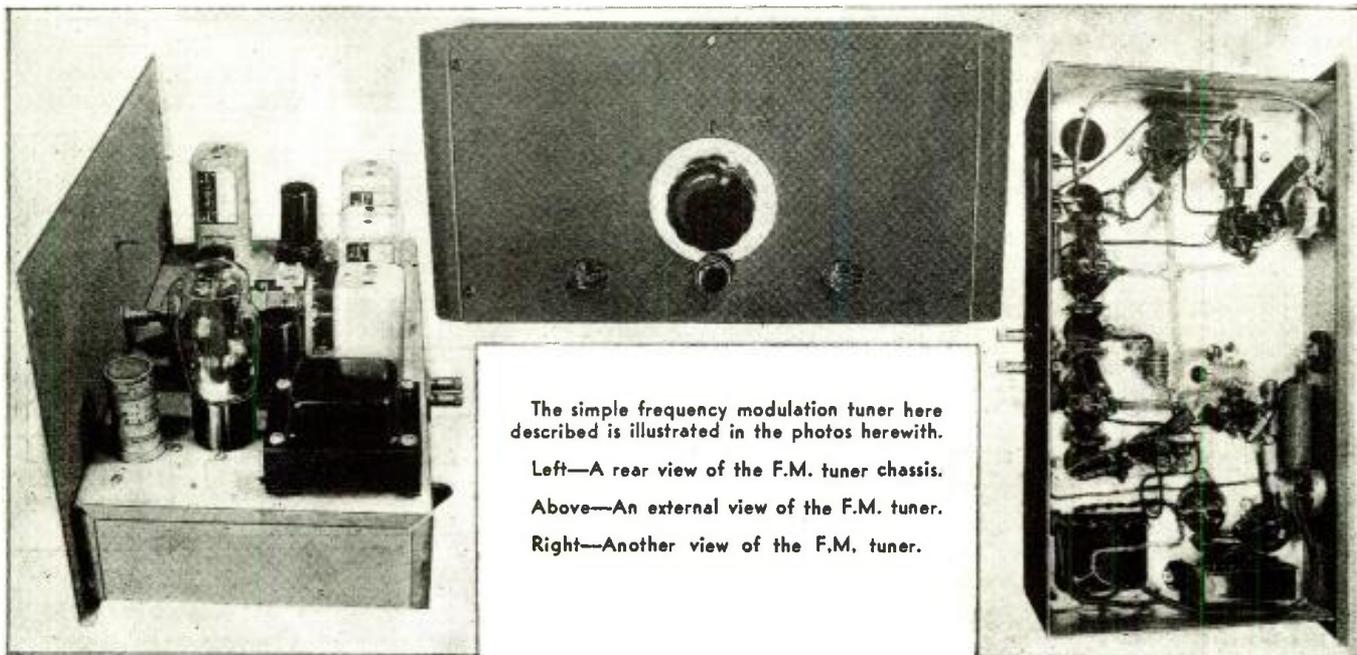
- 2—6K7 tubes
- 1—6F6 tube
- 1—6H8 tube
- 1—6R7 tube
- 1—80 tube
- 1—Matched 8 1/2" dynamic speaker with 2500 ohm field coil & output transformer
- 1—4-foot 4-conductor cord
- 1—Four prong plug

MISCELLANEOUS

- 1—Roll pushback hookup wire
- 1—A.C. line cord and plug
- 4—Control knobs
- 4—Rubber grommets, medium size
- 3—Rubber grommets, small size
- 2—5-lug terminal strips
- 4—2-lug terminal strips
- 4—Grid caps
- 2—2.5 volt pilot light bulbs
- 1—Antenna ground strip

Plan view of the 4-band receiver—showing arrangement of parts.





The simple frequency modulation tuner here described is illustrated in the photos herewith.

Left—A rear view of the F.M. tuner chassis.

Above—An external view of the F.M. tuner.

Right—Another view of the F.M. tuner.

Frequency Modulation Tuner

To Suit Your Pocketbook

By Larry LeKashman, W2IOP,
and Anton Schmidt, W2KWY*

The accompanying article and pictures show a new frequency modulation adapter or tuner which can be easily built at moderate cost. All of the parts are standard and no fancy apparatus has to be built. With frequency modulation transmitters increasing daily in number, this set should be of paramount interest.

● *Frequency modulation* has been forcefully brought to the public's attention within the past several months by its universal acceptance and static-free properties.

A reasonable price F-M adapter is the Harvey seven-tube F-M tuner illustrated. All New York stations were received with excellent clarity, even from a location not favorable to radio reception. The crowning achievement was reception of Chicago's F-M station. Now in use at many points throughout the Eastern part of the United States, users of this F-M tuner are reporting excellent results.

There are numerous ways of economizing in materials and circuits without impairing the efficient operation of an F-M unit. R.F. stages are not necessary for local reception and may always be added at a later date. Their elimination also does away with tracking difficulties. Magic-eye tubes with their attendant amplifiers have been eliminated in this unit, but they too may be added at some later date.

Tube Line-up: The F-M tuner consists of a 6SA7 mixer; 6J5GT oscillator; two 1852's as I.F. amplifiers; a 6SJ7 as a limiter; 6H6 discriminator; and an 80 rectifier. It is only necessary to feed the output of the 6H6 through an external amplifier, or the amplifier of another receiver, to have a complete F-M set. The output may be plugged directly into a phonograph input,

if one is available.

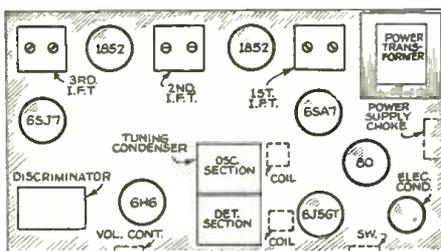
To keep the price down standard I.F. transformers were used. Miller 3000 kc. air-core mica-tuned transformers were used in this particular model. The windings of these I.F.'s are wide spaced and must be pressed together for satisfactory operation, since the band width is so wide in F-M reception. Scrape off the wax coat and press the bottom winding up until the two coils are spaced $\frac{1}{2}$ " apart. The discriminator coil, which is nothing but a standard 3000 kc. tapped diode transformer coil, is pressed together until the air gap is $\frac{3}{8}$ " between windings.

When using the 6SA7 as a combination mixer-oscillator at F-M frequencies, there is a tendency for the oscillator to *pull*, or follow strong signals. Therefore a separate oscillator is used to isolate the oscillator circuit and minimize drift. The 1852's are used in the I.F.'s to supply sufficient voltage

to the limiter. The 6SJ7 makes a very efficient limiter tube since it operates with lower signal voltage than most similar tubes.

Wiring: In wiring the adapter keep all leads as short as possible, using grounding braid between each circuit. *Do not* depend upon the chassis for ground returns. Completion of the wiring will bring you to the one part of F-M construction considered difficult—lining up the *discriminator* transformer. Apply a signal of 3000 kc. to the grid of the 6SJ7 and connect an 0-1 ma. meter with a 100,000 ohm resistor in series with the meter across the 6H6 cathodes. Adjust the secondary trimmer of the discriminator until a leading is noted. As the trimmer is tuned the meter will go plus or minus, either side of the resonant frequency. Set the trimmer so the meter reads zero voltage. The primary trimmer of the discriminator transformer is adjusted to the maximum reading on the meter when it is connected between the center tap of the transformer and ground.

To align the I.F.'s the same 0-1 ma. is connected in series with the ground resistor of the 6SJ7 at the point marked X. Bypass the meter with a .01 mf. condenser and apply a signal to the grid of the preceding 1852. Tune the transformer for maximum reading of the meter. Apply a signal to the next 1852 and repeat the procedure.



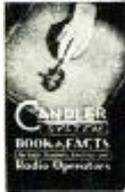
Chassis layout.

*Harvey Radio Co., N. Y. City.

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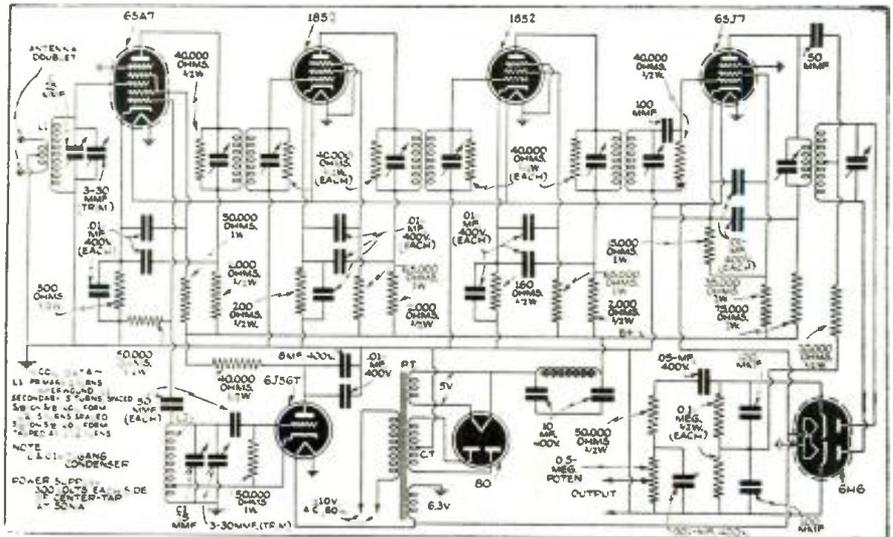
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Wiring diagram of the frequency modulation tuner.

PARTS LIST: F.M. TUNER

NATIONAL CO.

- 1—O dial
- 1—ODD Vernier
- 1—FWB

J. W. MILLER CO.

- 3—512-N2 IF's
- 1—512-N3 (Di-criminator—to be changed as indicated in text)

JAMES MILLEN MFG. CO., INC.

- 2—26030 padders

I.R.C. (Resistors)

- 2 F, 40M
- 6—BT, 40M
- 1—BT, 500
- 1—BT, 5000
- 1—BT, 160
- 1—BT, 200
- 2—BT, 2000
- 1—BT, 50M
- 2—BT, 100M
- 1—BT, 20M
- 1—BT, 50M
- 2—BT, 65M
- 1—BT, 15M
- 1—BT, 35M
- 1—BT, 75M

- 1—RT2 40M
- Wire, solder, etc.

PAR-METAL PRODUCTS CORP.

- 1—CA103
- 1—B4513

ALLEN B. CARDWELL MFG. CORP.

- 1—ER 25 AD

CORNELL-DUBILIER ELEC. CORP.

- 1—CP 1145 filter
- 1—BR 845
- 10—DT 6S1
- 2—DT 4P1
- 3—.0005 mf. mica
- 3—.001 mf. mica
- 1—.001 mf. mica

UNITED TRANSFORMER CO.

- 1—R6 power transformer
- 1—R18 choke

AMPHENOL

- 5—Octal sockets (MIP 8)
- 1—MIPT-8
- 1—RS4

EBY MFG. CO.

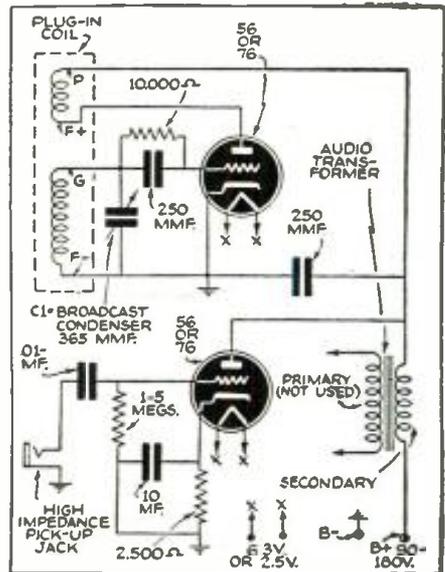
- 2—Binding posts
- 1—Phone jack

Phonograph Oscillator

● HERewith is a diagram of a phonograph oscillator which I recently constructed. Although there is nothing new or startling about the idea I think the simplicity and low cost will appeal to anyone desiring such an oscillator. The unit, which is designed for use with a high-impedance type pick-up, need only be placed near the receiver it is desired to use; no external connections are necessary.

In operation, the receiver is tuned to a quiet place in the band and C1 rotated until the signal from the oscillator is heard. In my case, a standard four-prong coil designed to tune to the 160-meter amateur band with a 100 mF. variable condenser was used. Use of .000365 mf. at C1 allows the broadcast band to be covered and any type receiver to be used.

Care should be taken that the voltage to the oscillator is kept sufficiently low to prevent radiation of too powerful a signal which might cause interference to neighboring receivers. Experiment will reveal the correct voltage which will give a signal sufficiently strong to carry to the desired receiver, but which will not radiate to a greater distance than the twenty foot maximum allowed by the Federal Communications Commission.—James F. Ranney, W8OQJ.



Here's how to build a phonograph oscillator.

plywood will make an economical and easily worked panel for those who dislike metal panels. Although the three chassis fastened together is a little too long to be placed in a standard rack, the two units comprising the oscillator and buffer can be mounted behind one panel, with the final stage mounted behind a second panel and placed above the first panel in a relay rack or cabinet. An antenna tuning unit can be placed alongside the final stage.

How Meter Measures Stage

As in the previous units, the same 150 milliamper meter is used with the rotary switch for metering the final stage. A 10 ohm resistor is permanently placed in the grid circuit and the meter switched across it to measure the 812 grid current. In the plate circuit the meter has been so placed in the negative line as not to read the sum of plate and grid currents, but only the plate current. Since the 812 tubes draw 300 milliamperes, it will be necessary to provide a shunt for the meter. Some resistance wire taken from an old rheostat will do quite nicely and should be wired into the circuit at the place marked 'RS' on the diagram. This shunt should be of a size to make the meter reading about 500 mils full scale, instead of the original 150 mils, and is across the meter only when reading the 812 plate current.

Adjusting the shunt to the correct value can be accomplished by connecting the meter in series with a battery and a variable resistance of about 100 ohms, and adjusting the current through the meter to 100 mils; the shunt is then added and varied until the meter needle is deflected one-fifth full scale, giving a full scale sensitivity of 500 mils.

It will be remembered that break-in operation was used in the preceding units by keying the two tubes cathodes. With the addition of the high-power final, break-in operation has been retained through the keying of the oscillator buffer and applying sufficient fixed bias to the final to keep the plate current at a very low level, so that the plate dissipation with the key up is much below the maximum rating of the tubes. However, this necessitates the use of an external bias supply of about 100 volts, supplied by either a couple of "B" batteries or from a small bias supply. Additional bias is furnished by the 2000 ohm grid-leak. If the break-in feature is not desired, straight grid leak bias can be used, with a grid resistor of 3500 ohms. Keying can then be accomplished between the filament transformer center tap and ground, but the filament bypass condensers will have to be of the high voltage type, since full plate voltage will appear here with the key in the *up* position. Safety considerations would dictate the use of a keying relay in this circuit.

Tuning the Final Stage

The final plate circuit should always be tuned to the same frequency as the buffer plate circuit and the final grid circuit. With the proper grid and plate coils plugged into their respective receptacles and the oscillator and buffer all tuned up, let's proceed to tune the final stage.

Always use reduced plate voltage to avoid damage to equipment through abnormal

currents resulting from off resonance conditions. First tune the grid circuit to resonance as indicated by maximum grid current. If the grid current is greater than about 40 mils, decrease the coupling by pulling the grid link coil slightly out of the grid coil. Now, with the neutralizing condenser open about one inch, rapidly tune the plate condenser to resonance, as indicated by minimum plate current. The output link coil should be entirely outside the plate coil. Now remove the plate voltage and with the meter switched to the 812 grid circuit, vary the capacity of both neutralizing condensers simultaneously, until a point is reached where varying the plate tuning condenser through resonance will not cause any flicker in the grid current. After neutralizing the final, re-apply the plate voltage and the antenna can now be connected. With the antenna connected, the final can be loaded to about 300 mils by varying the position of the output link coil.

With the tuning condensers specified, it will not be possible to tune to 160 meters, unless additional fixed capacity is used. This may consist of a small fixed air condenser (single spaced) across the grid coil, and a fixed condenser across the plate coil.

If 80 meter operation is not desired, the tuning condensers can be reduced to 100 mmf. units and will provide better tuning on 10 meters.

In testing this unit, the writer used the power supply described in the November 1939 issue.

Parts List—Economy Transmitter

- BUD RADIO**
 1—150-150 mmf. tuning condenser JC-1562
 1—140-140 mmf. grid tuning condenser, type MC-912
 2—neutralizing condensers NC-853
 1—set grid coils with center link, type OLS
 1—set 500 watt plug-in coils, type VLS
 1—jack base for 500 watt coil with swinging spiral link, type AM-1352
 2— $\frac{23}{4}$ " dial #D-1732
 1— $7\frac{1}{2}$ x $12\frac{1}{2}$ x 3" chassis #CB-793
 1—4.3 mh., cone 600 ma. choke #CH-509
 2—1" cone insulators #I-301
 2— $4\frac{1}{4}$ " Lucite stand-off insulators #I-1907
 1—insulated shaft extender #SE-1209
 1—insulated shaft coupling #SE-1206
 1—length of $\frac{3}{4}$ " fiber shafting #SE-1055

RCA MFG. CO.

- 2—812 tubes

JAMES MILLEN MFG. CO.

- 2—4 prong isolantite sockets #33001
 2—plate caps (insulated)
 1—5 prong isolantite socket #33005

SPRAGUE PRODUCTS

- 3—.004 mf. mica condensers, type #1FM-21
 1—2000 ohm 10 watt resistor

AEROVOX CORP.

- 1—.002 mf. 5000 volt condenser #1652

CORNISH WIRE CO.

- 1—Super Corlac hookup wire.

VIBROPLEX CO.

- 1—"Lightning Bug" Vibroplex key

COIL DATA Grid Coil

Band	Turns	Wire Size	Length Including $\frac{3}{4}$ " Gap at		Link Coil
			Diameter	Center	
10	6	#14	1.5"	13"	2 turns #14
20	10	#14	1.5"	11"	2 turns #15
40	18	#15	1.5"	12"	2 turns #15
80	30	#18	1.5"	2"	2 turns #13
160	54	#23	1.5"	2"	4 turns #17

PLATE COIL

Band	Turns	Wire Size	Length Including $\frac{3}{4}$ " Gap at	
			Diameter	Center
20	4	#8	2.1"	3.1"
20	10	#10	2.3"	4"
40	20	#11	2.3"	4"
80	26	#11	2.9/16"	4"
160	34	#14	3.3"	4.3"

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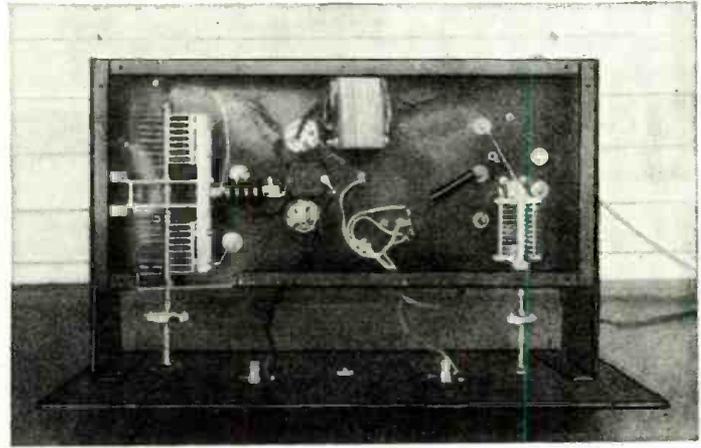
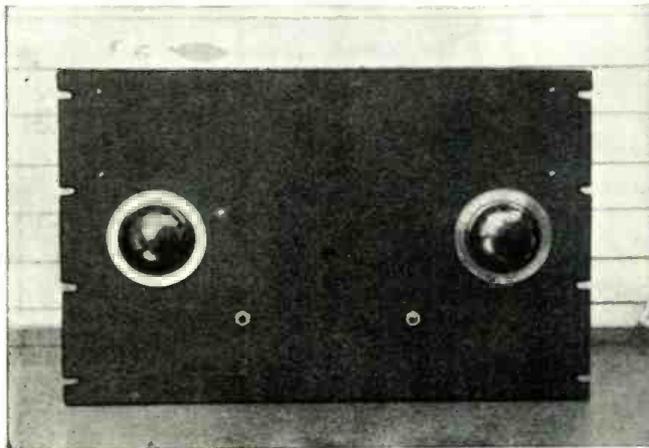
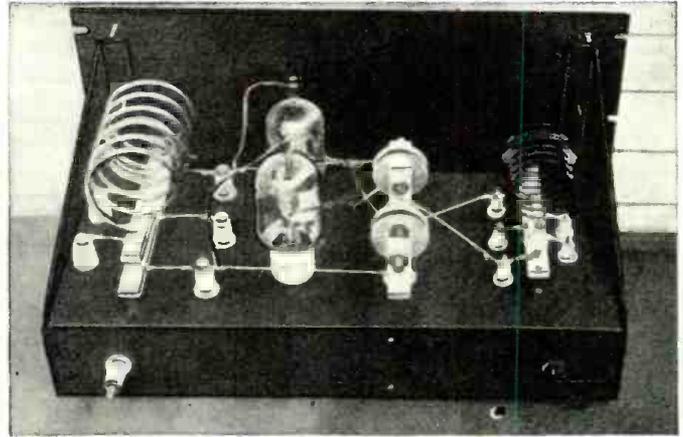
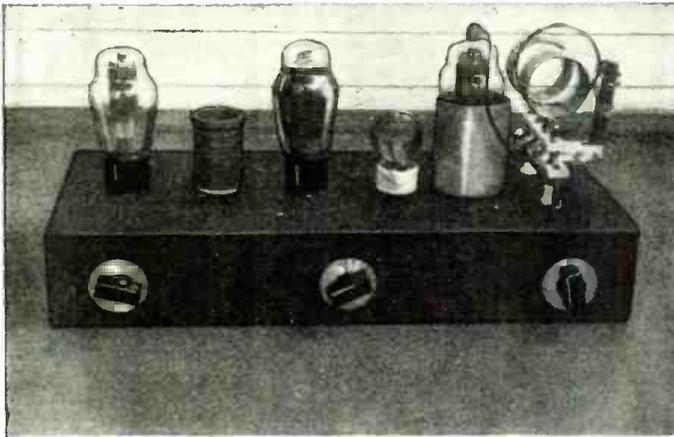
AMERICAN RADIO INSTITUTE
 1123 BROADWAY NEW YORK, N. Y.

5, 10 and 20 Meter

Cathode-Modulated

Xmitter

Harry D. Hooton, W8KPX



Top left: The exciter. A 6L6 tritode oscillator, a 6L6 doubler and an RK-39 buffer. Lower left: Front view of the final amplifier. Grid tuning dial is at the left; plate dial at the right. Top right: Final amplifier. The tubes shown are the new HK-54s. The output of this amplifier on C.W. is 400 watts. Lower right: Underside of final amplifier.

● THE new W8KPX 5, 10 and 20 meter receiver was described in the August issue of this magazine. This month we shall describe the new W8KPX companion 5, 10 and 20 meter transmitter which may be operated either as a 250 watt cathode-modulated phone or a 500 watt C.W. telegraph transmitter. Using the new Heintz and Kaufman HK-54 tubes, which are exceptionally easy to drive and neutralize, and which may be run at full ratings up to and including 5 meters, the final amplifier operates efficiently on four bands—5, 10, 20 and 40 meters. As a cathode-modulated phone on 5, 10 and 20 meters, a carrier output of 190 watts on the 20 and 10 meter bands and 130 watts on the 5 meter band is easily obtained with 1500 volts on the HK-54s. For C.W. code work on 20 and 40 meters, a carrier output of at least 400 watts may be obtained with an input of 550-600 watts to the final.

As the diagram, Fig. 1, shows, the entire R.F. circuit line-up consists of a 6L6G tritode oscillator-frequency doubler, a 6L6G buffer-doubler and an RK-39 or 807 second buffer. This part of the R.F. circuit is built up on a single 10x17x3 inch black crackle finish steel chassis as shown in the photos. The output of the RK-39 stage is link

coupled to the grid circuit of the HK-54s by means of a length of the new low-loss Amphenol coaxial cable.

Three power supplies are used, one supplying 400 volts at 350 milliamperes for the 6L6G oscillator, the 6L6G buffer-doubler and the 6L6G class AB2 modulators. The second power supply occupies the left half of the low-voltage supply chassis and supplies 650 volts at 250 milliamperes for the RK-39 buffer, with a tap at 300 volts for the 6L6G modulator screens and the plates of the speech amplifier tubes. The rectifier for the 400 volt supply is an 83; the 650 volt supply uses a pair of 866 juniors as rectifiers.

The third power unit is, as might be expected, that used to supply plate voltage to the final amplifier. This supply has a current rating of 350 milliamperes and either 1250 or 1500 volts, according to the adjustment of the taps at the transformer. No taps are taken from the bleeder resistor in the present arrangement. However, a variable-slider type bleeder of 200 watts rating is used so that 1000 volts at 150 milliamperes for a pair of HK-24s as class B modulators can be taken from this power supply if we ever decide to use plate modulation. If this is done, it will be neces-

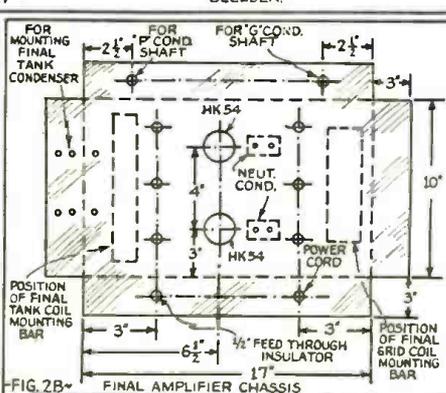
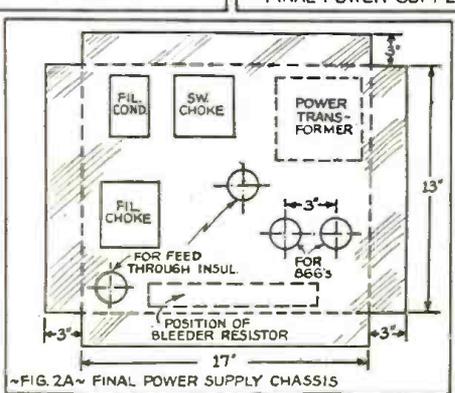
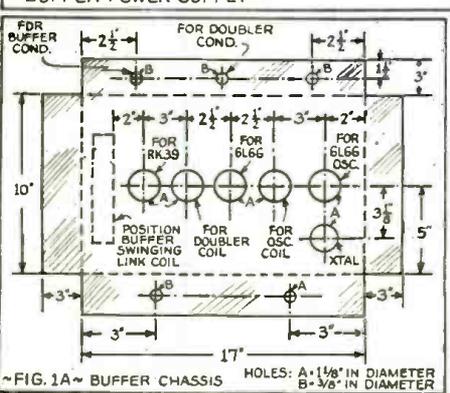
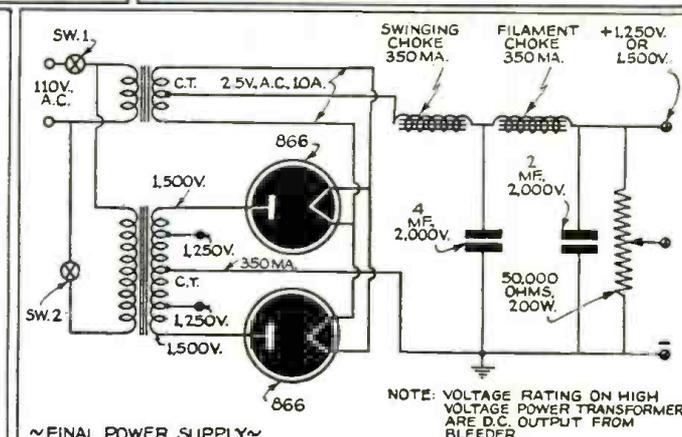
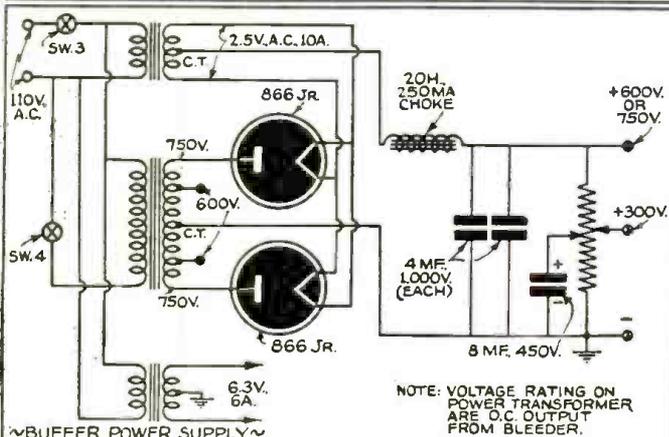
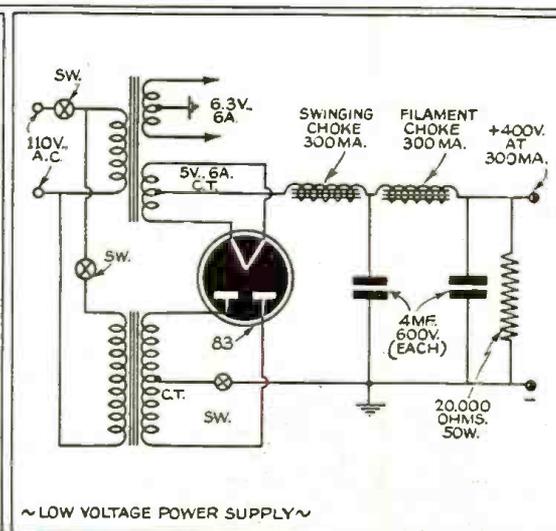
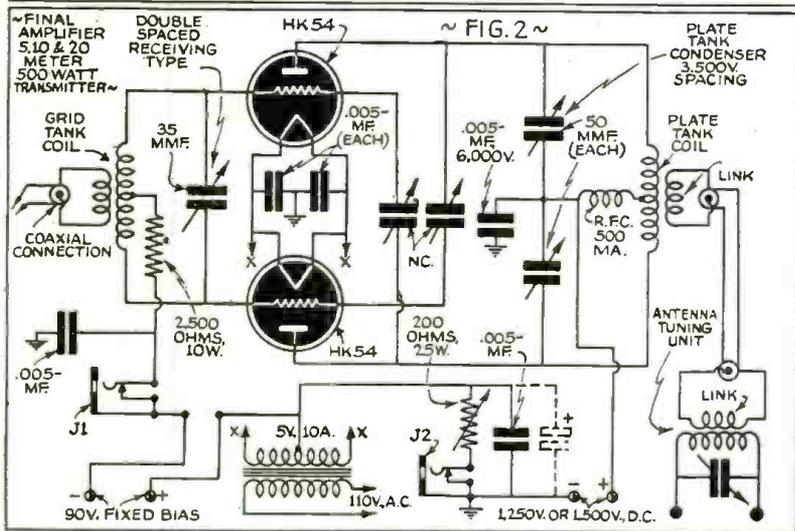
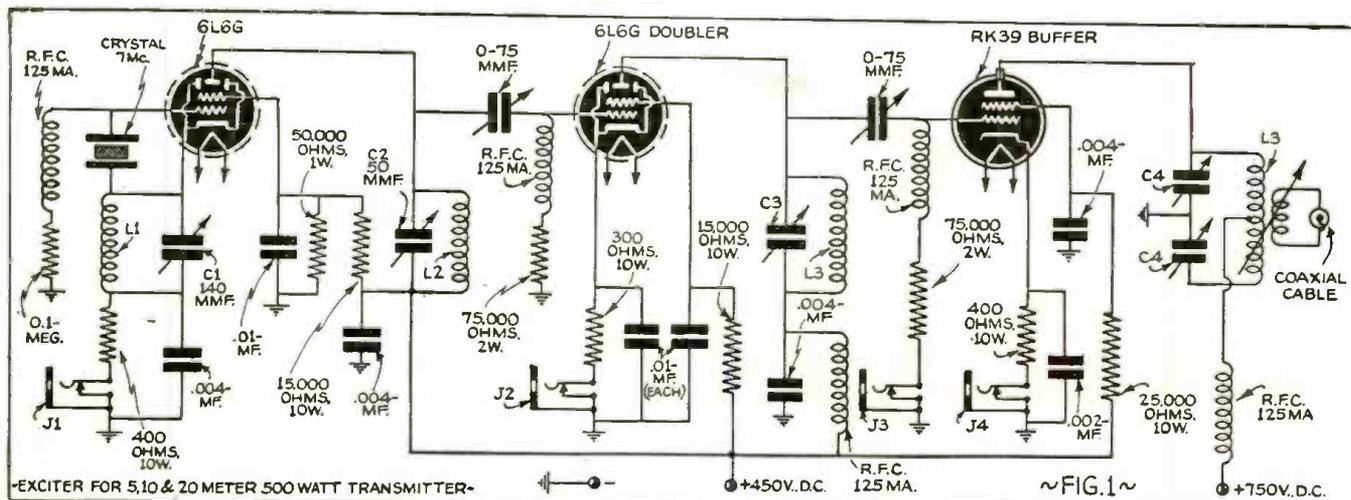
sary, of course, to reduce the input to the final amplifier to about 200 milliamperes or approximately 300 watts.

Tuning for 3-Band Operation

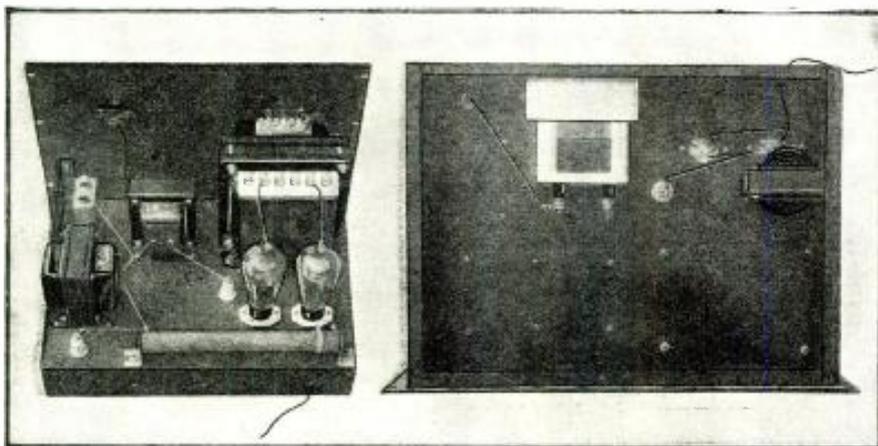
Most amateurs will be interested chiefly in the method of adjusting or tuning the transmitter for three-band operation and this procedure will be given in "ABC" style.

Make absolutely certain that you have everything properly wired and connected. Check each circuit thoroughly with an ohmmeter, if you have one, and especially the grid circuits. An open grid circuit spells disaster in any transmitter and this is especially true when one is running a final amplifier with 1500 volts on the plates! Insert the fixed bias at the proper points and check the fixed bias by measuring the voltage between the grid terminal of the tube and the cathode or filament center tap. Assuming that everything checks out OK, we will proceed to place the rig on 20 meters CW. This is probably the easiest tune-up procedure of all and should always be made before making any attempt to operate on the other bands or to modulate the final amplifier.

Place a 40 meter crystal in the crystal socket, making certain that the frequency



Diagrams above show hook-up of exciter for 5, 10 and 20 meter 500 watt transmitter, also hook-up of final amplifier with HK54s in push-pull. Other drawings show power-supply units and chassis data.



Final power supply. D.C. output is 1250 or 1500 volts at 350 milliamperes, using 866's.

when doubling or quadrupling does not fall outside the legal limits of the higher frequency amateur bands. Place a 40 meter coil in the 6L6G oscillator plate tank circuit; place a 20 meter coil in the second 6L6G plate circuit and 20 meter coils in the buffer plate and the final amplifier grid and plate circuits. Turn on the filaments of *all* of the tubes, giving them at least one minute to heat up. If you have never before used your 866, 866 juniors and the 83 *with plate voltage applied*, let the filaments burn for at least *fifteen minutes* before applying the plate voltage. If this precaution is not observed, the condensed or liquid mercury on the plates, filament or glass stem, may offer a practical short-circuit of your power transformer, causing the rectifier to "blow up" or damaging the power transformer. Once the mercury is vaporized, however, it is only necessary to burn the filaments for about one minute before applying the plate voltage. Place a "dead" or open plug in the second 6L6G cathode jack and plug the 0-150 milliammeter into the 6L6G oscillator cathode jack.

Turn the midget 100 mmf. cathode tuning condenser across the oscillator cathode coil with its plates "all in." The tip of one rotor plate has previously been bent so that the condenser effectively shorts the coil with the plates fully enmeshed. Now apply the plate voltage to the oscillator and rotate the plate tuning condenser for the dip in plate current as indicated by the milliammeter. Tune for the greatest dip, then adjust the condenser toward the high-capacity side so that the current increases about 5 per cent. This gives better stability and the crystal is less likely to "kick out" of oscillation when tuning the 6L6G doubler. Remove the open plug from the second 6L6G cathode and insert the milliammeter plug in its place. Tune the plate circuit of this stage for the greatest dip. The output frequency of this stage is on the 20 meter band. Finally, the plate voltage is applied to the RK-39 and its plate circuit tuned to resonance. About 90 volts of fixed bias should be applied to the grid of the tube; otherwise, the current in the cathode circuit will be considerably in excess of 100 milliamperes, probably damaging the tube or giving rise to erratic operation and parasitics.

At this point it will be necessary to neutralize the final amplifier. This pro-

cedure is quite simple and is easily carried out in the following manner: Turn the variable link on the buffer tank coil assembly so that the coupling value is very low and rotate the grid tuning condenser of the final to resonance as indicated by a rise in the RK-39 plate current and an indication on the final grid milliammeter. Retune the RK-39 plate circuit for the dip and adjust the final grid tank condenser for maximum grid current reading. If a reading of at least 50 milliamperes of grid current cannot be obtained with the grid condenser on the peak of resonance, adjust the link in the buffer coil so that 50 milliamperes is obtained with the circuits tuned right "on the nose." Swing the final tank condenser through resonance, watching the effect of resonance on the grid current. *Remember we do not apply plate voltage to the final until it is neutralized perfectly.* As the condenser passes through the resonant point, the grid current will fluctuate sharply. Simply adjust the two neutralizing condensers, turning both "in" or "out" simultaneously, until there is no movement of the needle of the grid milliammeter when the final tank condenser is rotated through its scale. Apply the plate voltage to the HK-54s and tune the plate circuit for the lowest plate current. With 1500 volts on the plates of the final tubes, the plate current will dip to about 10 or 15 milliamperes when properly tuned with the antenna disconnected. For C.W. work, the final may be loaded to 300 milliamperes or 450 watts input. If greater power input is desired, more voltage should be applied to the plates as the life of the Gammatrons will be shortened considerably if plate currents in excess of 150 milliamperes per tube are drawn.

For operation on 10 meters, the following tuning procedure is used: Place a 40 meter crystal in the oscillator circuit and a 20 meter coil in the oscillator plate coil socket. Apply the plate voltage to this stage as outlined above, and tune for the 20 meter dip. If the cathode tuning condenser is "all in," only a small dip will be noticed. Now carefully *turn out* the plates of the cathode condenser, returning the plate circuit for the minimum cathode current. If the cathode capacity is too small, excessive excitation in the crystal circuit may be obtained, causing the crystal to lose control of the frequency and the oscillator will operate self-excited. By careful adjustment of the

cathode condenser rather large outputs can be obtained on both the second and fourth harmonics—more than enough to drive the second 6L6G tube.

The plate circuit of the 6L6G doubler is now tuned to 10 meters and a 10-meter variable-link coil is placed in the buffer plate tank socket. Tune the RK-39 for minimum cathode current. Do not under any circumstances apply plate voltage to the buffer or doubler tubes with their plate circuits detuned. Even though there is sufficient bias for cut-off on the RK-39, with 650 volts on the plate and being driven to maximum grid current, the plate current may go high enough to completely ruin the tube if allowed to continue for more than a few seconds. The final amplifier is tuned and loaded in exactly the same manner as described above.

For 5 meters, the 6L6G oscillator plate circuit is tuned to the fourth harmonic or 10 meters. This dip in plate current will be very low and it is advisable to use a neon lamp to help locate the proper adjustment point. Once the harmonic is found, however, the cathode condenser can be adjusted to produce a considerable amount of fourth harmonic output, entirely sufficient to drive the 6L6G doubler. The second 6L6G, of course, doubles to 5 meters, driving the RK-39 buffer and the final amplifier "straight through." The buffer circuit should be tuned very carefully as the adjustments are extremely critical on 5 meters. It is advisable to reduce the plate voltage on the final to 1250 volts when operating on this highest frequency band. When operated in this manner only 40 milliamperes of grid current to the HK-54s is required, which is approximately the peak output of the RK-39 on 5 meters. The final may be loaded up to approximately 250 milliamperes when the antenna is connected.

In this article we have described the simple basic adjustments of the three-band transmitter for C.W. code work. Next month we shall describe the 60 watt *cathode modulator* used for phone work on 5, 10 and 20 meters, and describe the proper adjustments for the cathode-modulated phone transmitter. The photographs will show the complete transmitter mounted in its cabinet rack.

Parts List, W8KPX Transmitter

EXCITER UNIT

HAMMARLUND MFG. CO.

- 1—140 mmf. midget tuning condenser, type APC-140 (C1)
- 1—50 mmf. midget tuning condenser, type MC-50-SX (C2)
- 1—35 mmf. midget tuning condenser, type MC-35-SX (C3)
- 1—50 mmf. per section dual tuning condenser, type MCD-50-M or one 35 mmf. single type MC-35-SX (C4)
- 2—0.70 mmf. variable padder condensers
- 1—Shield for RK-39 tube

JAMES MILLEN

- 5—Midget R.F. chokes, 2.5 mh., 125 ma. cone-mounting type

IRC

- 1—100,000 ohm, 1 watt metallized resistor, insulated type
- 1—50,000 ohm, 1 watt metallized resistor, insulated type
- 2—75,000 ohm, 2 watts metallized resistors, insulated type
- 2—400 ohm, 10 watts metallized resistors, wire-wound type
- 1—300 ohm, 10 watts metallized resistor, wire-wound type
- 2—15,000 ohm, 10 watts metallized resistors, wire-wound type
- 1—25,000 ohm, 10 watts metallized resistor, wire-wound type

BUD RADIO

- 1—Set midget, 5-prong transmitting coils for 5, 10 and 20 meters. Links on the end.

NATIONAL COMPANY

- 3—HRO type dials, 0-10 degrees. Counterclockwise.

AMPHENOL

- 2—"Octal" ceramic sockets (for 6L6G tubes)
- 3—5-prong ceramic sockets (for coils and RK-39 tube)
- 1—6-prong ceramic socket (for power plug)
- 1—Chassis connector for coaxial line (output link)
- 1—Length No. 72 flexible coaxial (for link)

CORNELL-DUBILIER

- 4—0.004 mfd. mica condensers, 2500 volts
- 1—0.002 mfd. mica condenser, 1000 volts
- 3—0.01 mfd. paper condensers, 600 volts

PAR METAL

- 1—Black crackle finished chassis, 17 x 10 x 3 ins.
- 1—Black crackle finished panel, 10½ x 19 ins.

MALLORY

- 4—Closed-circuit midget jacks

RAYTHEON

- 2—6L6G tubes
- 1—RK-39 tube

BARKER and WILLIAMSON

- 1—Set 5, 10 and 20 meter "swinging-link" coils, type BVL
- 1—Base and link-assembly for BVL coils

Final Amplifier

HAMMARLUND

- 1—35 mmf. midget tuning condenser, MC-35-SX
- 2—2.1-10 mmf. neutralizing condensers, N-10
- 1—2.5 mh., 500 ma. R.F. choke, CH-500

JAMES MILLEN

- 1—50 mmf. per section dual transmitting condenser, .077 air-gap, 3000 v. rating, type 13050
- 2—4-inch transmitter dials, nickel silver, 0-100 clockwise

IRC

- 1—2500 ohm, 25 watt resistor, wire-wound
- 1—200 ohm, 25 watt resistor, wire-wound

AMPHENOL

- 2—4-prong ceramic sockets for HK-54s
- 2—Chassis connectors for coaxial line (input and output links)
- 12 Ft. No. 72 indoor coaxial line (to antenna tuner unit)

STANCOR

- 1—5 volts, 10 amperes, filament transformer, type P-6135

MALLORY

- 2—Closed-circuit midget jacks

CORNELL-DUBILIER

- 1—0.005 mica condenser, 1000 volts
- 3—0.005 mica condensers, 2500 volts
- 1—0.005 mica condenser, 5000 volts

PAR METAL

- 1—Black crackle finished chassis, 17 x 10 x 3 ins.
- 1—Set chassis mounting brackets (small size)
- 1—Black crackle finished panel, 12¼ x 19 ins.

BARKER and WILLIAMSON

- 1—Set 5, 10 and 20 meter fixed-link coils, type BL
- 1—Set 5, 10 and 20 meter fixed-link coils, type TL
- 1—Set bases and mounting hardware for BL and TL coils

HEINTZ and KAUFMAN

- 2—HK-54 Gammatron tubes

Low Voltage Power Supply

IRC

- 1—Wire-wound bleeder resistor, 20,000 ohms, 50 watts

STANCOR

- 1—Plate transformer, 400 v. D.C. after filter, 300 ma. Type P-4024
- 1—Filament transformer, 6.3 v. A.C. at 6 amp. and 5 v. A.C. at 6 amp. Type P-4022
- 1—Swinging choke, 8-25 henries, 300 ma. Type C-1403
- 1—Filter choke, 12 henries, 300 ma. Type C-1413

CORNELL-DUBILIER

- 2—Oil-filled tubular can type transmitting condensers, 600 volts D.C., 4 mf. each

PAR METAL

- 1—Black crackle finished chassis, 13 x 17 x 3 ins.
- 1—Black crackle finished steel panel, 8¾ x 19 ins.

BUFFER POWER SUPPLY

IRC

- 1—Wire-wound bleeder resistor, slider type, 40,000 ohms, 50 watts

for October, 1940



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STANCOR

- 1—Plate transformer, tapped 600 and 750 v. D.C. after filter, 250 ma. Type P-5050
- 1—Filament transformer, 2.5 volts A.C. at 10 amperes, 10,000 volts insulation. Type P-3060
- 1—Filter choke, 15 henries, 200 ma. Type C-1721

CORNELL-DUBILIER

- 2—Oil-filled transmitting condensers, 1000 volts, 4 mf. each
- 1—Electrolytic condenser, 450 volts, 8 mf.

TAYLOR Tubes

- 2—866 Junior rectifying tubes

FINAL POWER SUPPLY

IRC

- 1—Bleeder resistor, adjustable, 200 watts, 50,000 ohms

STANCOR

- 1—Plate transformer, tapped, 1250 and 1500 volts after filter, 350 ma. Type P-5053
- 1—Filament transformer, 2.5 A.C. at 10 amperes, 10,000 volts insulation. Type P-3060

- 1—Filament transformer, 5 volts at 10 amperes. Type P-6135
- 1—Swinging choke, 8-25 henries, 300 ma. Type C-1403
- 1—Filter choke, 12 henries, 300 ma. Type C-1413

CORNELL-DUBILIER

- 1—Oil-filled transmitting condenser, 4 mf., 2,000 volts
- 1—Oil-filled transmitting condenser, 2 mf., 2,000 volts

RAYTHEON

- 2—866 rectifying tubes

PAR METAL

- 1—Black crackle finished chassis, 13 x 17 x 3 ins.
- 1—Black crackle finished steel panel, 14 x 19 ins.

MISCELLANEOUS

- 1—BLILEY "B5" 40 meter crystal
- 5—Heavy duty BUD switches
- 4—Ceramic chassis mounting sockets for high voltage rectifiers, 4-prongs. AMPHENOL.

"CQ"

Larry LeKashman, W2IOP

● ALL good radio magazines have a column devoted exclusively to Hams, SWL's, and amateur experimenters. Often this multi-element group don't hit off too well; the amateurs resent the inclusion of SWL's; the SWL's resent the amateur's resentment; until finally we have a vicious circle of "off resonant" opinions. It is our earnest hope that this new column, *CQ*, will reach that happy medium in which we are all able to enjoy amateur radio without any rancor or disagreements among ourselves.

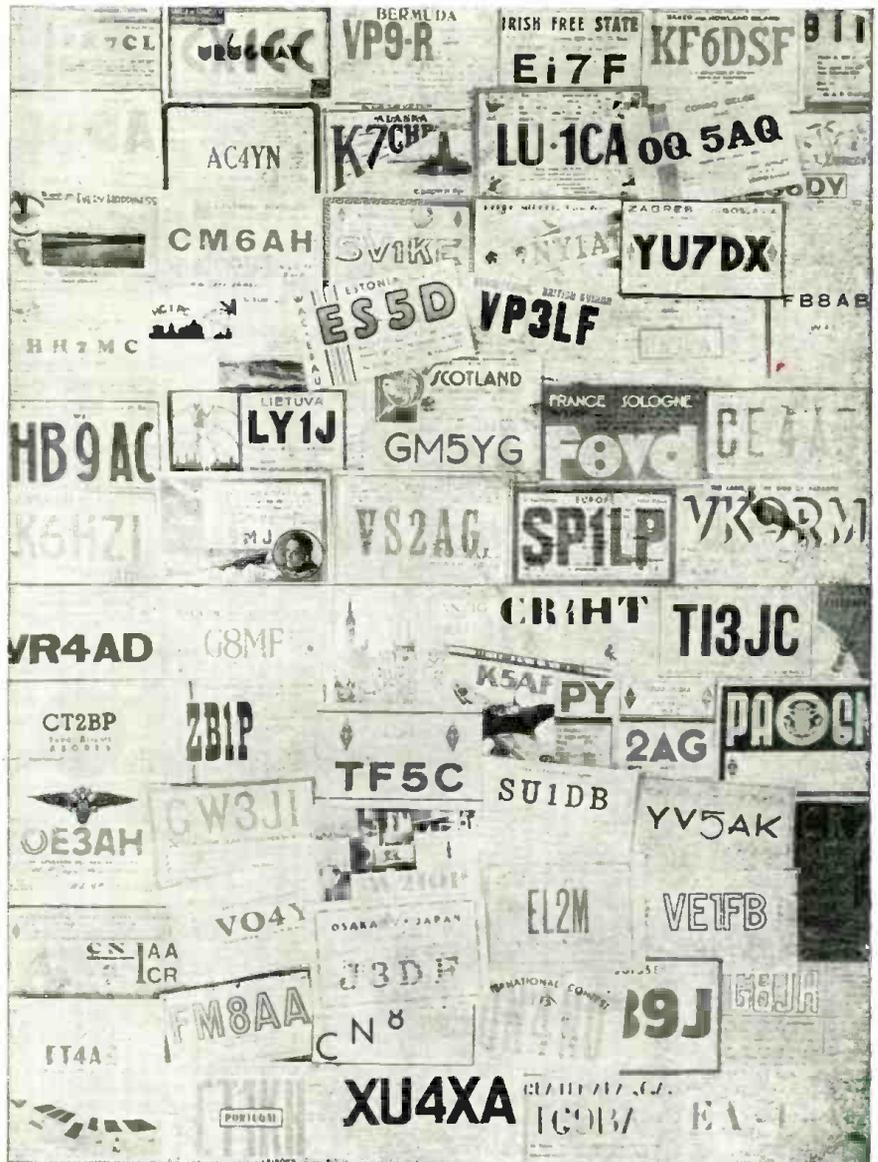
Each month *CQ* will bring to you anecdotes; photographs; comments from the readers; in fact anything that belongs in a real *Radio amateur* column. Such a big job is obviously beyond the scope of any one man. While yours truly is going to edit *CQ*, you—the reader—are asked to write the material. Letters addressed to the *Radio Amateur* Editor will be thoroughly digested and the best part offered to our fellow amateurs through the medium of this column.

As in all new things there will doubtlessly be many refinements in order. Here again readers' comments will be carefully considered and sincerely appreciated. Among the features we hope to foster is "station heard" reports from SWL's and *radio amateurs* throughout the world. In the United States there is still plenty of listening to be done on the UHF's that will prove invaluable to the Hams. Patience in listening where signals are few and far between will richly reward all concerned. In the case of DX, American amateurs will still appreciate reports, particularly on the lower frequency bands. In line with our listening suggestions it would be well to listen for transmissions of any questionable character for reports to the local FCC office.

As *CQ* develops we plan on devoting considerable space to chatter. This will appeal to local stations more than anyone else, but there is space for all who contribute, so do not hesitate to send in your notes.

Among our special feature department this month we are presenting two unusual photographs. Taken by W2ICX it shows, for the first time, cards from 110 different countries gathered in plain view. Careful examination will reveal amazing detail, even the fact that the QSL's all belong to W2IOP. If sufficient interest is shown we will probably make enlargements of this interesting shot, available at no charge. All 110 countries were worked on 40 and 20 meters, using a beam for only two of them. Power averaged 200 watts and it took about three years to garner the lot.

Ham-gossip can only be as interesting as you make it. But facts like W2KZP and W2KYT working W1HDQ on 2½ meters are worth while. W2JZO—besides running his station—keeps two airplanes going. W2MCS runs 300 watts into a pair of 812's on 28 mc. W2KBH has a new NHU receiver. W2JRE's home on Long Island was destroyed by a fire. W2TC has a new two-element rotary and a new receiver. W2EZC



If you are a short-wave fan here is one of the greatest collections of QSL cards the editors have seen. These stations were all contacted by Larry LeKashman.

added a NC101X to his rig. W2KIK has left New York and joined the army.

W2KKK now keeps his kilowatt on 75 meter phone. W2LJA is putting high power on 2½ meters. W2MJU is also joining the parade to 2½. W2I1JU is busy working for W2EKC in the ship radio business.

HAMS—Attention!

The editor of this department will be glad to receive news items concerning Ham activities, Club Meetings, etc. Reports on reception of "foreign" stations will prove of interest. Send along any bits of radio amateur news that you think will interest readers of *Radio & Television*. Send them to Mr. LeKashman in care of this magazine.

That's a sample of what we want from local contributors and you are invited to comment on this style set up. But don't think *CQ* is going to be limited to gossip. Our first crusade is for the re-birth of QSL'ing! We're loading the big guns and preparing to start our own blitz against the non-QSL'ers. This is not a move designed to soft-soap SWL's or satisfy personal grievances, so take your sides and join in the fun—it's time somebody did something to revive the greatest tradition of them all in Ham radio. 73 P.S.—We don't want to get nasty about the non-QSL'ers; it wouldn't be in line with our harmony policy. Let's just show them a little light on things as they are.



Another section of the huge QSL card collection of Mr. LeKashman—a fine tribute to the amateur photographer who took these "shots," as practically all of the cards are readable.

Have You VAC?

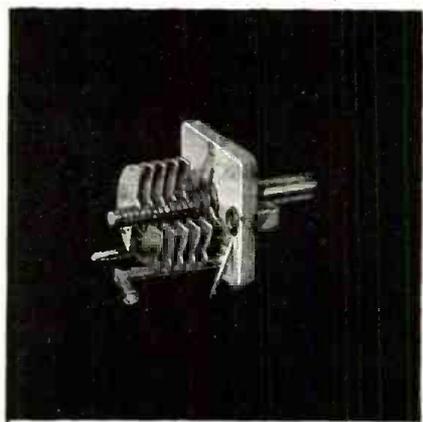
●THE handsome 9" x 12" VAC Certificates are still available and will grace any DXer's wall. To be eligible for this DX honor, a phone QSL is needed from each of the 6 continents, Asia, Africa, Europe, Australia, North America and South Amer-

ica (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.*

VAC
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MAGAZINE

This is to certify that
Frank Gordon
is admitted to Membership in the VAC CLUB,
having submitted adequate proof of his reception
of Radio Phone Signals from each of the six Continents.

Joe Miller



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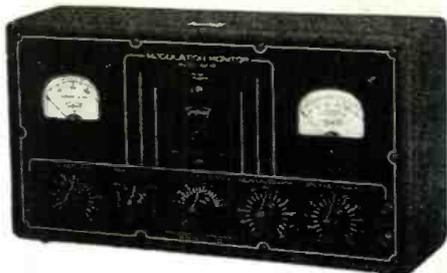
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"Honor" Plaque Awarded
To Wm. E. Renault, W1MTH

For Best HAM Station Photo

Editor,

I am glad to report that your magazine brought me good luck. I have been a S.W.L. since I purchased my first *Short Wave Craft* Magazine in 1937. I was elected a member of the *Short Wave League* by the officials of the League and have been a subscriber to the magazine ever since. Your magazine is my ideal because I have learned from it all my radio theory for an amateur radio operator's license.

I will QSL 100% to anyone sending me their S.W.L. card or Q.S.L.

My "rig" is a Thordarson transmitter, a commercially built job, running 100 watts.

I use a Collins antenna network. The receiver is a Super Skyrider SX17. Mike is American crystal, type C6. Key is a McElroy. I have made over 300 contacts since June 6th on 160 meter phone. I operate on 1820 kc. and 1962 kc. For anyone wishing to work me—I am on the air every morning from 1:15 a.m. to 3:00 a.m. for DX, and 9:00 a.m. to 4 p.m. every day. The lineup in the transmitter is 6L6Q osc.; 6L6G buffer and TZ40 final. The modulation mike uses a 6J7, a 6F5, a 6F6 and 6L6's in push-pull.
 WILLIAM E. RENAULT, W1MTH,
 Union Street, Box 125,
 Linwood, Mass.

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.

Note These Important Rules

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.

Address all photos and station descriptions to Editor, Ham Station Photo Contest, c/o RADIO & TELEVISION, 20 Vesey Street, New York, N. Y.



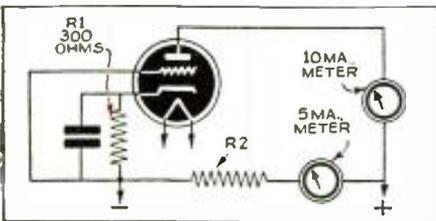
Amateur Radio Operator

LICENSE EXAMINATION STUDY GUIDE

Continued from September Issue

(Courtesy Federal Communications Commission)

26. What is the purpose of a Faraday (electrostatic shield) between the output circuit of a r.f. power amplifier and antenna coupling system?
27. What are the output circuit conditions for obtaining optimum power output from a radio-frequency amplifier?
28. In which stage of a transmitter is an amplifier of high harmonic output least desirable?
29. What are the relative plate current indications for resonance and off-resonance tuning of the plate tank circuit of a radio-frequency power amplifier?
30. What are the advantages of a push-pull r.f. power amplifier output stage as compared to a single-ended stage of the same power?
31. In the circuit diagram below, what is the value of the bias voltage? What is the value of the bleeder resistance, R2?



32. A certain 1750-kc. Y-cut quartz crystal has a positive temperature coefficient of 125 cycles per degree Centigrade and is started in operation at 40 degrees Centigrade. If the temperature-frequency characteristic is linear, what will the oscillation frequency be at a temperature of 60 degrees Centigrade?
33. A 2000-kc. low-drift crystal having a negative temperature coefficient of 5 cycles per megacycle per degree Centigrade is started in operation at 40 degrees Centigrade. If the temperature-frequency characteristic is linear, what will the oscillation frequency be at a temperature of 60 degrees Centigrade?
34. A low-drift crystal for the 3500-4000 kc. amateur band is guaranteed by a manufacturer to be calibrated to within 0.04% of its specified frequency. Desiring to operate as close to the lower hand limit of 3500 kc. as safely as possible, for what whole-number kilocycle frequency should you order your crystal, allowing 1 kc. additional for variation from temperature and circuit constants?
35. For what frequency should you order your crystal for operation as close as safely possible to the upper hand limit of 4000 kc., with the same calibration accuracy and allowance given in Question 34?
36. Draw a schematic diagram of a full-wave single-phase power supply using a center-tapped high-voltage secondary with a filter circuit for best regulation,

"MARVELOUS, ME EYE!", SAID PROFESSOR OSWALD SQUEEGEE

PROFESSOR OSWALD Z. SQUEEGEE, Phd., ABC, PDQ., etc., turned an austere eye on the eager, upturned faces of his class in industrial engineering. Then, in the simple dignity becoming to a great man (which everyone, including himself, admitted he was) the Professor spoke:

"Listen, you dimwits," he thundered. "If there's one thing I want to pound through your thick skulls, it's simply this: The easiest way of doing any job is generally the complicated way. The hardest way is to keep plugging along until you've developed the simple way. That takes time. It takes patience and—ahem!—it takes brains."

Here the Professor paused, reached for the glass of water on his desk, got the ink by mistake, and sipped it calmly. Then he cleared his throat and continued:

"Some of the world's greatest inventions have been so simple that everyone wondered why Noah hadn't thought of them while he was sitting in the Ark.

"What, for instance, was more logical than putting an eraser on the end of a pencil? What was more logical than the safety razor? What was more logical than, instead of making nuts to fit the wrench, to make the monkey fit the nuts. I mean—ahem—the monkey wrench."

Fishing through the pile of notebooks, overshoes and chewing gum wrappers on his desk, Professor Squeegee found a Sprague Koolohm Resistor and held it up for his class to see.

"Now here is a practical example of simplified improvement," he bellowed. "One of

you clucks brought this resistor in and told me how marvelous it was.

"Marvelous, me eye! The only thing marvelous is that some resistor manufacturer didn't do it sooner—that it took a condenser manufacturer to figure out how much simpler it would be to insulate the wire itself, instead of trying to insulate the resistor after it is wound without shorting a lot of turns, or without having a coating that will crack, chip or maybe even peel like a banana. Now hand me that crowbar and cold chisel and I'll show you something real."

After 15 minutes' hard work and 3 skinned knuckles, the Professor pried the outer ceramic shell off the Koolohm.

"There it is," he beamed, "a practical example of a little simple simplification that meant a whale of a big improvement. Larger wire. No danger of shorted turns. More resistance in less space. So moisture-proof a duck's back would turn green with envy. So well designed it runs cooler than any other resistor of equal size and rating. The only resistor with an automatic overload indicator, and the first..."

Just then the phone rang. It was the Professor's wife telling him he was already three hours late for lunch. Without even waiting to bid his class goodbye, he laid a handkerchief carefully on his head, crammed his hat into a pocket, shut the door and walked calmly out through the open window.

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5 BAND BE ORIGINAL! DESIGN YOUR SWITCH-COIL OWN MODERN TUNING UNIT! KIT 66¢



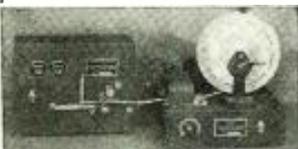
Basic kit contains ball bearing index head (A) with 3 1/2" pillars, divided to hold up to 6 switch wafers; one 2 contact, 5 band switch-wafer; one 1-5 inducting dial plate; 5 3/4"x2" polystyrenized-fibre coil forms; inductance tape reading 10-145 microhenries and L.C. formula. Only 66¢. Basic kit builds E.C. receiver or Preselector. With extra (B) wafers—85¢, and (C) coil forms, band-spread super-hets, hi-d TRF receivers are possible.

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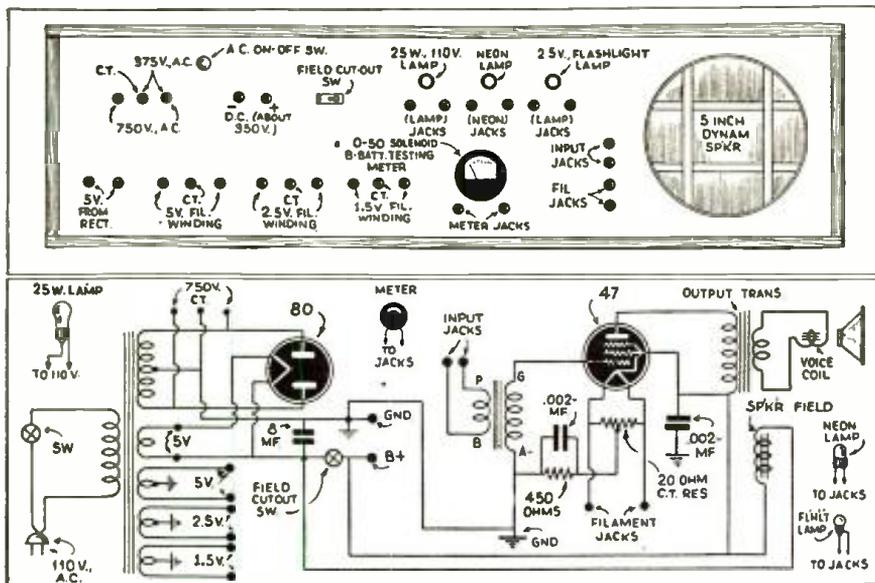
the interfering signal and a parallel-tuned (trap) circuit in series with the receiver input to reject the interfering signal.

42. Draw a schematic diagram of a pentode audio power amplifier stage with an output coupling transformer and load resistor, showing suitable instruments connected in the secondary for measurement of the audio-frequency voltage and current, and naming each component part.
43. What is the principal purpose of using door interlock switches on a transmitter?
44. What is the usual means for protecting amateur station equipment from damage by charges of atmospheric electricity on the antenna system?
45. What is a safe procedure for removing an unconscious person from contact with a high-voltage circuit?
46. Using a frequency meter with a possible error of 0.75% on what whole-number kilocycle frequency nearest the high-frequency end of the 3500-4000 kc. amateur band could a transmitter safely be set?
47. Using a frequency meter with a possible error of 0.75% on what whole-number kilocycle frequency nearest the low frequency end of the 7000-7300 kc. amateur band could a transmitter safely be set?
48. What radio messages have priority over all other communications?
49. What is the penalty for willful or malicious interference with other radio communications?
50. What is the F.C.C. rule regarding emission of unmodulated carriers by amateur stations?
51. On what amateur bands is portable operation permitted without prior notification to the inspector of the district in which such operation is contemplated?
52. When may third-party messages be handled between amateur stations of different countries?
53. What period of each hour shall be used for making important initial calls when a state of communication emergency has been proclaimed by the F.C.C.?
54. When does a state of emergency affecting amateur communications become effective and when is it terminated?
55. What amateur bands are affected and what frequencies are reserved for emergency calling when a state of communications emergency has been proclaimed by the F.C.C.?
56. On what frequencies may a licensee holding Class-B amateur privileges operate an amateur radiotelephone station?
57. What is the F.C.C. regulation regarding transmission of music by an amateur radiotelephone station for testing purposes?
58. What is the highest modulation percentage of an amateur radiotelephone transmitter permitted by F.C.C. regulations and under what condition may it be employed?
59. What power input should an amateur station use for a particular communication when the maximum legal input is 1 kw.?

(To be continued)

An Experimenter's Test Set

Terrence Genes



A handy test board for the set-builder and radio experimenter.

● HERE is a simple yet useful test outfit that can be made very cheaply from junk-box parts. It is very useful for testing radio sets, electrical motors and other electrical equipment.

The cabinet for this set can be taken from one of the old model wood radio cabinets. The original cabinet was an Atwater Kent model 20 cabinet, measuring about 26 inches long by 8½ inches high by 7¾ inches deep. By removing all the parts and the metal panel a piece of 3 plywood 7¼ by 24¾ inches just fitted in the front of the cabinet. All parts are mounted on or just behind the plywood panel. The drawing gives the approximate placement of the parts on this panel. Of course if you use a different size cabinet it may not be possible to mount the parts in just this position.

The actual parts of the tester itself are taken from old radios. The power supply used in the original was taken from an old Crosley set, but practically any old power supply can be used. Leads are connected from the power supply to tip jacks on the front panel, except in the case of the 110 volt line cord. This is run through a hole in the rear of the cabinet. The switch to cut in the power supply is located on the panel.

The audio amplifier is made from old radio parts and practically any power tube that you have handy can be used with just a few changes in the wiring. The hook-up shown is for a type 47 tube and this tube works very well. To connect this up merely plug in a cord in the tip jacks of the power supply marked 2.5 vts. and plug the other end of the cords in the jacks marked filament; then flip the switch in the speaker field circuit. This automatically turns on

the B+ to the rest of the amplifier. The original speaker used was a 5-inch dynamic, but any one you have handy that will match the tube you use will work. To test the audio gain between sections of the audio stage, merely connect test leads to the input jacks of the tester and touch them to the different parts of the audio circuit. By plugging the test leads into the phone plug of a small receiver, you have an additional audio stage added to the set. This set can also be used to some extent as a small PA set or as a record-player amplifier.

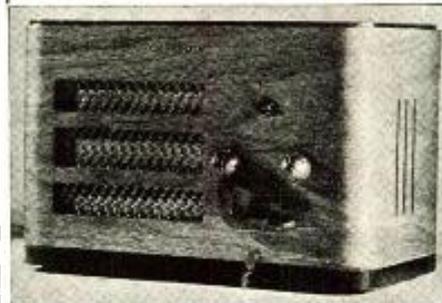
The voltmeter, neon tube, and the two lights may or may not be added to the set, but if you have them they will come in very handy. With them you can test shorted, burnt-out or open resistors, condensers, transformers, motor windings and many other things. You can also test batteries and parts of power supplies or other parts of a radio or PA system.

By connecting the various parts of the power supply together you can get a large variety of voltages. On the one pictured in the drawing you can get up to 14 volts A.C. from the filament winding of the transformer, by connecting the windings in series. These come in handy for controlling the speed of small motors, electric trains, etc.

I think that the diagram needs no explanation, as there is very little wiring to do outside of connecting up the amplifier. I found that phone leads from a single earphone (the leads which have a phone tip on each end) are very useful for connecting together various parts of this tester.

A safety precaution to remember is to never connect wires to the high voltage terminals of this outfit while the current is turned on.

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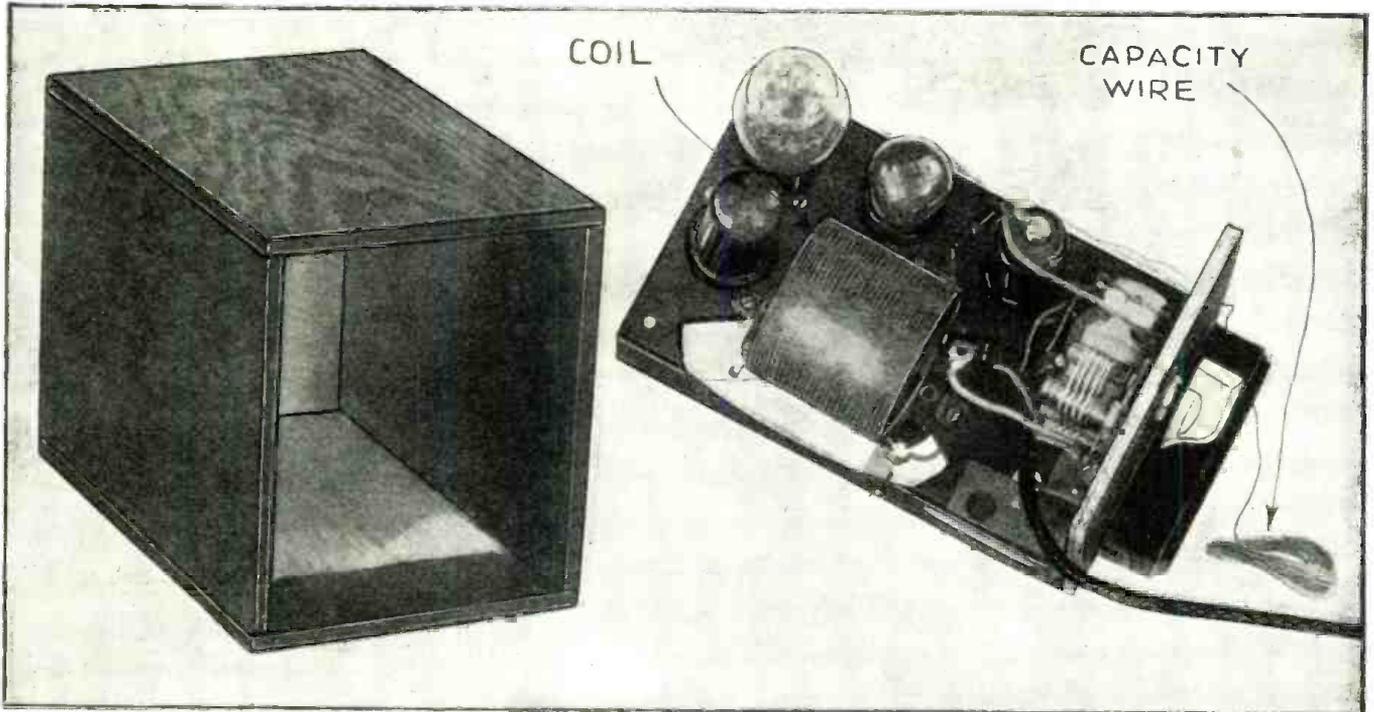
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Complete capacity-operated relay and case. It can be used for counting purposes, as a burglar alarm, etc.

A Sensitive

Capacity-Actuated Relay

• WHILE light-sensitive devices have their own particular fields of application, there are many instances where it is impracticable or inadvisable to employ a photoelectric cell and a light beam to actuate alarms and other relay mechanisms. Furthermore, the *capacity-actuated* device may be arranged to give a wider degree of action, since with the light beam, it is imperative that the beam be intercepted in order to obtain the desired action of the

H. G. Cisin, M.E.

relay. Still another advantage of the capacity-operated relay, is the fact that it is very simple and inexpensive to build.

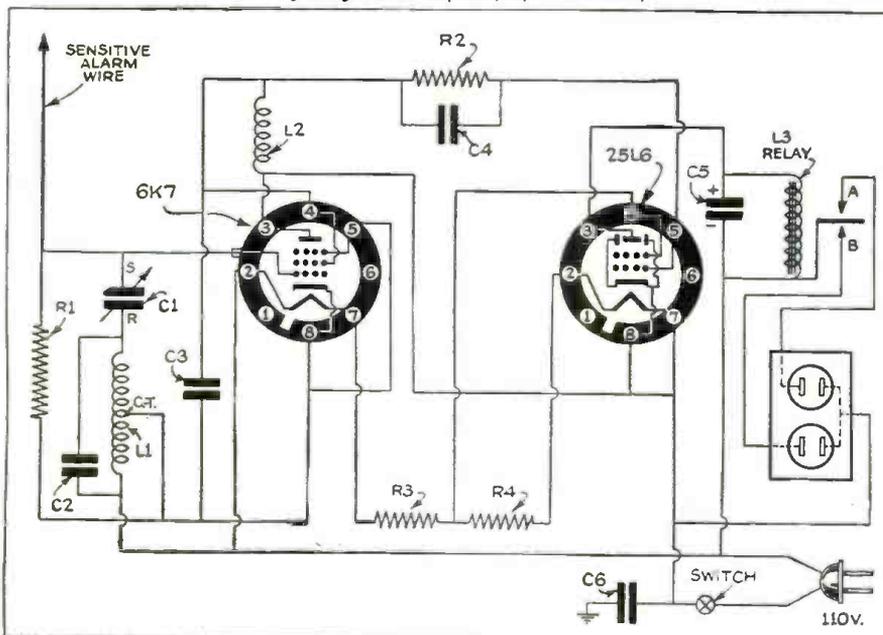
The device described in this article was designed to accomplish a dual purpose. In the daytime it was used with a Veeder counter, to register the number of people entering a store. At night, it was used with a system of gong alarms, to give warning

of trespassers or burglars. This same device may be put to a great many other uses. For example, it may be employed to open a garage door or the door between dining room and kitchen in a restaurant; or it may be used for a wide variety of advertising purposes. In fact, the number of applications are limited only by the ingenuity of the experimenter.

The schematic diagram shown in figure 1 has a number of interesting features which are worth consideration. A 6K7 tube is employed as an oscillator. With a certain amount of capacity added, either by adjustment of the variable condenser or because someone approaches the capacity sensitive wire, the circuit becomes resonant and a radio frequency current passes to the grid of the 25L6 tube. This grid becomes positive thus permitting a considerable increase in the plate current. Since the relay is connected directly in the plate circuit of the 25L6, it is then actuated and closes or opens the desired external circuit.

Although this circuit does not employ a conventional rectifier, nevertheless rectified operating current is obtained through a novel arrangement which makes both tubes self-rectifying. Instead of using a single ballast tube, two are used. This permits a connection between them, in order to obtain the proper voltage for the screen grid of the 25L6 tube. When the plate of the 25L6 is at the high voltage point, the cathode is at ground potential; conversely when the plate of the 6K7 is at high voltage, its cathode is at ground potential. Consequently, each tube rectifies on alternate halves of the cycle.

Wiring diagram of capacity-operated relay.



A 10 mf. 35 volt electrolytic condenser is shunted across the relay magnet to prevent chattering. The coil L1 consists of 90 turns of No. 24 cotton covered wire wound on a 2 inch air core. A center tap is made at the 45th turn. The coil may be wound on bakelite tubing if desired. The dimensions of the coil are not critical. Therefore, with a little experimentation, it may be possible to adapt almost any cylindrical coil, such as a plug-in type broadcast coil, for use in this device.

As regards the relay, a plate circuit relay should be used. This may be of the cheapest type obtainable. The relay shown is a single-pole, double-throw relay having a 2500 ohm winding which "pulls in" on from 6 to 8 mils and "drops out" at from 3 to 5 mils.

It will be noted that only one control is required to balance the device. This is a 50 mmf. midget type variable condenser, mounted on the front panel. In operating the device, this control is rotated slowly until the relay "pulls in" or clicks. The condenser is then turned back a fraction of a degree in order to leave the system at a point of maximum sensitivity. Naturally, it is necessary to make a different adjustment for variations in the length of the capacity sensitive "alarm" wire. Incidentally, this wire may be stretched out to a length of over 20 feet *without impairing the sensitivity of the device.*

Construction Details

In building the outfit shown, a metal chassis was used. The dimensions of this chassis are 6½ inches by 4 inches by 1 5/16 inches high. All parts are mounted either above or below the chassis, with the exception of the control condenser and the double outlet. The dual outlet is connected so that the external or alarm circuit will be opened or closed when the relay closes, depending upon whether the plug is inserted in one or in the other outlet. The method of making the connections to accomplish this result, is shown in the schematic diagram. The double outlet is of the standard type which may be obtained at any 5 and 10 cents store or at any electrical supply store. However, it must be altered slightly before it can be used. When the outlet is purchased, it will be found that the terminals on either side are connected in parallel. Leave the terminals on one side in parallel. On the other side, however cut the metal (cutters may be used for this purpose as metal is thin), so that independent connections may be made to the upper and lower points "A" and "B" of the relay.

A wood panel 5" by 4¼" made of ¼" plywood, serves as the front panel. This is fastened to the metal chassis by means of small right-angle metal brackets. The entire device is then mounted in a wood cabinet having top, bottom, sides, back, but no front. The panel of the device serves as the cabinet front. The cabinet dimensions are given in the sketch. When the cabinet is completed, drill as many holes as are necessary, at the top and sides, to furnish sufficient ventilation to prevent overheating during long-continued operation.

After the device has been completed and put through its initial tests, it is ready to be set up and put to practical use. It is plugged into a 110-volt outlet in an incon-

spicuous place and the plug from the external circuit is inserted in either one of the outlets on the front panel. The power supply for the external circuit will be obtained directly from the device. The capacity sensitive alarm wire is then stretched out to the point where it is to be used. Thus, if it is to be used at a doorway, it is put under a thin doormat, so that everyone entering or leaving will be obliged to cross over it. If it is to be used as a burglar alarm, it may be connected to a wire screen or it may be arranged about the doors and windows, so that no entrance can be made without approaching the wire. Just as soon as anyone does come near this wire, the capacity of the entire system is changed, the relay is actuated and the alarm is given.

HAMMARLUND (Condensers, Coils, Sockets)
 1—7 Plate, 50 mmf. Midget Variable Tuning Condenser, type MC-50-M (C1)
 1—10 mh. R.F. Choke, type CH-10-S (L2)
 4—Isolantite 8-Prong (Octal) Sockets, type S-8

CORNELL-DUBILIER (Condensers)
 1—Mica Condenser, .0002 mf., type 1W (C2)
 1—.001 mf. Tub. Condenser, type DT-6D1 (C3)
 1—.05 mf. Tubular Condenser, type DT-4S5 (C6)
 1—.1 mf. Tubular Condenser, type DT-4P1 (C4)
 1—10 mf., 25 V. electrolytic, EDJ-2100 (C5)

Resistors
 1—2 meg., ½ watt Fixed Resistor (R1)
 1—½ meg., ½ watt Fixed Resistor (R2)

Tubes
 1—6K7 Tube
 1—25L6 Tube
 1—K-36A Ballast Tube (R4)
 1—K-105-A or 808-5 Ballast Tube (R3)

Miscellaneous
 1—Plate Circuit Relay, 2500 ohms (L3)
 1—Special Tapped Coil (Data given in article)

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FREQUENCY MODULATION . . . the sensational new and entirely different system of radio broadcasting and reception . . . has been approved and declared "highly perfected" by the Federal Communications Commission. It is generally predicted that some 1000 new F.M. transmitters will be installed at an early date. More than 20 are already in full operation. *A completely new type of receiver is required for this amazing new Frequency Modulation reception! Always far ahead, Mr. E. H. Scott has developed a magnificent new SCOTT custom built F.M. Receiver which is causing a sensation. It creates a perfection in radio reception far above any the world has ever known!*

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Frequency modulation reception by the remarkable new custom built SCOTT is incredibly beautiful . . . like a dream come true! NO STATIC, no interference, no "noise" can be heard within the service area

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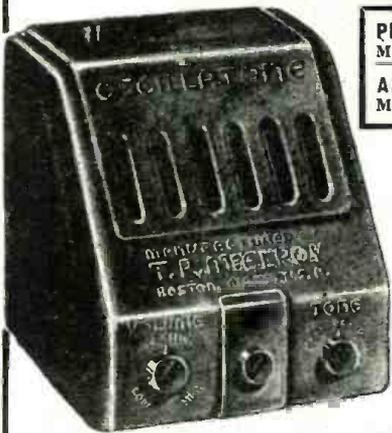
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Color Television Announced

● TELEVISION fans have been anxiously awaiting the day when images in color would be announced and it has remained for the Columbia Broadcasting System and their television expert, Dr. Peter Goldmark, to demonstrate practical color television.

The first test before anyone aside from the laboratory experts was recently viewed in New York by Chairman James L. Fly of the Federal Communications Commission. Mr. Fly, after seeing the color television, said that he was tremendously interested in the new system and that its basic simplicity indicates its practical possibilities. Most important, it is said that the new color images can be transmitted on the conventional 6-megacycle television channel and only one cathode-ray screen is employed. It is said that existing receivers do not need to be radically changed to adapt them to three colors instead of a mere black and white.

Du Mont's Washington, D. C., Station Gets Call Letters

● A RECENT report received from the Federal Communications Commission announces the fact that the Allen B. Du Mont Laboratories of Passaic, New Jersey, have been assigned call letters W3XWT for their Washington, D. C., television station now being rapidly completed.

Television Glossary

(Concluded)

OPTICAL LINE-OF-SIGHT—Refers to the fact that a person on a high tower or building can only see to the horizon, not beyond; the ultra short waves, in general, follow this law of optics and thus the range of a television station is partially limited by this phenomenon.

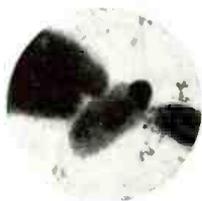
PHOTO-ELECTRIC CELL—Usually an evacuated glass tube containing two or more electrodes, one of which is coated with chemicals sensitive to changes in light. Fluctuating light impressed upon such a cell causes corresponding fluctuations in the electric current, controlled or generated by the cell.

KINESCOPE—The name given to the cathode-ray tube when used for reproducing television image at the receiver.

REFLECTING LAYERS—Refers to the various ionized layers in the upper atmosphere which reflect radio waves, the angle and degree of deflection depending upon the frequency of the waves, time of day, season of the year, etc.

SCANNING—The process of breaking up the image into paths or strips whereby the cathode ray (for example) scans the image, path by path, in a progressive manner until the whole image has been completely scanned. The whole process is repeated many times per second, similar to a motion picture, at a speed which obviates any flicker to the eye.

SYNCHRONIZING—The method whereby the scanning of the image at the receiver is kept in perfect step with the scanning of the object or scene at the transmitter, usually effected by transmission of regular synchronizing impulses.



Bacillus S. paratyphi,
magnified 12,000 diameters



Lacquer pigments,
magnified 27,000 diameters

FROM RCA LABORATORIES COME

Radio Eyes

FOR MICROBE HUNTERS



Anthony van Leeuwenhoek of Amsterdam was the first to peer into the universe of the infinitesimal. With his crude microscope, he discovered in 1683 the "small beasties" which Pasteur and Koch and Theobald Smith later branded the most dangerous enemies of man—the germs of disease.

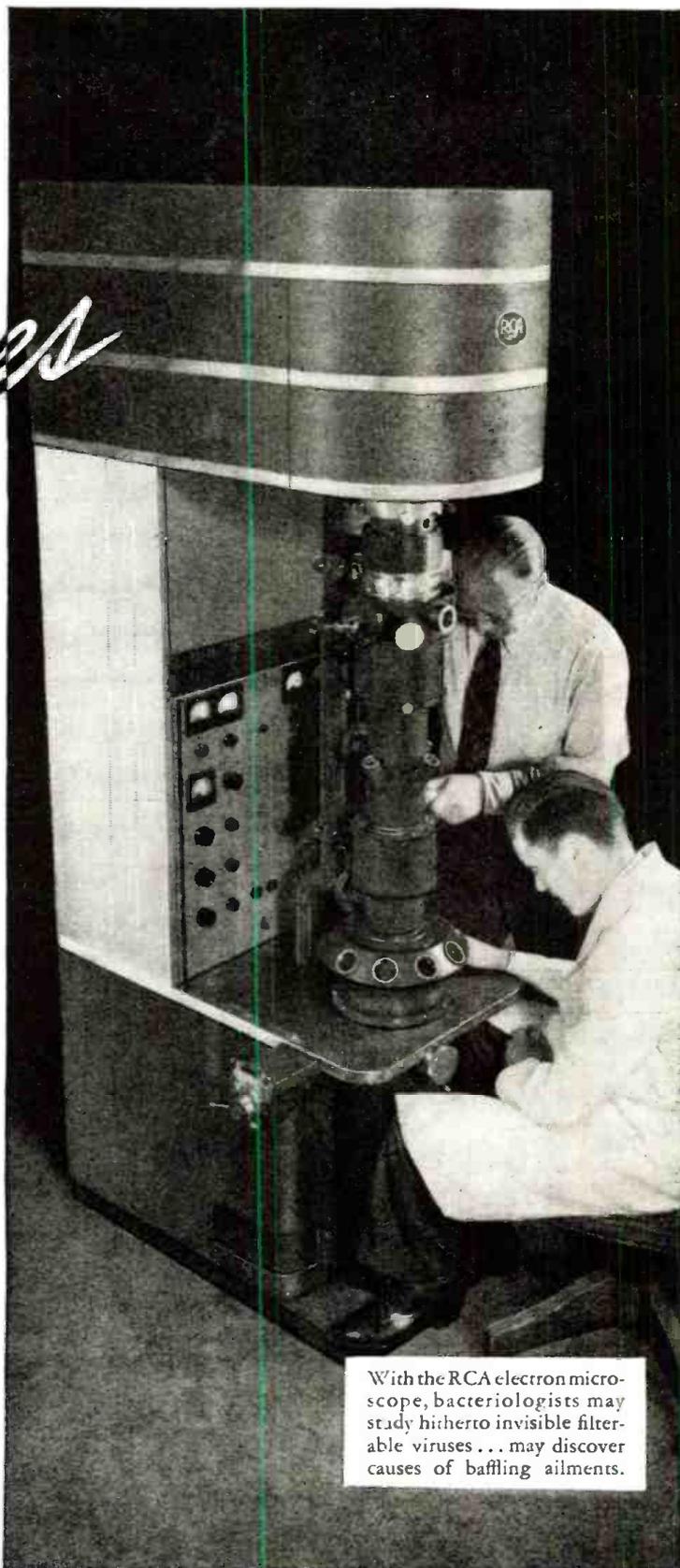
BUT there are micro-organisms too small for optical microscopes to detect. These instruments operate by visible light, which cannot resolve objects much smaller than the wavelength of the light. Bacteriologists have been able to see only the larger microbes. They have been able only to hope that somewhere, somehow, an instrument would be found that would magnify not 1,500, but 20,000... 50,000... 100,000 diameters!

Scientists in RCA Laboratories have engineered such a microscope. They studied the electrons active in radio and television, whose length was but a tiny fraction of that of a light wave. Research proved these electrons could be used as "seeing" rays. Focused by powerful magnets upon photographic film, they would reveal what had hitherto been invisible.

Research is Radio's Road to Progress

RCA's contribution to the development of the electron microscope is the result of a far-seeing policy laid down by the founders of the company in 1919: *that fundamental research must be the keystone of every activity of RCA.*

RCA research has made broadcasting better. It has made receiving sets better. It has perfected a magic voice for the motion picture. It has pioneered in television. It has developed facsimile transmission of pictures and printed matter. It has made substantial contributions to industrial progress in fields outside of radio... From continuing RCA research will come still more progress... still greater services to America and to the world.



With the RCA electron microscope, bacteriologists may study hitherto invisible filterable viruses... may discover causes of baffling ailments.



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RADIO CITY, NEW YORK

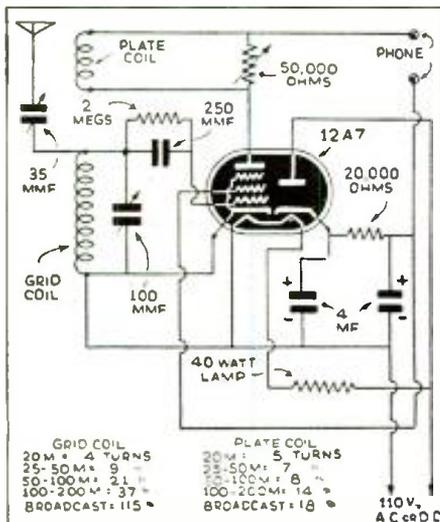
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Radiomarine Corporation of America
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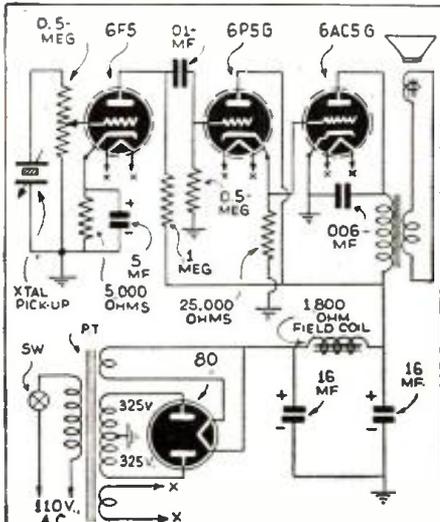
to the Radio Experimenter

"Front Cover" Hook-up



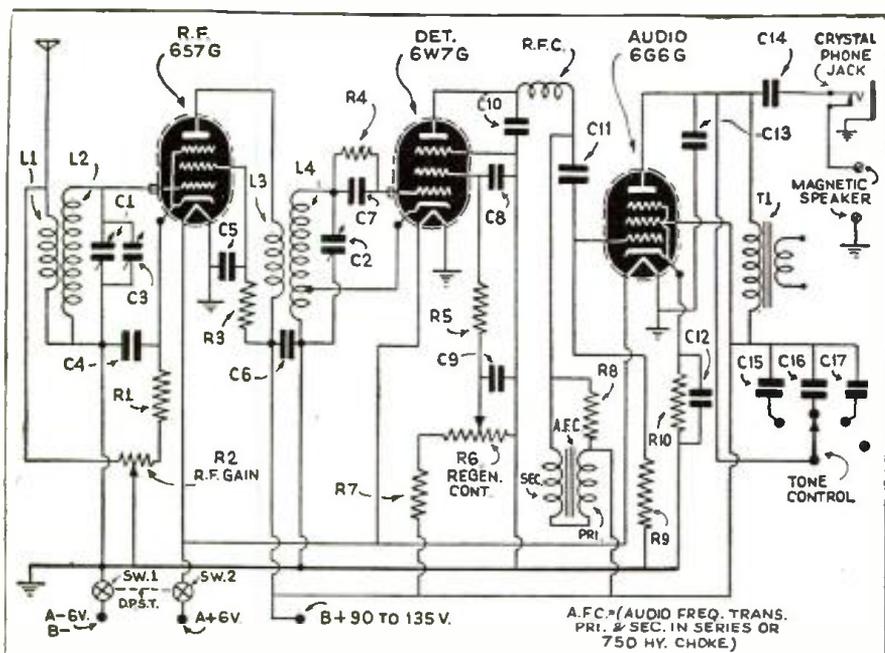
Here is a one-tube receiver that operates from 110 volts A.C.-D.C. with excellent results, says Ed. Ervin, W8SUI, of 336 Crestwood Ave., Buffalo, N. Y. Coil data is given in the diagram.

Phono-Amplifier



This dynamic-coupled PHONO-AMPLIFIER delivers 3½ watts. The coupling supplies the grid bias. Use a 7,000 ohm output transformer. Kenneth Benedict, Savannah, Mo.

3-tube T.R.F. Receiver Circuit

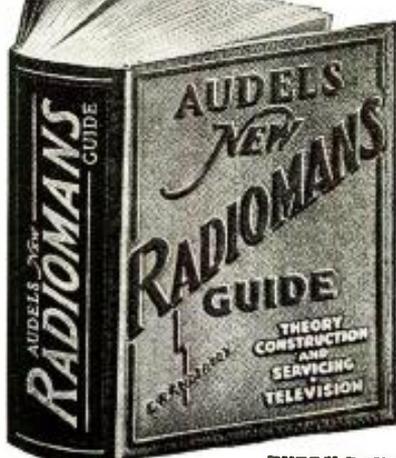


- | | | |
|-----------------------------|-------------------------|------------------------|
| R2 = 25,000 OHM POT. | R6 = 50,000 OHM POT. | C17 = .02-MF., 400V. |
| C1 & C2 = 140 MMF. (GANGED) | C9 = 0.1-MF., 400V. | R1 = 300 OHMS, 1/2W. |
| R.F.C. = 2.1 MH. | C10 = .0015-MF. (MICA.) | R3 = 0.1-MEG., 1/2W. |
| C3 = 25 MMF. | C11 = .01-MF., 400V. | R4 = 2 MEGS., 1/2W. |
| C4 = 0.1-MF., 400V. | C12 = 10MF., 25V. | R5 = 1,000 OHMS 1/2W. |
| C5 = 0.1-MF., 400V. | C13 = .006-MF. (MICA.) | R7 = 50,000 OHMS 1/2W. |
| C6 = 0.1-MF., 400V. | C14 = .25-MF., 600V. | R8 = 1 MEG., 1/2W. |
| C7 = .001-MF. (MICA.) | C15 = .003-MF., 400V. | R9 = 0.5-MEG., 1/2W. |
| C8 = .01-MF., 400V. | C16 = .008-MF., 400V. | R10 = 1,000 OHMS 1/2W. |

This 3-tube T.R.F. receiver circuit is contributed by Curtis Samp of Brewster, Minnesota. Coil winding data below:

- | | | |
|--------------------------------|---------------------------|---------------------------------------|
| 10-20 meters | 33-75 meters | 135-270 meters |
| L4—3½ turns No. 19 Enam. wire. | L4—18 turns No. 20 Enam. | L4—85 turns No. 28 Enam. |
| L3—2½ turns No. 28 D.S.C. | L3—6 turns No. 30 D.S.C. | L3—15 turns No. 30 D.S.C. |
| (cathode tap—¼ turn up. | (cathode tap 2/5 turn up. | (cathode tap ½ turn up. |
| 17-41 meters | 68-150 meters | L3 is wound between bottom turns of |
| L4—9 turns No. 19 Enam. | L4—38 turns No. 24 Enam. | L4 or over it. SWKS coils can be used |
| L3—3 turns No. 28 D.S.C. | L3—9 turns No. 30 D.S.C. | by alternating same to coincide with |
| (cathode tap 1/3 turn up. | (cathode tap 2/5 turn up. | data. |

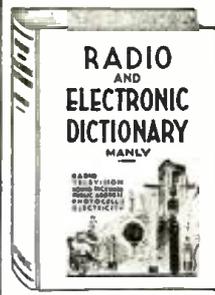
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PROSPECTING OUTFITS**



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- Folder No. 2. The "Harmonic Frequency Locator"—Transmitter radiates low frequency wave to receiver, tuned to one of Harmonics of transmitter. Using regenerative circuit. Emits aural signals. Tubes used: one 1G6G—one 1N5G.
- Folder No. 3. The "Beat-Note Indicator"—Two oscillators so adjusted as to produce beat-note. Emits visual and aural signals. Tubes used: Three type '30.
- Folder No. 4. The "Radio-Balance Surveyor"—a modulated transmitter and very sensitive loop receiver. Principle: Balanced loop. Emits visual and aural signals. By triangulation depth of objects in ground can be established. Tubes used: Seven type '30.
- Folder No. 5. The "Variable Inductance Monitor"—a single tube oscillator generating fixed modulated signals and receiver employing two stages R.F. amplification. Works on the inductance principle. Emits aural signals. Tubes used: six type '30.
- Folder No. 6. The "Hughes Inductance-Balance Explorer"—a single tube Hartley oscillator transmitter and sensitive 3-tube receiver. Principle: Wheatstone bridge. Emits aural signals. Tubes used: two type '30—one type '32—one type '33.
- Folder No. 7. The "Radiodyne Prospector"—a completely shielded instrument. Principle: Balanced loop. Transmitter, receiver and batteries enclosed in steel box. Very large field of radiation and depth of penetration. Emits aural signals. Tubes used: two 1N5G—one 1G4G—one 1H5G—one 1Q5—one 1G4.

With any one of the modern geophysical methods described in the Blue-Print patterns, Radio outfits and instruments can be constructed to locate metal and ore deposits (prospecting); finding lost or buried treasures; metal war relics; sea and land mines and "duds"; mineral deposits; subterranean water veins; oil deposits (under certain circumstances); buried gas and water pipes; tools or other metallic objects sunken in water, etc., etc.

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Complete set of seven folders.

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RT-1040

"Getting that Veri . . ." Harold B. Clein

(Continued from last issue)

"All right," you say, "but what is a good report?" Well, I was expecting that question, and here is the answer to the very best of my ability. Every good report should include the following:

1. Write your name and address clearly in upper right hand corner.
2. Give exact date station was heard.
3. Give exact time program was logged, and mention your local time zone (Eastern Standard Time, etc.).
4. Also include Greenwich Mean Time.
5. Give the exact frequency the station was transmitting on, in kilocycles-per-second. (Don't use megacycles or meters.)
6. Offer plenty of "proof of reception," giving the exact time, *right to the minute*. It is best to name a musical selection or two, but if this is impossible, then describe the type of program, type of music, etc. At least an hour of this detail should be given when it is not possible to name the actual musical selections, etc.
7. Give an honest signal report. "R" units mean little to any radio operator, unless he has something to compare the signal strength with. Try to describe the volume by some comparison the operator will easily understand. Mention the clarity of the voice, and music. Any distortion? Describe fading. Describe any type of interference, such as "Atmospherics," Man-made static. Interference from another station, etc. Anything that can be added to give a clear picture of reception in your location is welcome.
8. Comment on the educational or entertainment value of the program. If you have honest suggestions or criticisms be sure to include them, for if anything, this will greatly increase your chance for a veri. Mention the type of program you would like to hear from the station.
9. Describe your receiving equipment in detail. Give the number of tubes in your receiver. Mention type circuit (superheterodyne, etc.). If any unusual feature is incorporated in your receiver which you believe tends to improve reception, describe it. Do you use ear-phones, or loud speaker? Describe your antenna. What type? (Marconi, etc.) What length? How high? Type of lead-in? How far above nearest object? Is your antenna directional, and if so what direction does it favor?
10. Describe receiving location in detail. If a small town, mention the nearest city. How far away, and in what direction?
11. Describe weather conditions at time of reception. Clear? Rain? Humidity? Temperature? etc.
12. Comment on your hobby. How long have you listened? How many countries have you heard? What is your favorite station? If possible, tell why! In fact, give information until it hurts! The more information you give, the more likely is the postman to stop at your mail-box some morning and deposit that cherished verification!

I'm not a bit superstitious, but rather than add a "13th" item, I'll simply mention that when writing for a verification from a station, it is a good idea to request one! The station personnel are not mind-readers.

Postage is a moot question. Some writers forever shout "discourteous" about not enclosing postage, but my own experience is that any radio broadcasting station that will verify a *good* report will do so regardless of postage, and those that do not verify (Davenport, for instance) will not do so for a dozen Reply Coupons. Sometimes, on the hard-to-crack stations, I enclose a stamped, self-addressed envelope with my report, and this does bring home the bacon in most cases. (Foreign unused stamps may be purchased in most shops catering to stamp collectors.) I suggest that you play safe and enclose an International Reply Coupon with each report.

Now, here is a secret! If you really want that QSL, and if the station is a "tough one" to verify, then by all means register your report. This is especially true today when powerful belligerent nations have taken unto themselves the task of censoring mail to all parts of the world. When registering your letter, it is just as easy to make the envelope (or "cover," as the stamp collectors call a prepared envelope) appear interesting. It takes 15 cents to register a letter to most foreign countries, and 5 cents additional for postage, or a total of 20 cents. Secure seven *different* U. S. 3 cent commemorative stamps and affix these neatly to a number 10 size envelope. It costs one cent extra, but the startling effect is well worth the slight extra cost. You may be sure that when your letter arrives at the radio station, it will attract immediate attention, first, because it is registered, and there is something about a registered letter that arouses interest; and second, the stamps on your envelope will be a knockout! If the person receiving your letter is a stamp-collector, you've gained a friend for life—and a verification, too! (The different U. S. commemorative stamps may be purchased at face value at the "Philatelic Agency, Washington, D. C." A postcard request will bring the latest list.) This "registry" stunt is used by leading DX'ers everywhere, and in many cases explains that "rare" verification that no one else has!

Just one or two comments about SWL cards. Yes, I use a SWL card, too, but I never send a card unless it is accompanied by a very complete letter-report. A SWL card without a good letter-report is of little or no use to the personnel of a radio station, and in most cases these cards are simply ignored. In the report-files of the high frequency broadcasting station mentioned at the start of this article there are many SWL cards with not even one item of "Proof of reception" on them. Just, "I Hrd Ur Sigs R9 Plus. Pse QSL." Some cards vary. Some say, "I Hrd Ur Sigs R8," instead of the customary R9!

Mistakes beginners make! When you write a letter-report, do *not* use abbreviations, or even use the Radio "Q" code. If you have something to say, spell it out in full. Write "Receiver" instead of "RX," and "Interference" instead of "QRM," etc. You'll find that radio broadcast station operators are often not familiar with these abbreviations, and as a result your report will gather dust and cobwebs in the "Don't answer" file of that radio station! These abbreviations are all right—even necessary—on a SWL card, but in a good report, nix, friend, nix!

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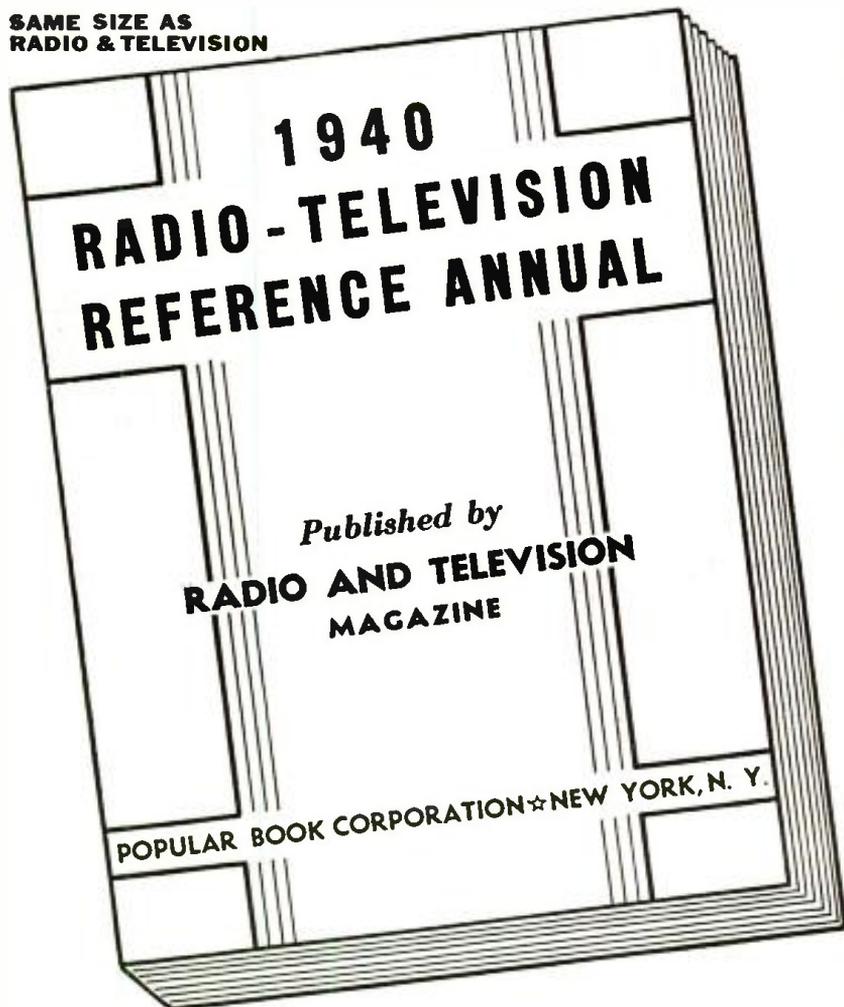
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The QUADRAFLEX

2 Tubes Do Work of 4

● THE short wave experimenter will find the accompanying circuit very interesting and rather out of the ordinary, especially in view of the fact that two 1G6G tubes actually perform the functions of four tubes. The two sets of elements in the first tube are utilized as a push-pull detector, while the two sets of elements in the 2nd tube are used to provide two stages of audio amplification. On strong signals a permanent magnet loud-speaker may be operated, while for weaker signals a pair of phones may be substituted.

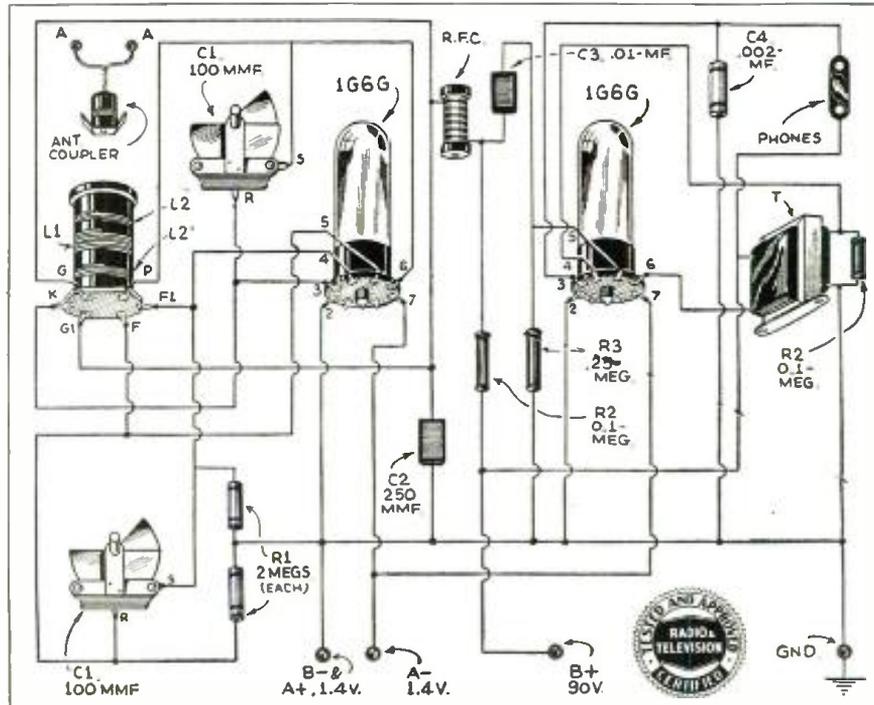
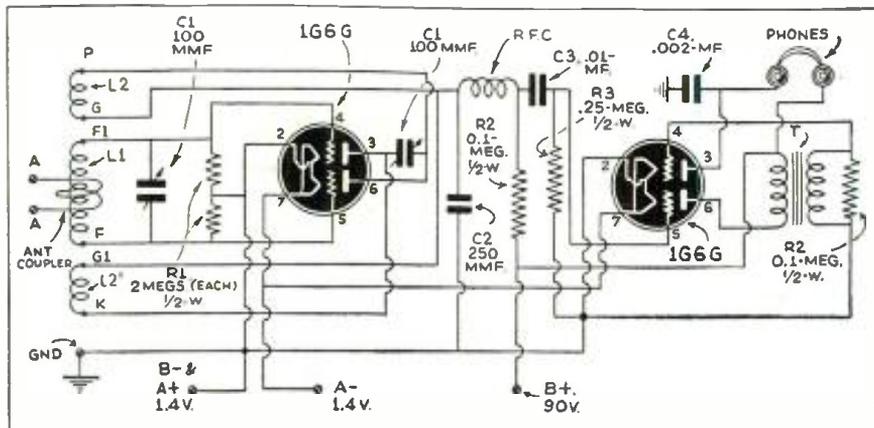
Coil data is given herewith to cover a range of 15 to 200 meters and they may be wound on regular plug-in coil forms, measuring about 1 3/8" in diameter.

The plug-in coil and its socket are mounted at the left of the baseboard; next comes the main tuning condenser and its

vernier dial and at the right of the board, the regeneration control condenser. Each of these condensers are of 100 mmf. capacity. Since both the tuning and regeneration condensers are connected in hot parts of the circuits, these condensers were mounted on small metal angles and they are rotated by means of bakelite or other insulating rods connected by means of universal couplings fastened on the shafts of the condensers. Looking along the back of the baseboard we find the audio amplifier tube, audio transformer and the power-supply plug. To simplify the connection of batteries to the set, an old 4-prong tube base may be used with 4 pieces of insulating flexible wire soldered to the prongs.

The coils, as the diagram shows, are especially made, with a split tickler winding; standard 5-prong coil forms are used.

Schematic and picture wiring diagrams are given below for the construction of the Quadraflex—an unusual 2-tube receiver.



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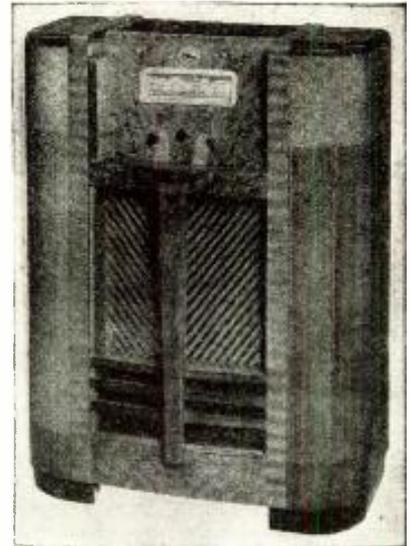
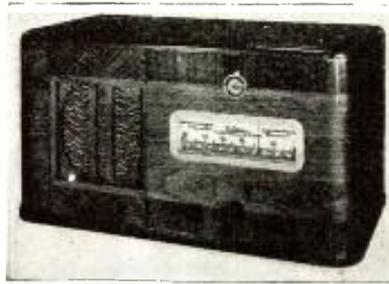


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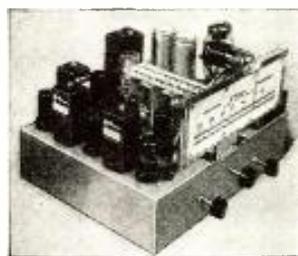
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All coils are wound with No. 30 double cotton covered copper wire, and note when winding the coils that all of the windings are to be wound in the same direction.

Here's another hint on adjusting the tickler of the regeneration windings; the tickler windings may be carefully slid closer to or further from the grid coil and in this way the inductive reaction between them changed. If too many turns of wire are used on the tickler coils, the set will be liable to act as a super-regenerator, manifested by a peculiar high pitched whistle or background noise. This type of super-regenerator, however, is very active in picking up DX stations but the background noise or whistle is usually so objectionable that the average short wave listener will not care to tolerate it. Therefore, the tickler windings may have to be a little more carefully balanced by reducing the number of turns if such an effect is heard. If the set refuses to regenerate reverse the connections to the tickler coil.

The antenna coupling may be made by means of a small plug or tube which fits inside of the grid coil form. This tube may be wound with 6 or 8 turns of No. 30 wire connected to two terminals as shown, so that if desired, a doublet antenna may be used with the set, or else a regular antenna and ground. If desired the antenna coil may be wound over the center of the grid coil, placing a piece of paper between the two. If an ordinary single wire antenna and a ground connection are used, it is desirable to place a small adjustable condenser of about 30 to 40 mmf. capacity (max.) in series with the antenna so that the aerial circuit can be tuned.

In tuning in stations the main vernier tuning dial is slowly rotated and the regeneration control knob is turned until a slight rushing sound is heard. Next the main tuning dial is moved until a station is heard. If the regeneration control is advanced a little too far the presence of a station or its carrier wave will be made manifest by a whistling sound as you turn the tuning dial, and you can then decrease the regeneration by slowly turning the control knob for this particular condenser. The main tuning dial may then have to be slightly readjusted. This procedure is for tuning in regular phone stations, but for CW or code stations the regeneration may be left quite well advanced and the set will work very well for this purpose in that (oscillating) condition.

Parts List

- 1—Set of plug-in coil forms (5-prong)
- 1—Socket to suit
- 2—1G6G tubes
- 2—Sockets for same
- 2—100 mmf. variable condensers
- 2—.1 meg. resistors, 1/2 watt
- 1—.25 meg. resistors, 1/2 watt
- 2—2 meg. resistors, 1/2 watt
- 1—250 mmf. fixed condenser
- 1—.01 mf. fixed condenser
- 1—.002 mf. fixed condenser
- 1—(about 3 to 1 ratio) A.F. transformer
- 1—R.F.C. (R.F. choke, 2 1/2 m.h.)
- 1—Vernier tuning dial
- 1—Regeneration control knob
- 1—Panel and sub-base
- 1—Pair head-phones (Cannon-ball type, etc.)

Coil Data—15-200 Meters

All Coils Close Wound, No. 30 D.C.C. Wire

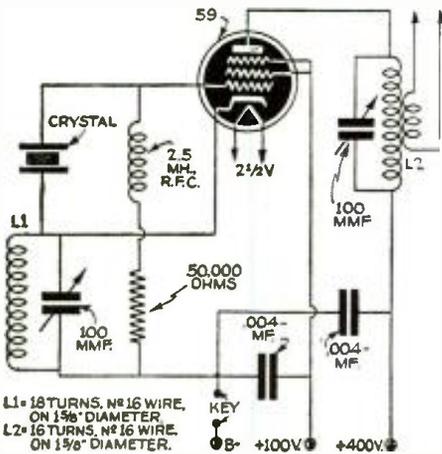
Coil No.	Grid Turns	Tickler Each Coil
Coil No. 1	5	2
Coil No. 2	11	3
Coil No. 3	20	3
Coil No. 4	45	4

Space between Tickler and Grid Coils, 1/8 inch.

Simple Transmitter

? Please show a diagram of a simple crystal-controlled transmitter using a 59 tube?—R. J. Chase, Stoneham, Mass.

A. The circuit shown is that of the "tritet". Using an 80 meter crystal, output is obtainable on either 80 or 40 meters. By shorting out the cathode coil L-1, 80 meter output is available; for 40 meter operation, the cathode coil-condenser is tuned to approximately 1½ times the crystal frequency, while the plate circuit is tuned to the second harmonic of the crystal. Coil L-1 consists of 18 turns of #16 wire, wound on a 1½" diameter form. L-2 for 40 meters consists of 16 turns of #16. For 80 meters, L-2 consists of 40 turns of #16 D.C.C. All coils are wound on 1½" diameter forms.



Hook-up for a simple crystal-controlled transmitter using a 59 type tube. This transmitter is useful only for code transmission, the key being connected in the B minus-cathode circuit.

Vibrator Power Supply

? Can you advise me as to the type or catalog number of the vibrator used in the power supply described and shown in diagram 1229, page 245, of the August issue?—J. P. Harmacy, Winfield, Alberta, Can.

A. The power supply you mention makes use of a Ford spark coil, which consists of a step-up transformer and vibrator in one housing. Were you to use a standard radio type of vibrator, it would be necessary to also employ a vibrator type of power transformer.

Condenser Question

? In the Sept. 1939 issue on page 275 there is a diagram of a 3-tube S.W. receiver. Since I am using this on 220 volts A.C. should the values of the .01 mf. condensers across the transformer primary be changed?—T. Cohn, Manila, P. I.

A. No, the same value of condenser capacity can be used on 220 volts, but make sure the condensers are rated at 400 volts.

Interference

? How can I eliminate the interference heard in my short-wave receiver and caused by an electric fan?—A. H. Moser, Winnetka, Ill.

A. The most effective way to eliminate interference is always at its source. Connect two .05 mf. paper condensers in series across the fan motor terminals, and ground the center tap of these two condensers. They should be connected as close to the motor as possible; use a good grade of condenser rated at about 400 volts, since if they become defective the house fuses will be blown.

In some cases noise in the radio receiver caused by an electric motor such as a fan, etc., can be considerably reduced if not eliminated entirely by reversing the supply wires to the motor, or else reversing the 110 volt plug feeding the radio set.

In some cases noises picked up from the 110 volt supply line may be trapped or shunted to ground at the receiver itself by

means of a filter network. These networks comprise a series of chokes and condensers with a central ground connection and have been described in previous issues, as well as in numerous radio handbooks.

Battery Charger

? I would like a diagram of a battery charger, using a type 80 or 81 tube?—W. Hughes, Long Beach, Calif.

A. Neither one of these tubes can furnish sufficient current to make it of use in a battery charger, since the rectifier tube must be capable of handling at least 5 to 10 amperes. The Tungar rectifier tubes are ideal for this purpose, although some types of home chargers make use of a vibrator type rectifier.

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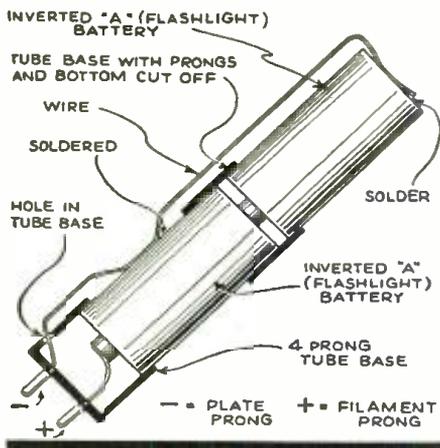


New HOWARD "490"

The Cover Kink First Prize Winner

Plug-in "A" Battery

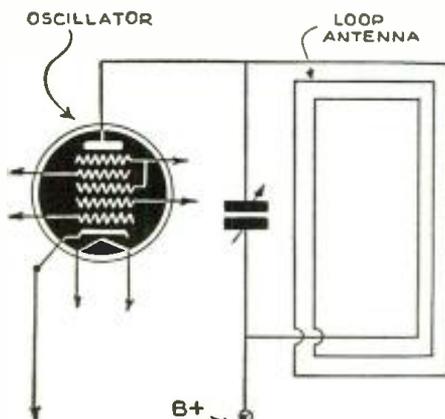
Here is a very handy plug-in "A" battery unit, which can be made up with 1, 2 or 3 cells if desired. Flashlight battery units are employed to make up this very useful device and 4-prong tube bases (or coil forms) are used in the manner shown. If only one cell is required, then a wire from one of the pins leads to the outer casing of the battery. If two cells are used to give 3 volts, then the negative pin wire leads to the outer casing of the uppermost battery, the connection between the two cells being made in the manner illustrated. This idea should prove very useful and practical for portable sets, especially those of the home-made variety, as the batteries can be quickly plugged into the set in this manner.—*Walter Koschik.*



Old tube base makes plug-in battery.

Phono Oscillator Hint

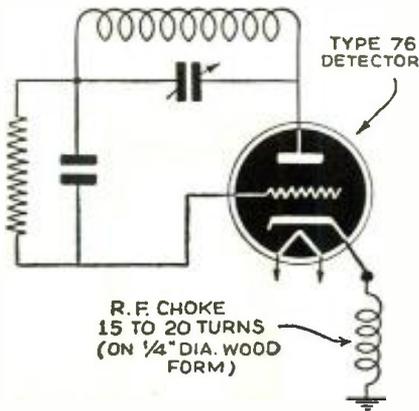
Here's an idea for eliminating much of the interference caused to neighboring radio receivers, due to the operation of your phono oscillator, if you use one. A loop antenna is inserted in the plate circuit of the oscillator tube; the loop acts as a directional radiator. Thus instead of radiating waves in all directions, the signal will be confined to only two directions. Therefore, when the loop is "aimed" at your receiver, there is just half as much chance of interference with neighboring sets as when using the oscillator's original antenna.—*Clarence P. Docken.*



Loop antenna improves phono oscillator.

2½ Meter Stunt

While experimenting on 2½ meters, I have found it in some cases to be somewhat difficult to make ordinary receiving tubes work properly in receiving circuits on this

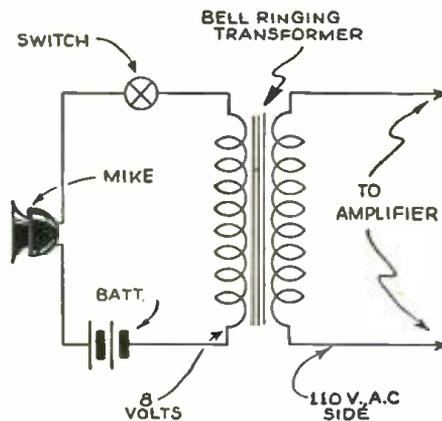


Ordinary tube for 2½ meters.

high frequency. With some experimenting I found that by winding a small 2½ meter choke, consisting of 15 to 20 turns of wire on a ¼" diameter wood or other rod, and connecting this in the cathode lead to ground, that much better results were obtained and steady oscillation was possible over the whole band.—*Gilbert J. Howie, Jr., W8TWG.*

Substitute "Mike" Transformer

If your mike transformer should burn out or suddenly become open-circuited, here is a good way to overcome the trouble mo-

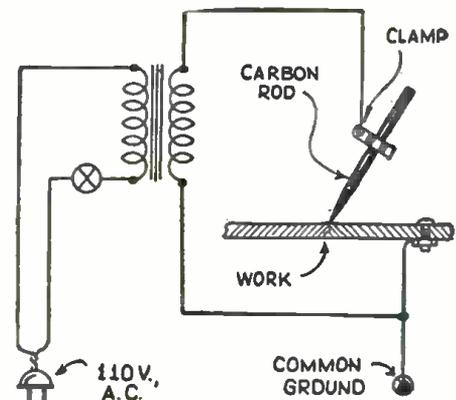


Bell transformer works with "mike".

mentarily until you can get a new transformer. Simply connect a bell ringing transformer in the place of the former unit, connecting the microphone to the low voltage or 8 volt winding, and the high-impedance 110 volt winding of the transformer to the input terminals of the amplifier, as the diagram shows. One of these bell transformers can be used as a substitute in many other locations around any radio station in an emergency, and this is a good point to keep in mind.—*Hendrick A. Williams.*

Electric Welder

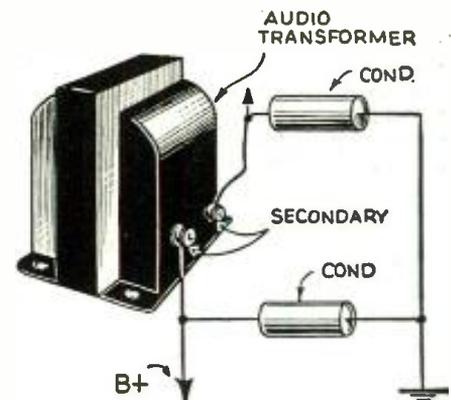
For making small electric welds I rigged up apparatus according to the accompanying diagram. I used a filament transformer having an output winding of 2.5 to 6.3 volts at 5 to 10 amps. The 110 volt winding is connected to the A.C. lighting circuit; in the secondary low-voltage circuit a carbon rod such as one obtained from a flashlight cell is used as the live electrode. The other low voltage terminal is connected to ground or the piece of metal or wire which is to be welded.—*Cecil W. Sparks.*



Carbon rod makes low cost welder.

Filter Kink

Has it ever occurred during your radio experience that suddenly you found the filter choke had become open-circuited, and you did not have a new one to connect in its place? Here is a good way to overcome the trouble until you can obtain a new choke—connect the secondary winding of an old audio transformer in the place of the burned out filter unit. If the transformer should happen to have only the primary winding in good condition, you may use it instead of the secondary; if the winding should get too hot and you have a couple of such transformers handy, connect two of them in parallel.—*Howard Sparks.*



Emergency repair for open filter choke.

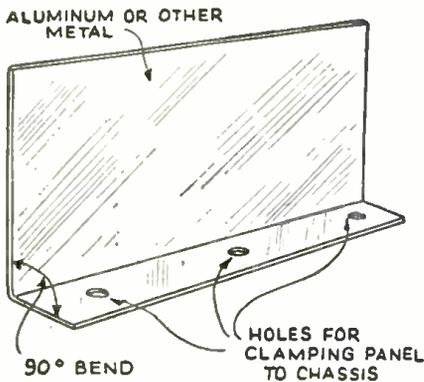
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Metal Panel Shield

Where a large metal panel is not at hand you can obtain proper shielding around tuning condensers, etc., by employing small secondary metal shields as shown in the sketch, connecting these shields to the chassis or ground. The dials may be joined to the condenser shaft through insulated couplings; it is well to leave a gap between the front wood (or other non-metal panel) and the aluminum or iron shield on which the condenser is mounted.

The efficiency of radio receivers is often greatly reduced through unwanted inter-stage coupling. However, shields such as those described should not be permitted to get within the fields of R.F. or I.F. coils.—James Laurer, Jr.



Shield aids set efficiency.

High Quality Keys

Either a straight key of the Navy type or the popular "bug" can easily be made from a Micro-switch, and these have the advantage of being completely protected and insulated for high voltage, in case they are to be used in a high voltage output circuit without relays. To make the regular telegraph key, the plunger type switch will be found more convenient. All that is necessary is to take a metal disk of convenient size and to solder to its under side a short length of tubing of a size which will fit snugly over the end of the switch's plunger. A normally open model switch should be used in this application. For making the "bug" type switch, the lever operated model may be mounted on its side, and a longer weighted lever used to replace the one provided on the switch.—Ike Berg.

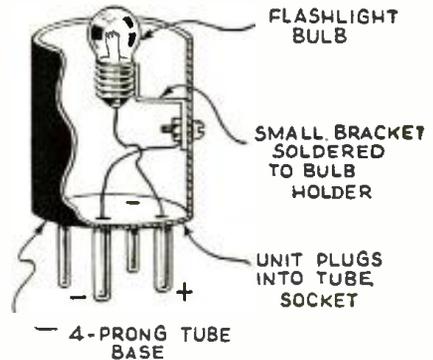
Improving "Pick-up" Volume

If insufficient volume is obtained with your present magnetic phono pick-up, here is a trick which I have used to improve the gain. The phono pick-up is connected to the primary winding of a 3 to 1 ratio audio transformer. A 50,000 ohm volume control is connected to the secondary output of the transformer. By inserting the transformer in series with the phono leads, there is sufficient step-up so that no further power is needed after connecting through the radio in the usual manner. I also found that by connecting a low capacity condenser (.05 to .1 mf. will do) across the primary winding that needle scratch was practically eliminated.—Cecil W. Sparks.

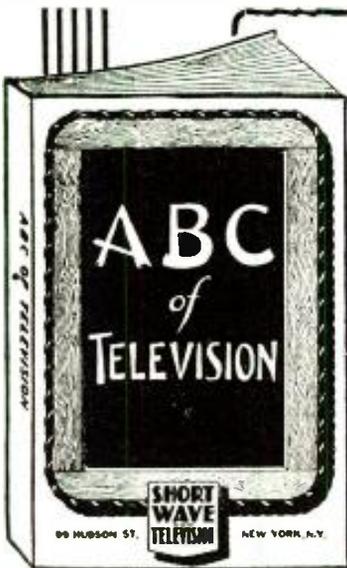
"A" Circuit Tester

After the radio beginner has hastily hooked up a new circuit to try it out, he frequently forgets or is in too big a hurry to check over his wiring of the tube sockets in the "A" circuit. This little device which plugs into the tube socket will make possible a quick check to determine if only "A" current is present in the tube wiring. If there is "B" current present in the wiring, the bulb will blow out, and the experimenter will know the set is wired wrong, thus saving a tube!

While it takes a little time and trouble to build a coil of this sort, its use will save many dollars in tubes which might otherwise be blown out through an incorrect connection in the filament circuit.—Phillip Hendricks.



Pilot light tests filament circuit.



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CHAPTER 1—The simplest television receiver; how the eye sees; its likeness to television equipment.

CHAPTER 2—Theory of scanning; the Nipkow disc and its relation to television; the photo-electric cell; neon lamps; brief description of several modern mechanical systems.

CHAPTER 3—Need for a large number of picture elements; need for broad channel width in transmission of high-fidelity television signals.

CHAPTER 4—The use of the cathode ray tube in television receivers; necessary associated equipment used in cathode-ray systems.

CHAPTER 5—How a television station looks and how the various parts are operated.

CHAPTER 6—The Iconoscope as used for television transmission in the RCA system.

CHAPTER 7—The Farnsworth system of television transmission.

CHAPTER 8—The future of television; probable cost of receivers; some expressions of opinion by prominent men; list of present television transmitters.

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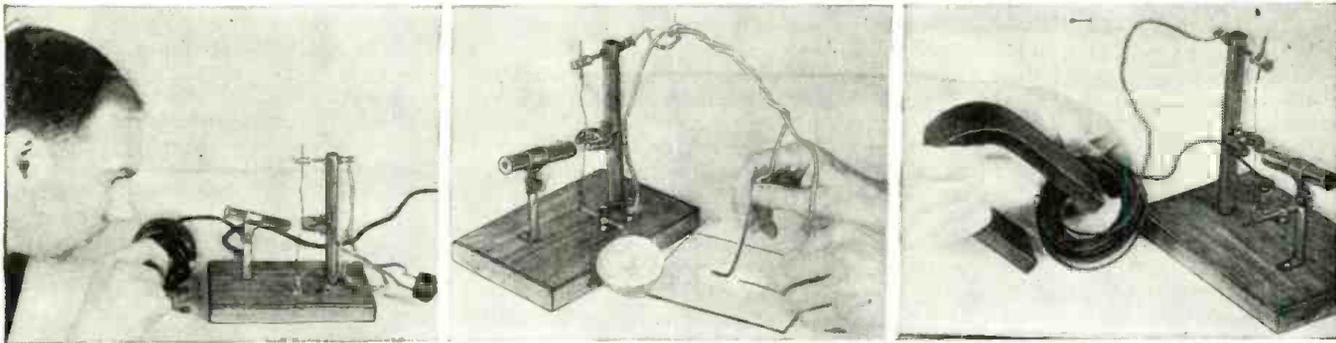


Covers hundreds of short-wave questions and answers; illustrates popular short-wave kinks; gives explicit instructions for building simple short-wave receivers; instruction on the best type of antenna installation; diagram and construction details for building transmitters.

S. W. RADIO QUIZ BOOK

This book covers questions and answers on transmitters, short-wave receivers, ultra short-wave receivers; practical kinks, wrinkles and coil winding data; novel hook-ups for experimenters; how to "hook-up" converters, noise silencers, power supplies, modulators, beat oscillators, antennas, pre-selectors and 5-meter receivers.





Left: Spinning the armature of the motor generates a current, showing that a motor is another form of dynamo or electric generator. Center: A galvanized iron wire and a copper wire connected to the string galvanometer produces a current when touched to a drop of salt water or a cut lemon. Right: A magnet thrust into a coil of wire creates a very strong electric current.

String Galvanometer

Raymond B. Wailes

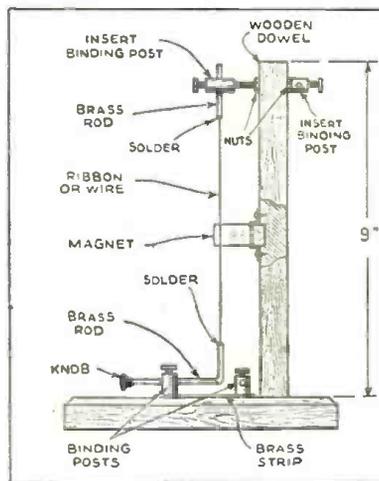
Detects Tiny Currents

● MADE from one of the small powerful nickel-alloy magnets, this string galvanometer will detect tiny currents derived in many different and often very queer ways.

The string galvanometer, Fig. 1, consists of a length of brass ribbon taken from a piece of indoor aerial wire, or a seven inch length of No. 36 or smaller copper wire, taken from the secondary coil of a spark coil, audio or bell ringing transformer. The "string," ribbon, or wire is supported as shown between the poles of a permanent magnet. When a current is applied to the "string," or wire, which must be somewhat slack, a decided movement of the wire takes place. It jumping to one of the magnet poles. The motion is easily seen with the eye but a small magnifying device of the what-have-you type will reveal small movements when extremely tiny currents are applied.

You can perform many experiments with the galvanometer. Light a small bulb from two dry cells, allowing one of the lead wires to be bare. Place wires from the galvanometer some inches apart on the bare wire, and the string will move, showing the presence of the current in the wire (Figure 2). You can also detect thermo-electric currents by twisting an iron and copper wire together at their ends, heating the twisted

junction in the flame, and applying the free ends of the wires to the galvanometer, as shown in Figure 3. If a galvanized wire is connected to one side of the galvanometer and a copper wire to the other terminal, the wires then being placed in a drop of salt water or on a cut lemon, a current is obtained, for the zinc and copper wire in the acid or saline solution make a wet cell.

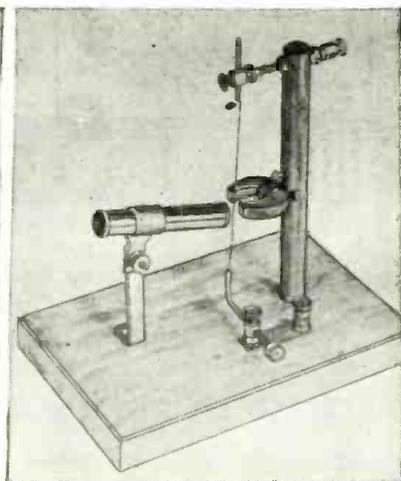
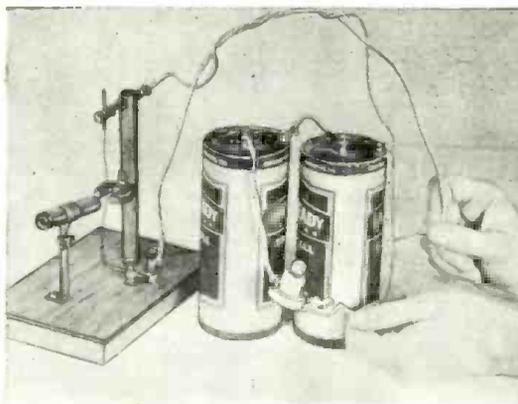
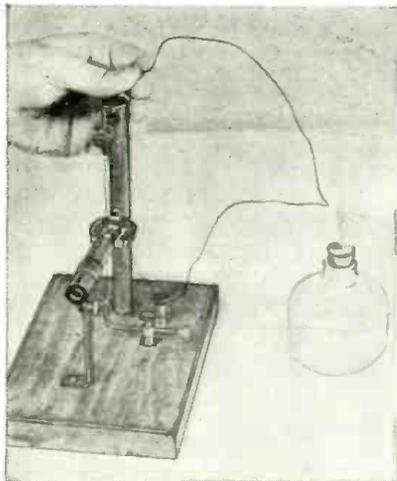


If a coil of wire is connected to the instrument and a magnet thrust into the coil, as shown above, a current can be observed to be flowing, for the wire will move. The electric generator operates on this principle. A current is also noted when the magnet is withdrawn from the coil.

Connect a motor to the galvanometer and then spin the armature with the fingers. The wire string of the galvanometer will move violently, showing that a motor can be operated to produce a current. The similarity of a motor and dynamo is thus realized. See top left photo.

The little straight and ell shaped brass rods to which the ends of the string or wire are soldered make for adjustment and placing of the wire between the poles of the magnet. Insert-type binding posts are ideal for supporting and clamping these rods. The adjustment is not critical. If the wire is shorter than 7 inches, it will be sluggish and not respond readily to tiny currents.

The string galvanometer has been used to measure and record tiny heart beat currents. The instrument employing the string galvanometer for this purpose is known as the *electro-cardiograph*. The movements of the string are recorded on a moving strip of film.

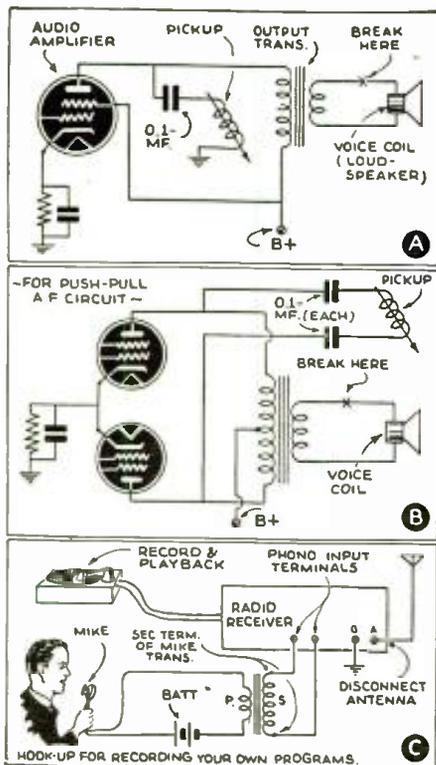


Left: A thermo-electric current is easily generated and detected. Center: The current flowing through a portion of a closed circuit can be detected. Right: Galvanometer made from a few easily obtained parts.

HOW TO RECORD PROGRAMS

THE radio experimenter often desires to record a program and the accompanying diagrams show how this may be accomplished quite easily. In diagram A, the circuit from the secondary of the output transformer to the voice coil is opened, and a switch may be used so that this circuit can be opened and closed as desired. The voice current is trapped off from the plate circuit of the audio output tube, through a .1 mf. condenser into a magnetic or other suitable type recorder. By using pre-grooved records and a magnetic recorder (pick-up) fitted with an extra weight of 6 to 10 oz. (as determined by experiment) programs may be quite satisfactorily recorded. A special recording needle is used in the magnetic pickup, for the purpose of recording, and afterwards a regular playback needle is inserted in the pickup arm for playing back the record. The terminals from the pickup are fed through the usual volume control potentiometer and possibly a coupling transformer, the output of which is connected to the "phono" terminals on the receiver.

For push-pull audio output circuits, diagram B offers a suggestion and here the voice coil circuit is opened while recording. The voice current is trapped off through two .1 mf. condensers into the pickup which is fitted with an extra weight and a recording stylus as previously described. A further extension of this idea is shown in diagram C, and here it becomes possible to talk through a mike, so the voice will be reproduced through the speaker in the set. The microphone may be a single-button affair, connected with a battery in series with the primary winding of a modulation transformer; the secondary connects to the receiver.



Several circuits for use in recording programs are shown above.

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AUTO-RADIO REMOTE CONTROL
 Designed for Ford cars, this fine remote control head may be adapted for use with most auto-radio receivers and in other type cars. Control furnished complete with two flexible cables (one for tuning and one for volume) and built-in pilot light. Flexible cables each 20 inches long. Tuning ratio is approximately 7 1/2 to 2. The on-off switch is built directly into the remote control. Over-all dimensions 3 1/2 inches wide, 3 1/2 inches high. Complete with matched knobs. Packed in original box. Shp. Wt. 4 lbs.
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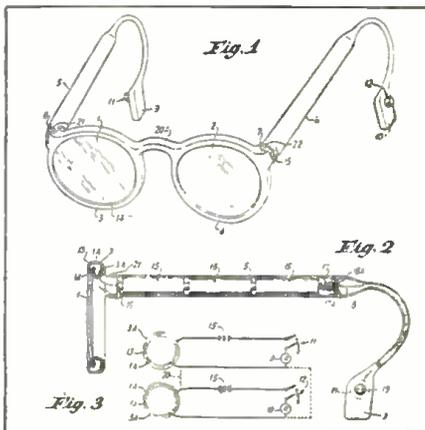
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HEARING AID DEVICE

● A PURPOSE of this invention (patent No. 2,207,705 issued to John Walter Cox) is to provide alleviation of the sensitiveness of persons who are unfortunate in having their hearing impaired. This is accomplished by combining a miniature microphone with a pair of eye glasses.

Briefly, the convenience of this invention is realized by having the ordinary lens of the eye glasses act as a pickup element or a diaphragm and combining the same with sound amplifying equipment into one unit. The sound reproducing mechanism is attached to or incorporated in the ear gripping portion of the temple of the eye glasses. The battery used in connection with the microphone and sound reproducing mechanism is incorporated in a hollow portion of the (side) frame of the eye glasses.



New idea combines spectacles with hearing aid.

This invention requires little or no connecting wires and maximum efficiency is obtained from the sound pickup system, for the reason that the area supplied by the lens of the spectacle and the proximity of the speaker's mouth to the lens gives maximum pickup energy through miniature microphone or microphones.

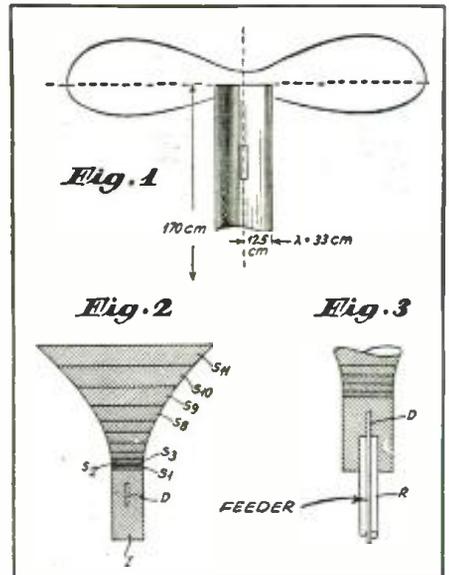
Another feature of this invention says the inventor is that it serves the dual purpose of providing spectacles with the proper lenses to correct any impairment of the sight and also assists in the hearing of either one or both ears.

SPACE RESONANCE ANTENNA

● THIS patent, No. 2,202,380 on a space resonance antenna was issued to Hans E. Hollmann, Berlin, Germany, and assigned to the Telefunken Company. If a radiating antenna or radiator, say, a dipole, is mounted inside a space which is practically completely closed and which has metallic boundary walls, provided that the space is of such proportions that standing waves will be set up therein, the space will act in respect to the antenna like a sounding board. The result is that the coupling between the antenna and the ambient air space is reinforced and thereby the radiation of the antenna is effectively increased.

Preferably the enclosing wall should be in the form of a hollow cylinder, in the axis

of which the antenna is disposed, the terminating surfaces or faces of this enclosure being closed either at one end or at both. If desired both ends may be left open.



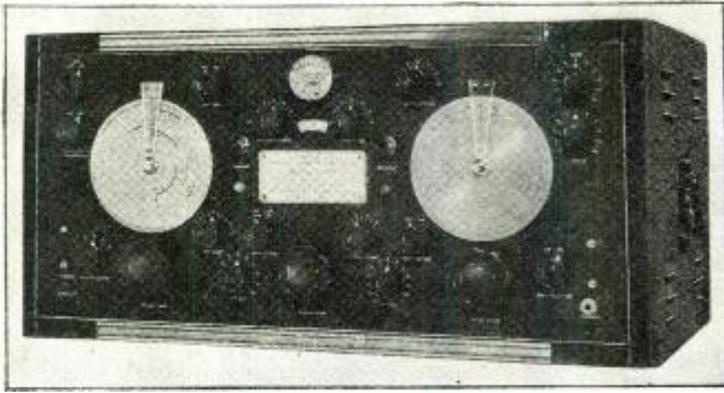
A space-resonance antenna.

It is suggested, according to another object of the invention, to fill the resonant space with a low-loss medium possessing a high dielectric constant.

Fig. 3 finally shows an arrangement for the purpose of feeding the antenna D in the simplest manner, through a concentric or coaxial feeder line R, terminating in the funnel from below. The middle conductor projects beyond the outer sheath of the feeder line and constitutes the antenna proper. Such a funnel antenna may be mounted upon the feeder line with additional support, thus providing an extremely simple and effective non-directional radiator. Of course, if desired, there is no difficulty in mounting the funnel antenna in the focus or in the focal line of a suitable reflector, in order that the radiation may be concentrated in the equatorial plane.

SHORT WAVE RESONANT CIRCUIT

● THIS unique ultra-high frequency circuit arrangement comprises two metal cups mounted on an axial tube and having a semi-spherical or rectangular cross-section like that shown. The axial tube together with the two metal cups in each of the designs constitutes the inductance of the oscillatory circuit, while the two flanges represent the capacity component of the circuit. It was found that such a circuit oscillates in an almost quasi-stationary manner, i.e., in the center of the hollow body a voltage node and current loop appear, while the voltage maxima appear at the two flanges. It was found further that such circuit design provides an excellent stability in the frequency, because thermal expansions will be compensated for. Another advantage is that owing to the comparatively large peripheral size, this type of circuit may be excited with several oscillator tubes,



One of the most elaborately engineered communications type receivers is this 26-tube Scott. It has 9 tuning ranges, from 4.68 to 2142 meters, including the broadcast band, with ample overlap. Features are variable selectivity; calibrated tuning meter; separate oscillators; noise-limiter; exceptional band-spread; audio-tone control; and 2 tuned R.F. stages on all bands. Loudspeaker or phones may be used.

Front view of the Scott 26-tube communications receiver which has many new and unusual features.

26 Tubes Give Surprising DX Range to

New SCOTT *Communications*

RECEIVER

● ONE of the most ambitious designs so far developed for a communications type receiver, capable of covering all of the usual short-wave and broadcast bands, plus a long wave band, is the 26-tube Scott receiver here illustrated and described. This receiver will prove a valuable asset to all dyed-in-the-wool *short-wave* Fans, as well as Hams, as it permits one to not only powerfully amplify a weak distant signal—thanks to the 2 R.F. stages used on all bands, but due to the careful and complete design of the receiver, the signal can be nursed along until it is in just the proper condition to impress on the loud-speaker. A doublet aerial of the type recommended and supplied by the manufacturers of this receiver should be used with it, for maximum results; an antenna compensator condenser provides a means for tuning the antenna circuit for maximum gain and signal-to-noise ratio, on all short-wave bands.

This report covers the features and performance characteristics of the new 26-tube Communications Receiver, which provides an unusually wide frequency coverage with high performance standards essential to this type of service. The frequency coverage

ratio is approximately 460:1, extending from 140 kc. to 64 mc. in 9 tuning ranges (2142 to 4.68 meters), as outlined here:

Range	
I	140 kc. to 395 kc.
II	520 kc. to 1710 kc.
III	1.7 mc. to 2.9 mc.
IV	2.8 mc. to 4.9 mc.
V	4.8 mc. to 8.1 mc.
VI	7.9 mc. to 13.9 mc.
VII	13.0 mc. to 22.1 mc.
VIII	20.1 mc. to 37.0 mc.
IX	33.3 mc. to 64.0 mc.

It will be noted that ample overlap is provided between each tuning range and that the only gap occurs around the intermediate frequency point.

The tube complement is employed in the following manner:

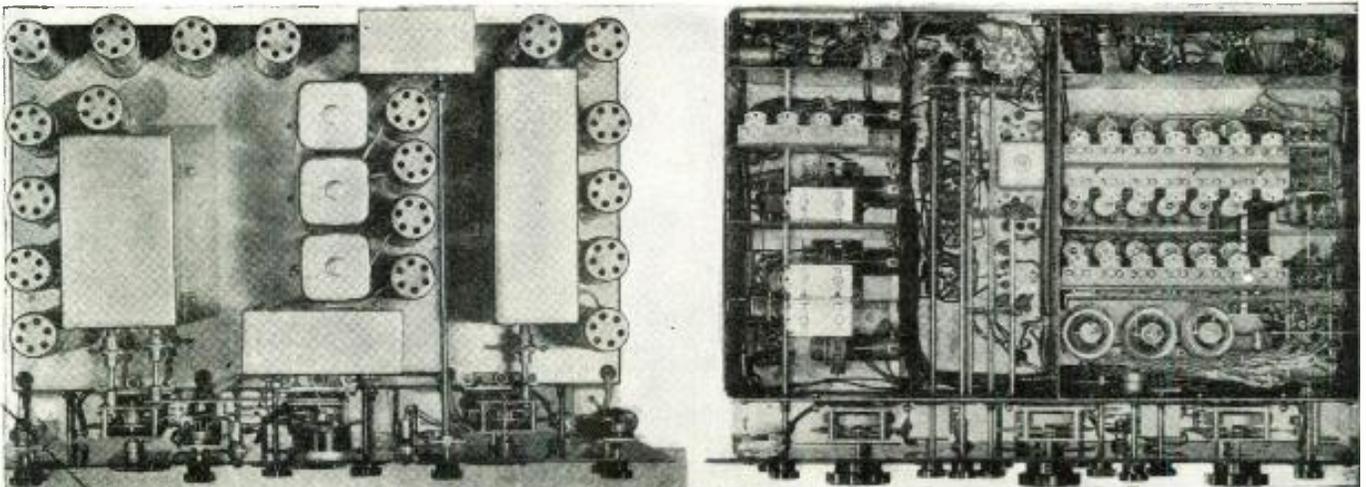
- 2 Type 6U7G—broadcast & long wave R.F. Amplifiers
- 1 Type 6L7G—broadcast & long wave mixer
- 1 Type 6J5G—broadcast & long wave oscillator
- 2 Type 6U7G—short wave R.F. amplifiers
- 1 Type 6L7G—short wave mixer

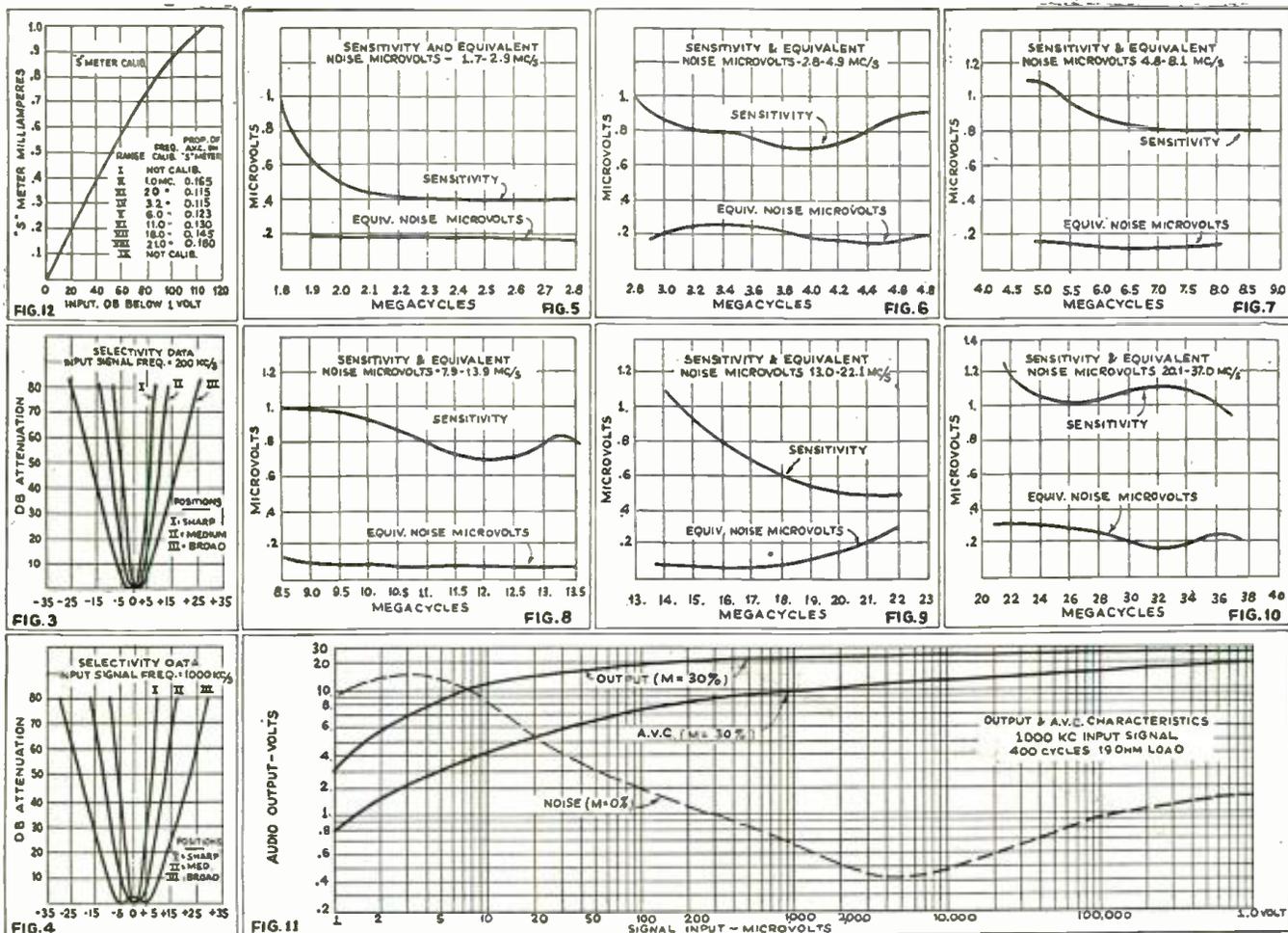
- 1 Type 6J5G—short wave oscillator
- 3 Type 6K7G—i.f. amplifiers
- 1 Type 6B8G—a.v.c. i.f. amplifier & a.v.c. detector
- 1 Type 6B8G—audio signal detector & beat frequency oscillator
- 1 Type 6K7G—1st audio amplifier
- 1 Type 6J5G—phase inverter
- 2 Type 6J5G—audio driver amplifiers
- 2 Type 6L6G—audio output amplifiers
- 1 Type 6B8G—static and scratch suppressor
- 1 Type 6J7G—static and scratch suppressor
- 1 Type 6J5G—tuning meter amplifier
- 1 Type 6H6G—noise limiter
- 1 Type VR150—oscillator—voltage regulator
- 2 Type 5U4G—rectifiers

The following features are incorporated in this receiver:

1. Two Tuned R.F. Stages on all bands to provide maximum signal-to-noise ratio as influenced by the receiver.
2. Super Shield Antenna Coupling System on all important bands. This system uses a special method of electro-static shielding and electro-magnetic coupling be-

Top and bottom chassis views of the 26-tube communications receiver.





The graphic curves above show some of the unusual selectivity and sensitivity features of the new 26-tube communications receiver. Fig. 11 shows the input-output characteristic of the receiver, while Fig. 12 shows calibration data for the "S" tuning meter.

tween the primary and secondary of each antenna transformer, thereby eliminating practically all noise voltage picked up in the lead-in under the most severe conditions.

3. Separate R.F. and Mixer Channels with separate variable condensers are used for the low frequency bands and the high frequency bands. The optimum stage gains are possible only under these conditions.

4. Electrical Band Spread Tuning is provided for all high frequency bands. Accurate logging and ease of tuning are assured by a stable mechanical drive arrangement developed in our laboratories.

5. Three degrees of variable selectivity are incorporated in the normal I.F. system and six degrees of crystal selectivity are added to allow a choice of the most suitable bandwidth for given interference conditions.

6. Diode type Noise Limiter effectively reduces ignition and other types of peak impulse noise when weak signals are being received.

7. Beat Frequency Oscillator at the intermediate frequency with variable pitch control permits detection of the weakest possible signals.

8. A circuit developed for the elimination of surface noise and needle scratch from records is incorporated because of its ability to improve the signal-to-noise ratio on weak radio signals with respect to high frequency hiss and static. This system is known as the scratch suppressor.

9. R.F. Gain control permits the selection of a sensitivity level for maximum signal-

to-noise ratio, and an adjustment of the tuning indicator to correct reference level.

10. Antenna Compensator Condenser provides a means for tuning the antenna circuit for maximum gain and signal-to-noise ratio on all short wave bands. Possible detuning by various types of antenna systems may be compensated for by this control.

11. A calibrated Tuning Meter is included so that the operator will know the relative strength of all received signals in terms of DB and R level.

12. Audio Tone Controls for both low and high audio frequencies allow a choice of the most desirable audio range for a given type of program, and thus permit an even more favorable signal-to-noise ratio than that obtainable by the most effective use of the selectivity control.

13. An Audio system of wide range fidelity characteristics allows the listener to obtain the maximum frequency range on the broadcast band, and the high power handling capacity of the system provides a remarkable volume and tonal range.

14. Provision is made for the use of phones or loudspeaker.

15. AVC Switch permits removal of AVC voltage for weak signal or code reception.

16. Three stage I.F. amplifier provides gain and selectivity adequate for all reception conditions.

17. Stable Separate Oscillators at low and high frequencies insure accurate dial calibration at all points.

18. Rugged mechanical construction of chassis and all components insures freedom from drift or alteration of characteristics.

Performance Curves

In figures 3 and 4 selectivity data for the long and medium wave bands is plotted. Positions I, II and III are the result of varying the electrical coupling of the I.F. transformer and do not include crystal selectivity. The selectivity data for 1000 kc. will apply to all of the high frequency bands, because it is determined chiefly by the intermediate frequency amplifier in the range in which it is plotted here.

In figures 5 to 10 sensitivity* and noise data are plotted for several bands. The sensitivity data given here is not an indication of the maximum sensitivity obtainable from this receiver, but has been measured by retarding the sensitivity control to approximately .7. By rotating the sensitivity control in the clockwise direction the sensitivity can be increased, up to the noise level plotted below the sensitivity curve. However, the data shown here represents a usable level of high sensitivity in which the desired signal is somewhat above the noise level.

In figure 11 the input-output characteristic of the receiver and its AVC characteristic are shown.

In figure 12 calibration data for the "S" tuning meter is shown to hold accurately on all of the important frequency bands.

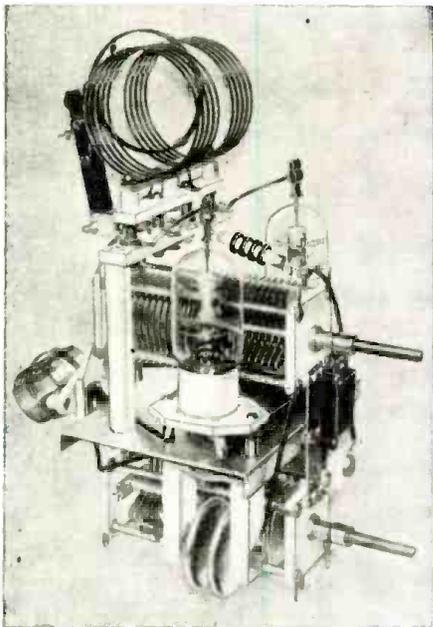
*Sensitivity for .5 watts output.

Power Amplifier Foundation Unit

• THE new Hammarlund "PA-150" power amplifier foundation unit is compact and efficient and designed to appeal to the amateur who wants to have the pleasure of building his own equipment. The "PA-150" uses small high efficiency tubes and is built around a new type of variable condenser.

These condensers have completely insulated rotors. Even the control shaft is insulated. This type of condenser design permits the high voltage to be applied directly to the rotor, thus allowing increased voltage for a given plate spacing.

Operated under normal conditions the output of the amplifier, with type HK-24 tubes is in the neighborhood of 175 watts. That is quite a bit of power to obtain from a unit only 11½" high x 8" deep and 5½" wide. The variable condensers are Hammarlund type "HFBD-100-C" and will operate safely with 2,000 volts applied to the tubes for



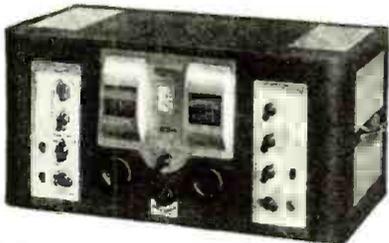
New Power-Amplifier Assembly

CW operation, or 1,000 volts 100% modulated for phone operation.

The method of assembly is quite simple. Everything is mounted either above or below the main shelf which comes completely drilled and shaped. Wiring, too, is very simple. A suitable driver for this unit would consist of a single 807 operated either as oscillator or as buffer-multiplier. Actual excitation requirements amount to approximately 10 watts.

New Howard 490 Receiver

• THIS new Howard 490 communication type receiver is designed for the advanced amateur, short wave listener and commercial operator. It features fourteen tubes, coverage in six bands, from 540 kc. to 43.5 mc. (550 to 7 meters), calibrated band spread, variable selectivity I.F., vari-



able fidelity audio system, temperature compensated oscillator, air tuned I.F. transformer and split stator ceramic insulated tuning condensers.

3-in-1 Portable Communications Receiver

• SOMETHING distinctly new in receiver equipment is the Hallicrafters Model S-29 "Sky Traveler", which combines the universal convenience features of the modern 3-in-1 portable, with those of a really good communications receiver. It therefore constitutes an ideal unit for use in Ham, commercial or all-wave broadcast services—at sea, ashore or in the air.

The "Sky Traveler" is housed in a crackle-finished aluminum case with carrying handle, 7 inches high, 8½ inches wide and 13¼ inches

for October, 1940

10 BEST RADIO BOOKS 10¢ ea.

RADIO FANS EVERYWHERE—these fine ten cent text books give you an excellent foundation for the study of RADIO. They are clearly written, profusely illustrated and contain over 15,000 words in each book. You'll be

amazed at the wealth of information contained in these handy books. Excellent for reference—ideal for every technical library. **YOUR MONEY BACK** if you are not satisfied. **PROMPT SHIPMENTS**



No. 1 HOW TO BUILD FOUR DOERLE SHORT WAVE SETS

Thousands of radio fans have built the famous DOERLE Short Wave Radio Receivers. So insistent has been the demand for these receivers, as well as construction details, that this book has been specially published. Contains **EVERYTHING** that has ever been printed on these famous receivers.

No. 2 HOW TO MAKE THE MOST POPULAR ALL-WAVE 1- and 2-TUBE RECEIVERS

This book contains a number of excellent sets, some of which have appeared in past issues of RADIO-CRAFT. These sets have been carefully engineered. They are not experiments. Not only are these sets described in this book, but it contains all of the illustrations, hookups, etc.

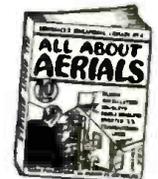


No. 3 ALTERNATING CURRENT FOR BEGINNERS

This book gives the beginner a foothold in electricity and Radio. Electric circuits are explained. Ohm's Law, one of the fundamental laws of radio, is explained; the generation of alternating current; sine waves; the units—volts, amperes, and watts are explained. Condensers, transformers, A.C. instruments, motors and generators.

No. 4 ALL ABOUT AERIALS

This book explains the theory underlying the various types of aerials; the inverted "L", the Doublet, the Doublet, etc. It explains noise-free reception, how low impedance transmission lines work; why transposed lead-ins are used. It gives in detail the construction of aerials suitable for long-wave broadcast receivers, for short-wave receivers and for all-wave receivers.



No. 5 BEGINNERS' RADIO DICTIONARY

Are you puzzled by radio language? Can you define Frequency? Kilocycle? Tetrad? Screen grid? Buffer? Anode? Triode? Pole? Ionization? Joule's Law? Harmonic? Gravity Cell? If you cannot define these very common radio words and dozens of other, more technical, terms used in all radio magazines and instruction books, you need this book in your library.

No. 6 HOW TO HAVE FUN WITH RADIO

Stunts for parties. Practical jokes, scientific experiments and other amusements which can be done with your radio set are explained in this fascinating volume. It tells how to make a newspaper talk—how to produce silent music for dances—how to make visible music—how to make a "silent radio" unit, usable by the deafened—how to make toys which dance to radio music, etc., etc.



No. 7 HOW TO READ RADIO DIAGRAMS

All of the symbols commonly used in radio diagrams are presented in this book, together with pictures of the apparatus they represent and explanations giving an easy method to memorize them. This book by Robert Elchberg, the well-known radio writer and member of the editorial staff of RADIO-CRAFT Magazine, also contains two dozen picture-wiring diagrams of simple radio sets that you can build.

No. 8 RADIO FOR BEGINNERS

Hugo Gernsback, the internationally famous radio pioneer, author and editor, whose famous magazines, RADIO AND TELEVISION and RADIO-CRAFT are read by millions, scores another triumph with this new book. Any beginner who reads it will get a thorough ground work in radio theory, clearly explained in simple language, and through the use of many illustrations. Analogies are used to make the mysteries of radio clear.



No. 9 SIMPLE ELECTRICAL EXPERIMENTS

Over 100 interesting and practical electrical experiments are described in this book, covering every branch of electricity—from simple experiments with magnets to high frequency "atuns." All of the experiments described can be carried out with simple apparatus, most of which can be found about the home.

No. 10 TELEVISION

Every one is asking the question: How does television work? This book explains all of the different systems of television from the simplest to the most complex. It describes in A-B-C style just how the image is scanned, how the scene is picked up by the television camera and broadcast to your home, etc. Various types of television systems are described.



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deep. The weight with self-contained batteries is 18 pounds. Operation is from any 110-volt A.C. or D.C. line or from the batteries. Battery life is prolonged by a "built-in" charging circuit, with the result that one set of batteries provides approximately 100 hours service.

Nine tubes provide one R.F. and two I.F. stages, mixer, detector and A.V.C., two audio stages, beat oscillator, automatic noise limiter, and line rectifier. The tuning range is continuous from 542 kc. to 30.5 megacycles in four steps and electrical band-spreading is provided for all parts of this range. Sensitivity averages better than 2 microvolts in all ranges.



The complete adaptability of this receiver for all types of service is indicated by the number of controls, the inclusion of both built-in speaker and headphone jack, a collapsible rod antenna socket mounted on the case plus external antenna connections for both doublet and "L" antennas. Controls include separate main and band-spread knobs and dials, R.F. gain, A.F. gain, band switch, power switch, A.V.C. off-on switch, B.F.O. off-on switch, noise limiter off-on switch, and send-receive switch.

Two New RCA Receivers

• THE new RCA Victor "Pick-Me-Up" model 15BP-3 features: five preferred type tubes, battery-A.C.-D.C. operation, low operating cost, built-in magic loop antenna, specially developed five-inch permanent-magnet dynamic loudspeaker and a durable woven fabric covering. Height 11 $\frac{1}{4}$ inches, width 11 $\frac{3}{4}$ inches, depth 6 $\frac{1}{4}$ inches.

Their new table model 18-2 (one among many new ones) features: eight preferred type tubes, newly styled push-buttons for stabilized automatic electric tuning, American and foreign reception, new three-band edge lighted dial, built-in magic loop antenna, four point tone control, plug-in for Victrola or television attachment. Cabinet top, dial and grille frames are of solid walnut, body of walnut veneer with a band of maple veneer. Height 12 $\frac{1}{4}$ inches, width 17 $\frac{1}{2}$ inches, depth 10 inches.



NEW CATALOGS

Lafayette 1941 Master Catalog

● LAFAYETTE RADIO CORPORATION (formerly Wholesale Radio Service Co., Inc.) now have their "Master" catalog for 1941, Number 82, ready for distribution. One of the biggest "books" ever issued by this concern, its 196 pages are brimming with items to meet every possible radio requirement. One of the most comprehensive radio buying guides published, this handsome new catalog with its four-color covers features 32 pages of the latest Lafayette radios and radio-phonograph combinations, in addition to several new types of its unique "Radiocorder" home recorder. Thirty-two pages are devoted to Lafayette's new line of public-address equipment; 96 pages are given over to every possible type of radio equipment, parts and tools for the serviceman, experimenter and set builder. Thirteen pages of test instruments for all purposes are included. The "Ham," F.M. and television fan will find over 25 pages devoted to the latest equipment for short wave and u.h.f. work. Three pages list the latest type of fluorescent lighting fixtures for home and industrial purposes.



A postcard will bring this catalog to any of our readers, without charge.

Bud Radio

● THE new 40-page catalog recently issued by Bud, No. 141, contains a great assortment of radio parts, with complete descriptions and pictures. Among the parts of interest to short-wave set builders and Hams, we find kits for transmitters, wave meters, code practice oscillators, etc. Among the parts there are transmitting condensers of all types, receiving condensers, coils for both receivers and transmitters, metal cabinets and racks, all types of R.F. chokes, microphone stands, tuning dials, radio knobs, crystal holders, toggle switches, jacks and plugs, etc.

Massachusetts Television Institute

● A NEW catalog has just been received from the Massachusetts Television Institute of Boston, Mass., which illustrates and describes the school and its instructors, and includes a description of their "technicians" course" for electrical communication, also the "communication engineering" course. This school also offers a home study radio course. Among the members of the school's advisory board are: Philo T. Farnsworth, Greenleaf W. Pickard, and John L. Barnes, The Dean of the school is A. M. Morgan.

New Allied Radio Catalog

● THE Allied Radio Corporation has just released a new 212-page radio catalog for 1941. Planned to include everything in radio, this new catalog is the largest and most complete yet issued by this concern. Carefully arranged, this new 212-page catalog features each radio field in individual, clearly defined sections. Each section and each piece of radio equipment is indexed for speedy reference.

The big special 40-page radio section introduces 83 new radios featuring new style plastic and wood table models, consoles, "Camera" and 3-way portables, newest 1941 low-cost phono-radios and phono-radio-recorder combinations, auto sets, record players, and a large, complete selection of phono and recording accessories.

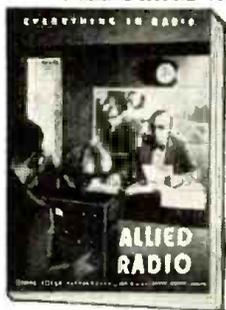
In the 35-page Public Address section are featured 24 complete new sound systems. There are systems ranging from 7 to 75 watts and incorporating many new features such as illuminated panels and new speaker development. Also listed in this section is a complete line of the latest P.A. accessories.

For Servicemen a 128-page section devoted to new test equipment and more than 15,000 radio parts. There are sections devoted to photo-cell equipment, latest books and manuals.

For experimenters and set-builders, there is an unusually complete section featuring the latest in kits, accessories, projects and diagrams.

Amateurs will find the latest Communication Receivers and Transmitters and parts of every description for "Ham" use.

A copy of this 212-page catalog may be obtained free.



COMMERCIAL NOTICES 10¢ A WORD

Under this heading only advertisements of a commercial nature are accepted. Remittance of 10¢ 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 sampler. 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.

DIATHERMY MACHINES

D I A T H E R M Y. 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, P.O. Box 56, Teaneck, N. J.

INSTRUCTION

BE AN AUTO NOISE SUPPRESSION specialist! Complete, compact treatise \$1.00. Unique! Nothing else like it. Details free. Jenkins, 392T, Elmira, N. Y.

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trical text-book bargains—see list. Life of Napoleon, 3 de luxe volumes \$3.00. \$10.00 New Cyclopaedia of Science, 1300 pp. \$1.50; Hopkins "Experimental Science," 2 vols. \$3.50. Harry Ackerson, Box 322, Ramsey, N. J.

MOTORS

RECONDITIONED MOTORS, 1/50 H.P. AC/DC, Nickel \$1.50; 1/30 H.P. truck \$2.50. Fully guaranteed. F.O.B. New York; Wonderful value limited quantity. Act Promptly! Gold Shield Products, Dept. 104, 330 Greenwich St., New York City.

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, Allvine & Rommel, 436 Bowen Building, Washington, D. C.

FOR SALE (NON COMMERCIAL) 3¢ A WORD

Under this heading we accept advertisements only when goods are offered for sale without profit. Remittance of 3¢ 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.

FOR SALE, HALLICRAFTERS 8-9 \$17.00 postpaid. SW3, five sets of coils and homebuilt power-pack \$15.00 postpaid. Supermultiset used. Little \$9.00 postpaid. Bill King, 942 Tower Rd., Winnetka, Ill.

als, Hammerlunds, Howards, RAIFs, and all other makes and models at lowest prices. Free Trial. Terms. Write for free list. W3ARA, Butler, Missouri. SELL—COMPLETE 30 WATT FONE-c-w. Transmitter, \$18.00, W2EJQ, 50 Cleveland Street, White Plains, N. Y.

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. Merchandise and other goods are not included; therefore we charge only 1¢ 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 in all these transactions. If you are bound by the U. S. Postal Laws, Describe anything you offer accurately and without exaggeration. Treat you 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.

TRADE AUTO, MIDGET OR FLOOR model radios, new or used, for cameras or equipment. Fred Harvey, 4533 Sheridan Road, Chicago, Ill.

SIX-RAND HOME-BUILT COMMUNICATIONS superheterodyne, 110 V. D.C. to A.C., 250 W. Inverter, new; 85—Ralston Radio Code Course—Crosley electric radio—3/4 H.P. gasoline engine. Wanted: Radio parts or Harry Parker, Sylva, N. C.

WILL TRADE THE FOLLOWING: Readrite Volt, Ohm, Mill, Meter, Model 735—Supreme tube tester model 85—Ralston Radio Code Course—Crosley electric radio—3/4 H.P. gasoline engine. Wanted: Radio parts or Harry Parker, Sylva, N. C.

WILL EXCHANGE NEW RADIO receiving and transmitting parts, tubes, receivers, Rider's Manuals, etc. for old U.S. stamps. Major Fred Luther Kline, Kent, Ohio.

TRADE: TUBES, TRANSFORMERS, meters, transmitting parts, receivers, relays, magazines, mikes. No junk. Have big lot, must dispose. Write for list. All answered. Exchange scientific experimental results. W910N, 3940 Greishaw, Chicago, Ill.

WANTED: WILL PAY CASH FOR Rider's Manuals, new parts, tubes, anything new in radio. Will answer all mail. Joseph Gevardo, 159 Sabin St., Pawtucket, R. I.

WILL PAY CASH FOR REVISITED Third Edition Hammarlund Comet-Pro Instruction book. Form number 107-W. Sixteen pages. George Britting, Middletown, N. Y., R. D. No. 1.

WANT SKYRIDER, HATCHER'S & McGivern's Books, 32/20 Remington Rifle, 410 Savage Single, 16 Savage with polychoke, 38/40 or 44/40 Remington Rifle with poor barrel. Have 410 Skeet Winchester, slights, parts, books, National Geographic & American Rifleman, Lake resort lots, etc. R. Welker, 406 N. Harvey, Oak Park, Ill.

HAVE JENSEN 10" SPEAKER, Maxtel cabinet, tubes, books. Trade for records, phono motor or what have you? Walter Robinson, 3210 E. 13th, Kansas City, Mo.

HAVE 3 1/2" x 4" AUTO GRAFTLEX H. & L. Tessar Lens, about 25 blocks nmt U.S. Comm. stamps, RCA Radio, etc. Want good 2 1/2 square Camera, Bee Bee or Itecom, or Michael Gianfresco, 604 Union Ave., Providence, R. I.

TRADE: TUBES, TRANSFORMERS, meters, transmitting parts, receivers, relays, magazines, mikes. No junk. Have big lot, must dispose. Write for list. All answered. Exchange scientific experimental results. W910N, 3940 Greishaw, Chicago, Ill.

HAVE BRITISH ARMY CAMERA, resembles Lewis Machine Gun in appearance. View Camera; (One Kodak; U. S. Army Air Service Motion Picture Gun Camera uses standard 35 mm film. Want old Guns, Victorio, 1023 Second Avenue, New York City.

WANT LATEST N.R.I. RADIO course. Have Ghirardi's Radio Physics, R.T. Servicing course, R & T Magazines, Transformers, flat back Mandolin and case, Tennis racket, camera and ready cash. Mac Rosenblatt, 853 E. 178th St., Bronx, N. Y.

WANT SKY BUDDY OR SKY Hampton, Code Course, servicing equipment and radio parts. Have 3 mm. Movie Camera, Tildou DeBruce, Big Sandy, Tenn.

ATTENTION: NEED 125 RADIO, Science, Photography magazines; broadcast, short wave midget table, console radios; many transmitting, receiving tubes, parts, general radio items. Swap for radio, photographic items or? Lists, Ladue, Parkway Court, Long Beach, N. Y.

WANTED: RADIO TEST EQUIPMENT, Oscilloscope, Rider's Manuals, Binoculars, Ghirardi's Physics course, and Tripod, Projectors, Lenses, Speakers. J. C. C. Co., M-G Set, many other articles. S. S. Karkula, Falconer, N. Y.

SMALL PRINTING PRESS AND equipment in exchange for portable typewriter, camera, or? Address: Church Press, Stanley, Wis.

HAVE: ONE TUBE RADIOS, CRYSTAL sets, Metal Locator. Want: Books on Art, Signs or what. John Hayes, 100 E. Hum, Missouri.

WANT FB-7 COILS, TOM SILVAGLO, 50 Steuben St., Providence, R. I.

HAVE PHONO OSCILLATOR, NEW tubes, speakers, crystal radio, cameras, book matches, panorama, etc. Want projectors, films, reels, rewinds, splitters, etc., in either size, 8 mm or 16 mm, Swap lists. Daily, 905 Reddick, Mishawaka, Indiana.

RCA AUTOMATIC RECORD PLAYER, complete with amplifier, relay system, motor, arm and record changer, needs some work. Trade to the best offer. Jos. Kubik, Gt. Barrington, Mass.

TRADE—187 CHEMICALS, WORTH \$20.00 for Phonograph, Radio or photographic supplies. David Weiss, 144 Columbia St., New York, N. Y.

WANTED: POWER PACK, COIRE-SPERRY electronic, test instruments. Jerry Erickson, Amersy, Wisconsin.

UNITED STATES PAUL F. BAIHR, 1205 W. 10th St., Marion, Indiana

AUTOMATIC CODE SENDER WITH Punched and blank tapes. Practically new. Swap for transmitting or receiving equipment. E. Christensen, 3917-43rd Ave. So., Minneapolis, Minn.

WANTED: ONE TUBE RADIOS, CRYSTAL sets, Metal Locator. Want: Books on Art, Signs or what. John Hayes, 100 E. Hum, Missouri.

GLIBERT BURNS, 2605 Q Street, Bakersfield, California

WHAT HAVE YOU? WILL ACCEPT anything of value—have meters, tubes, checkers, transmitters, relays, receiving, transmitting, parts, portables, camera, equipment, speakers, amplifiers, converters, dynamotors, transceivers, recording barometer, telescope. Will correspond. Martin Royal, 315 S. Western, Chicago, Ill.

HAVE PHONO OSCILLATOR, NEW tubes, speakers, crystal radio, cameras, book matches, panorama, etc. Want projectors, films, reels, rewinds, splitters, etc., in either size, 8 mm or 16 mm, Swap lists. Daily, 905 Reddick, Mishawaka, Indiana.

HOWARD CONRAD, R.F.D. #1, Killbuck, Ohio

WANT FB-7 COILS, TOM SILVAGLO, 50 Steuben St., Providence, R. I.

WANTED: POWER PACK, COIRE-SPERRY electronic, test instruments. Jerry Erickson, Amersy, Wisconsin.

JULIUS KARDOS, 385 Hall Ave., Perth Amboy, N. J.

TRADE—187 CHEMICALS, WORTH \$20.00 for Phonograph, Radio or photographic supplies. David Weiss, 144 Columbia St., New York, N. Y.

WANTED: VOLT-OHM—MILLIAMETER in exchange. Eddie Nelson, Eagle Bend, Minn.

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What Do YOU Think?

WANTS MORE 1 & 2 TUBE HOOK-UPS

Editor,

I have been getting my copy of R. & T. each month from the local newsstand and can really say you have a book long to be remembered by all beginners in radio, since you have done a little remodeling on R. & T. Here's hoping in the future we see more 1 and 2 tube receiving set diagrams.

A suggestion: How about an editorial on the crooks who take advantage of swappers, through the classified advertising columns, or perhaps R. & T. would answer the call for help by printing a so-called "black list," as we swappers can contribute many names for it. When I say this I have the backing of about five others, who would like to see this letter published.

EARL DAILY,
905 Reddick Street,
Mishawaka, Indiana.

[Strange as it may seem, we have received relatively few complaints of this nature. Most of the classified advertisers are apparently pretty honest—however, we'll be glad to hear of specific cases of misrepresentation by classified or other advertisers.—Editor]

A Plan to Help the S.W.L. Card Swappers

Editor,

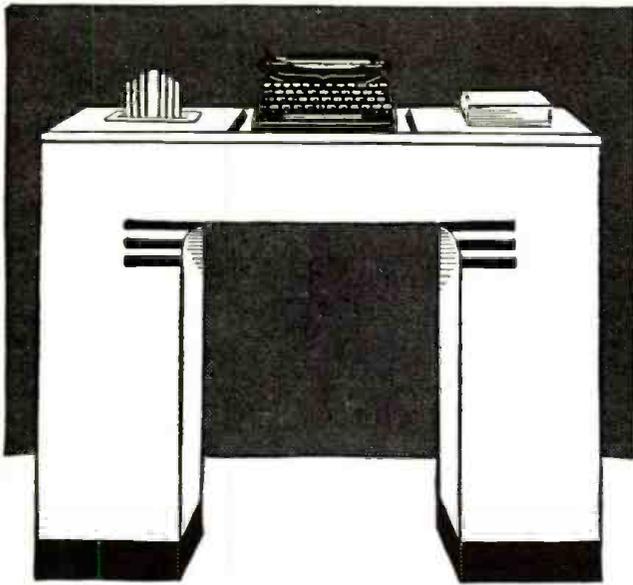
I have been a reader of your fine radio magazine for some time and in its present form it is "tops" and then some. The reason I am writing these lines is because it seems the "will" and "will not" return S.W.L.'s, etc.—sure are in a mess and all that's done about it is a lot of talk. I have a plan which I wish to make to all honest fellows who keep their word, so here you are fellows (and girls). I just so happen to be more or less a cripple, and have lots of time on my hands—now then, I want no one to accept my offer, if they cannot keep their word—all you fellows who have received S.W.L.'s, cards or letters, etc., send me their addresses (on penny postcard or letter) and I will keep these honest chaps' names on file. To all fellows who wish addresses of these fellows, I will send them to such S.W.L.'s, etc., who wish them—all I ask is you must enclose stamp for return answer—otherwise I will do the rest gladly. But again let me say—please do not waste your time and mine, if you do not intend to do your part, and play fair.

Should any fellow not answer, when you send your cards, you should let me know and I will cross his name off the list, so others will not be fooled by him—that's fair, is it not?

If any of you have good ideas send them along, and if we work together then we can all enjoy the hobby of trading S.W.L. cards—what say fellows?

Best wishes and luck to the editors of RADIO & TELEVISION magazine, for the fine magazine they now have.

J. ALBERT JOHNSON,
50 Lowell St
W. Springfield, Mass.
(Turn to page 384)



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Circuits Easy to Understand

Editor,

I've been a reader of RADIO & TELEVISION for three years. I find that it's a FB magazine for the SWL's and Hams. Its circuits and everything else are easy to understand. A feller can keep up on all the new developments in radio and in television. I have learned much from "R. & T."

The "rig" on the left is a Stancor 20-P, built from a kit. It operates on all bands both on phone and CW. The maximum power input is 30 watts. The mike is a Turner R-55 xtal mike. The antenna—a 128 ft. end-fed Marconi, that I use on 160, 80, 40 and 20 meters, isn't anything to brag about, but I have gotten fairly good reports from all sections of the U. S., and I also worked a few foreign countries with it (before the present ban on foreign contacts was established).

I QSL 100% to Hams and SWL's alike. So 73 and lots of luck and good wishes to R. & T. and all its readers.

PAUL FRANSICHI,
Route 1, Box 120,
Florida, Calif.

Likes Our "Radio Kinks"

Editor,

I am a new "ham"—just got my license in June. Maybe that is why I appreciate RADIO & TELEVISION so much. The material published in your magazine is clear and "clean cut." The circuit diagrams you publish are illustrated so perfectly, that anybody can build your "rigs" and equipment and make them work on the first trial. Other than the circuits you publish, I find "Radio Kinks" the next best section. Many of the little problems that annoy me are solved after studying that section.

I have only been reading R. & T. a short while, but from now on I am a "steady." 73.

ARNOLD HAWES, WIMTZ,
Route No. 1,
Augusta, Maine.

ANSWERS TO PUZZLE DIAGRAM ON PAGE 362

1. Grid-leak connected incorrectly; it should connect directly from grid to ground, or else across grid condenser.
2. Condensers 1 and 2 superfluous—not needed.
3. Tickler winding and B+ feed wire are grounded, causing a "short-circuit" across B+ to B-.
4. Condenser 4 not required; also the cathode is left ungrounded.
5. C should be a resistor and not a coil (inductance).
6. 5 should be a fixed condenser, not a variable type.
7. The potentiometer is indicated as a variable inductance, instead of a resistance.
8. The cathode of the tube V2 is left "floating"; it should be grounded, directly or indirectly.
9. The shield and suppressor grids of the tube V2 are both grounded; the shield grid should be connected to B+.
10. The output transformer T2 would waste energy and is not needed in this simple 2 tube set. The head-phones should be connected directly into the plate circuit.
11. Condenser C7 is superfluous.
12. Condenser 6 should be a fixed type, and it should connect from the arm of the potentiometer to ground.



From tiny bakelite-molded "postage-stamp" unit for receiving circuits, to large porcelain-case unit for high-frequency transmitting uses, AEROVOX offers a dozen and a half standard types of mica condensers.



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