RADIO NEWS

AUGUST
1945
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RADIO NEWS
Reg. U. S. Pat. Off

AUGUST • 1945

VOLUME 34, NUMBER 2

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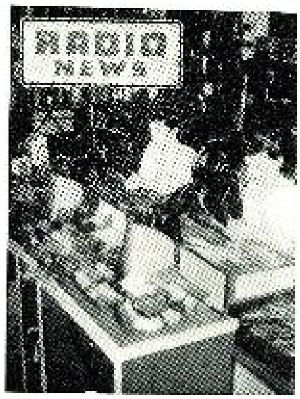

COVER PHOTO

By Frank Ross

(Staff Photographer)

Riveting wire-lead preassemblies for transformer applications at the Standard Transformer Company plant in Chicago. Various colored leads are used to properly code transformer polarity.

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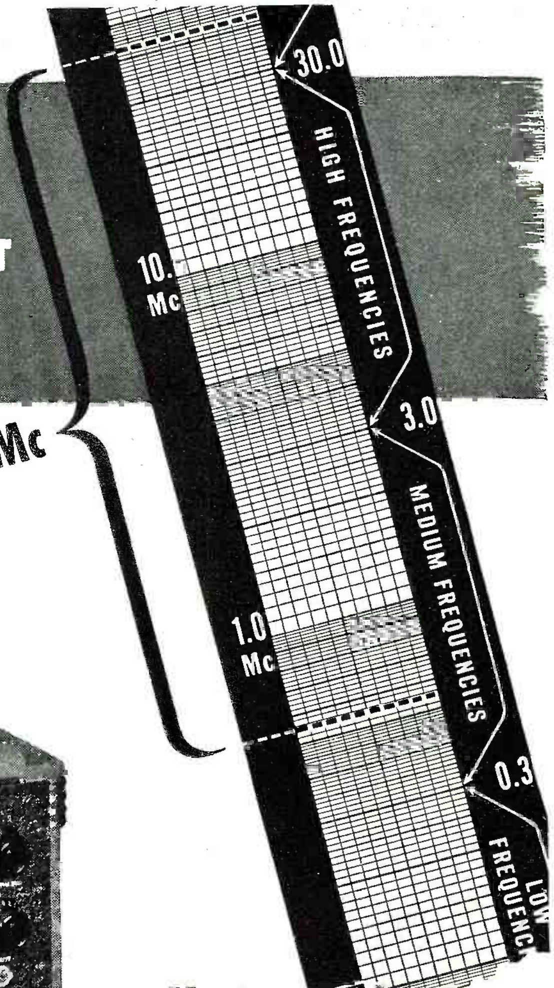
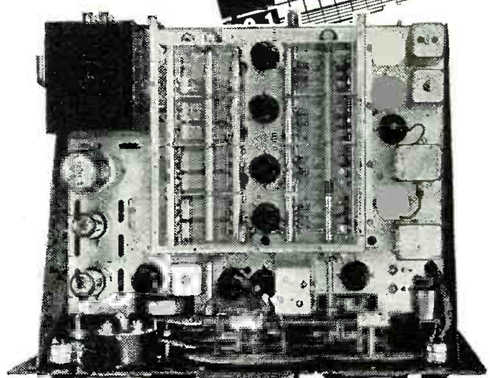
HOW hallicrafters EQUIPMENT COVERS THE SPECTRUM



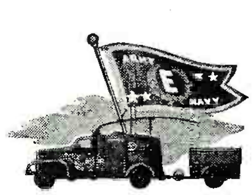
MODEL SX-28A — from 550 kc to 42 Mc



HALLICRAFTERS Super Skyrider, Model SX-28A, covers the busiest part of the radio spectrum – standard broadcast band, international short wave broadcast bands, long distance radio telegraph frequencies, and all the other vital services operating between 550 kilocycles and 42 megacycles. Designed primarily as a top flight communications receiver the SX-28A incorporates every feature which long experience has shown to be desirable in equipment of this type.

The traditional sensitivity and selectivity of the pre-war SX-28, ranking favorite with both amateur and professional operators, have been further improved in this new Super Skyrider by the use of "micro-set" permeability-tuned inductances in the RF section. The inductances, trimmer capacitors and associated components for each RF stage are mounted on small individual sub-chassis, easily removable for servicing.

Full temperature compensation and positive gear drive on both main and band-spread tuning dials make possible the accurate and permanent logging of stations. Circuit features include two RF stages, two IF stages, BFO, three stage Lamb-type noise limiter, etc. Six degrees of selectivity from BROAD IF (approximately 12 KC wide) for maximum fidelity to SHARP CRYSTAL for CW telegraphy are instantly available. Speaker terminals to match 500 or 5000 ohms are provided and the undistorted power output is 8 watts.



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Authorized Dealer Franchise
This is to certify that John Doe Radio Co.
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INCORPORATED
THIS FRANCHISE TO REMAIN IN EFFECT UNTIL REVOKED BY MANUFACTURER OR DISTRIBU

Now that V-E day is past, we look forward to the time when all our battle-scarred warriors return to their anxious families.

As quickly as Government restrictions are modified, Fada's great productive capacity will be ready to make available the finest in radio receivers.

The Fada dealer franchise will become a typical "Peace Pact" assuring you of your share of profitable business on Fada's electronic developments.

If your jobber has not told you about Fada's merchandising plan contact him or write us directly.

PLACE YOUR FAITH IN THE

FADA Radio

OF THE FUTURE

Famous Since Broadcasting Began!

FADA RADIO AND ELECTRIC COMPANY, INC., LONG ISLAND CITY, N. Y.

FOR THE RECORD

by the editor

TELEVISION manufacturers were undoubtedly amused when they read the column of Westbrook Pegler on June 6, 1945 when he literally tore this new service into many pieces and tossed them to the wind as being worthless.

Subheading his column "Television Not What Public Has Been Led to Hope It Is," he says in part "Television will be, for several years, a crude and expensive disappointment and its clients, or consumers, will pay high for the slow improvements of a primitive experiment."

Such statements coming at this time from misinformed crab artists can do much to hold back the very development of television. This isn't the first time the press has put the brake on television. It's simply a rehash of what has been said before.

MANUFACTURERS of television equipment have, for the most part, attempted to present Mr. and Mrs. America with an accurate picture of what might be expected from their postwar television sets. Some of them have pointed out that technical standards employed before the war were adequate for good pictures (and still are) and others have taken the reverse viewpoint that only by adopting higher technical standards can television have universal appeal.

An instrument as complicated as a modern television set requires a period of continued development before it can be considered as "acceptable." Unlike the development of the radio receiver, which emerged from the crystal detector and earphones to the use of one tube sets, television must, of necessity, employ many vacuum tubes to perform the necessary functions for reception of a video signal.

When greater volume or sensitivity was required in radio sets, it was only necessary to add on more tubes and to refine the tuning circuits. Television cannot start on this same basis. Therefore, manufacturers should point out the absolute necessity for using a greater number of tubes and parts in a television set than would be required for an average radio receiver. If the public will realize the basic differences, he will expect to pay a higher price for television equipment. If this is not pointed out, the public may feel that they are actually contributing a considerable amount of money to the "programming" of television. We do not agree with our ersatz informant that television will be a disappointment for several years. We insist that rapid development will improve the picture quality even without making changes in the sets then in service.

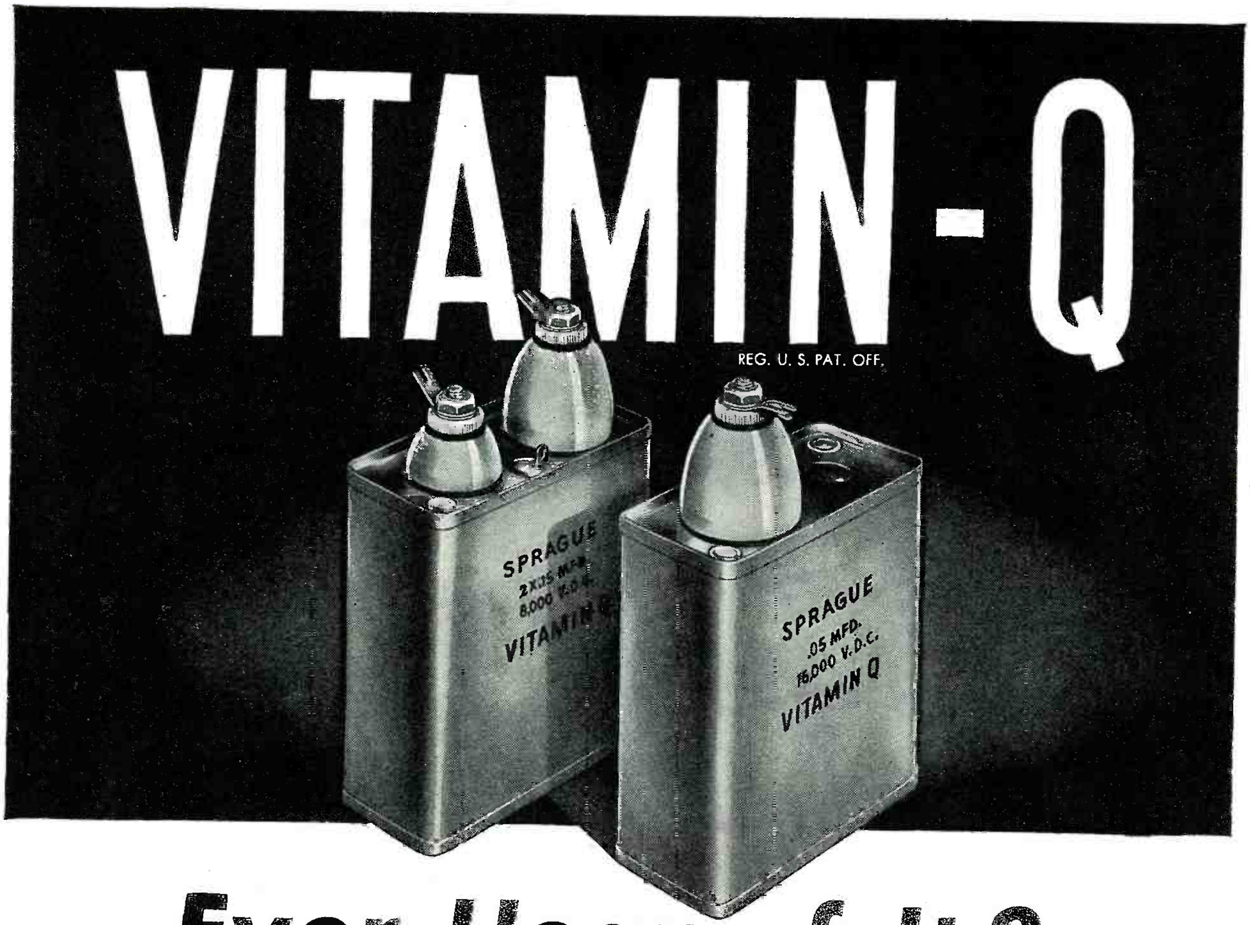
HE ALSO points out that "The radio apparatus of the more elaborate sets is no more efficient than the same device in the cheap editions, which is a manner of saying that most of them, whatever the price, are capricious and not dependable." By the same token a $5,000 automobile is no more efficient than a $500 automobile. But, he would be the last to deny that the $5,000 automobile has refinements of quiet operation, easier riding, finer upholstery, more comfortable seating and greater precision. Both of these automobiles use identical spark plugs just as radios employ common tubes. A defective plug can cause as much grief in the $5,000 car as it could in the $500 car.

We suggest that he visit one of the RID or FBIS stations of the FCC, where we find standard communications' receivers being used twenty-four hours per day month after month and, except on rare occasions, giving trouble-free performance and dependable reception. We do not know what kind of radio our overnight radio authority has and it really doesn't matter. Fortunately, he is one of a very small minority that fall under the following as covered in his editorial: "After all these years, they still crackle with static and cross-talk blurs reception. . . ."

Evidently "Mr. Knowitall" goes in for dx'ing on the standard AM band. At least it's been a long time since this writer has heard any cross-talk on practically any modern receiver whether it be of the $8.95 variety or in the $200.00 class. Yes—they do crackle with static, but only on rare occasions when circumstances beyond our control (commonly known as lightning) exist in the near vicinity of the receiver. He might be interested in knowing that there have been developed new and simple electronic devices which effectively reduce the reception of static noise or at least reduce it to a negligible amount.

NEXT to fall under the swinging axe is the record-changer mechanism. He says "In the phonograph

(*Continued on page* 141)



Ever Hear of It?

VITAMIN Q is an exclusive Sprague Electric Co. oil impregnant for capacitors that results in exceptional performance where thousands of volts and temperatures as high as 105° C. or as low as -40° C. are involved. Leakage resistance at room temperature is 20,000 megohms for one microfarad—*or at least 5 times better than previous types!*

This is only one of the many engineering and production achievements that have helped make Sprague a *five-time winner* of the coveted Army-Navy "E" award. And it is one that indicates plainer than mere words that, as always, you can rely on Sprague for the finest, most modern engineering in ANY capacitor type for radio service, amateur or experimental work.

ATTENTION TRADING POST USERS!

Our free wartime advertising service, THE SPRAGUE TRADING POST, will be found on another page in this issue. It will continue as long as there is a need for this unique method of selling or buying hard-to-get radio things.

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North Adams, Mass.
(Jobber Sales Organization for Products of the Sprague Electric Co.)

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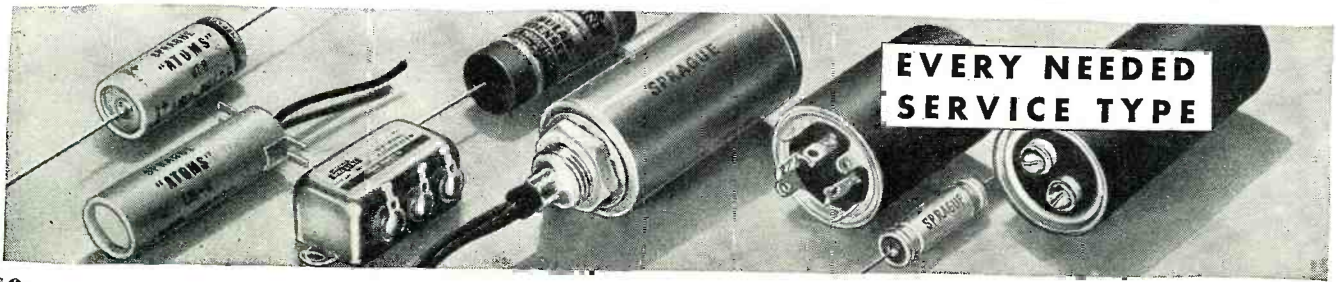
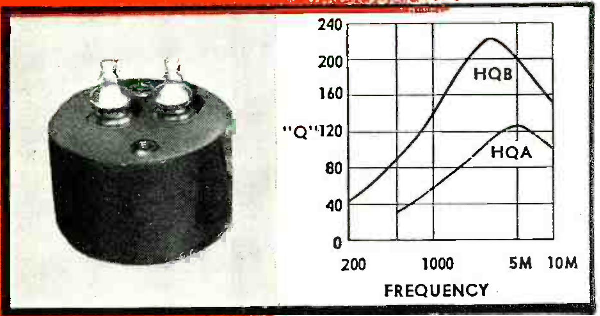
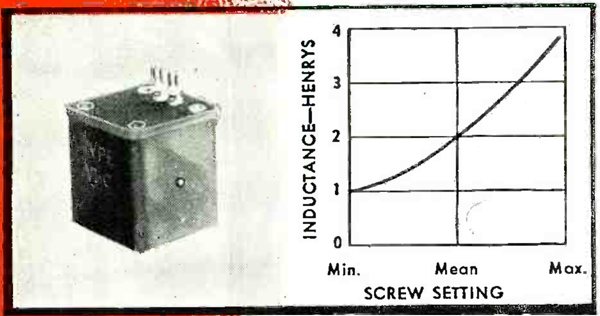


UTC FOR INDUCTORS



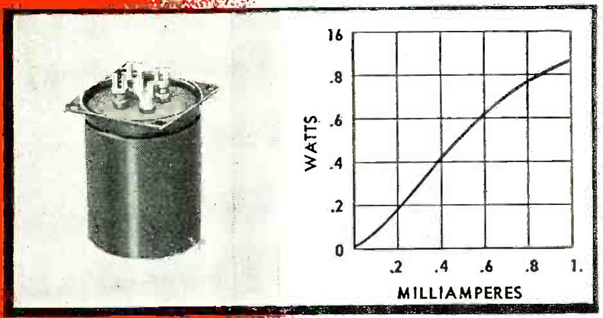
HQA AND HQB HIGH Q INDUCTORS

This series of toroid wound high stability inductors are available from 5 Mhy. to 2 Hys. Voltage stability is excellent, hum pickup is very low. Temperature effects are negligible. HQA units 1-13/16" in diameter by 1-3/16" high.



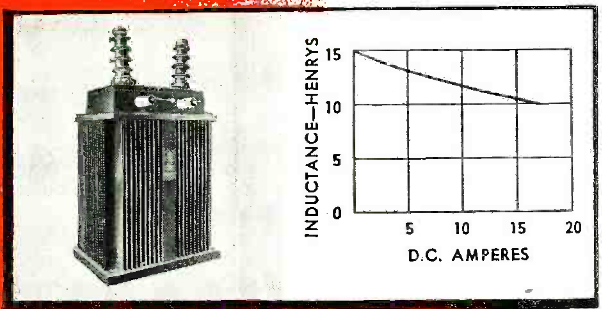
TYPE VI-C VARIABLE INDUCTORS

These inductors are available in optimum values from 10 Mhy. to 10 Hys. They are tunable over a wide range by inserting an Allen Head wrench in the adjusting screw. Units measure 1¼" x 1-7/16" x 1-7/16".



SENSITIVE SATURABLE INDUCTORS

UTC Saturable Inductors cover a wide range of application for magnetic amplification and control. These units are supplied to specific requirements. The curve shown illustrates a high sensitive type, showing DC saturation vs. AC watts into load.



POWER SUPPLY INDUCTORS

UTC supplies power supply components for every type of application, ranging from a one-third ounce reactor, which measures ⅝" x 7/16" x ¾", to the 10,000 pound, broadcast station, plate supply reactor, illustrated.

May we cooperate with you on design savings for your applications...war or postwar?

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United Transformer Corp.

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Spot Radio News

★ ***Presenting latest information on the Radio Industry.***

By FRED HAMLIN
Washington Editor, RADIO NEWS

ALTHOUGH L-265, the war-sponsored limitation order prohibiting production of radio and other electronic devices for civilian use, will be revoked on or about October 1, volume production of home receivers can not be expected before the end of the first quarter of 1946. Supplying all military requirements will continue to take top priority over civilian production after L-265 is repealed, of course, and one of the major problems to be solved during the early phases of the reconversion program will be a serious shortage of component parts. An important factor in that problem is the current OPA reconversion price plan. At the first session of the OPA Radio Parts Industry Advisory Committee since revision of MPR 136, the order which transferred control of radio parts prices within OPA in March, 1945, the consensus was that the broad reconversion price formula laid down by Administrator Bowles in May of this year should be modified in its application to radio parts. The alternative discussed at the meeting was complete elimination of price ceilings on sales of radio components. Members of the Advisory Committee are convinced that competition in the sale of parts to be used in new radio receivers will be so spirited that supply and demand will hold down prices and, therefore, do away with the necessity for price ceilings. A statement by R. C. Cosgrove, president of Radio Manufacturers Association, that twice as many manufacturers will be turning out radios after reconversion than before the war supports the supply and demand argument.

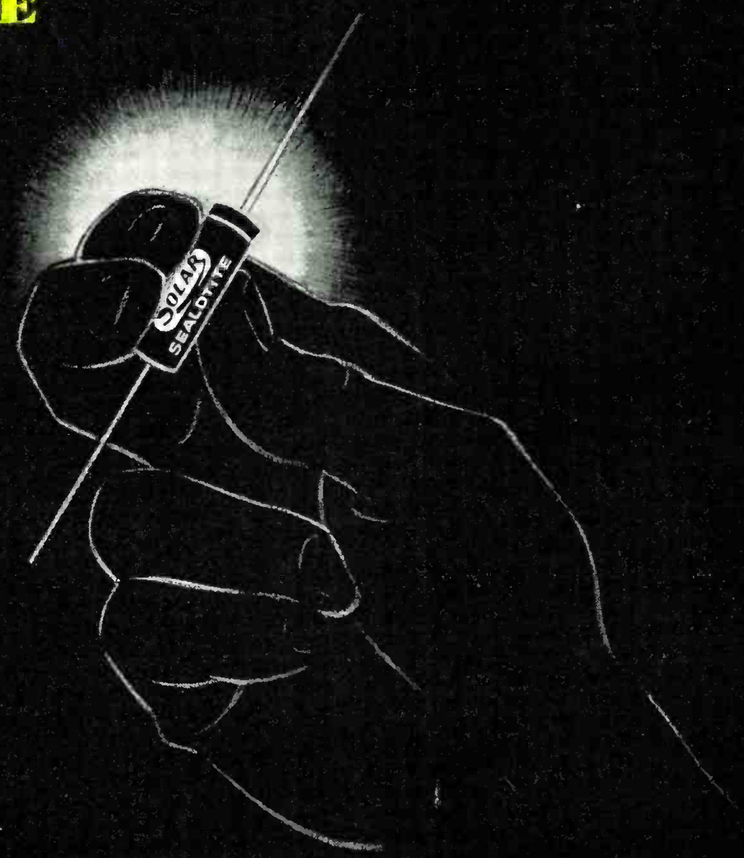
OPA officials have not swung around to that way of thinking, although they have considered the possibility of eliminating control of parts prices. In that connection, members of the Advisory Committee have pointed out repeatedly that producing and selling parts for civilian use would be difficult under provisions of the OPA price formula. A few went so far as to declare that they would not accept civilian orders under present restrictive OPA regulations.

While the session in Washington between the Advisory Committee and the OPA did not solve the problem of pricing, it permitted thorough discussion of the difficulties and crystallized the thinking of the interested groups. Members of the Committee pointed out that the OPA reconversion price formula did not allow for substantial increases in administrative expenses and overhead costs since the war started. Officials of OPA admitted that but announced increases in indirect labor and materials costs, plus direct labor and materials costs, were to be considered in fixing new prices. A good start toward ironing out points of difference was made when the Committee and the government agency agreed to a joint meeting of accountants of several radio parts manufacturers and OPA officials in New York several days after the Washington conference. Purpose of that meeting was to draft a cost survey questionnaire which will be sent to a cross-section of the parts industry following its approval by committee members and the Budget Bureau.

THE SURVEY QUESTIONNAIRE, which will produce information to be used as a yardstick in determining price ceilings for the parts industry, was agreed on and forwarded to the Advisory Committee for study. Before the conferees turned to the job of specific questions on the questionnaire, there was lively discussion of the same problem injected into the earlier meeting in Washington—administrative costs. The question of that phase of the parts manufacturers' operations was dropped temporarily pending a ruling by the OPA. It probably will appear on the questionnaire, because of its importance in computing costs on which ceiling prices are to be based. The questionnaire will request the parts manufacturers to list profit and loss since 1941, wage increases since 1941, information on increases in prices of materials since 1941, and data on net profits and net sales in the period 1936-1939.

Whether the pricing program finally adopted as a result of the studies now being made will provide for industry-wide price adjustments or for increases based on smaller segments of the industry is problematical. It appears now, however, that a satisfactory modification of the over-all OPA reconversion pricing formula, which applies to all industries, will be evolved for the parts industry without upsetting any of the major objectives of the basic price control procedures. On the other hand, it is

you can't *put the squeeze* on SEALDTITE CAPACITORS



Just try it . . . Take a genuine "Sealdtite" capacitor and try to *squeeze* it. No results. You'll find it has no soft spots, which in ordinary tubulars provide room for moisture, the capacitor's worst enemy, because the Solar capacitor has an internal winding of high quality paper and foil, skillfully *molded* into *solid* plastic.

No moisture can penetrate this protective case and its substantial construction permits rough handling, assures long and *reliable* service.

Use "Sealdtite" capacitors. Send for your copy of Catalog V-4.
Any Climate — Any Atmosphere — Any Service.

SOLAR

BAYONNE PLANT
WEST N.Y. PLANT
A TOTAL OF EIGHT ARMY-NAVY EXCELLENCE AWARDS

SOLAR CAPACITOR SALES CORP.
285 MADISON AVENUE, NEW YORK CITY

conceivable that a study of the findings of the questionnaire may dictate the elimination of price ceilings on products manufactured by the radio parts industry. If the current OPA price formula is applied to the parts manufacturers, a price for every item sold probably will not be set. Rather, the prices would be calculated on a flat percentage basis either for the company's over-all products or for the products of one of its divisions.

ONE INTERESTING SIDELIGHT on the problem of prices during reconversion cropped up at the New York OPA cost accountants meeting. It concerned the factory making many different pieces that can be used in connection with non-radio products. Example cited was the capacitor, which is used in radio but could also be used to start a motor. Problem there is whether to place two prices on the capacitor, one to apply when it is used in radio and the other when it is used in non-radio activity.

Paralleling the cost studies in the radio parts industry is the OPA project designed to assemble factual data on costs of manufacturing radio sets and cabinets as a means of fixing ceilings. The two studies when they are correlated will determine the retail prices of radio receivers.

While OPA and the Advisory Committee are attempting to resolve their differences, WPB has perfected its plan for, first, easing the restrictions imposed by L-265 and, later, of revoking the order. The WPB formula for lifting controls is geared to a two-stage time table. First stage permitted modification of L-265 in July to permit unrestricted production of components, including tubes for replacement purposes, and all electronic equipment except broadcasting, receiving, and entertainment products. That step was, of course, dictated by a small decrease in military production.

The second stage of the WPB formula calls for complete revocation of L-265 in October to permit production of home receivers, broadcasting equipment and other civilian entertainment aids. This step will move only as fast as component parts become available. It should be remembered, however, that both steps, particularly the second one, were subject to approval of the military services.

THE TOTAL BROADCAST SERVICE INCOME of 836 standard broadcast stations reporting to FCC was $68,888,110 for 1944, and that figure constituted an increase of 47 per cent over the 1943 earnings and more than 125 per cent over the 1942 total. A break-down shows that the average broadcast income per station rose from $36,488 in 1942 to $55,848 in 1943 to $82,402 in 1944. Only 33 stations lost during 1944, while 85 lost money in 1943 and 199 in 1942. Of the total reporting, 765 stations had increases in 1944 (over 1943) amounting to $22,678,087, and 71 stations had decreases amounting to $562,558. Total increase in 1944 over 1943 was $22,115,529.

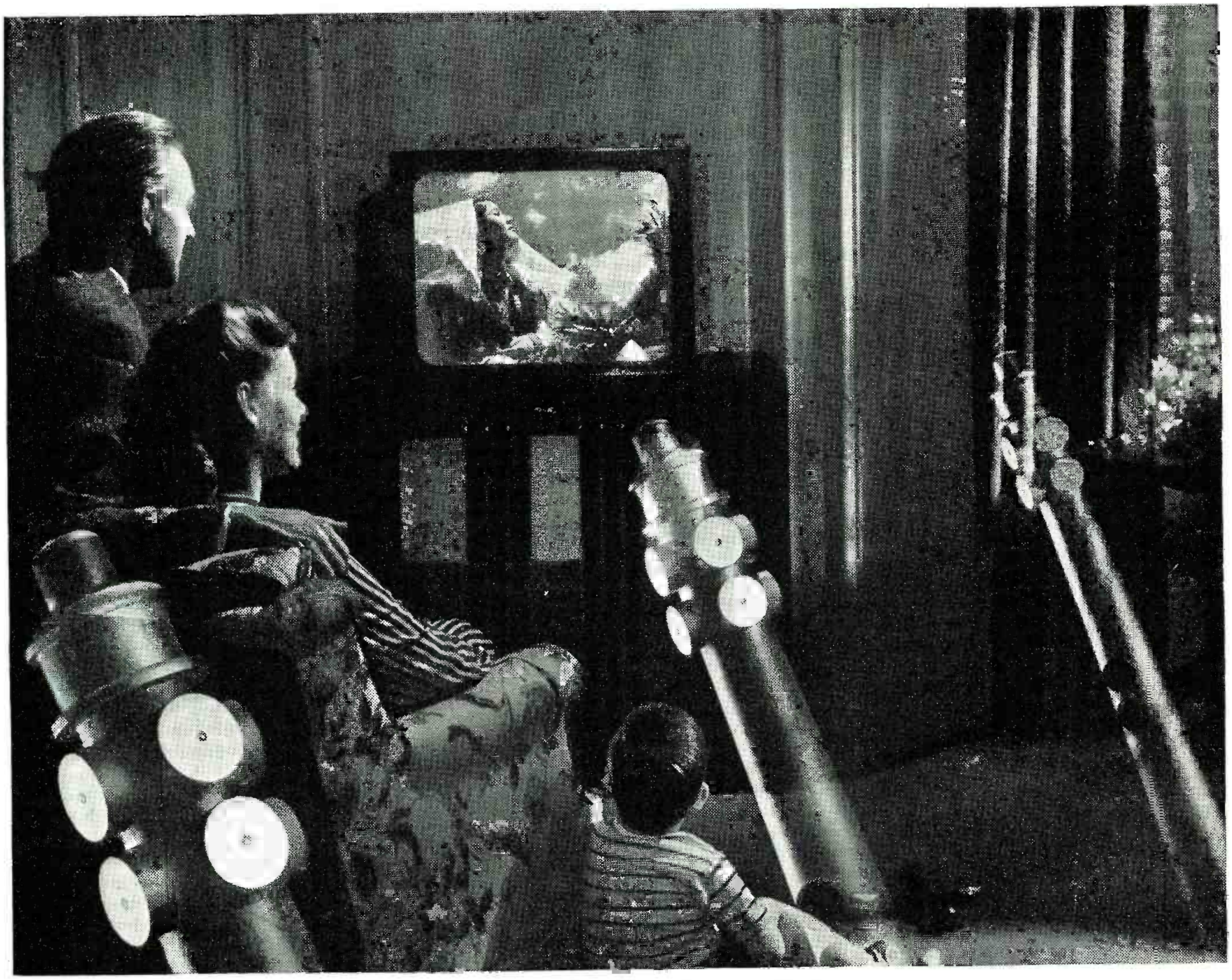
In 1944 there were 919 standard broadcast stations operating in the United States, Alaska, Puerto Rico and Hawaii, of which 35 were noncommercial stations Twenty-four of the 884 commercial stations have not sent in their 1944 financial reports to FCC.

LATEST REPORT FROM FCC is that FM transmission program tests in the spectrum 44 to 108 megacycles, begun as part of the allocation studies, are to be continued to gather propagation information vitally necessary in determining standards for station frequency assignments. The recent allocation hearings revealed the need for that type of FM information. The additional research will substitute factual data for opinion testimony on propagation characteristics of FM frequencies. The tests are designed to develop information on the problem of the proper distance between stations operating on the same and adjacent channels and on the field intensities required for the various services under different conditions. After completion of tests in the 44 to 108 megacycle region, the FCC plans to extend studies, in cooperation with the industry, to higher portions of the spectrum.

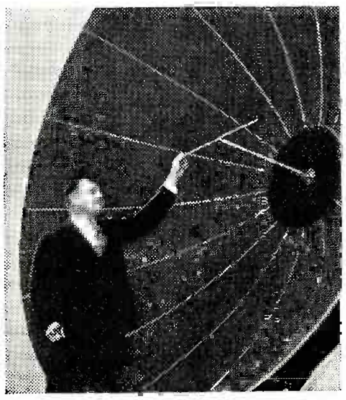
SURPRISING FACTS AND FIGURES have been uncovered by a survey among consumers in Canada, according to a report from *Canadian Facts, Ltd.* First outstanding fact uncovered is that although most Canadians expect great improvements in post-war radio they will not be in a hurry to buy new sets Forty-two per cent of those interviewed said they plan to buy a new radio, but only 5 per cent said they would buy as soon as new sets become available. *Canadian Facts* estimates the immediate market in Canada as 135,000 sets, of which 65 per cent would be a.c. models, 20 per cent combination models, and 15 per cent battery sets. Canada has a population of about 11,500,000 and the survey covered a representative cross-section of 2,058 persons. Other facts on Canada: Nine out of 10 Canadian families own a radio set, and 1 out of 10 has more than one; 5 per cent of all sets now owned are out of order; principal buyer interest is in combination sets with tone first consideration and price second; only one in 10 has heard of FM, and half of those interviewed think television is not more than three years away.

FROM THE SIGNAL CORPS comes word that streamlined antennas for vehicular radios have solved many problems that formerly caused seri-

(*Continued on page 83*)



RCA radio-relay towers—like those phantomed above—will leap the hurdle of *distance* in post-war television.



C. W. Hansell, RCA specialist in transmitters and relays, is shown here with a radio-relay reflector that can "bounce" radio messages, radiophotos and Frequency Modulation programs at the same time that it relays television!

Coast-to-Coast Television... through "Radio-Relay"

For a long time it looked as though post-war television might be confined to local stations. Only persons within a fifty-mile radius of New York, for example, would see the important television broadcasts from NBC's pioneer station WNBT, atop the Empire State Building.

That was because the ultra short waves that carry television do not bend with the curvature of the earth. They go in a straight line out to the horizon—and then keep on going into the sky.

But today, television's big handicap of short range has been completely overcome—by RCA scientists and engineers.

The *radio-relay* was developed—a tower that "bounces" television programs to the next tower 30 to 50 miles away. Through a network of these automatic, unattended, radio-relays, coast-to-coast television is made practical.

This is but one more example of how RCA research constantly "makes things better." Such research is reflected in *all* RCA products. And when you buy a television set, or radio-phonograph, or anything made by RCA, you enjoy a unique pride of ownership. For if it's an RCA you can be sure it is one of the finest instruments of its kind that science has achieved.

RADIO CORPORATION of AMERICA

PIONEERS IN PROGRESS

Contact in transit

Communication with, or between, moving vehicles becomes more important as this Age of Speed advances. Every factor is vital which promotes clarity of transmission. When trains, taxis, ships and passenger cars can contact each other or their "home stations" at will, Amphenol Cable Assemblies, Connectors and Sockets will do their share to provide good electrical contact *within the equipment.* Atmospheric and static conditions excepted, successful radio communication in transit depends largely on low-loss stability and good design of the equipment's component parts. The name "Amphenol" indicates to the user that they have been designed, made and tested to give the best possible service in spite of interference, vibration and moisture. Detailed technical information on all Amphenol products in which you may be interested is available and will be sent on your request—ask for Catalog Section D.

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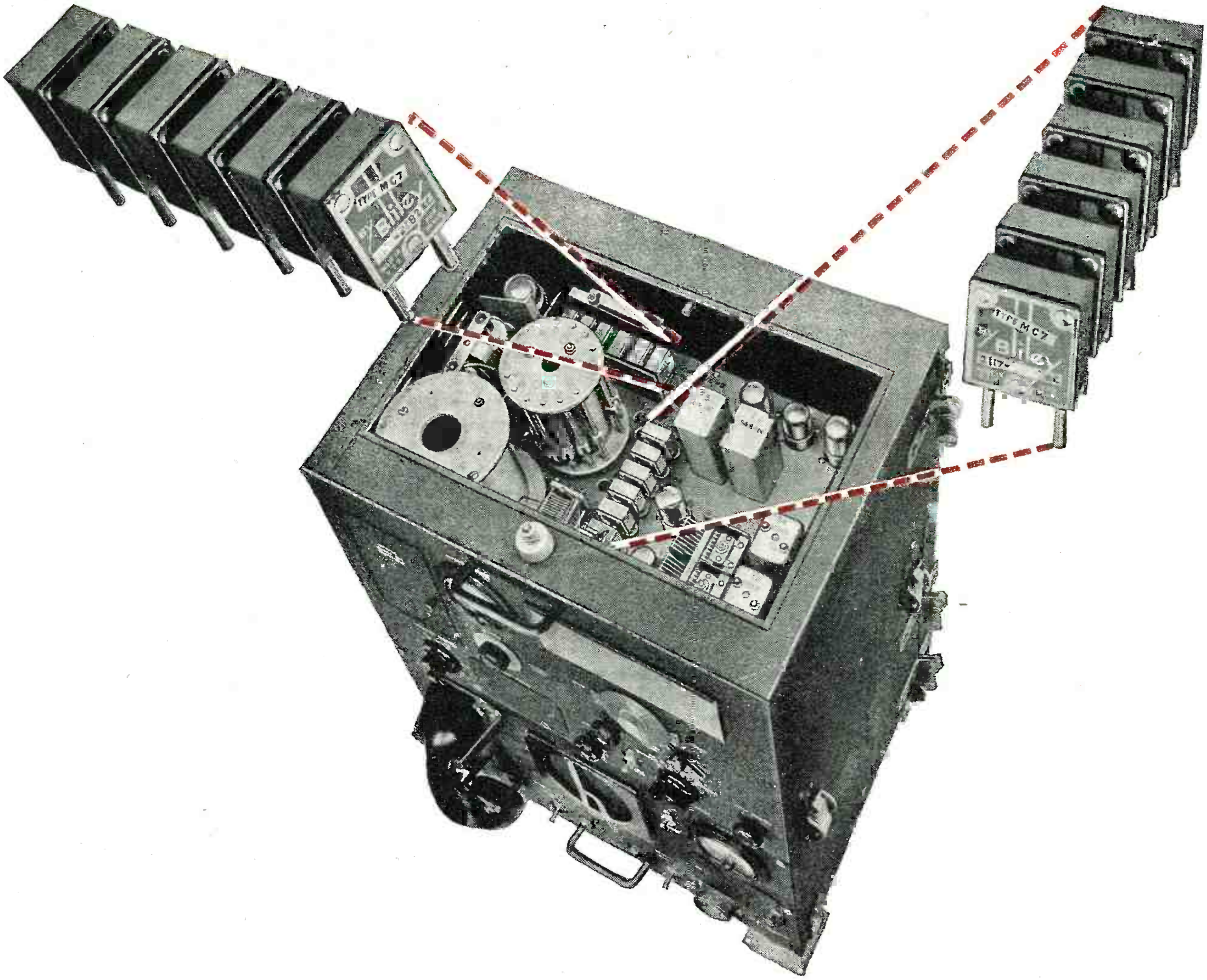
U.H.F. Cables and Connectors—Radio Parts—Cable Assemblies—Conduit—Connectors (A-N and British)—Plastics for Industry



The 6 operating frequencies are BLILEY CRYSTAL-controlled

For dependable communications on the high seas here is a battle-tested set incorporating every modern feature that experience has shown to be most desirable for ship-to-shore and ship-to-ship radiotelephone service.

The six Bliley crystal-controlled operating frequencies permit instant and positive channel selection in both transmitter and receiver.

The Bliley *acid etched** Crystals used in this Hallicrafters HT-14 set were designed to meet specific objectives in the operation of two-way radiotelephone communications. They, too, have been battle-tested.

It's a habit with most communications engineers to specify Bliley for all crystal requirements. This is particularly true today when new applications and complex designs require technical excellence in every component. There is no substitute for the 15 years of experience offered by Bliley craftsmen and engineers.

✢ ✢ ✢

**Acid etching quartz crystals to frequency is a patented Bliley process.*

ARMY E NAVY

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Do more than before . . .

buy **extra** War Bonds

BLILEY ELECTRIC COMPANY

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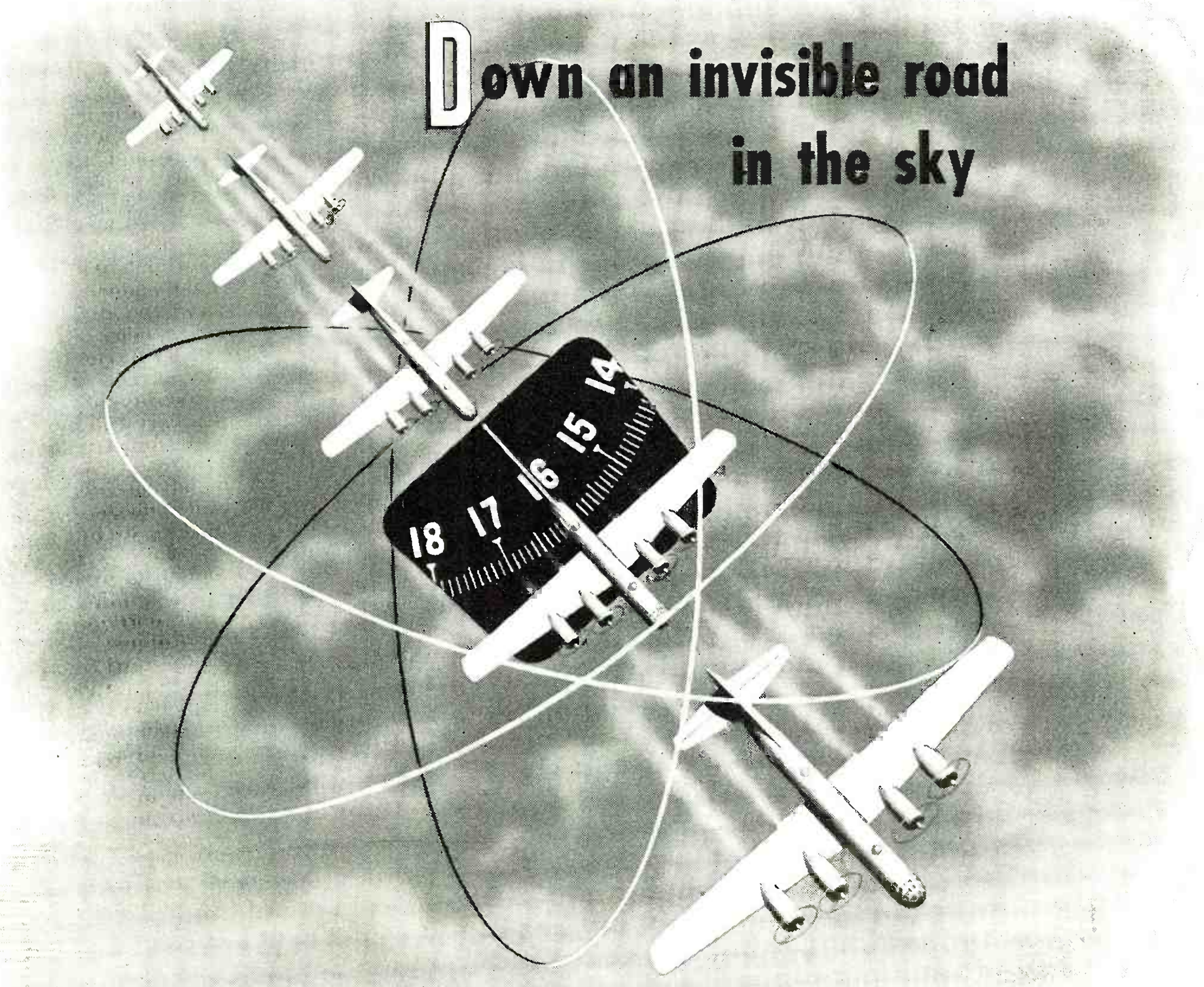
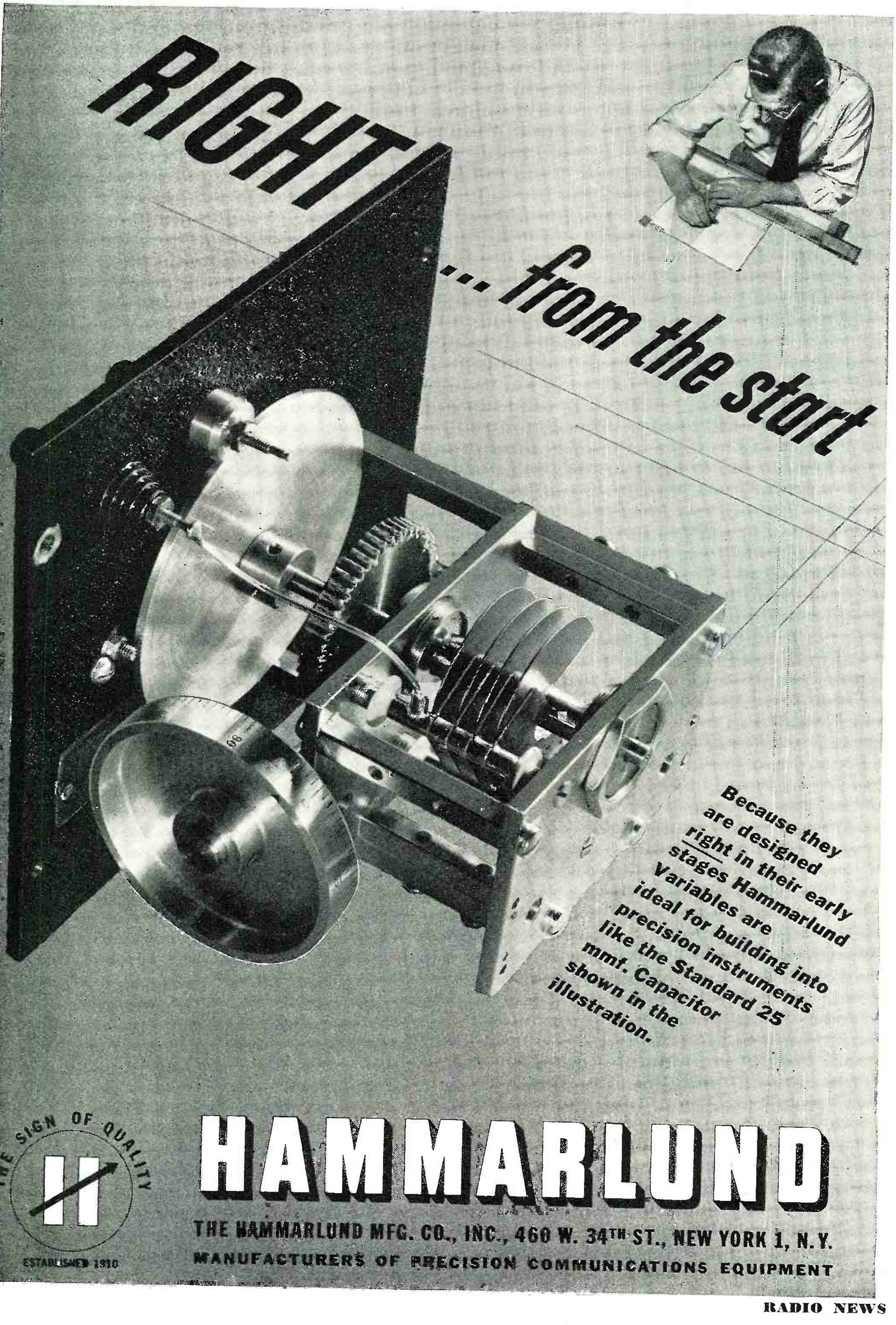

Down an invisible road
in the sky
18 17 16 15 14


RIGHT
... from the start
Because they are designed right in their early stages Hammarlund Variables are ideal for building into precision instruments like the Standard 25 mmf. Capacitor shown in the illustration.
THE SIGN OF QUALITY
ESTABLISHED 1910
HAMMARLUND
THE HAMMARLUND MFG. CO., INC., 460 W. 34TH ST., NEW YORK 1, N.Y.
MANUFACTURERS OF PRECISION COMMUNICATIONS EQUIPMENT

INSTRUMENT LANDING SYSTEM

By

1st Lt. R. J. Hennessy

Scott Field, Ill.

Scott Field, Illinois—the proving ground for the men who operate and maintain blind landing equipment for planes of our Armed Forces.

Mobile transmitter unit, housing directional radiators, is parked 1,000 feet from the far end of the runway.

MARK TWAIN'S remark concerning everybody talking about the weather and not doing anything about it certainly does not apply to the Army Air Forces technicians, for at Scott Field, Illinois, they are doing something about the weather every day. At this parent radio school of the AAF Training Command, ground technicians and pilots are being taught to ignore the weather!

Before the development of the almost supernatural instrument landing system which brings planes in flight to a safe landing even though visibility is zero, when a fog bank would roll in over the countryside and the flight control bulb in operation would snap to "N," air crews had no other alternative but to relax and "sweat" out the weather as the field was closed to all flying activities.

Today all that is changed for there is a small, highly-trained unit at many airfields which grasps at the opportunity to justify its existence when the "soup" closes in and the field is declared on instrument status. This group is the Instrument Landing Equipment crew. Its function is to provide a safe and reliable path to the runway for all aircraft which were unable to get in under the weather.

At Scott Feld, commanded by Col. Neal Creighton, part of the vast laboratories and classrooms at this radio school are devoted to the training of the men who operate and maintain this system.

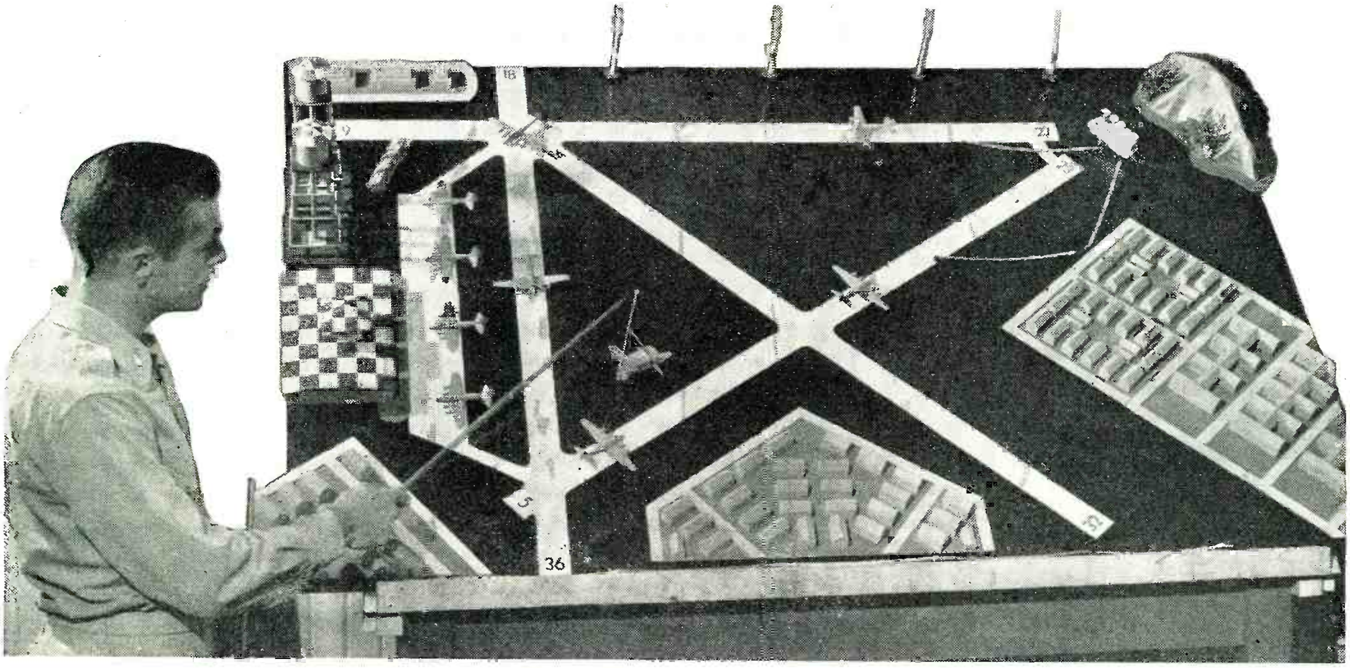
Students are selected graduates of Radio-Mechanic courses and officers and enlisted men who have acquired experience "on the line." These men are given a seven-week specialized instructional program on this equipment at this incubator for Air Force Radio Operators and Technicians.

The school is unique in that it is the only institution of its kind in the Army and until recently in the entire service. The recent adoption of the system by the Navy, as taught at Scott, precipitated an influx of sailors to this field for training in this work. This marked the initial occasion on which the Navy saw fit to visit this mid-Western Air Force Post and indicated an increased cooperation between the branches of the service.

Unlike many schools which train men and send them out to the using agency, this institution follows the accepted Scott Field inclination to train the man on the job so that he arrives at the line with some experience in the task for which he is trained.

The popularly accepted program embodies a combined theoretical and practical application of the course material on localizer, glide path, and marker beacon transmitters and receivers, as well as a treatment in frequency-modulation transceivers.

Installation of the airborne localizer, glide path, and marker beacon receivers and antennas is coupled with



Miniature replicas of buildings, trees, and other obstructions, are moved about on a large magnetic board, representing a landing field. This training aid is used to brief students prior to flights and in working out instrument landing problems.

a short telephone procedure course, as is used in control towers.

Map reading, compass, and aerial photograph interpretation are also employed to provide the student with required knowledge to be used in the late phases of the program and in actual line activity.

Five weeks are devoted to classroom work and two weeks are spent on the Scott Field airport in actual work on the system.

Further, every Training Command student participates in several instrument landing problems, the progress of which he observes from a converted Bombardier's position in the nose of a B-17, assigned for training purposes. A duplicate set of instruments has been provided for the student's benefit in this position.

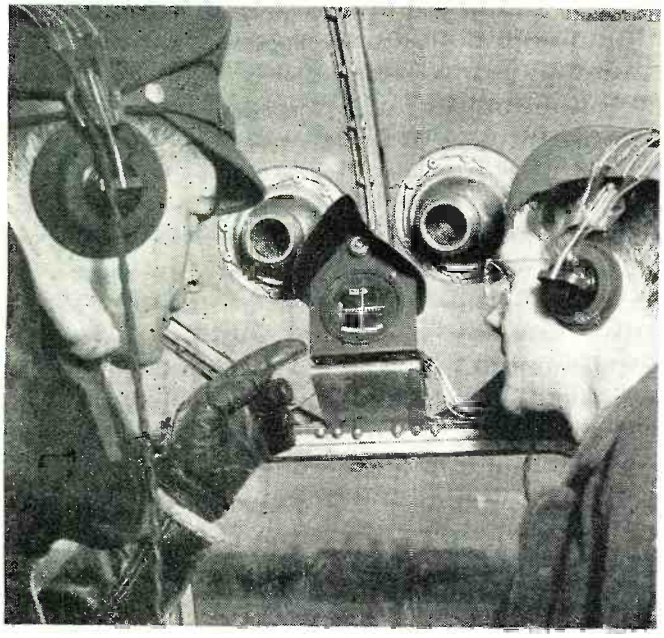
The syllabus of instruction makes good use of electrically-actuated training aids and a life sized mock-up of a "B-26 Marauder" is utilized to teach installation of the airborne equipment under actual conditions usually encountered.

A mobile device is used to check the localizer and glide path courses prior to flight tests. This device consists of a standard Army "jeep" and is equipped with antennas, receivers, and indicators identical to those found in the plane, and powered directly from a storage battery.

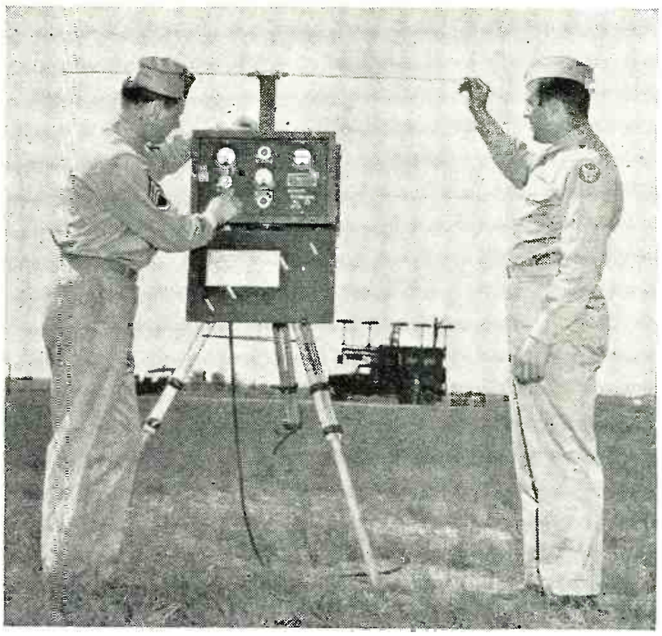
By driving this strange-looking contrivance down the centerline of the runway to be used and varying the height of the antenna, the glide path and localizer courses are detected and positions of the cross-haired indicator needles are observed.

This very useful combination of a training aid and course monitor acts as a mobile classroom and serves to insure that the localizer is transmitting an accurately aligned pattern for the plane to follow and also determines the absolute angle of glide from the approach end of the runway to the point of contact. The plane usually crosses the boundary of the field at approximately 40 ft. and the antenna

In a blind landing, the pilot corrects his approach until both needles are at right angles to each other and both centered exactly on a horizontal and vertical axis.



A fixed-course detector checks the signal sent out by the localizer truck. Should the course shift for any reason, an automatic alarm bell sounds in the localizer truck.



on the "jeep" can be telescoped to this height and follow the radiated course right to the ground.

Students set up and operate all positions and, after "sitting" the apparatus, then proceed to inspect the quality of their work with the "worry wart." This name is aptly applied to this monitor as it consistently displays reluctance to accept any but positive indications of a true course.

Instructors, having had considerable experience with the equipment, have learned certain course characteristics which manifest themselves in the form of definite troubles when the equipment is not properly set up. These "bugs" are purposely introduced in the apparatus from time to time and students observe the resultant effects while riding down the runway in this vehicle.

The Army Air Forces Instrument Approach system (designated SCS-51) as taught at Scott Field is a product of research extending back to 1919. At that time the Bureau of Standards, recognizing the need for a means to land planes under conditions of poor or zero visibility, combined a low-frequency radio range with a marker beacon transmitter and were able to affect low-level approaches to an altitude of 300 feet.

Later developments saw the introduction of a localizer transmitter and several marker stations. At this stage, by means of overlapping signals transmitted at low frequency, it was possible to provide a pilot with two-dimensional guidance. The localizer aligned his plane with the runway and the markers gave him "fix" points or distance from the runway. These markers were keyed differently for identification. This was an audible system of guidance.

Atmospheric conditions interfered with this method to such an extent as to render it questionable and a more efficient system was sought.

The *Federal Telephone* and *Radio Corporation* in cooperation with the Army Air Forces and the Civil Aeronautics Authority finally produced the system best suited to the needs of the service in war time. This method, in which all the component ground units are mobile, employs a localizer transmitter mounted in a large truck and crystal controlled to operate in the very-high-frequency band.

A glide path transmitter was designed in similar fashion and mounted in a trailer unit. This unit was also crystal controlled and operates in the ultra-high-frequency band.

Three marker beacon transmitters, keyed at different intervals, are mounted in "jeeps." These send out the conventional 75-megacycle cone-shaped patterns.

The five components are laid out physically in the following arrangement: The localizer is sited off the far end of the runway. It is placed in such a manner so that its radiated course bisects the centerline of the runway and therein provides the pilot with horizontal or right and left guidance. This course extends out over the terrain off the approach end of the runway for the required usable distance.

The radiation pattern of this transmitter resembles two overlapped, pear-shaped lobes. These lobes have been formed by means of mechanical modulation at two separate audio frequencies. One is modulated at 90 cycles and the other at 150 cycles. The overlapping of these patterns provides an area in which these two frequencies are evenly distributed.

It is in this area that the plane is flown, because these audio signals, being essentially equal, do not provide

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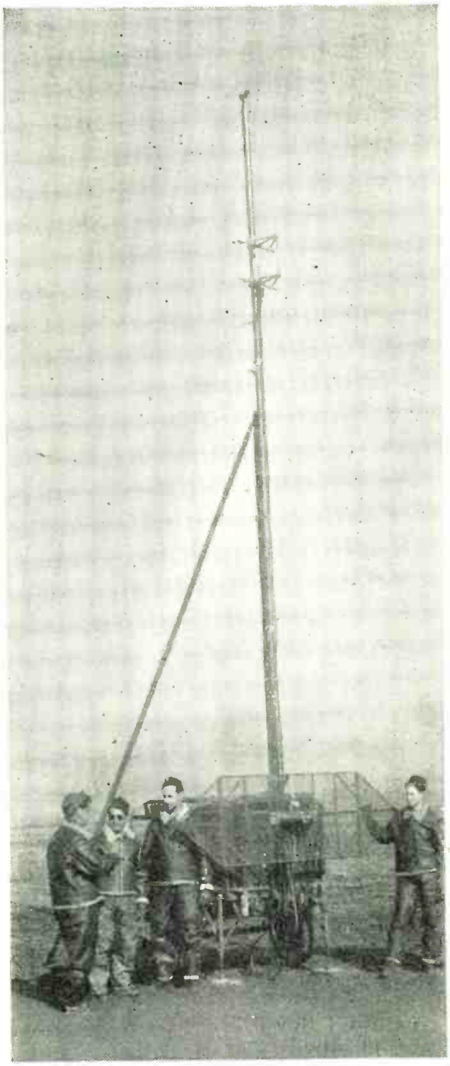
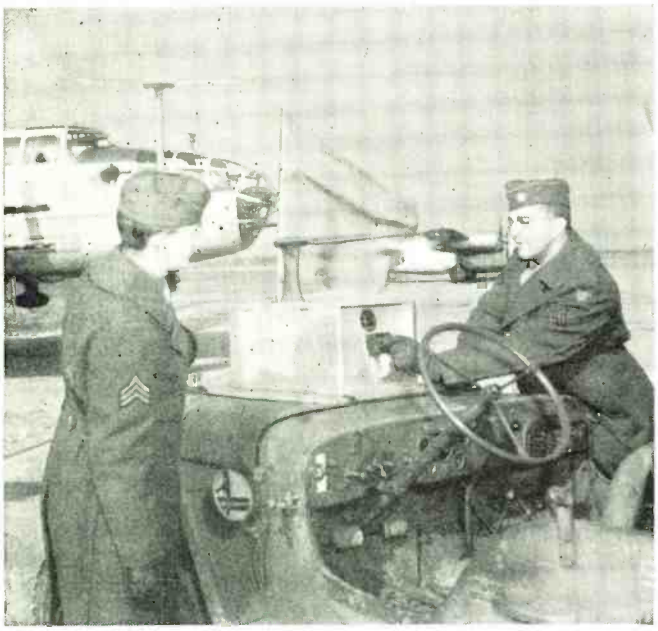
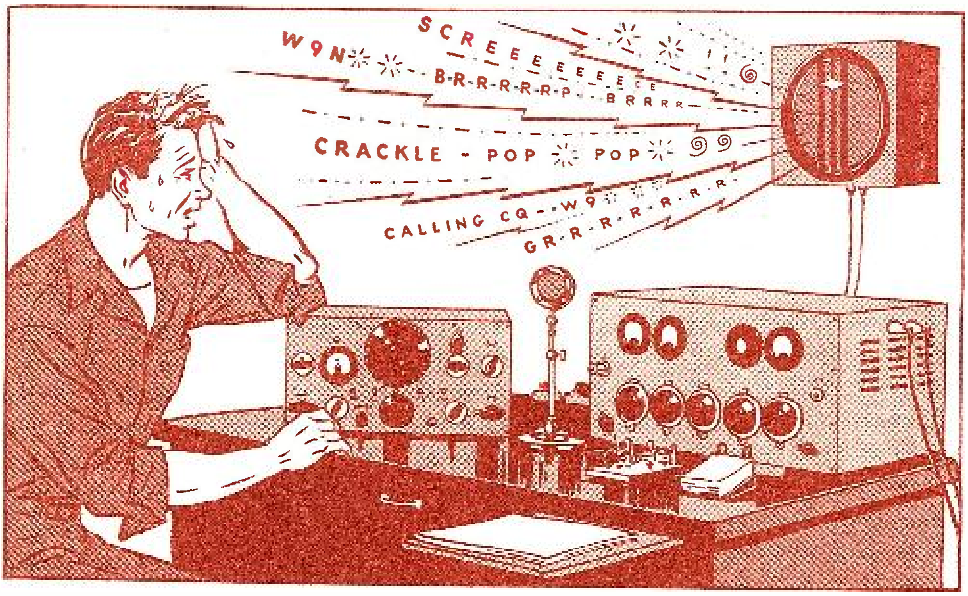


The glide-path transmitter. Like all other components of the system, this transmitter is mobile so that it can be quickly set up at whichever runway is in use.

Jeep, carrying same equipment as on aircraft, is used to check mobile transmitter. By varying the height of the horseshoe antenna, the vertical angle and glide-path can be checked.



Checking facility chart prior to a flight. All students are taken up on at least two flights so that they may see how the equipment guides their planes to a safe landing.



"QRM" A Threat to Amateur Radio

By T/Sgt. GEORGE MOBUS, W9UAO

ONE of these days, and we hope it will not be far away, a goodly number of men—and women—in Army khaki, Navy blue and Marine forest green are going to lay down their walkie-talkies, SCR's and TBY's and kiss (or cuss—depending upon what and with whom they have been operating!) good-bye to military equipment and operating procedure.

Many of these folks were pre-war hams. Many of the others, having been bitten by the bug that few can resist, will want to become hams. All of them are radio operators.

After the daze of their sudden new-found freedom passes, these people are going to force the FCC Amateur Licensing Bureau to place a "HELP WANTED" ad in all newspapers. Thousands of old-timers on the ham bands will return to their too long neglected "rag-chewing." Additional thousands will flock to the folds within a few months after the lid is off and Amateur Radio will see such an influx of devotees as has no other hobby.

Hamming, before the war, had been pretty well whipped into shape. Equipment, on the whole, was of a good quality. While the junk-box ham had not completely disappeared, the quality of the signals on the air indicated that most fellows were making a conscientious effort to clean up their sigs by using better grade parts and engineering their rigs more carefully. Much of this house-cleaning was done voluntarily and through the hams' own ingenuity although there were and are, at this time, a number of clubs and publications devoting a great deal of time and effort toward helping the ham in this project. However, in the final analysis it is going to have to be the man who built and is operating the station who will have to see to it that HIS signal is clear and that his operating habits are free of faults.

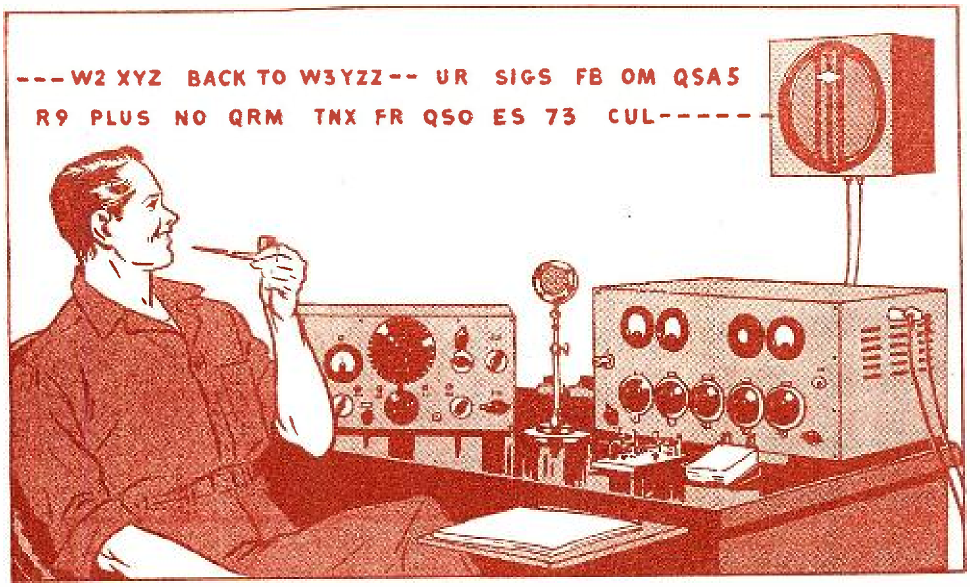
The ham-band picture has changed considerably from what it was twenty years ago. Back in the good old days (?) it did not matter so much if your signal was a trifle wobbly and sounded like a saw-mill. No one cared much, either, if you spent a couple of hours tuning your transmitter with the antenna radiating or if you used several hundred watts to talk to some other bird a couple of miles away. The high-frequency radio spectrum was something like the wild west back in the 1800's—plenty of room for all.

Like a two-gun bad-man in the panhandle, proudly cutting another notch in his six-shooters, a lot of the "old-timers" took pleasure in putting out a nice raw, broad signal. It was distinctive! Don't get me wrong now—those old-timers could not help it to any great extent. They just did not have the equipment to work with. The point of the whole thing is that they were not stepping on anyone's toes. What the heck—no one was fighting anyone else for the frequencies allotted the hams. Of the amateurs, they were few and in most cases far apart. Their sigs did not, as a rule, travel very far and there just was no congestion problem. It was not until higher frequencies came into general use that the signal "QRM" came to have much significance for amateurs.

Yes, the Radio Amateur was free to do as he pleased for many years. True, there were certain laws he was asked to obey and certain limitations and restrictions he had to observe. As long as the ham stayed within the bands allotted him (and there was not much reason to crowd the edge in those days), he was smiled on benevolently by others, who regarded him as a harmless "bug." Possible exceptions to this were the irate owners of broadcast receivers whose misfortune it was to live in the near vicinity of said "bug."

This state of bliss was enjoyed by the fraternity prior to World War I and for a few short years after. However, with the advent of cheaper parts and the more general use of vacuum tubes plus the opening up of bands below two-hundred meters, this situation was changed. Signals from afar were added to those of a neighboring ham to create interference and the words "Sorri OM, qrm hvy nw. 73 es cul" became frequently heard as more and more amateurs joined the ranks—lured by the natural thrill of personal communications with far places and the decreasing cost of equipment.

Who, among those active, does not remember the chaos that existed on all ham bands just prior to the shut-down of amateur activity at the entry



Only through the full cooperation of all hams in following sound operating techniques and by employing efficiently designed equipment can the discouraging effects of QRM be reduced.

of this country into World War II? Remember 40 and 80 meters in the evening about nine o'clock? Fun—wasn't it? You called some fellow and then hoped that you could hang on to him long enough to get a signal strength report through. Most of the time you could not. Just when you got going good some other fellow, who had as much legal right to the frequency as you or the station with which you were trying to "QSO," came blasting in like a ton of bricks calling "CQ" for five minutes or so or maybe just plain testing. You all know the way it went—no need for anyone to remind you.

Some fellows did not mind this so much. They had the "cabbage" so they just went ahead and built a more powerful final amplifier and drowned the other guy out. After all, there was not much system and it became a case of the survival of the fittest. Some of us were not so fortunate though. Money talked in amateur radio because it was with money that these "California Kilowatts" came into being. We tried various gadgets to shift our frequency and while we enjoyed some success in getting out from under the high-powered signals, we did not enjoy chasing a signal all over the band.

We were Radio Amateurs too! We had a license that gave us the privilege of using certain frequencies to transmit and receive radio messages. We were assigned call letters and were listed in the call-book. We had a radio station capable of putting out a signal—a pretty decent sort of signal as a matter of fact. Yes, we were Radio Amateurs! The only trouble was, it just wasn't any fun anymore to sit and fight "qrm" all evening instead of being able to log a half-dozen "qso's" as completed. Some of us found a partial solution. We banded together, ten or twelve stations, on a common frequency and several nights during the week we operated as a net or a "roundtable." Generally, another ham would steer clear of a freq if he heard a net in operation thereon.

Of course, ham radio is not a matter of building or buying a piece of equipment and putting it into operation and then just sitting down to logging "qso" after "qso" with no further regard to the technical side of radio. The increase of interference on the amateur bands did this for radio. It spurred the radio industry and the hams themselves into greater effort toward the improvement of their old standard gear and the development of new equipment. Necessity, they say, is the mother of invention. This was never more clearly shown than in the field of radio communications. Crystal and single-signal receivers, to cite only two important innovations, were a direct outgrowth of the problem of conquering the enemy—QRM. The role of the radio amateur in this endeavor is legend. Countless improvements and inventions, accepted and put into use by the radio industry and by our Armed Forces, are traceable directly to the radio ham whose sole idea, generally speaking, was to make some improvement in his signal or in his reception of the other fellow's signal.

All this was for the good of radio—both amateur and commercial. The improvements, however, did not go far enough. The increase in activity on the bands swept far ahead of the new equipment designed to alleviate the troubles of interference. We can assume that after the war a great number of further improvements in design and the invention of new equipment will be brought to light. These ideas and inventions were born of the necessity that our armed services and those of our allies have the undisputed superiority of communications material. We can only have a faint glimmer of what will be revealed after the last shot has been fired and the swords of war are beaten back into the plowshares of peace.

There is one development, in particular, however, that may be worth considerable attention. That is, VHF—"Very High Frequency"—or, as it was more generally known to hamdom, Ultra High Frequency. We were all aware of the limitations of the frequencies in the 56 megacycle band and we were just experimenting with those of 112 megacycles. These bands were okay for short-haul communications but the "Line of Sight" limitation characteristic precluded their use by all except those hams living in close proximity to each other.

But what of those frequencies even higher? How about two-hundred megs and up? Remember how dubious the radio world was regarding the frequencies above two hundred kilocycles? Maybe the vast unknown spectrum in the "Very Highs" holds some startling secrets also. As a matter of fact there has been considerable use of the "Very Highs" in this war and much research has been carried out. At this time, for obvious reasons, the findings of this research must be kept secret, but we have a hint of great results in the fact that the FCC has allocated frequency bands up in the hundreds of megacycles to the amateur and other radio services. *What a future ham radio has in this field!*

Even though we all remember the problem of interference in the days before the war, none of us know exactly to what extent we will be troubled by this same bug-a-boo after the war. Because we do not know the problem we cannot find a solution. However, we can look at it in the light of what we faced before the shut-down. The problem was simple enough then—there were too many amateurs putting out a signal on the same frequency at the same time.

There is no doubt that there will be even more signals competing with each other after the war—even with greater space in the radio spectrum having now been allotted. It all boils down to the fact that we, the ama-

(*Continued on page* 146)

BUILD THIS VICTORY TRANSMITTER

Constructional details of an effective and flexible small transmitter to keep on hand for the grand reopening of amateur radio.

By GUY DEXTER

ALTHOUGH the war emergency has kept us off the air for very nearly four years, no ham's ardor for his transmitter has cooled down one iota. And with the war situation getting pretty well in hand, many amateurs already are straining at the bit. Many have kept their rigs intact, from key to antenna, ready to go the minute the lid is lifted. Many more have sold their gear to the armed services, training schools, or war plants.

One thought captures the fancy of each ham who does not have a transmitter of some sort set up to celebrate the grand reopening—and that is to assemble something as quickly as possible from the odds and ends in the junkbox. No one will want to be left out of the fun. The 64-dollar question is what to build.

We feel that a major portion of our activity still will be on the popular lower-frequency bands, although the new ultra-high spectrum is virgin territory for experimentation. Most of the "standby" victory transmitters which will be constructed within the next few months, in anticipation of the green light, are thus apt to be intended for low-frequency use. Rumors regarding which bands we will retain are flying faster than the predictions of VJ Day. However, it is possible to build a flexible transmitter which, by means of wide-band, plug-in coils and suitable crystals, may be operated on any frequency for which we have crystals or may re-grind a present crystal.

Junkbox parts are not apt to yield a kilowatt, or anything even near that power. But a very effective little transmitter may be built from occasional material, mostly receiver components. While we were casting about mentally and looking over our own spare parts for an inspiration, we came across a unit built recently for the green light by Raymond Minichiello, W1HBR. It is this rig that is described in this article.

General Arrangement

The transmitter is a two-stage, crystal oscillator—beam power amplifier unit which may be used in a variety of ways. For example; the oscillator and amplifier may be operated at the same frequency without neutralization, or the amplifier may be made to double, triple, or quadruple the oscillator frequency. Likewise; the transmitter may be used directly on c.w., or, by the addition of a simple external modulator (an audio amplifier with 500-ohm output will do), may be adapted to radiophone service. When the unit has no further use as a complete transmitter, it may be used readily as an exciter for a more powerful class-C amplifier.

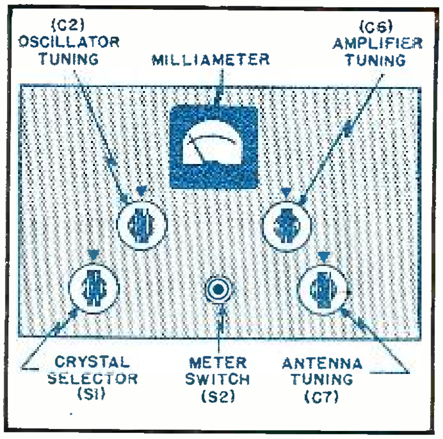
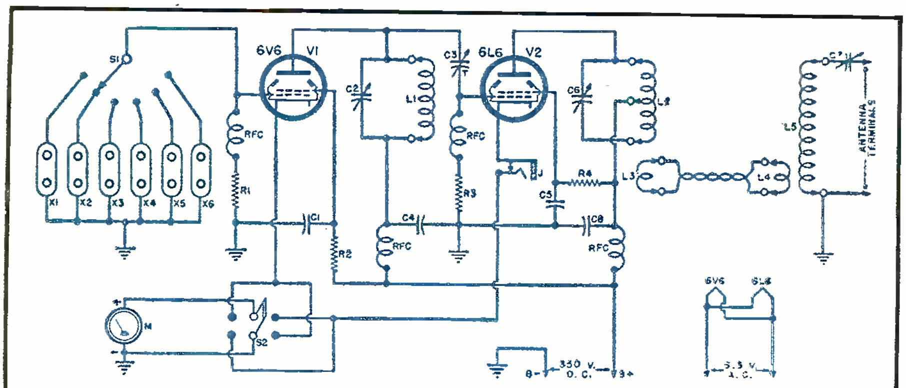


Fig. 2. Panel layout showing proper placement of the various controls.

For maximum flexibility and minimum size, the transmitter has been built without an internal power supply. The 350 to 400 volts d.c. required for plates and screens and the 6.3 volts a.c. required for the tube heaters may be obtained from an external power supply situated at any convenient point with respect to the transmitter. When the victory transmitter later is used as the exciter portion of a larger transmitter, these operating voltages may be obtained through voltage dividers and filament transformer windings in the main power supply section of the transmitter.

Some special features of the little unit are: The antenna tuning coupler is made integral with the transmitter and is tuned from the front panel; the milliammeter may be switched into either oscillator or amplifier circuit, by means of a front-panel switch, to check plate currents during tune-up adjustments; six crystal sockets are provided, and a front-panel rotary

Fig. 1. Complete diagram of the victory transmitter. This transmitter employs only two tubes and is designed for use with an external power supply.



C_1, C_4, C_5, C_8—.001-μfd. mica cond.
C_2, C_6, C_7—100-μμfd. midget variable cond.
C_3—100-μμfd. miniature air padder cond.
J—Normally closed, single-circuit midget jack
L_1—See Table I
L_2, L_3, L_4, L_5—Commercial coil sets (See Text) or plug-in units wound according to Table I.
R_1, R_2, R_3, R_4—15,000-ohm, 2 watt
RFC—2½-mh., 125 ma., pi-wound r.f. choke
S_1—single-pole, six position rotary selector switch
S_2—d.p.d.t. toggle switch
V_1—6V6
V_2—6L6-G
X_1 to X_6—Special sockets for standard crystal holders—Millen 33002 or equivalent.
M—0-200 d.c. milliammeter

switch permits either of the crystals semi-permanently mounted in the sockets inside the cabinet to be switched-in at will; and most of the components used are receiver parts, small in size and usually found in amateur junkboxes. The tubes likewise are in the receiving category, but give good account of themselves when employed for r.f. power generation.

The complete victory transmitter is shown in the accompanying photographs and drawings. Fig. 3 shows the external view, while the layout drawing—Fig. 2—identifies the components appearing in the photograph. Fig. 3 also includes a top-chassis view, with the layout drawing—shown in Fig. 4—identifying the parts seen in the second photograph. Fig. 5 is an under-chassis view, showing wiring and the mounting of "hidden" circuit components.

The transmitter is housed in a 13½" x 7¼" x 7" general purpose steel cabinet. The chassis is the folded-edge inside tray supplied with this type of cabinet. All controls and circuit-access components are mounted on the front panel, with the exception of the keying and modulation jack, antenna terminals, and power cable outlet which are found on the back of the cabinet.

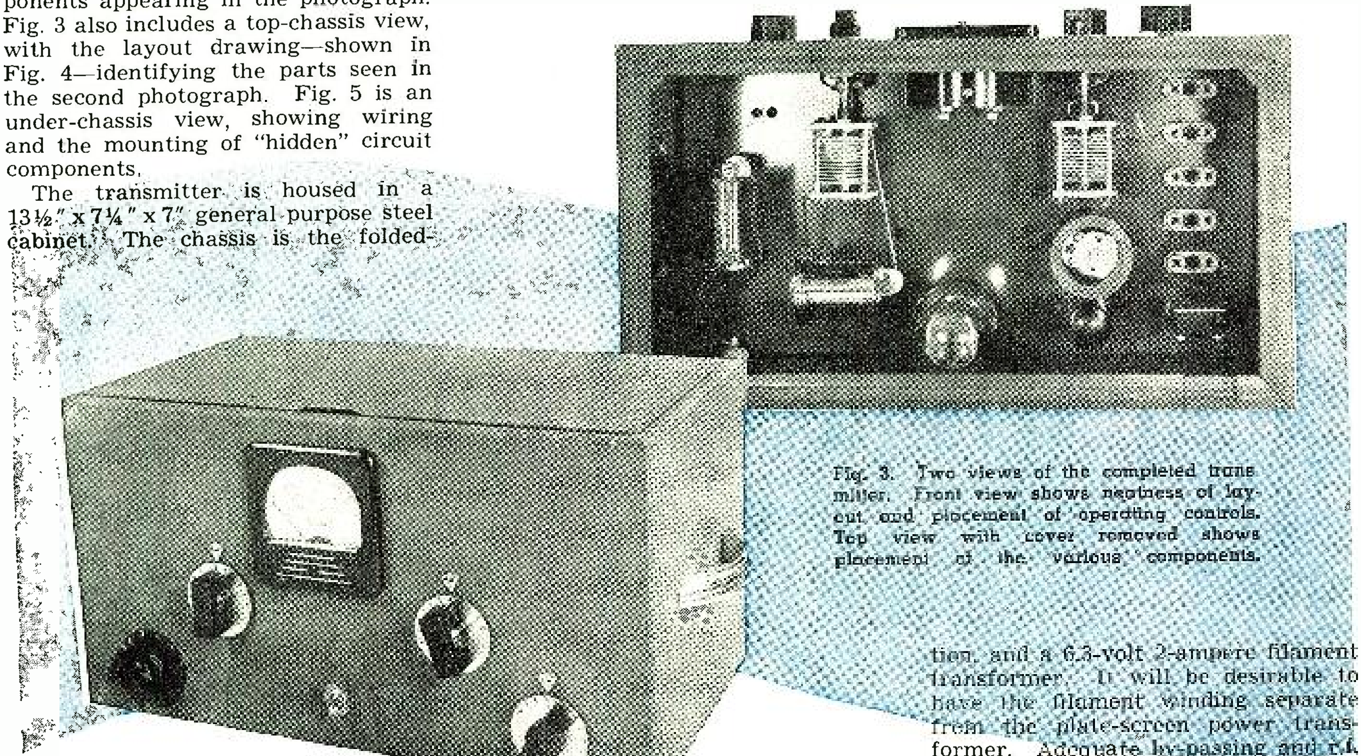


Fig. 3. Two views of the completed transmitter. Front view shows neatness of layout and placement of operating controls. Top view with cover removed shows placement of the various components.

Circuits

The complete circuit schematic for the victory transmitter is given in Fig. 1.

The crystal oscillator is the conventional arrangement built around a 6V6 tube, V_1. The crystals are placed in special sockets, X_1 to X_6, which are connected to the contact points of the single-pole, 6-position rotary selector switch, S_1. The oscillator tank is comprised of the plug-in coil, L_1, wound on a 1½"-diameter bakelite form, and the 100-$\mu\mu$fd. variable air capacitor, C_2. The coupling capacitor, C_3, a 100-$\mu\mu$fd. midget variable air unit, is mounted inside the oscillator coil form and may be seen there in Fig. 3. A separate capacitor C_3 is provided in each plug-in oscillator coil and is set, during tune-up adjustments, for proper excitation of the final amplifier.

The output amplifier tube, V_2, a 6L6-G, is capacitively-coupled from the oscillator. The amplifier plate tank comprises a center-tapped coil, L_2 with end-link coil, L_3, and the 100-$\mu\mu$fd. variable air capacitor, C_6. L_3 is connected directly to a short length of twisted pair (made of hookup wire) which terminates in a similar link coil, L_1, wound around the end of the antenna coil, L_5. The antenna coil is tuned by a third 100-$\mu\mu$fd. variable air capacitor, C_7. L_2 and L_5 both are plug-in, air-wound coils, as shown in the photographs, but may be wound on bakelite, ceramic, or polystyrene forms if desired. If the prewar amateur bands are of interest to the builder, the following manufactured coil sets may be employed: *National* type AR, *Barker & Williamson* type MEL, or *Bud* type OEL. These coils plug into ceramic plug-in bases, visible in Fig. 3. If the builder desires to wind his own coils for wide frequency coverage, Table I accompanying this article may be followed.

The single 0-200 d.c. milliammeter is switched between the oscillator and doubler plate-cathode circuits by means of a double-pole, double-throw toggle switch, S_2. When S_2 is thrown to the left-hand position, the meter is inserted in series with ground and the cathode of tube V_1, while the cathode of tube V_2 is grounded. When S_2 is thrown to the right-hand position, the meter is inserted in series with ground and the cathode of tube V_2, while the cathode of tube V_1 is grounded.

The jack, J, in the cathode circuit of the 6L6-G amplifier tube receives a key for c.w. telegraphy or the 500-ohm output of a 5-watt amplifier for cathode modulation. It is a normally-closed midget-frame jack which must be insulated from the metal front panel of the transmitter by means of a shoulder-type bakelite washer.

Operating Characteristics

The victory transmitter must be powered by a 350-to-400-volt 200-milliampere d.c. unit having good filtration, and a 6.3-volt 2-ampere filament transformer. It will be desirable to have the filament winding separate from the plate-screen power transformer. Adequate by-passing and r.f. chokes have been provided in the transmitter, thus precluding shielding and by-passing in the power supply unit. The type 83 is recommended as the most suitable rectifier tube for the power unit.

At a d.c. plate voltage of 350, the 6V6 crystal oscillator draws approximately 15 ma., and the 6L6-G amplifier approximately 100 ma. Plate power input of the amplifier thus is approximately 35 watts d.c.

The circuit operates well at all frequencies up to 30 mc. without it becoming necessary to reduce the plate power input. Crystal heating is very slight.

The simple series-tuned antenna coupler permits use of a variety of simple and complex low-frequency antennas. Excellent results have been obtained with couplers of this type when feeding directly into a half wavelength of wire, working against ground.

The 6L6-G amplifier keys well, but a key-click filter must be installed in series with the key to eliminate click interference.

An external plate modulator may be employed, if desired, however an au-

(*Continued on page* 84)

The panoramic unit is in the form of an adaptor to be employed in conjunction with your present receiver. Any number of signals can be seen for comparison.

Combining actual visual inspection and the added advantages of a panoramic adapter, many a "DX'ers" aural reception problems will be greatly simplified.

Comparison of Visual and Oral Reception

By HARVEY POLLACK

Panoramic Radio Corp.

ANY SYSTEM which employs vision to convey intelligence through the use of external visual stimuli has a great advantage over methods involving the other senses. This is true because, of all our senses, vision is the only one capable of analyzing parts of a "blended" whole.

The extraordinary faculty of vision makes panoramic reception of outstanding significance to radio amateurs. Operators never try to copy more than one signal at a time because their sense of hearing is not capable of "describing the many components of the whole." On the other hand, the panoramic method of visual presentation of almost *any* number of signals simultaneously provides a composite picture that is completely open to piece-meal analysis.

The Screen of the Panoramic Receiver

Let's peek in through the window of a postwar ham shack. The operator's bench, replete with all the usual ham accessories, carries a modern panoramic superheterodyne. With regards to reception, this receiver behaves exactly as the prewar superhets did; its highly selective circuits enable the operator to listen to single signals without the distraction of interference. The receiver contains a CRT whose face is masked and filtered by an emerald plastic screen which is calibrated horizontally in terms of frequency. As the receiver is tuned, inverted-V deflections of the CRT trace move across the screen; just at the moment that a signal is heard on the loudspeaker, the deflection belonging to that signal is seen on the screen at the center, as shown in Fig. 1.

The other visible deflections indicate the presence of signals of which the operator would be totally unaware were it not for the broad vision of the panoramic. The position of each deflection along the baseline, its amplitude, and its shape convey to the operator, *immediately,* the frequency, strength and character of the signal producing it. Thus, panoramic grants the operator an insight that assists in eliminating the headaches and limitations of unisignal aural reception and permits him to see the *whole* band as it exists at that very moment.

Theory of Operation

The panoramic portion of the typical post-war ham superhet will consist of the stages shown in Fig. 2.

Special Bandpass Amplifier.—The aural converter feeds a series of signals picked up by the receiving antenna into the special r.f. amplifier of the panoramic section. The usual selectivity of converters, even when preceded by one or more tuned r.f. stages, is such as to produce a broad response. Of course, the resonant signal suffers the least attenuation while signals which differ from the resonant one in frequency are attenuated in proportion to this difference. One of the goals in panoramic reception is the visual reproduction of signals in the form of deflections whose amplitudes are *in the same ratio as the original signals.* Referring to Fig. 1, if the signal which produced deflection A was half as strong as the one which gave rise to signal B, and if signal C was about half the strength of A, then we have established the correct amplitude ratios. In order to accomplish this result, it is necessary that the special panoramic bandpass amplifier compensate for the selectivity of the r.f. section of the aural receiver; it must therefore amplify where the receiver attenuates, and attenuate where the receiver amplifies in order to produce a flat response over the entire visual band. If the visual band chosen is

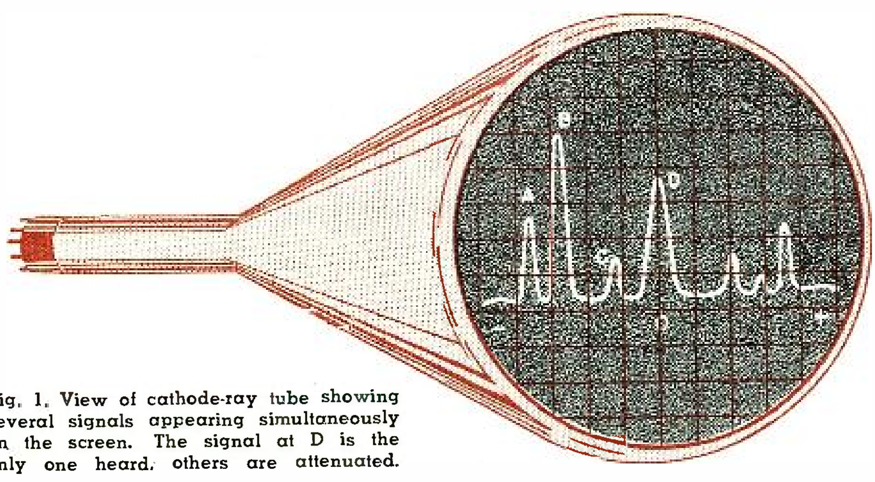


Fig. 1. View of cathode-ray tube showing several signals appearing simultaneously on the screen. The signal at D is the only one heard; others are attenuated.

200 kc. (100 kc. on each side of the zero line), then the combination of the bandpass amplifier's response and the aural r.f. response must approximate a straight line over a band of 200 kc.

The FM Oscillator.—Just as in the conventional superheterodyne receiver, the panoramic contains a local oscillator. However, this oscillator is frequency modulated (wobbulated) over a range of frequencies corresponding to the pass band (200 kc. in our example) so that it successively heterodynes all of the signals which are fed to the mixer stage from the bandpass amplifier, producing a series of signals corresponding to the i.f. of the adaptor. These signals of the correct intermediate frequency are separated from each other by *time*. That is, as the oscillator sweeps over its range of frequencies, it beats with one after another of the signals in the mixer so that one after another of these signals produces the correct intermediate frequency to be amplified by the following sharply tuned i.f. stage.

The Reactor.—This stage performs as an artificial inductance which is made part of the tank circuit of the FM oscillator. By means of a phase shifting network, the current and voltage in the plate circuit of the reactor tube are thrown out of phase with each other so that, as far as the oscillator is concerned, an additional inductance now exists across its tank coil. Furthermore, as the grid voltage on the reactor changes (see Sawtooth Generator below) the amount of apparent inductance changes. This, of course, results in a variation of oscillator frequency which keeps perfect step with the variations of voltage applied to the grid of the reactor.

The Sawtooth Generator.—A blocking-tube oscillator is used to produce a sawtooth waveform which is applied as a sawtooth voltage to the grid of the reactor tube. Since the sawtooth voltage is linear, the frequency excursions of the FM oscillator have a linear form. This results in a set of screen calibrations which are equidistant from one another and represents a distinct advantage for determining the frequency of any deflection in terms of the frequency of the center deflection. In effect, then, the steps which give rise to frequency modulation are: (1) production of a sawtooth voltage which is applied to (2) the grid of the reactor. This causes the apparent inductance of the latter to vary in step with the sawtooth voltage and hence, (3) the frequency of the local oscillator varies at the same rate.

It may be seen from Fig. 2 that the sawtooth amplifiers are connected to the horizontal deflection plates of the cathode-ray tube. The same sawtooth generator which produces frequency modulation of the oscillator is thus made to swing the CRT electron beam horizontally along the face of the tube. Thus, the successive peaks produced by the FM oscillator are separated from each other along a horizontal axis and, furthermore, always appear steady because of the synchronization between the FM action and the horizontal sweep action. It must be remembered that deflections which appear stationary and discrete are not actually that way; due to persistence of vision and persistence of fluorescence, signals which appear, disappear, and reappear with rapid periodicity seem to be present all the time.

Detector and Video Amplifiers.—The behavior of these stages is normal. Rectification of signal voltages takes place in the detector circuit. These voltages are then amplified and fed to the vertical deflection plates of the CRT. The deflections which appear as a result of these voltages are evidently reproductions of the response curves of the i.f. stages of the panoramic.

Maximum Sweepwidth

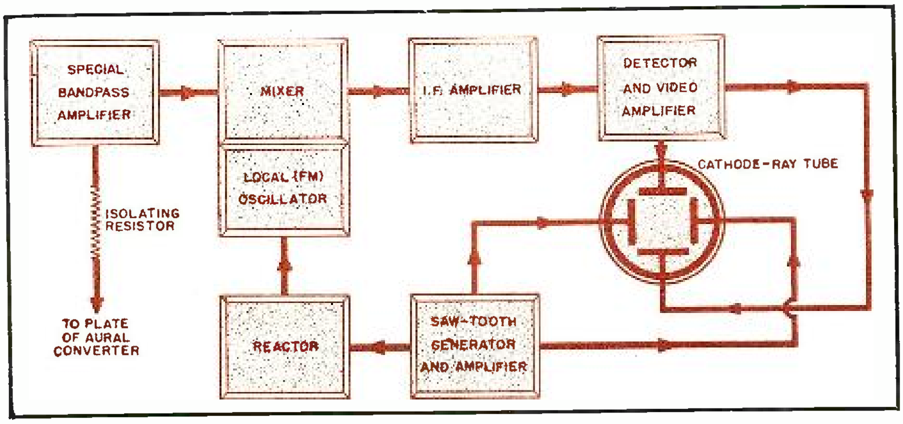
The visual pass-band of 200 kc. mentioned in connection with Fig. 2 was purely arbitrary. Many types of panoramics are scheduled for postwar production. Pass-bands (we shall call these "maximum sweepwidths") ranging from 50 kc. all the way up to 10,000 kc. or higher will be available. The choice of any particular maximum sweepwidth will depend upon several factors, not the least important of which is the design of the aural receiver.

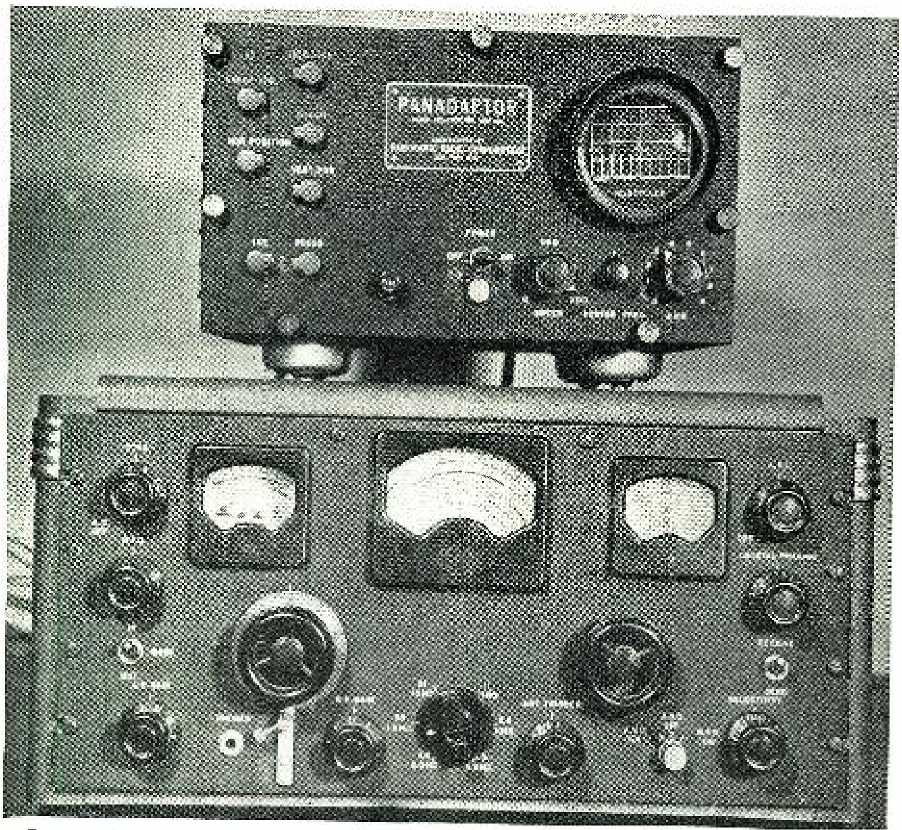
Variable Sweepwidth

Every panoramic receiver, regardless of type, will be equipped with a control for varying the sweepwidth from maximum, through all the intermediate positions down to zero. One reason that this is an extremely valuable feature is that it enables the operator to better analyze the characteristics of individual signals. Fig. 3A is a picture of a single signal as it appears on the screen at *maximum* sweep. In B, the sweepwidth has been reduced to about 20% of maximum. Notice how the modulation on the carrier is becoming visible as a secondary waveform superimposed on the original deflection. The panoramic, at zero sweep (Fig. 3C) becomes a p e r f e c t oscillograph for minute analysis of received signals.

Referring to Fig. 4A, two signals of adjacent frequency are interfering with each other, producing a pair of deflections which are almost merged. Under these conditions, neither signal can be studied satisfactorily. At about 20% sweep, however, the signal deflections separate (see Fig. 4B) and become readily accessible for analysis. For the amateur operator, this increase of visual selectivity (resolution) is exceedingly valuable because it enables him to determine the side (high or low frequency) where interference is taking place. Armed with this knowledge, he can advise the transmitting station to shift higher or

Fig. 2. Block diagram showing stage-by-stage operation of the panadapter.





Proper placement of the panoramic adapter with relation to the shortwave receiver.

lower in order to clear his channel.

In Fig. 5 are shown reproductions of photographs of the panoramic screen taken under actual operating conditions and showing typical signals that operators may find when they tune to the bands indicated.

1. Signal modulated at 3000 cycles. Sweepwidth 100 kc. The sidebands are too close to the fundamental to be resolved. Some irregularity at the base is the only indication of their presence.

2. Same signal as in 1. Sweepwidth reduced to 70 kc. The resolution is better and the sidebands are clearly separated on each side of the carrier.

3. Same signal as in 1. Sweepwidth reduced to 50 kc. The sidebands separate still more. The amplitude of the deflection has increased. Slight amount of overload is apparent by the flattening of the apex of the deflection.

4. Same signal as in 1. Sweepwidth reduced to 25 kc. The sidebands are still further away. (The gain of the panoramic receiver was somewhat reduced, to avoid overload).

5. Signal modulated at 15,000 cycles, sweepwidth 100 kc. The sidebands are quite distinct from the carrier.

Resolution versus Sweepwidth

6. Two carriers 5 kc. apart at full sweepwidth of 100 kc.

7. Same carriers as in 6 with sweepwidth reduced to 50 kc.

8. Same signals as 6 and 7 with sweepwidth reduced to 20 kc. (Gain slightly reduced to avoid overload.)

Deflection Amplitude versus Signal Strength

(100 kc. sweepwidth, no AVC control, fixed gain control.)

9. 10 microvolt signal.

10. 100 microvolt signal. Limiting amplitude has been reached.

11. 1000 microvolt signal. Base widens up. Limiting action causes square top.

12. 10,000 microvolt signal. Small spurious signal visible on the left. Some irregularity at the base is the only indication of its presence.

13. 100,000 microvolt signal. The deflection breaks up into three portions; one central portion flattened on the top and two "harmonic spurious."

Example of Actual Receiving Conditions

14. 14 mc. amateur phone band. About six modulated phone stations are visible.

15. A portion of the broadcast band. Stations are distributed at every 10 kc.

16. Three c.w. stations. Due to the rapid keying, the deflections appear closed at the bottom. On the left side a "key click" appears.

FM Signals (100kc. Sweepwidth)

17. Carrier during period of silence.
18. Very little modulation.
19. Increased modulation.
20. Heavy modulation.

Panoramic Aids Operating Efficiency

With his eye on the panoramic screen, the operator can watch the answers he has heard in tuning through the band; he gives them a fast dit dah dit dit dit the minute they sign, and holds them while he waits for the other calls to finish up.

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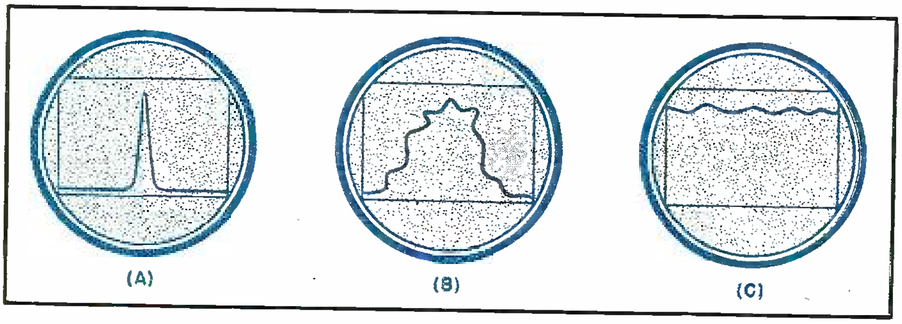
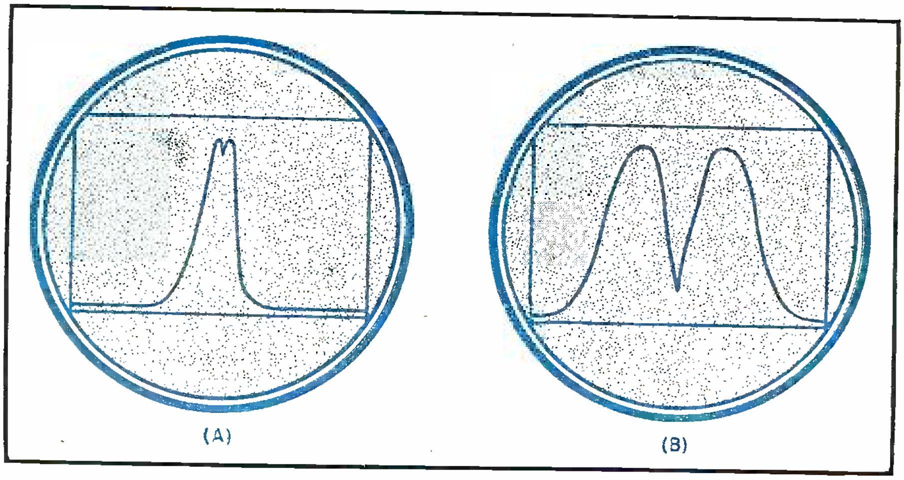


Fig. 3. Effect of reduction of sweepwidth on the appearance of a single signal.

Fig. 4. Two signals of adjacent frequency are shown interfering with each other.



Television for the Amateur

By OLIVER READ, W9ETI
Managing Editor, Radio News

Television—a new field for the postwar ham—will provide additional interest to amateur activity.

TELEVISION is not too complicated for the amateur—neither is it too expensive. The radio amateur, always inquisitive, and with a comprehensive knowledge of transmitter and receiver practical theory and operation, has only three obstacles in his path: study of high-frequency methods, study of circuits for non-sinusoidal waves, and study of the assembly of the various signal components which constitute the composite television signal. If he already has appreciable high-frequency and cathode-ray-tube experience, which I conservatively estimate 60% of the radio amateurs have obtained in their commendable war contributions, he is two giant steps closer to the television goal. A knowledge of patterns and internal electron'tricities of the cathode-ray test oscillograph is a step in the approach. A radio amateur with high-frequency relay or link experience and with radar design, construction, or repair experience, has the acme of pre-television instruction.

To learn how the receiver functions is a major portion of the task, for understanding exactly what occurs in the receiver entails a knowledge of the composition and arrangement of the transmitted television signal. This information can be obtained by studying the present and back installments of the receiver series now appearing in RADIO NEWS.

Function

What are the basic functions of the television system?

A. Transmission

1. Forms a picture signal which is a parade of electrical charges representing the light distribution on the object televised.

2. Forms a series of rectangular pulses, sync and blanking, of various amplitudes and durations, which are inserted into the picture signal at prescribed intervals, to hold the picture stationary or "in sync" on the receiver screen and to prevent picture from streaking.

3. Generation of a high-frequency carrier which is modulated by this composite television signal.

4. Generation of an associated sound carrier, which is, in commercial practice and possibly will be in amateur practice, frequency-modulated by the sound information.

B. Reception

1. The receiver in commercial practice picks up both picture and sound carriers and passes them into separate i.f. systems. The amateur can use the same method or two separate receivers, whichever is most convenient.

2. Picture signal is transferred back into light variations on the screen of the picture tube.

3. Sync pulses hold the reproduced image on the picture tube screen, prevent "tearing out" (horizontal displacement of picture elements) and "flopping over" (vertical displacement of picture elements).

Thus, the television system has two primary functions, namely: to get the light information to the picture tube, and to display it in proper sequence (synchronized) with stability.

Frequency

To transmit a picture with clarity and definition, a wide-band of frequencies is necessary. Thus, if a signal is transmitted which contains two-megacycle components, a four-megacycle bandwidth is required, unless some elaborate scheme is used to partially suppress one sideband. If better definition is desired, the bandwidth must be proportionately greater.

Observation of the frequency bands allocated to the amateur shows that only the very high-frequency bands can accommodate such a wide channel. These bands are listed in the accompanying chart. One other band is five megacycles broad, 220 to 225 megacycles. This band could only accommodate one four-megacycle channel. It is not likely that television will be permitted in this band, because of interference between television stations and other types of communications on the band. It is desirable that the FCC allocate separate television sections on the high-frequency amateur bands, and specify bandwidths which become progressively wider (permitting higher definition) on the higher frequency bands. A tentative outline for such a system is shown in Table 1.

While these frequencies are consid-

(*Continued on page* 120)

Table 1. Frequency bands allocated to the amateur. Only the very high frequency bands can satisfactorily accommodate television transmissions.

Amateur Band Megacycles	No. of Channels	Max. Band-Width per Channel Megacycles	Television Band Megacycles
420-450	3	4	420-432
1125-1225	5	8	1125-1165
2500-2700	7	10	2500-2570
5200-5750	10	20	5200-5400
10,000-10,500	10	20	10,000-10,200
21,000-22,000	20	20	21,000-21,400

5" OSCILLOSCOPE DESIGN

By

RUFUS P. TURNER
Consulting Eng. RADIO NEWS

Oscilloscope tube of the type now offered for sale which may be obtained without priorities.

The design and construction of an oscilloscope employing five-inch government surplus tubes.

SURPLUS goods houses recently have advertised in the radio and mechanical magazines 5-inch oscilloscope tubes of the 5BP1 and 5BP4 types. These tubes, which are being offered at an attractive price and may be obtained without priorities, were bought originally by the Government for the armed radio services. They are the first oscilloscope tubes to be obtained so easily by the public since Pearl Harbor.

The 5-inch screen gives a magnificent view of all patterns. Such a tube is applicable to television reception, on an experimental basis, as well as to oscillography, and it is likely that many experimenters will use the Government surplus tubes in home-made equipment. We have received queries already by quite a few experimenters who want particular pointers on building a 5-inch oscilloscope of good design.

It is with these experimenters in mind that we offer the following article, describing 5-inch oscilloscope design and construction. In preparing this material, we have drawn largely upon our own experience and to some extent upon the previous literature. The leading facts have been digested into working data.

Tube Differences

Both 5BP1 and 5BP4 have been made available to the public. The main differences between these tubes are in certain of their operating voltages and in the screen materials they employ. The 5BP1 screen is coated with phosphor No. 1 (green fluorescence), while the 5BP4 screen uses phosphor No. 4 (white fluorescence). There is a slight difference in anode voltages. The lowest anode #2 (high-voltage electrode) voltage common to both types, for a bright pattern, is 1500 volts d.c. Lowest common anode #1 voltage is 310 volts d.c. Both tubes have 6.3-volt, .6-ampere (a.c. or d.c.) heaters and have the same physical dimensions: over-all length $16\frac{3}{4}''$ plus or minus $\frac{3}{8}''$, diameter $5\frac{1}{4}''$ plus $\frac{1}{16}''$ minus $\frac{3}{32}''$. Both have medium persistence. The 5BP1 is similar to type 1802-P1, and the 5BP4 to type 1802-P4. Each type requires a large wafer magnal, 11-pin socket.

5-Inch Oscilloscope Circuits

Two arrangements are of interest to oscilloscope builders—the *basic* and *complete* circuits. These arrangements are shown in functional block diagrams in Fig. 1. Practical circuit schematics appear in Figs. 3 and 4. The first type embraces only the oscilloscope tube, power supply, and vertical and horizontal input terminals. This type is used only when simple observations are to be made. Such observations include those of modulation patterns or of resonance figures from relatively high voltage sources, and high-level signal voltages (a.c. or d.c.) which do not require amplification or a time base. The basic oscilloscope may readily be converted into a complete instrument on occasion by adding, externally, the horizontal and vertical input amplifiers and the linear-base sweep oscillator. The complete type includes, in addition to the oscilloscope tube and power supply, internal vertical and horizontal signal amplifiers, internal saw-tooth sweep oscillator, gain controls, synchronizing control, and a complete set of input terminals and associated switching circuits.

Basic Oscilloscope

The circuit diagram of a practical 5-inch basic oscilloscope is given in Fig. 3. This unit is powered by two type 6X5 tubes and a small transformer, T, of the broadcast replacement type, having a 350-0-350 v., 180-ma. high-voltage secondary. The entire high-voltage winding is used (center tap left floating) and is connected with the two rectifier tubes and two 8-μfd., 1000-volt oil-impregnated, oil-filled capacitors, C_1 and C_2, to form a half-wave voltage doubler circuit. Two separate filament windings are employed, since use of a single winding would result in a dangerous heater-cathode potential in the 6X5's. The high d.c. voltage delivered to the #2 anode of the oscilloscope tube will be between 1500 and 2000 volts.

Voltages for the various d.c. electrodes of the oscilloscope tube are obtained from the voltage divider string —R_1-R_2-R_3-R_4. The focus control (R_2) and the brilliance control (R_4) are standard good-grade volume control-type potentiometers. R_1 and R_3 each must be rated at 2 watts.

One 6.3-volt winding of the power transformer supplies heater voltage to the two 6X5 tubes and the pilot light. The other 6.3-volt winding supplies the heater of the cathode-ray tube. The 5-volt secondary, commonly supplying rectifier filament voltage, is left floating.

Signal and sweep voltage sources, or separately-housed horizontal and vertical amplifiers may be connected to the corresponding input terminals. Isolating capacitors, C_3 and C_4, are inserted in the signal input lines, but may temporarily be shorted out when checking d.c. signal voltages.

When testing or operating the basic oscilloscope, it must be borne in mind that this is a high-voltage device which is potentially dangerous. Points, such as chassis and one leg of each input circuit, which normally are "cold" in ordinary radio sets and instruments, are at high positive potential in this oscilloscope. The operator must not probe about inside the 'scope with the power turned on, without first taking every precaution, including extra mental alertness and increased familiarity with the wiring diagram, to prevent electric shock.

To place the instrument into operation; (1) Turn brilliance control R_4 to lowest setting; (2) Insert line plug into 115-v. a.c. receptacle and throw switch S to "ON" position; (3) After waiting about 1 minute for tube heaters to reach normal operating temperature, advance brilliance control R_4 slowly, noting that luminous spot appears on screen end of oscilloscope tube; (4) Adjust focus control R_2 until spot is sharp and clear; (5) If spot is not bright enough for easy visibility, advance brilliance control further in direction of top setting. Signal voltages now may be applied to horizontal and vertical input terminals.

It is unwise to keep a *bright* stationary spot or pattern on the screen for any appreciable length of time, since the screen will be damaged thereby. When stationary patterns must be studied, brilliance should be reduced to the lowest possible level which will give accurate visibility with a minimum of eye-strain.

Suggested mechanical construction of the basic oscilloscope is shown in Fig. 2. Here, front, side, and top views are shown to indicate recommended placement of parts on the metal chassis, front panel, and back plate. For viewing the oscilloscope screen, a 5-inch-diameter hole is cut in the 7" x 14" front panel, 1 inch down from the top and 1 inch in from left and right sides. Directly behind this hole is mounted a retaining ring for holding the screen end of the tube in place.

The socket required by the oscilloscope tube is rather large, having its contacts in a circle a little better than 1 inch in diameter. A suitable socket is *Amphenol* type 49-SS11L. This is a steatite component requiring a mounting hole 1 9/16" in diameter which is cut near the top of the 7" x 12" back plate shown in the drawings. On the same back plate, below the 'scope-tube socket, a square cutout is made for the transformer. The latter is mounted with its shell to the rear of the instrument. It is imperative that the transformer be mounted below the rear of the 'scope tube, in the manner shown, in order that hum fields may not distort the patterns on the screen.

Transformer leads pass through the top of the chassis through a pair of grommet-lined holes. Leads from the 'scope-tube socket pass through a pair of similar holes in the back plate and then through grommet-lined holes in the top of the chassis. The leads from 'scope tube terminals 3, 6, 8, and 9 should be covered with a good-grade shield braid. These four leads must be kept clear of tube-heater and power line leads from which hum might be picked up. The power cord extends from the rear of the chassis.

The minimum chassis dimensions will be 7" x 22" x 2". The entire foundation unit—front panel, chassis, back plate, and an outer case to enclose the entire instrument—may be made from heavy-gauge steel, galvanized iron, or other sheet metal stock. The metal case is effective in shielding the oscilloscope from stray fields. However, if scarcity of sheet metal dictates, the instrument may be built on a wooden front panel, back plate and baseboard and housed in a wooden cabinet. But an instrument built in this manner is extremely sensitive to stray fields and hum pickup and must be kept clear of all sources of magnetic fields.

The basic oscilloscope is entirely practical but is *adequate* only in those applications where input amplifiers and a linear sweep circuit would seldom, if ever, be used. At an anode #2 voltage of 2000, the 5BP1 tube in the basic oscilloscope offers a horizontal deflection sensitivity of .30 millimeter per volt d.c. and a vertical deflection sensitivity of .33 millimeter per volt d.c. The 5BP4 tube, operated at the same anode #2 potential in the basic instrument, offers a horizontal deflection sensitivity of .17 millimeter per volt d.c. and a vertical deflection sensitivity of .21.

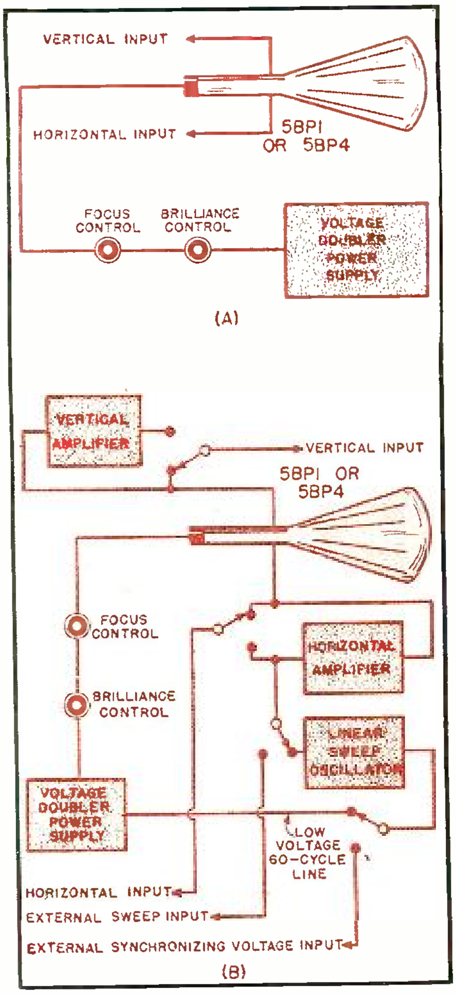


Fig. 1. Block diagrams of the basic oscilloscope (A) and the complete unit (B).

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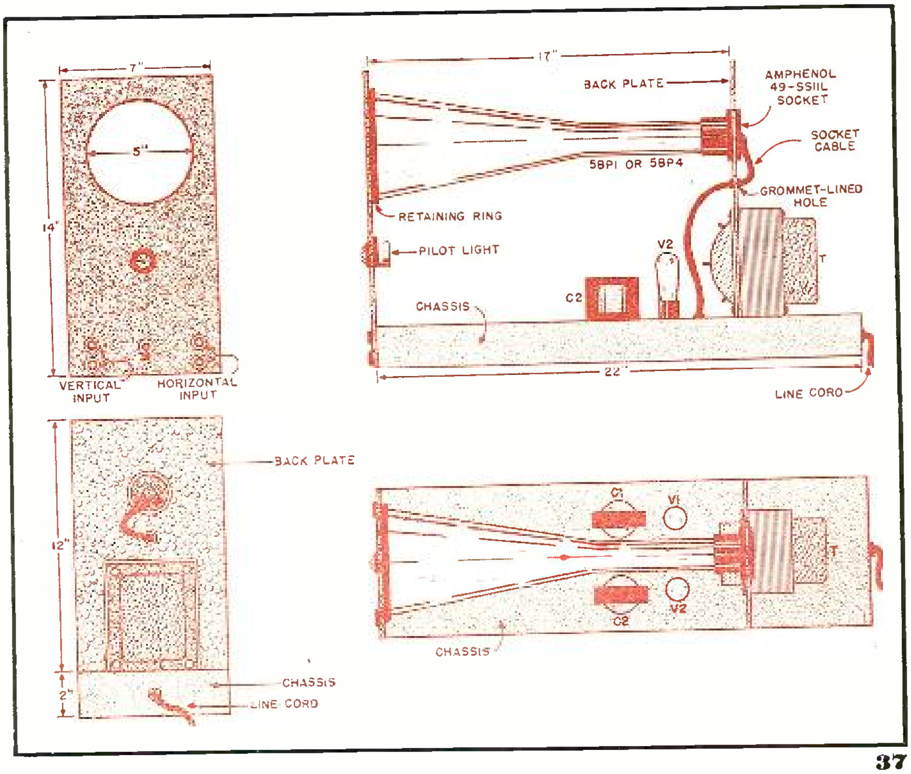
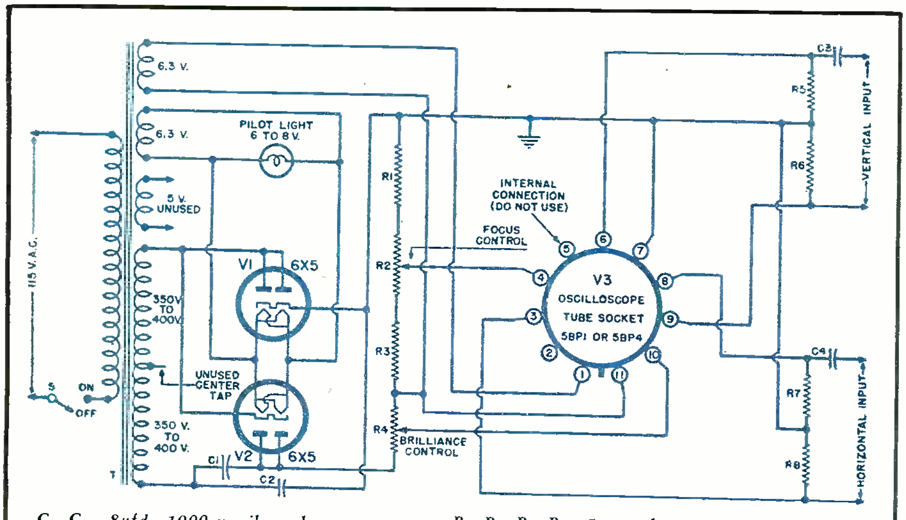
Fig. 2. Mechanical layout for basic oscilloscope showing proper component placement.





C_1, C_2—8μfd., 1000 v. oil cond.
C_3, C_4—.5μfd., 600 v. tub. cond.
R_1—600.000 ohm, 2 watt res.
R_2—200,000 ohm, pot., 2w.
R_3—175.000 ohm. 2 watt res.
R_4—50,000 ohm pot., 2w.
R_5, R_6, R_7, R_8—5 megohm, 1 watt. res.
S—s.p.s.t. toggle switch
T—Power transformer, 350-0-350 v., 5 v., 6.3 v., 6.3 v.—U.T.C. R-5
V_1, V_2—Type 6X5 tube
V_3—Type 5BP1 or 5BP4—cathode-ray tube.

Fig. 3. Basic diagram of the oscilloscope with many of its possible features omitted.

The circuit schematic for a complete 5-inch oscilloscope with all amplifiers, linear sweep oscillator, controls, and input terminals, is shown in Fig. 4. Like the basic 'scope just described, this instrument may employ either the 5BP1 or 5BP4 with the same circuit constants shown in Fig. 4.

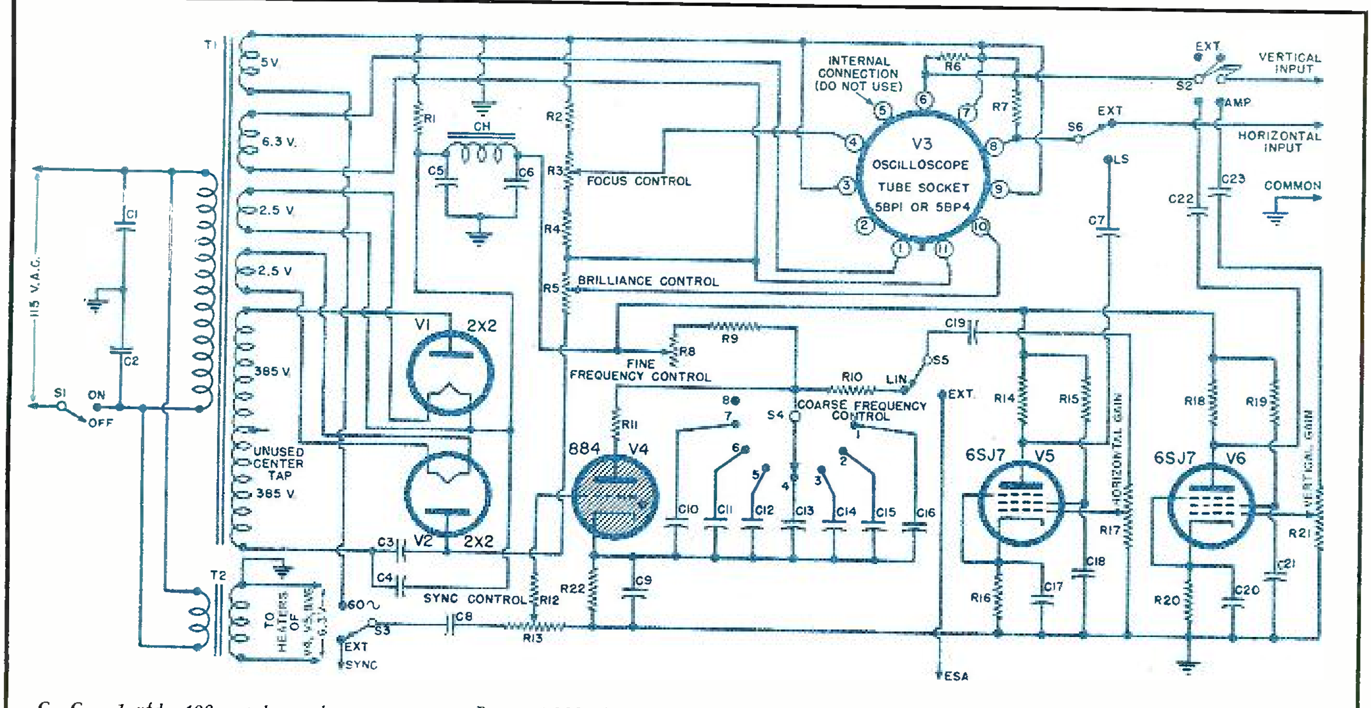
As in the basic instrument, a voltage doubler type of power supply is employed. The unit in the complete oscilloscope uses two type 2X2 tubes, in place of the smaller rectifiers, along with the two 8-μfd., oil-impregnated, oil-filled capacitors and the full high-voltage secondary winding of a small, compact transformer. The high-voltage secondary must deliver a slightly higher potential in this instance (385 volts each side of center tap), and the transformer must have two separate 2½-volt secondaries, as well as one 6.3-volt winding. Since the heaters of the cathode-ray tube and amplifiers cannot be operated from the same winding without introducing a destructive heater-cathode potential in the amplifiers, a separate miniature 6.3-volt transformer, T_2, is included in the circuit expressly for the heaters of the two amplifier tubes (V_5 and V_6) and the sweep oscillator tube (V_4).

The power supply shown in Fig. 4, as well as the one in Fig. 3, is an emergency arrangement designed to make use of a regular, replacement type transformer. Special oscilloscope transformers are very scarce at this time. Other equally satisfactory arrangements will occur to individual builders who have components of other types on hand.

The horizontal and vertical input amplifiers are 6SJ7 pentodes, V_5 and V_6 respectively. The linear sweep oscillator is the type 884 gas triode, V_4.

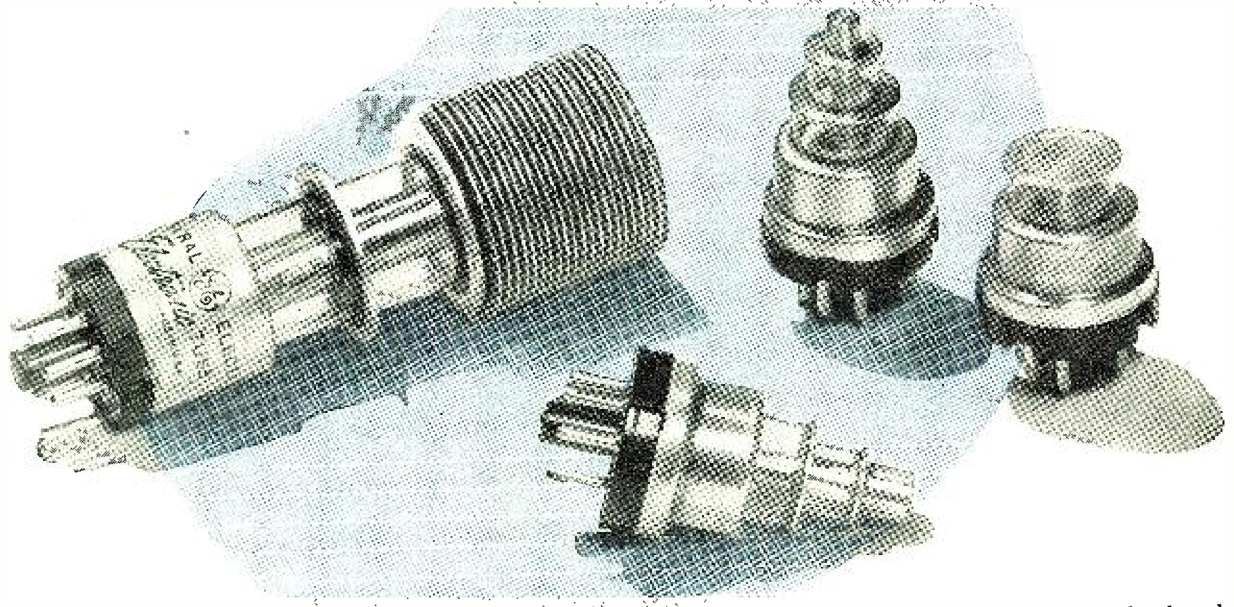
(*Continued on page* 127)

Fig. 4. Complete wiring diagram including the horizontal and vertical amplifiers, internal saw-tooth sweep oscillator, gain controls, synchronizing controls, and a complete set of associated switching circuits.



C_1, C_2—.1 μfd., 400 v. tub. cond.
C_3, C_4—8 μfd., 1000 v. oil cond.
C_5, C_6—Dual 8 μfd., 450 d.c. w.v. elec. cond.
C_7, C_8—.25 μfd., 600 v. tub. cond.
C_9—25 μfd., 50 d.c. w.v. elec. cond.
C_{10}—.0008 μfd. mica cond.
C_{11}—.002 μfd. mica cond.
C_{12}—.005 μfd. mica cond.
C_{13}, C_{15}—.015 μfd., 400 v. tub. cond.
C_{14}—.05 μfd., 400 v. tub. cond.
C_{16}, C_{18}, C_{21}, C_{22}—.25 μfd., 400 v. tub. cond.
C_{17}, C_{20}—.003 μfd. mica cond.
C_{19}, C_{23}—.5 μfd. 600 v. tub. cond.
CH—10 henry, 40 ma. choke
R_1—165,000 ohm, 5 watt, w.w. res.
R_2—450,000 ohm, 2 watt res.
R_3—200,000 ohm pot.
R_4—175,000 ohm, 2 watt res.
R_5—50,000 ohm pot.
R_6, R_7—5 megohm, 1 watt res.
R_8—2 megohm pot.
R_9—300,000 ohm, 1 watt res.
R_{10}—1 megohm, 1 watt res.
R_{11}—500 ohm, 1 watt res.
R_{12}—25,000 ohm, 1 watt res.
R_{13}—.25—megohm pot.
R_{14}, R_{18}—.1 megohm 1 watt res.
R_{15}, R_{19}—200,000 ohm, 1 watt res.
R_{16}, R_{20}—1000 ohm, 2 watt res.
R_{17}, R_{21}—.5 megohm pot.
R_{22}—2,000 ohm, 1 watt res.
S_1—s.p.s.t. toggle switch
S_2—d.p.d.t. toggle switch
S_3, S_5, S_6, s.p.d.t. toggle switch
S_4—8-position, single pole rotary switch
T_1—power trans., 385-0-385 v., 2½ v., 2½ v., 6.3 v., 5 v.—Utah Y62-25F
T_2—Small 6.3 v. filament trans.
V_1, V_2—2X2 tube
V_3—5BP1 or 5BP4 cathode-ray tube
V_4—884 tube
V_5, V_6—6SJ7 tube.

Practical RADAR



Four General Electric tubes based on the revolutionary disc-seal development. Tube at left is a transmitting type; others are receiving tubes.

By

JORDAN McQUAY

Part 3. Theoretical analysis of how precisely timed pulses of ultra-high r. f. energy are generated in sufficient strength to reach all targets.

ADAR'S ingenious method of detecting and locating targets in the sky or on the sea or land is based wholly on the transmission and reception of radio frequency pulses.

All components of a radar set—the transmitter, receiver, electronic timer, and indicator—play an equally responsible part in the generation, transmission, reception, and measurement of these pulses.

But much of the effectiveness of radar depends upon the ability of the transmitter to radiate pulses of sufficient strength to reach all targets within maximum range of the set. Thus, the radar transmitter plays an important and difficult role in the generation of brief, precisely timed, and extremely powerful pulses of ultra-high radio frequency energy.

These pulses are radiated into space by the antenna and travel at the speed of light until they strike an object or surface. The r.f. energy is then reflected or re-radiated in all directions from the object, and some of this reflected energy reaches the radar receiver in the form of *echoes.*

After radiating an r.f. pulse, the transmitter is turned off and there is a quiescent or "listening" period—during which echoes from targets within range of the set can be received. Then the transmitter generates another pulse of u.h.f. energy and the complete cycle is repeated—always allowing sufficient time for echoes to return from targets within maximum range of the set.

The entire out-and-back cycle of an r.f. pulse takes place thousands of times per second, due to the high speed of radio waves in space. And the echoes are displayed on the radar indicator only a few microseconds after the original r.f. pulses have been transmitted.

The determination of the range and direction of objects or targets is based on the facts that radio frequency energy travels at the constant velocity of light (about 186,000 miles per second), and that the transmitting and receiving antennas of the radar set are movable and highly directional.

Since the speed of the r.f. pulses through space is known, the range or distance between the radar set and the target can be found by multiplying the speed of light by one-half the time a single radar pulse requires to complete a round trip cycle. This time is measured and displayed on the time base of a cathode ray oscilloscope and translated instantaneously into terms of distance; in yards or miles.

Having determined range or distance, the direction of the target in azimuth (relative to north) and in elevation (relative to the horizontal plane of the earth) can be determined by the physical position of the antenna system. And this gives us sufficient information—range or distance, azimuth or bearing, and angle of elevation—with which we can locate accurately the position of the target in space or on land or water.

Radar Pulses

Last month we discussed in detail the operation of the electronic timer and the creation of the all-important radar control voltage; a series of identical rectangular pulses, having a certain duration and recurring at an exact and unvarying rate of repetition. This pulse timing rate is known as the *pulse recurrence frequency* of the radar set—usually a value between 250 and 5000 pulses per second, depending upon the maximum range of the set.

The electronic-timer controls and synchronizes other components of the radar set, but its most important function is the creation of the basic control pulses which are applied to the radar transmitter.

A block diagram of this controlling action is shown in Fig. 1. The voltage control pulses from the electronic

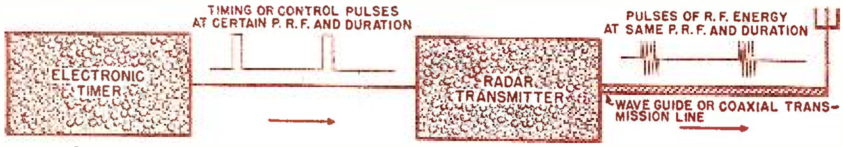


Fig. 1. Block diagram illustrating basic operation of the transmitter.

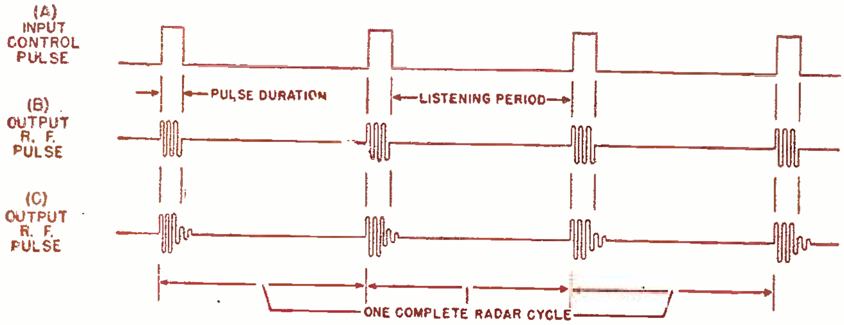


Fig. 2. Two types of radio-frequency pulses from a radar transmitter.

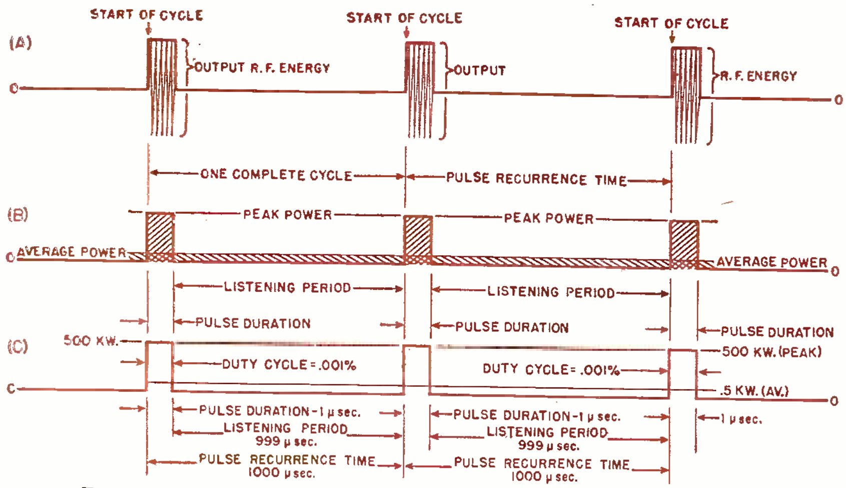


Fig. 3. Graphically illustrating three separate wave forms that in general represent the same basic radio frequency pulse that is used.

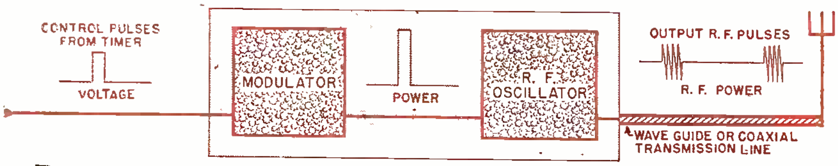


Fig. 4. Block diagram of radar transmitter showing wave form at each stage.

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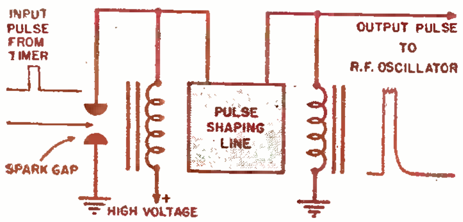

Fig. 5. Basic circuit of spark-gap modulator.

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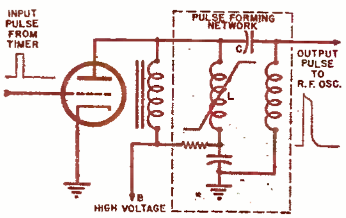


Fig. 6. Basic circuit of saturable-inductance modulator.

timer cause the radar transmitter to generate similar pulses of ultra-high radio frequency energy of extremely high power.

The output r.f. pulses from the transmitter have the same duration as the input control pulses. The output r.f. pulses also recur at the same pulse recurrence frequency as the input control pulses. And the output r.f. pulses have the same general shape or *envelope* as the input control pulses.

But in order to radiate energy into space, the output pulses consist of very powerful ultra-high frequency oscillations.

Thus, in considering the output pulses of a radar transmitter, *two* frequencies are involved: the u.h.f. *carrier frequency* at which the pulses are transmitted into space—and the relatively low *pulse recurrence frequency*—usually between 250 and 5000 pulses per second.

In other words, the ultra-high frequency carrier of the radar transmitter is modulated by means of the control pulses from the electronic timer.

The related effect of this type of modulation is shown by the wave forms in Fig. 2. The input control pulse *A* to the transmitter causes a series of u.h.f. oscillations *B* which start and stop according to the modulating voltage from the timer. In some cases, however, it should be noted that r.f. oscillations do not always cease abruptly *C* when the control voltage is removed from the transmitter; these r.f. oscillations manifest a damped or attenuated effect, resulting in the appearance of a "tail," due to imperfect characteristics of the transmitter.

For all practical purposes, however, the r.f. pulse forms shown at *B* and *C* of Fig. 2 are equally effective in the detection and location of targets.

From this point in our discussion it will be necessary to think of *two* frequencies taking place simultaneously every time a radar transmitter pulses; the carrier frequency of the ultra-high frequency oscillations, and the p.r.f. or pulse recurrence frequency of the pulses. We have previously discussed the creation and timing of the control pulses. Now we are concerned with the generation of u.h.f. oscillations at very high power, and the methods of modulating this output carrier according to the timer's control pulse.

Carrier Frequency

The ultra-high frequency at which pulses of r.f. energy are generated is known as the carrier frequency of the radar set. This frequency of operation will vary over a wide range depending on the tactical use of the different types of radar sets.

In general, however, there are only two factors influencing the choice of the carrier frequency: the difficulty in generating high-power u.h.f. energy, and the desired directivity of the radar set.

Reviewing briefly the radar method of determining azimuth and angle of elevation of the target, it will be remembered that these angular measurements are obtained from the actual, physical position of the antenna system *after* the target is detected by means of r.f. pulses. The antenna system is rotated in azimuth or tilted back at an angle, so that the full strength of the radar beam of pulsed energy falls upon the center of the target. We can determine this condition by observing the size of the echo on the cathode ray oscilloscope; the size of the echo will be greatest when the beam of pulsed energy is directly on the target.

Thus, with the antenna system facing toward the target, the antenna and the radar beam itself form an angle with the horizontal plane of the earth—giving us the angle of elevation. The antenna and the radar beam also point in a certain angular direction with respect to north—giving us the angle of azimuth or bearing.

This determination of the angles of elevation and azimuth is performed entirely by electro-mechanical means—without the use of radar pulses. After the radar set has been oriented with respect to north and properly levelled, compass-like devices measure the two required angles (in degrees or mils) from the physical position of the antenna system when its beam is on the target.

The degree of accuracy of this angular information will, therefore, depend largely on the directivity of the radar antenna system and the width of the radar beam of energy.

The radar antenna system should be highly directive, with the transmitted energy concentrated so that a greater part of it is useful in locating targets.

This desired directivity can be accomplished by reducing the physical size of the antenna system, which might well consist of a large number of dipole elements arranged in an array. The shorter the wave length of the dipoles, the smaller and more directional becomes the antenna array.

Thus, a high carrier frequency results not only in a greater concentration of r.f. energy in the radar beam and a more highly directive beam, but the radar antenna array will be relatively small from the physical standpoint.

The directional advantages of an extremely high carrier frequency are somewhat offset, however, by the many difficulties encountered in generating and amplifying such high frequencies.

Therefore, the carrier frequency selected for radar operation is usually a compromise between the directional advantages of u.h.f. energy and the generating difficulties in producing such frequencies.

Output Power

A radar transmitter does not generate r.f. oscillations continuously. Between the recurrent pulses of ultra-high frequency energy, the transmitter is quiescent for comparatively long intervals of time.

For example, a given radar transmitter might generate r.f. energy for only 1 microsecond and then be turned off for a period of 999 microseconds.

Since the useful output power of the radar transmitter is the power contained in the radiated pulses, the circuits of a transmitter are designed to concentrate as much power as possible into these brief and all-important r.f. pulses.

The maximum power output *during the time the pulse is being transmitted* is known as the *peak power* of the radar transmitter. And conventional reference to the "power" of a radar set is always intended to mean the peak power radiated during the transmission of a pulse.

Output power of most other radio devices is measured as an average value over a considerable period of time. But since the quiescent period of a radar transmitter is comparatively long with respect to its operating time, the average power radiated by a transmitter during one cycle of operation is extremely low compared to the peak power radiated during the pulse.

A relationship exists, however, between the *peak power* during the brief time of a pulse and the *average power* during an extended period of time. The time of one complete radar cycle of operation is the reciprocal of the pulse recurrence frequency, or

$$T = \frac{1}{\text{p.r.f.}}$$

Other factors remaining constant, the longer the pulse recurrence time the lower will be the average power; and the greater the pulse duration the higher will be the average power. This gives us the ratio:

$$\frac{\text{average power}}{\text{peak power}} = \frac{\text{pulse duration}}{\text{pulse recurrence time}}$$

(*Continued on page* 108)

GLOSSARY OF RADAR TERMS

Azimuth—Bearing or angular direction relative to true north.

Beam width—The width in azimuth of the pulsed r.f. energy beam.

Bearing—See Azimuth.

Blocking oscillator—Tuned-grid, tuned plate r.f. oscillator in which the grid circuit controls the pulse duration.

Carrier frequency—The ultra-high frequency at which a radar transmitter operates.

Cathode follower—Distortionless, impedance-matching, isolating stage.

Charged line—A pulse-shaping network which reflects a steep-sided rectangular pulse of a duration determined by the electrical constants of the line.

Clamping circuit—A circuit which holds either the positive or negative amplitude extreme of a wave form to a given reference level of voltage.

Cut-off limiting—Limiting action of an amplifier when operated beyond the point of plate current cut-off.

D.C. restorer—See clamping circuit.

Delay circuit—Network or circuit which introduces a time or phase delay of a wave form.

Differentiator circuit—A short time constant (RC) circuit and amplifier which produces an output voltage with an amplitude proportional to the rate of change of the input volage. A circuit used to sharpen a wave form. Sometimes called a peaking circuit.

Dipole—A half-wave center-fed radiating element.

Duty cycle—The fraction of a complete radar cycle during which energy is transmitted.

Echo—That part of the r.f. pulse reflected back to the radar set by a target.

Electronic timer—The component of a radar set that originates the pulse recurrence frequency, and synchronizes the operation of other components with the radiation of r.f. pulses by the transmitter.

Elevation angle—The angle of the target with respect to the radar set and the horizontal plane of the earth.

Envelope—The general outline of a wave form.

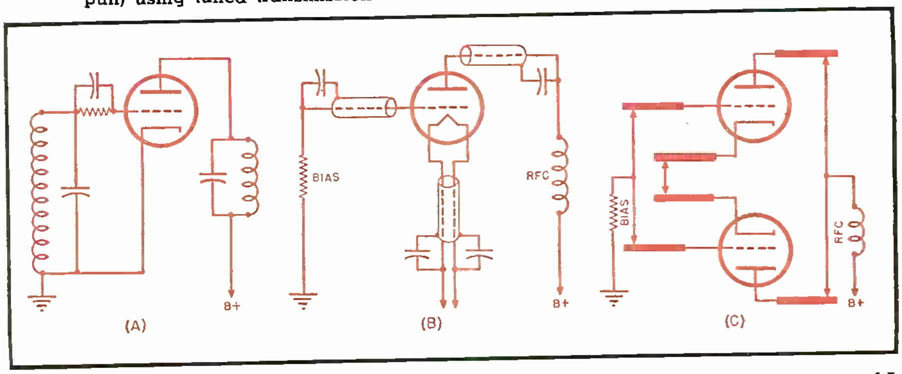
Gate—A rectangular wave used to switch a circuit on or off electronically during certain portions of the radar operating cycle.

Grass—Static or noise appearing as intermittent, minute interruptions of the oscilloscope time base.

Ground return—That part of the r.f. pulse reflected by the ground surrounding the radar set.

(Continued on page 151)

Fig. 7. (A) Basic tuned-grid tuned-plate oscillator. (B) Equivalent u.h.f. oscillator using concentric lines. (C) Equivalent u.h.f. oscillator (push-pull) using tuned transmission lines in the plate, grid, and cathode circuits.



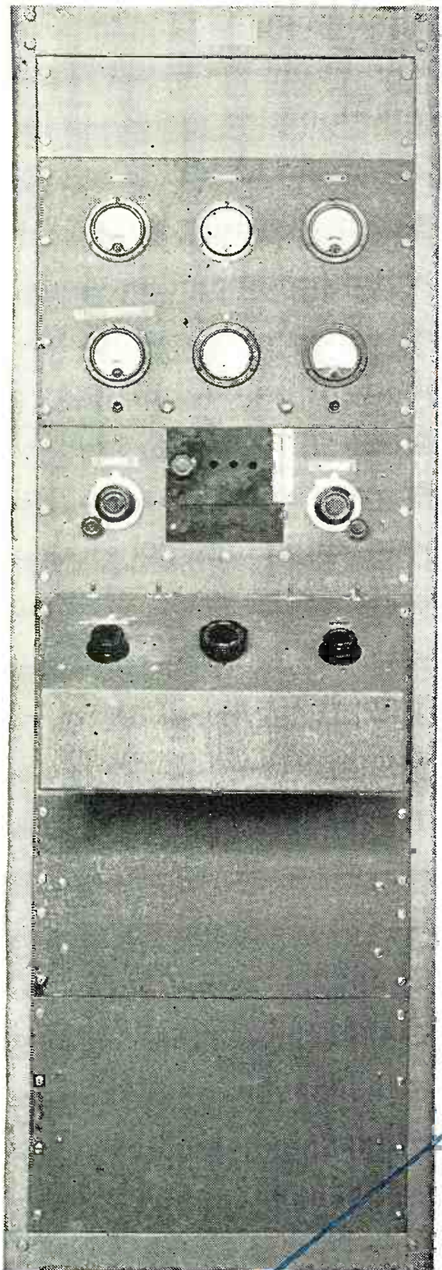


Fig. 1. Front view of the complete unit. All meters and controls are within easy reach of the operator.

100 MC. TRANSMITTER

By WILLIAM MARON
Senior Radio Engineer, North American Philips Co., Inc.

Many radio amateurs, through necessity, will swing towards the higher frequencies. Interesting features on high frequency design are presented.

As THE trend toward higher and higher frequencies progresses, it seems opportune to present a design for a 100 megacycle transmitter.

Although 100 megacycles is not extremely high, as far as frequency is concerned, the circuit design and layout problems involved make it necessary to adhere strictly to high frequency engineering standards. Slight deviations from the path of proper design will result in the transmitter being plagued with faults too numerous to cure without complete rebuilding.

The transmitter has five r.f. stages; each will be described in detail. The final stage operates as a straight class "C" amplifier on 100 mc. with a power output of 35 watts or better. Fig. 4 shows the schematic diagram for the complete transmitter.

A detailed description of each stage follows:

First Stage — Crystal Oscillator — A 2A5 vacuum tube (and its associated circuit elements) is connected in a mildly-regenerative, crystal-controlled harmonic generating oscillator circuit. The plate tank of this stage is resonated to 12.5 megacycles, which is the third harmonic of the quartz crystal used in the control-grid circuit.

Second Stage — First Doubler — The r.f. power from the oscillator stage is injected (through a variable capacitor) into the control-grid of a doubler employing a 24G. The input of this stage is aperiodic. The output tank circuit is resonated at 25 megacycles.

Third Stage — Second Doubler — The r.f. from the preceding doubler is injected through a fixed capacitor into a second and similar doubler, using a 24G. The input is also aperiodic. The output tank is resonated at 50 megacycles.

Fourth Stage — Third Doubler and Buffer — The r.f. from the preceding stage is injected into the control grid of a doubler-buffer, also a 24G. The output circuit is a ⅛ wave linear tank, loaded to ¼ wave by means of a variable capacitor.

Fifth Stage — Power Output — The r.f. power from the preceding doubler-buffer stage is inductively transferred from its linear plate-tank circuit to the ⅛ wave linear-input circuit of the 24G output stage. The grid input circuit is loaded to ¼ wave by means of a variable capacitor.

Power Output Measuring

The r.f. power output of the final 100-megacycle amplifier stage and its consequent visual indication is measured by a photometric system.

The photometric system consists of a ⅛ wave linear circuit inductively coupled to the tank circuit. This is shunted by a 60 watt, 120 volt incandescent lamp. It is loaded to resonance by means of a variable capacitor. The circuit is adjusted and then locked.

Inductive coupling between the ⅛ wave linear circuit and the output-circuit of the final 100 megacycle amplifier is adjusted and held at an optimum value. Conditions affecting transfer of r.f. energy to the photometric system are fixed and invariable. Thus, it is obvious that the magnitude of voltage induced in this circuit is entirely dependent upon the amount of r.f. power developed in the final 100 megacycle amplifier. The induced r.f. power is utilized to heat the filament of the 60 watt bulb. Amount of light given off is a direct function (within certain limits) of induced r.f. voltage.

Light intensity is translated into measurable units of direct current through the use of a photo-electric cell, located in the beam of light generated by the 60 watt bulb. Current developed by the photo-electric cell is not a linear function of light intensity projected upon its sensitized surface. For this reason, it is neces-

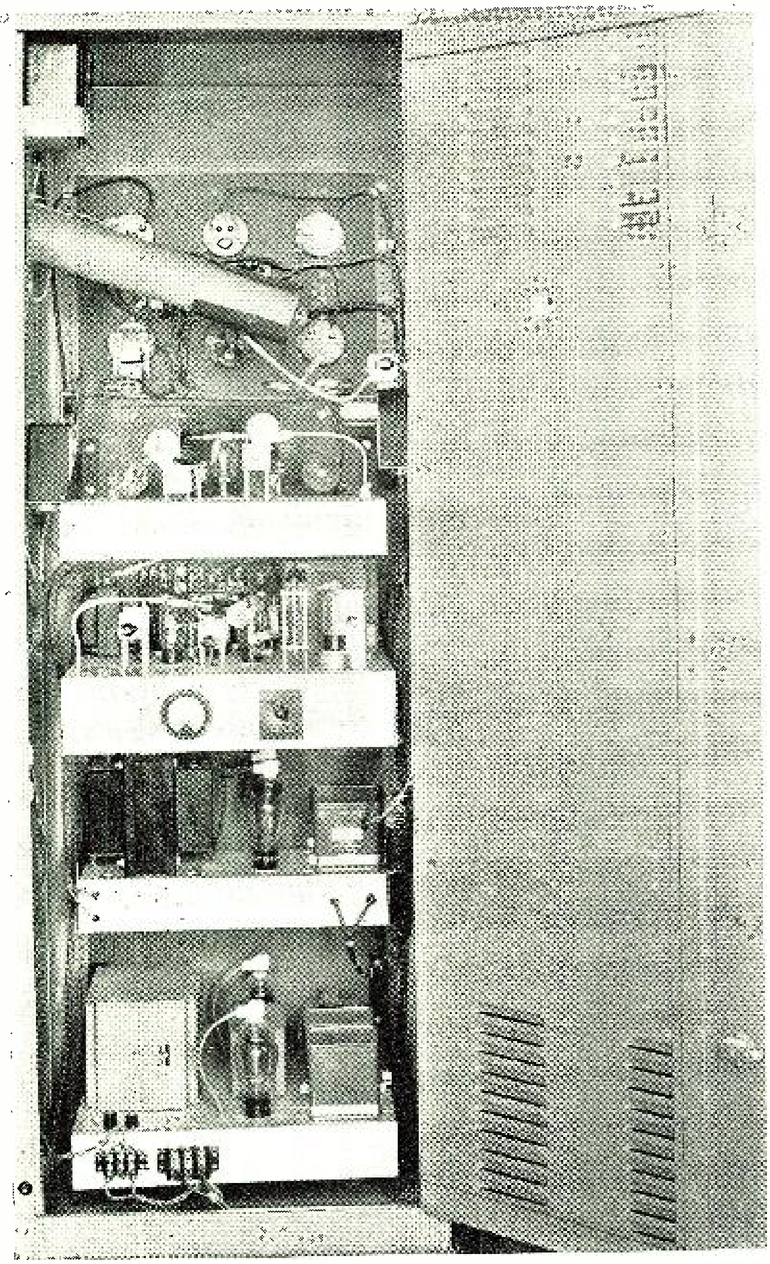


Fig. 2. Rear view of the transmitter shows proper placement of the various sub-assemblies. By combining two of the power supplies into a single unit, provision may be made for the addition of audio equipment.

sary to calibrate lamp and photo-electric cell combination. This is done by plotting e.m.f. (developed by the photo-electric cell) as a function of various measured power inputs to the lamp.

Naturally, the power-output measuring device need not be included when this unit is used as a transmitter. If installed, however, power output of the final stage tube can be checked quickly. Since tubes vary considerably in power output, at these frequencies, the additional expense of incorporating the measuring device would seem justified.

Fig. 3 is a block diagram for this transmitter. Power supply 1 is composed of transformer (T_1), a rectifier tube, 5U4G, and its associated circuit elements. This unit supplies plate and filament voltage for the oscillator. It also provides filament voltage for the 25-megacycle and 50-megacycle stages. Power supply 2 delivers grid bias voltage to the 25-, 50-, and 100-megacycle stages. Power supply 3 supplies plate voltage to the last three mentioned stages. Power supply 4 supplies plate voltage to the 100-megacycle output stage.

It will be noticed in Fig. 4 that a relay (marked RY_1) is connected in series with the bleeder of the grid bias supply. This relay immediately opens the main power supply circuit if the grid bias supply fails.

Power supplies 3 and 4 each have individual variac control. This makes possible:

1. Adjustment of the grid driver to the final stage.

2. Compensation for line-voltage variations in the power supply of the final stage.

This transmitter, as will be seen from Figs. 1 and 2, is constructed in a standard 6 ft. relay rack. Fig. 1, the front view, shows the six meters and two tuning controls for the grid and plate of the final stage, along with the associated switches controlling filament and inputs to the variacs in the plate supplies. They also handle the variac control and the filament voltage to the final stage. The control console extends forward from the front panel. This makes the variacs easily accessible and conserves space within the cabinet.

Fig. 2 shows the rear of the unit. The bottom chassis holds the power supply for the final stage. The next chassis contains the power supply for the 25-, 50-, and 100-megacycle doubler-buffer stages. Above that is the bias and oscillator filament and plate supplies. This chassis *also* contains the complete exciter unit and a meter with its associated switch. The meter is used to read grid and plate currents (by switching) in the 25-, 50-, and 100-megacycle stages. The top chassis contains the 100-megacycle power-output stage. Above the top chassis, the power-measuring coupling-tank is mounted. The slanting housing at one end encloses the incandescent bulb. The photo-electric cell is at the other end. Fig. 5 shows the location of all major components of the transmitter unit.

In developing the design, it was necessary to supply adequate grid drive to all stages in order to obtain sufficient power for the final stage. The oscillator, first doubler, and second doubler use coils and condenser tanks. The two 100-megacycle stages have tanks made of ¼" copper tubing that is heavily silver-plated. It is of utmost importance to keep all leads as short as possible, particularly those carrying r.f. All r.f. leads are ⅜" copper strap, silver plated. When operating at this frequency, it is quite difficult to mount standard by-pass condensers so that they really by-pass. However, the following mounting method worked successfully:

Condensers are mounted flush against the underside of the chassis. A hole (large enough to prevent arcing of the d.c. voltage) was drilled above the hot end of the condenser, in the chassis. Thus the d.c. voltage enters through the underside of the condenser, passes through the hole in the chassis and then to the tank.

Initial Tuning

After carefully checking the entire unit for wiring errors, tubes are inserted, the line switch is turned on. The white pilot light should light. If it does not, it means that the rear door is not closed and the interlock is open. When the filament switch is turned on, all tubes should light. As soon as the bias supply begins to function, the red pilot lamp will light. At this point, C_4 is quickly rotated until meter M_1 indicates minimum current, indicating that the crystal

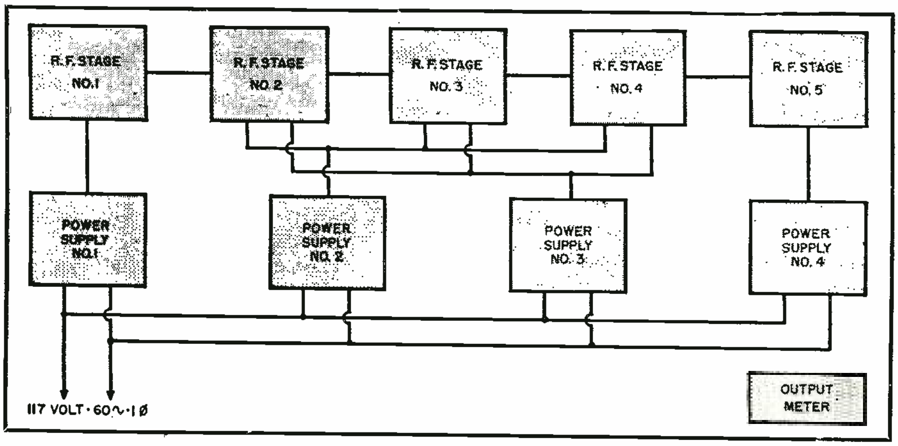


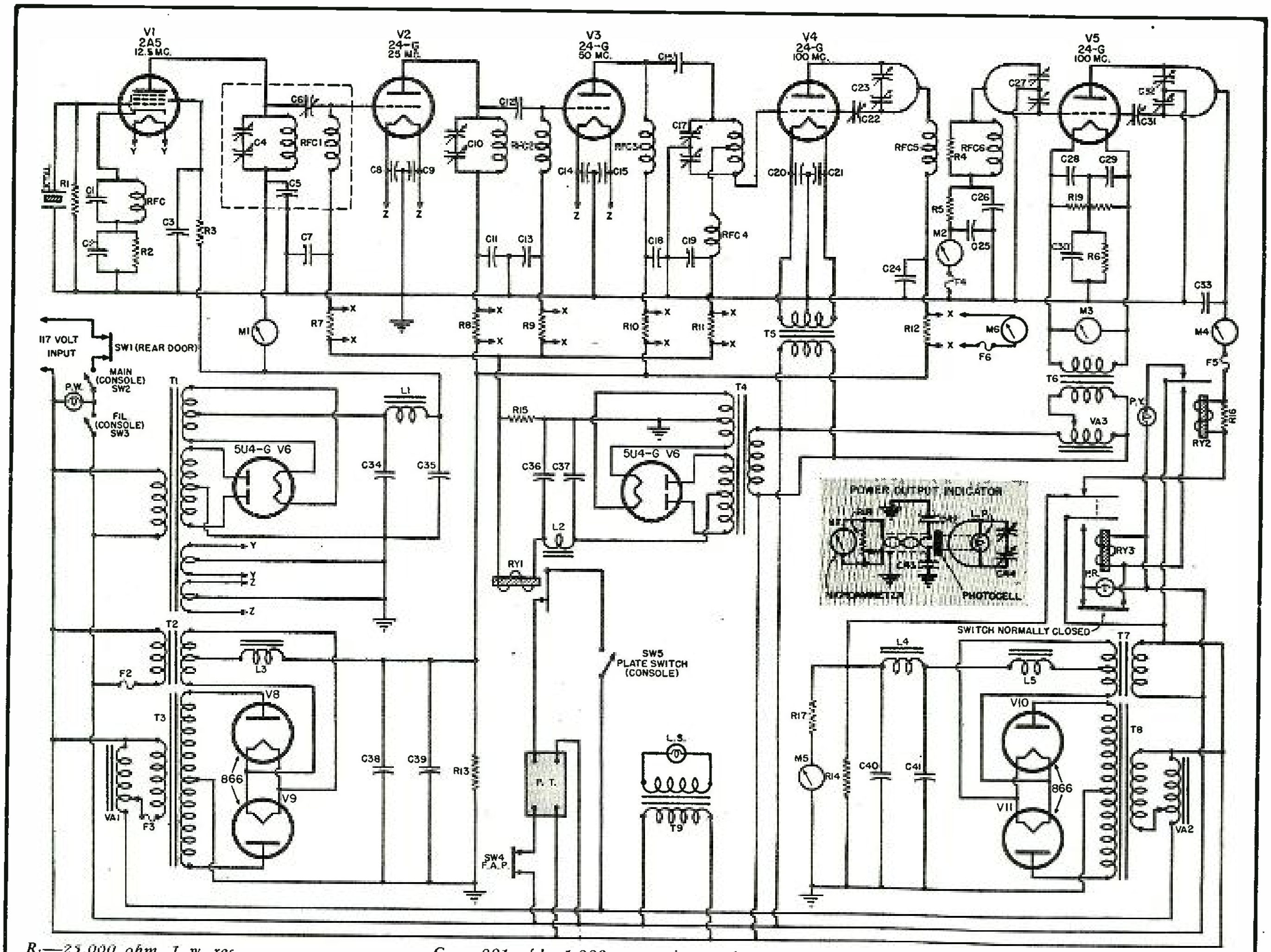
Fig. 3. Block diagram illustrating the stage by stage operation of the transmitter.

oscillator is in operation. Since it is necessary to tune the entire driver from the back, the rear door interlock should be shorted out for this operation.

The meter insertion switch is turned to read grid current on the first 24G doubler. Without overloading the oscillator, C_6 is adjusted for maximum grid current. At this point it is advisable to wait 15 minutes in order to allow the 866 tubes to become thoroughly warm. VA_1 is now raised until there is a potential of about 500 volts on the plates of the 25-, 50-, and 100-megacycle stages. For the time being, no plate voltage is applied to the output stage. The meter insertion

(*Continued on page* 142)

Fig. 4. Schematic diagram of complete unit. A 70 ohm coaxial cable may be connected in place of lamp, L.P., to feed the antennas.



R_1—25,000 ohm, 1 w. res.
R_2—300 ohm, 1 w. res.
R_3—50,000 ohm, 1 w. res.
R_4—500 ohm, 2 w. res.
R_5, R_6—1,000 ohm, 20 w., w.w. res.
R_7, R_8, R_9, R_{10}, R_{11}, R_{12}—47 ohm, 1 w. res.
R_{13}, R_{14}—50,000 ohm, 100 w., w.w. res.
R_{15}—1,000 ohm, 200 w., w.w. res.
R_{16}—3,000 ohm, 1 w. res.
R_{17}—w.w. meter multiplier res.
R_{18}—500 ohm, 3 w., w.w. var. res.
R_{19}—100 ohm, w.w., center tapped res.

C_1—100 μμfd. mica cond.
C_2—.01 μfd. mica cond.
C_3—.1 μfd. paper cond.
C_4—150 μμfd. (per section) var. cond.
C_5, C_7, C_{25}, C_{30}, C_{42}, C_{43}—.001 μfd. mica cond.
C_6—100 μμfd. var. cond.
C_8, C_9, C_{13}, C_{14}, C_{15}, C_{19}, C_{20}, C_{21}, C_{26}, C_{28}, C_{29}—.001 μfd., 1,000 w.v., mica cond.
C_{10}, C_{17}, C_{23}, C_{11}—35 μμfd. (per section) var. cond.
C_{11}, C_{18}, C_{24}—.001 μfd., 2,500 w.v., mica cond.
C_{12}—.0001 μfd., 2,500 w.v., mica cond.
C_{16}—500 μμfd., 2,500 w.v., mica cond.
C_{22}, C_{31}—.5-4 μμfd. plunger neutraliizng cond.
C_{27}, C_{32}—15 μμfd. (per section) var. cond.
C_{33}—.001 μfd., 5,000 w.v., mica cond.
C_{34}—2 μfd., 1,000 v., paper cond.
C_{35}—4 μfd., 1,000 v., paper cond.
C_{36}, C_{37}—4-4 μfd., 425 v. elec. cond.
C_{38}, C_{39}—2 μfd., 3,000 w.v. paper cond.
C_{40}, C_{41}—2 μfd., 2,000 w.v. paper cond.

T_1, T_3, T_4—Power Trans.
T_2—Fil. Trans., 2.5 v. @ 10 amp., 10,000 v. insulation
T_5—Fil. Trans., 6.3 v. @ 4 amp.
T_6, T_7—Fil. Trans.
T_8—Power Trans. 1200-0-1200 v. @ 150 ma.
T_9—Light Source Trans., Photo Troller

L_1—Choke, 20 h. @ 150 ma.
L_2, L_4—Choke, 20 h. @ 200 ma.
L_3, L_5—Choke, 10 h. @ 200 ma.

M_1—Meter, 0-75 ma. d.c
M_2—Meter, 0-50 ma. d.c.
M_3—Meter, 0-8 v. a.c.
M_4—Meter, 0-150 ma. d.c.
M_5—Meter, 0-1500 v. d.c.
M_6—Meter, 0-100 ma. d.c.
M_7—Meter, 0-500 microamperes d.c.

PT—Photo Troller
RFC_1, RFC_2, RFC_3, RFC_4—R.F. Choke, 2.5 mh.
RFC_5—R.F. Choke, 10 microhenries
RFC_6—R.F. Choke, 3 microhenries
All pilot lights—Type S 6

LET'S TALK SHOP

With JOE MARTY

Eastern Editor, RADIO NEWS

WE HAVE talked many times about the future of the serviceman: his great opportunities and how he can help himself in the coming postwar world of tough competition in a returning buyers market.

Many business and professional firms have been making surveys in the field to determine, if possible, the extent of this market in the postwar era. Perhaps no accurate estimate can be given at this time due to the number of unknown factors.

One such survey has been released by a prominent manufacturer in the radio industry and paints a very rosy picture for the future of the radio service business. According to this survey there will be 30 000 radio shops. They will sell 60,000,000 tubes and employ about 90,000 men. We do not know whether to be glad or sorry about this announcement. If it means an added number of shops in a field already overcrowded, we are not very much enthused and an influx of untold numbers of these shops cannot help but have a very bad effect on an already overstaffed field.

Tube Types

A majority of all servicemen, as shown in the report, are in favor of reducing the number of types of replacement tubes carried in peacetime stores to less than 200. 89% thought there should be less than 200; 79% said less than 150. 65% thought there should be less than 100. Certainly no operating serviceman doubts or would question this statement since we all know from bitter experience the troubles we have had in the past in trying to stock all the slow movers that are needed only once or twice a year.

The report made it clear that the greatest cause of trouble in a receiver is the tubes, and consequently is the one item that provided the greatest sales possibilities for the serviceman. It has been the writer's experience that at least twice the number of tubes could be sold per call if the serviceman would use his selling ability. Too often the serviceman's sole thought is to get in and get out of the house in the shortest possible time due to the press of work thereby overlooking much that could be done to increase his rate of return per call. This must be corrected if a profitable operation is anticipated in the coming tough competition of postwar operation.

Labor Charges

The survey further pointed out that only 44% of the sets required labor. This is a very interesting figure since it was given to the interviewers by servicemen themselves. Does this mean that 56% of the sets are repaired free of charge? If so then this is a most glaring weakness in the radio serviceman's way of doing business. It is the writer's opinion that there should be a labor charge on 100% of the repairs even though nothing is done except change a tube on a set that is brought into the store by the customer. The radio serviceman should remember that the only thing he has to sell is his labor and thus if he gives this away he will very shortly go broke.

Set Sales Possibilities

Servicemen influenced or accounted for 19% of the radios sold according to the report. This figure, if accurate, represents a very large amount of business over which the serviceman exercises some control. No doubt it can be increased if common sense principles of selling are used by the serviceman when making his calls. The radio serviceman is in the best position of anyone in the industry to make sales of radios. He is the only person invited into the home; he is always there at a psychological moment and he enjoys the confidence of his customer. Many great businesses have been built on this combination of successful sales elements. It cannot be too strongly emphasized that in order to be successful in a peacetime operation a serviceman must become more and more of a salesman and a business man.

The most optimistic estimate we have seen is for 75 million radio homes after the war and for 25 million auto sets. This should tell the serviceman that there will be great opportunity provided he arranges his business to meet changing conditions. The feeling in the trade is that the majority of auto radio sets will be sold as original equipment by the various car manufacturers. However, we do not know at this point how much of the subsequent service will be done by the various retail auto dealers. It would seem that the local serviceman could make a very profitable arrangement with the auto dealer since he is on the spot, and has the necessary equipment and knowledge to take over this business from the auto dealer. The time to talk to him is right now.

One of the most startling statements made in the survey was to the effect that the public was almost unanimous in saying that they were satisfied with the work being done by the average serviceman. This statement is hard to believe, especially to the writer who has spent countless hours on the phone listening to such complaints as, "it never worked since you brought it back," or "I didn't know the plug was out." Maybe the serviceman is getting better or the customer is easier to please, but we doubt it. If this statement is accurate, what about all the complaints of gyps and the need for licensing to protect the public. Perhaps the serviceman should take a copy of the survey with him when he goes to answer a complaint to prove it isn't so. All joking aside, these surveys help a lot and the more accurate ones we have, the better able we will be to tell where we are going.

—30—

"He wants a girl who is very receptive—he's a radioman!"

Tone Control Circuits

By J. CARLISLE HOADLEY

Several unique types of high- and low-frequency tone-control circuits. By employing two controls, any desired tonal response may be had.

TONE controls, like the weather, will always be with us, the reason being the lack of uniformity of the ears of listeners and the highly varied tastes of different individuals, not to mention special applications such as sound effects, static and hum reduction, and compensation to make up for a deficiency in frequency response in some unit. We have a multitude of types to pick from, all the way from a simple high frequency attenuator which consists of a series resistor and condenser shunted from a grid or a plate of an amplifier tube to ground, to a complex multisection band pass filter. For the reduction of noise, etc., a simple high frequency attenuator is adequate, but where response is to be altered to fit personal tastes, more than attenuation is desirable.

A good compromise is two controls which may attenuate or boost either the high or low frequencies. The frequencies at which these controls start to be effective is a matter of taste and the quality of the audio system to which they are applied; *i.e.* there would be no point in boosting 20 c.p.s. in a system whose speaker could not reproduce frequencies lower than 50 c.p.s., nor would anything be gained in boosting 9000 c.p.s. response in a receiver whose i.f. system was so sharp as to limit the detector output to 4000 c.p.s. The points of boost and the amount then must be determined first. What is desirable there, and why must there be boost at all?

First we have the problem of the peculiar condition of the ear wherein the response curve changes with level. That is to say, if sounds are loud enough, your ear has a flat response to them from say 30 c.p.s. to 10,000 c.p.s. If the level is lowered appreciably, the ear response falls off faster at 30 c.p.s. and 10,000 c.p.s. than it does at 3000 c.p.s. Now if we were present in the studio when a recording was made, we would hear the orchestra at its normal volume. If we were to play the recording of the same orchestra back at the same volume that we heard it, we would require a completely flat system from the recording microphone to the phonograph speaker. But unfortunately, we do not play back orchestral renditions at their original volume, particularly if we live in apartments. We therefore must replace the decreased sensitivity at high and low frequencies of our ear at this new low level. As people's ear-curves vary, the amount of compensation necessary is not a constant. Neither do all bands play at the same volume, so some variable means must be provided to give the individual listener that feeling of naturalness which is necessary for his complete enjoyment of recorded or broadcast music.

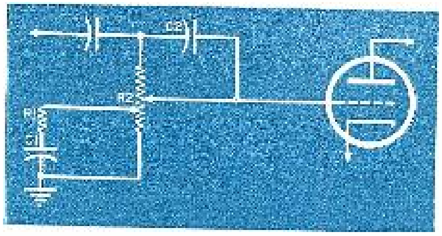
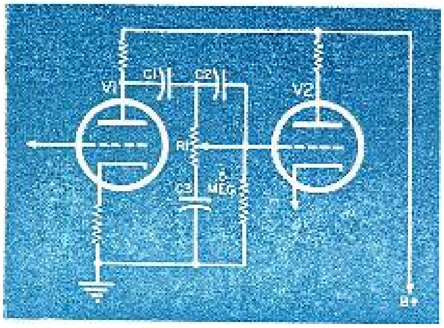


Fig. 1. Automatic tone-control incorporated in volume-control circuit.

There is a second reason, too, for compensation. A great reduction in extraneous noise may be effected by the limiting of the range to that necessary for the program material. For instance, if one is listening to a trumpet solo, there is no benefit in having response down to 30 c.p.s., and if it is limited above 60 c.p.s. or 120 c.p.s., there will be a material reduction in hum. Conversely, if a phonograph record which is old and possesses a high scratch level is played, a flat response to 10,000 c.p.s. is undesirable. In connection with high frequency response, an interesting point is that if the response is limited to say 5000 c.p.s. with a boost between 3000 and 5000 c.p.s. and then cut off sharply, the effect to the ear is very nearly that of flat response out to a much higher frequency, with, incidentally, a material reduction in surface noise of records, static, etc. Let us therefore discuss some methods for obtaining high and low frequency compensation in some specific circuits.

Fig. 2. Circuit combining both low- and high-frequency attenuation, depending on the position of the single control.



In Fig. 3 we see several high and low frequency tone control circuits. C_1 and R_1 comprise a low frequency attenuation circuit. The variable resistance R_1 places in the circuit or removes series condenser C_1. As C_1 is low in capacitance the low frequencies are attenuated. The values in the diagram are correct for attenuation below 150 c.p.s. Between V_1 and V_2 we have a negative feedback type bass boost circuit, consisting of R_2, C_2, and R_3. The output of V_2 is fed back through the *RC* combination to its grid and the amount of boost possible is determined by the mu of V_2. As a method of control of the amount of boost without varying the gain of V_2, we short out the condenser C_2. This eliminates the high-pass nature of the network and it feeds back all frequencies equally. When R_3 is set at its maximum value, only the higher frequencies are fed back, determined, of course, by the value of C_2, and the gain is only reduced at the higher frequencies effecting a bass boost.

In the cathode of V_2 we have a high boost circuit comprising R_4, R_5, and C_3. The cathode resistor is made larger than usual and may even be larger than the plate resistor. We then bypass the cathode resistor with a condenser whose bypass effect is variable by the series variable resistor R_5. The gain of V_2 is reduced by the degeneration introduced by the unbypassed cathode resistor. The value of C_3 determines at what frequency the degeneration will be relieved, and the tube operate at its full gain. Then we have a high boost whose starting frequency is determined by the value of C_3. It is dependent, too, on the size of R_4. The value can be arrived at by experimental insertion methods to fit a specific case much more readily than as if it were computed because of the assumption one must make in regards to the exact frequency we wish to boost to make a noisy record sound better for instance. Incidentally, one would not use the two circuits R_2, C_2, R_3, and R_4, R_5, C_3 in the same tube, as drawn, as they are negative feedback controls and would defeat each other's purpose. These degeneration circuits are good in the respect that they actually reduce the distortion at the attenuated frequencies, and do not increase it at the boosted frequencies. Their disadvantage is that they consume gain and it may be necessary to add an extra stage of amplification to offset the loss. In R_6 and C_4 we have the time worn high frequency attenuating "tone" control which was standard equipment on nearly every radio in the past. It still has its uses, however, when the high frequencies are to be attenuated without too steep a cut off. In the plate circuit of the last 6J5 we have another bass boost circuit. It consists of R_7, R_8, and C_5. R_7 and R_8 are the plate load resistors of V_3. R_8 is partly bypassed by C_5 so that at low frequencies the gain of V_3 is that obtained with a load resistor equal to R_7 plus R_8, while at high frequencies the gain is that obtained with only the plate load resistor R_7. The ratio of their sizes determines the amount of boost, and C_5 determines the frequency at which it occurs. It must be borne in mind that Fig. 3 was drawn with the idea of presenting these different methods of tone compensation and does not represent a three tube amplifier as such, but merely serves as an illustration. These are the simpler types of tone controls which may be used where very sharp cutoff characteristics are not desired. If steeper transition slopes from boost to flat are desired, the same circuit may be used in successive stages, giving steeper transitions and greater boosts. Controls may easily be ganged such as duplicating the R_4, R_5, C_3 network in a later stage and then using a two gang variable control (R_5) so that the degeneration in both stages may be varied simultaneously.

So much for the general *RC* circuits which may be used, let us now consider some specific applications.

In Fig. 2 we have a simple tone control circuit which allows the lows to be attenuated, or the highs to be attenuated. When R_1 is turned all the way to the right, C_2 is shorted out and the low frequency response is determined by the size of C_1. As R_1 is rotated to the left, C_2 is introduced in series with C_1 which causes a decrease in low frequency response. As R_1 is rotated even farther to the left, C_3 is shunted across the grid of V_2 attenuating the high frequencies. This gives the two functions all on one control. If, in addition, a high frequency and low frequency boost be incorporated in some other part of the circuit, it will permit any tone quality desired.

In Fig. 5 we have the typical preamplifier and output stage in a small receiver or automobile radio to which has been added two of our circuits. We find incorporated independent high frequency and low frequency boost controls. This is particularly advantageous when a small receiver is to be connected to a well baffled

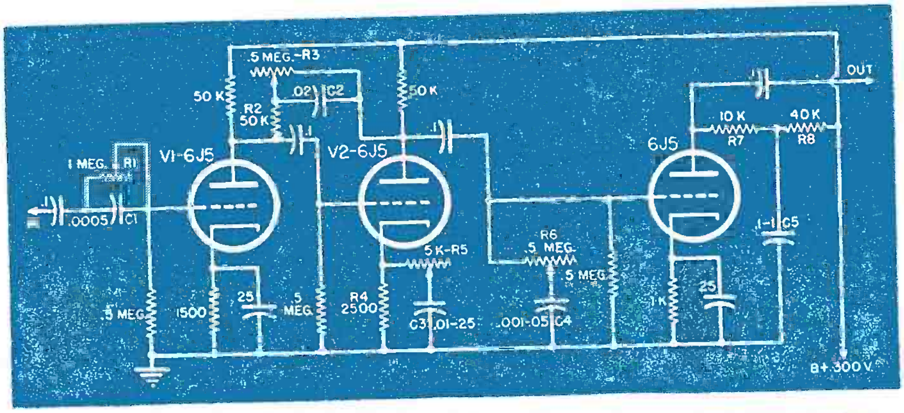


Fig. 3. Several methods of obtaining high- and low-frequency tonal compensation.

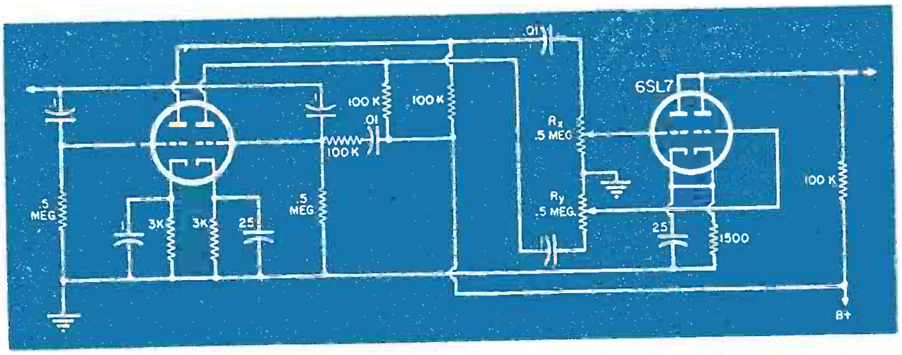


Fig. 4. Circuit employing separate amplifier stages for the high- and low-frequencies. By varying the gain of these stages, desired tonal response may be had.

10" or 12" speaker. It is amazing what can be done with the average six or seven tube table model radio in this respect. It is quite possible to enhance its tone quality to the point that it compares favorably with those in the $200.00 class. The older automobile radios may be given the same treatment with great improvement in tone quality. The tone control system in Fig. 5 is of a negative feedback type. A voltage is fed back from the secondary of the output transformer through the high pass filter C_3, R_1, C_4, R_2 to the cathode of the previous amplifier stage. This then reduces the tube gain at the high frequencies. The cathode resistor R_3 is bypassed with the network R_4, C_1 which varies the degeneration in the circuit at the high frequencies. R_2 is a variable resistor shunted across the high pass filter in the feedback network so that C_3, C_4 may be shorted out and the circuit then becomes non-frequency discriminatory. This, then, effectively controls the low frequency boost while R_4 controls the high frequency boost. C_1 may be from .01-.25 μfd. and C_3-C_4, may be .01 to .1 μfd. R_5 and R_6 are made as small as possible without oscillation occurring. If a violent oscillation occurs, reverse the connections to the output winding of the output transformer T_1.

In Fig. 1 is another type of tone control. It falls in the automatic class. It consists of compensation in the volume control circuit so arranged by means of a tap on volume control R_2, that as R_2 is turned away from

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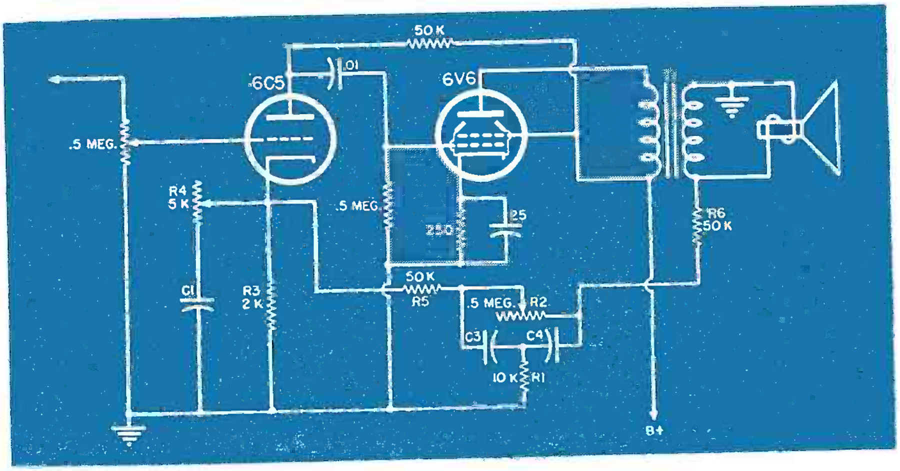
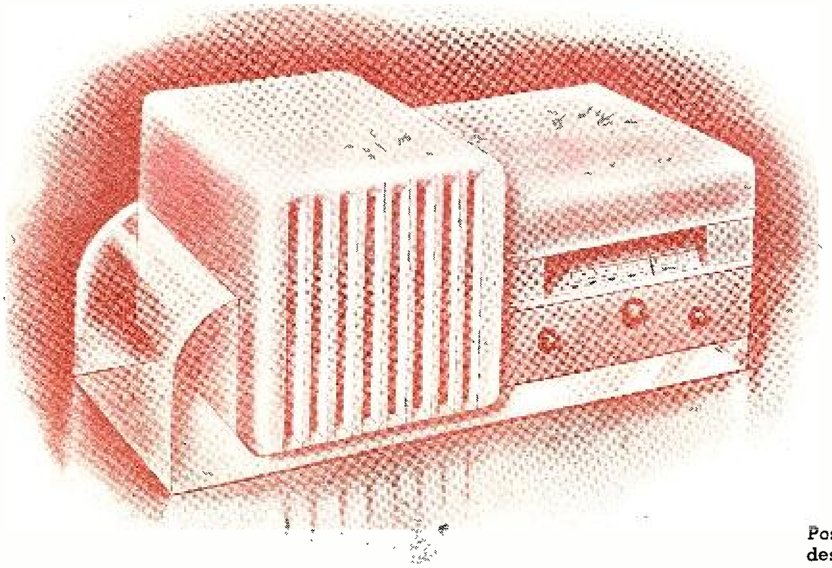
Fig. 5. Typical preamplifier and output stage of a small receiver, incorporating independent high- and low-frequency controls for obtaining desired tonal response.



Practical RADIO COURSE



Part 36. An analysis of the methods employed in accurately "tracking" the oscillator and preselector tuned circuits of a superhet receiver.

Postwar table model home receiver cabinet design which may be molded from various colored plastic material. Designed and illustrated by Radio News staff artist, Julian Krupa.

By ALFRED A. GHIRARDI

IN ORDER to achieve single-control manual tuning in a capacitor-tuned superheterodyne receiver, the variable tuning capacitor of the oscillator must be "ganged" (operated by a common shaft) to rotate simultaneously with those of the closely "aligned" tuning circuits of the r.f. preselector.[1]

If the receiver is to function as a sensitive superheterodyne, and if it is to be free from "image" interference, it is also necessary that the oscillator frequency be made to "track" higher (usually) than that of the preselector tuning circuits by a constant amount equal to the intermediate frequency employed in the receiver's i.f. amplifier—*for all settings of the receiver tuning control.* Furthermore, if the receiver is designed for multi-band reception, this same frequency difference must be maintained throughout *each* receiving band. This means that for best operation it is necessary to make the oscillator frequency "track" exactly i.f.-kc. *higher* than that of the preselector tuned circuits—over the entire signal-frequency range of the receiver.[2]

Fig. 1 shows the preselector and oscillator tuning curves required for correct operation over the entire broadcast tuning band—assuming the receiver employs an i.f. of 455 kc. Notice that the oscillator frequency "tracks" always 455 kc. *higher* than the preselector frequency, over the entire tuning band of the receiver. The particular frequencies existing in the various tuned circuits of a superhet employing a 455-kc. i.f. when it is tuned to receive a 1200-kc. incoming signal are shown in Fig. 4. Notice that the oscillator frequency is 455 kc. higher than the signal frequency.

Any deviation from this frequency difference causes the i.f. carrier to be displaced in frequency from the center of the pass band of the i.f. amplifier. If the deviation is small, for an amplitude-modulated wave, frequency distortion, producing high-pitched shrill reproduction will be the result; if the deviation and resulting off-centering is excessive, the equivalent of single-sideband transmission occurs and amplitude distortion results.

Offhand, it would appear that the oscillator frequency could be made the required number of kc. higher than that of the preselector simply by employing in its tuning circuit either a smaller tuning capacitance, or a smaller inductance, than is used in the preselector tuned circuits. Let us assume that a combination of smaller oscillator tuning inductance with oscillator tuning capacitor of same size as those used for the preselector circuits is used. The tuning circuits of the preselector and oscillator will then be as illustrated at (*A*) of Fig. 2. Suppose further that the receiver i.f. is 455 kc. and that these tuning circuits are designed so the oscillator frequency is exactly 455 kc. higher than the preselector frequency when the tuning capacitors are all fully unmeshed (high-frequency end of the receiver tuning band. These two frequencies are at a dial setting of 100 shown in Fig. 2B. The oscillator and preselector tuning circuits would then definitely be "tied down" to the correct relative frequencies at this point on the dial, so for this position of the

[1] The methods employed to align the individual tuned circuits of the r.f. preselector were explained in the installment of this series appearing in the June, 1945, issue of RADIO NEWS.

[2] Although in most receivers the oscillator is designed to operate always at a frequency, *higher*, by an amount equal to the intermediate frequency employed in the i.f. amplifier, than that to which the preselector circuits are tuned, in some it is operated i.f.-kc. *lower*.

tuning control the osc.-preselector frequency difference would be correct —equal to the i.f. of the receiver.

Now if the tuning control were slowly turned toward the low-frequency end of the tuning range, the frequency of the preselector tuning circuits would vary over the range of values approximately as represented by the solid-line curve of Fig. 2B. Simultaneously, the oscillator frequency would vary over the range of values represented by the dotted-line curve above this. Notice that the frequency difference (vertical separation) between the two curves does not remain constant, but diminishes as the receiver is tuned toward the low-frequency end of the dial. For example, at a dial setting of 60 the frequency difference is only 304 kc.; at a setting of 35 the frequency difference is 225 kc.; and at a setting of 0 it has diminished to 152 kc. Of course the sharply-tuned 455 kc. i.f. amplifier would provide little or no amplification for i.f. signals of such frequencies entering it. Accordingly, it is likely that only one or two stations close to the upper frequency range of the receiver (1500 kc.) would be received with such an arrangement, for only here would i.f. signals of the correct 455-kc. frequency be produced.

The attack might be made from the other end—the *low-frequency* end —by designing the oscillator tuning circuit to produce the correct frequency (500 + 455 = 955 kc.) required for exact tracking or "tie-down" at the low-frequency (500 kc.) end of the dial. If this were done, the oscillator frequency would be increasingly *too high* at every other point over the tuning range.

The reason for this mis-tracking of the oscillator frequency is that we are using variable capacitors of similar plate shape to simultaneously tune circuits of two *different* frequencies—those of the preselector and that of the oscillator. Consequently, as the tuning dial is varied, the oscillator frequency is always a fixed *percentage* above that of the preselector, instead of always being a fixed *numerical amount in kc.* above it.

Inspection of the preselector and oscillator tuning curves in Fig. 2*B* reveals that our trouble is caused by the fact that the capacitance of the oscillator *increases* at too fast a rate (frequency *decreases* too rapidly) as the receiver is tuned from the high-frequency end to the low-frequency end of the dial (right to left on the graph). What is needed is some arrangement that will automatically cause the oscillator frequency to decrease sufficiently *less rapidly* so that it will always be higher than that of the preselector by exactly the same number of kc.

Oscillator—Preselector Tracking Methods

This important problem of "tracking" the oscillator and preselector tuned circuits in manually-operated capacitor-tuned receivers has been solved in three different ways,

1. by using the same amount of inductance and identical (ganged) straight-line-frequency tuning capacitors in both circuits. The rotor of the oscillator tuning capacitor is *advanced* in the gang by just as many degrees as is necessary to provide the desired frequency difference.
2. by using a ganged tuning capacitor with the plates of the oscillator-tuning section suitably shaped to give the proper rate of change of capacitance required to maintain the necessary *constant* frequency difference (equal to the i.f.) between the preselector and the oscillator as the tuning control is rotated from "minimum" to "maximum" position. This is known as a "cut-plate" type tuning capacitor.
3. by using a ganged tuning capacitor having identical sections, but providing a series-padding circuit arrangement for the oscillator tuning circuit in order to provide the required oscillator-frequency tuning curve for proper tracking at the low-frequency end of the band.

As the first method no longer is used because a very clumsy tuning capacitor plate shape must be employed, and it is difficult to manufacture economically such capacitors to sufficiently close tolerances in quantity production, it will not be considered further here.

Method of Producing Correct Oscillator Tracking

The second method of solving the oscillator-preselector tracking problem is really a mechanical one, and has been successfully used on hundreds of thousands of portable, home, and auto-radio single-band receivers.

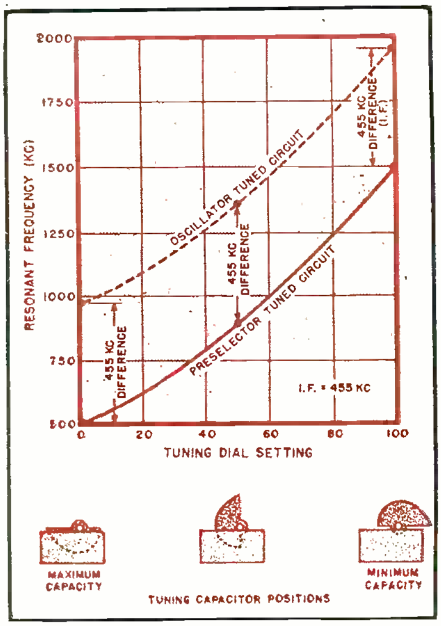


Fig. 1. Ideal oscillator and preselector relationship. The numerical frequency difference, over the entire receiver tuning band, must always be equal to the i.f. frequency employed.

If the oscillator frequency is to be always *higher* than the signal frequency, a lower value of inductance is used for the oscillator than is employed for the preselector tuned circuits. In addition, the rotor plates (and usually also the stator plates) of the oscillator tuning capacitor are shaped differently from the corresponding plates of the preselector tuning capacitors. They are shaped so the proper *slower rate of change* of

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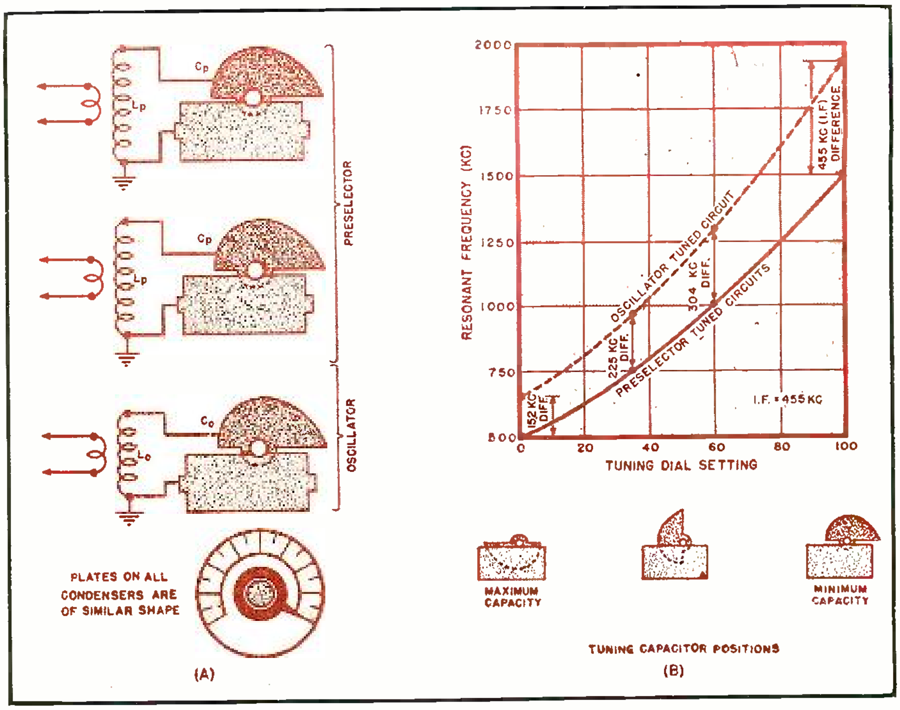
Fig. 2. Special preselector-oscillator tracking provisions are required. because the simple tuning arrangement illustrated at (A) does not maintain the necessary constant preselector-oscillator difference over the entire tuning band.



11,500 mile RADIO NET

Planes operated by Pan American World Airways, under contract to the Air Transport Command, travel in relays and cover this 11,500 mile span in 84 hours.

Radio signals emanating from remote corners of the world guide our planes to their many military objectives.

CASTING shadows that hurtle across the face of the earth from the United States to India at the rate of two miles a minute, the Cannonball flyers speed American war materiel and military personnel to fighting American forces in the Southeast Asia battle zone. These giant, four-motored U. S. Army transport planes flown by *Pan American* crews are guided on their 11,500 mile flight over trackless oceans and impenetrable jungles by short-wave radio transmitters developed by *Bell Telephone Laboratories* and manufactured by the *Western Electric Company*. By locating these transmitters every few hundred miles along their flight lanes, the Army and *Pan American World Airways* have succeeded in constructing an efficient radio-communications network for supplying their crews with necessary flight information and essential navigational aids. So successful and effective has been the operation of these transmitters that following the Allied invasion of North Africa the U. S. Army took over and used those that had already been installed there and subsequently ordered others of a slightly-modified design for their own ground station service.

By 1939 the *Pan American World Airways* had pioneered the remotest spots of all four quarters of the globe, a service to America and the world that will live forever in the annals of aviation history. Following this achievement was the problem of maintaining the best possible service over these far-flung air routes. One important phase of this problem consisted of procuring adequate ground-to-plane communications equipment that could withstand the vicissitudes of weather from the lands of torrential rains to hot, dry plateau country. Approximately 450 of these short-wave transmitters were required.

They consist of 100-350 watt, dual-channel three-frequency radio telephone and c.w. telegraph units which are designed to operate on frequencies between 1.6 and 13.2 megacycles. The transmitter is self-contained and consists of a power supply, modulator, and radio frequency chassis mounted in a cabinet designed for tropical service that measures 5′, 7$\frac{5}{16}$″ high, 1′, 10⅛″ wide, and 1′, 6¼″ deep. The complete unit weighs approximately 393 pounds. As one protective feature against the elements, the unit is equipped with a fan and spun-glass dust filter mounted in the door of the unit for furnishing filtered air under forced draft to all parts of the set. All power for operating the transmitter may be obtained from a single-phase, 200-250 volt, 50 or 60-cycle a.c. source.

In view of the difficulty of the terrain, crossed by most of the *Pan American* routes, it was deemed advisable to design the transmitter so that it could be controlled either locally or from a remote point.

Remote control equipment used in conjunction with the transmitter was

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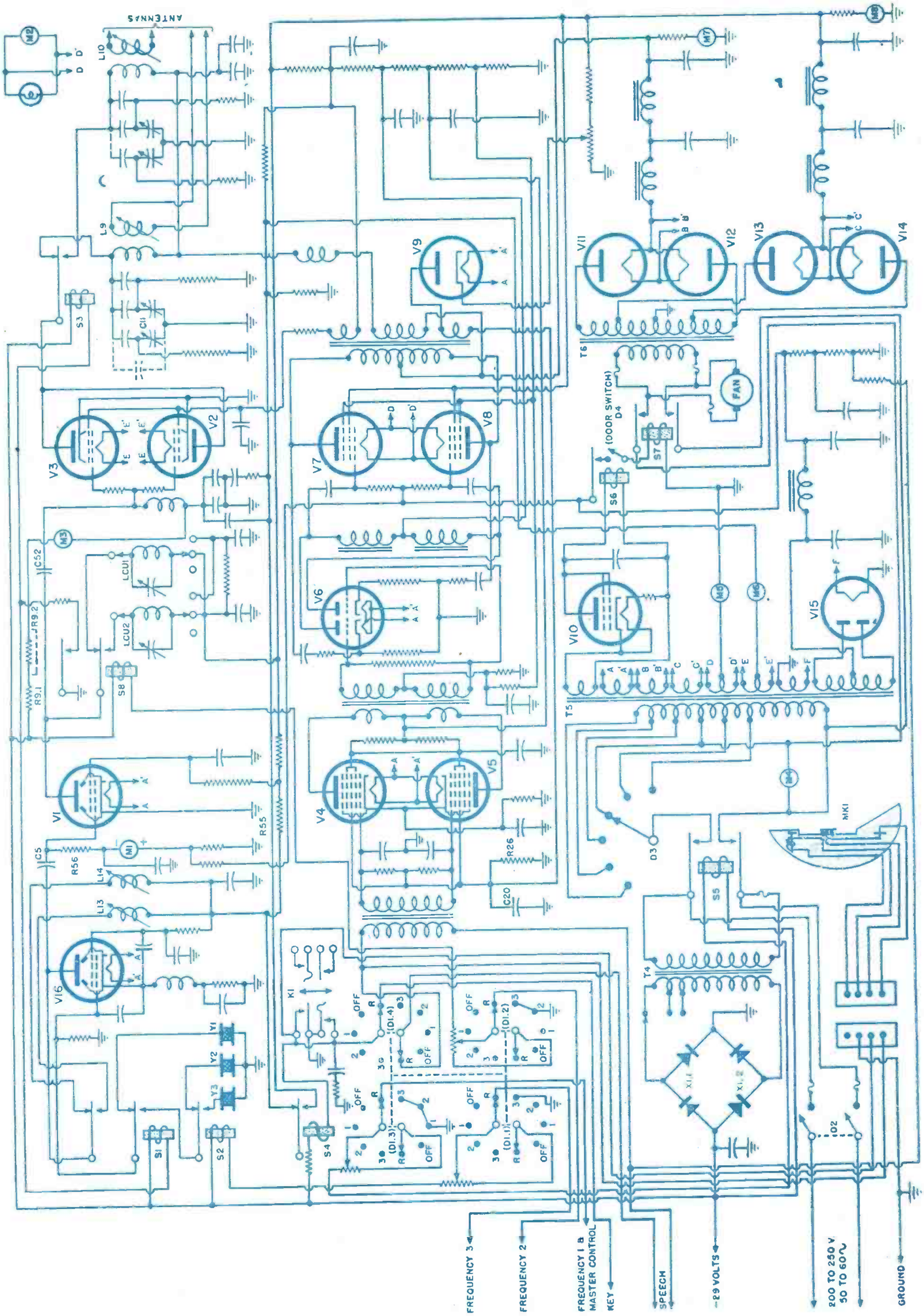
Fig. 1. Diagram of Western Electric Model 4WTF-A transmitter.



Television Sound Channel

Part 8. Design and operation of the sound channel of present-day television receivers, based on an i.f. carrier of 8.25 megacycles.

By EDWARD M. NOLL

THE sound system of the television receiver is similar to a conventional FM receiver, with the possible exception that its i.f. frequency is higher. A typical sound i.f. carrier for television is on 8¼ megacycles. The sound system of the *G.E.* Model 90, Fig. 1, consists of a single stage of i.f. amplification (following the stage in which picture and sound branch into separate paths), a limiter, combination discriminator and first audio, and an audio output stage. As in the picture i.f. system discussed last month, the i.f. and limiter tuned circuits resonate with the total distributed capacity and are tuned to the exact frequency by movable iron cores. The sound tuned circuits are loaded lightly with resistors to insure linear amplification over the 150-kc. FM bandwidth. However, they are not loaded as heavily (shunted by relatively high value resistors) as the picture i.f. tuned circuits and, consequently, a much greater gain per stage is obtainable.

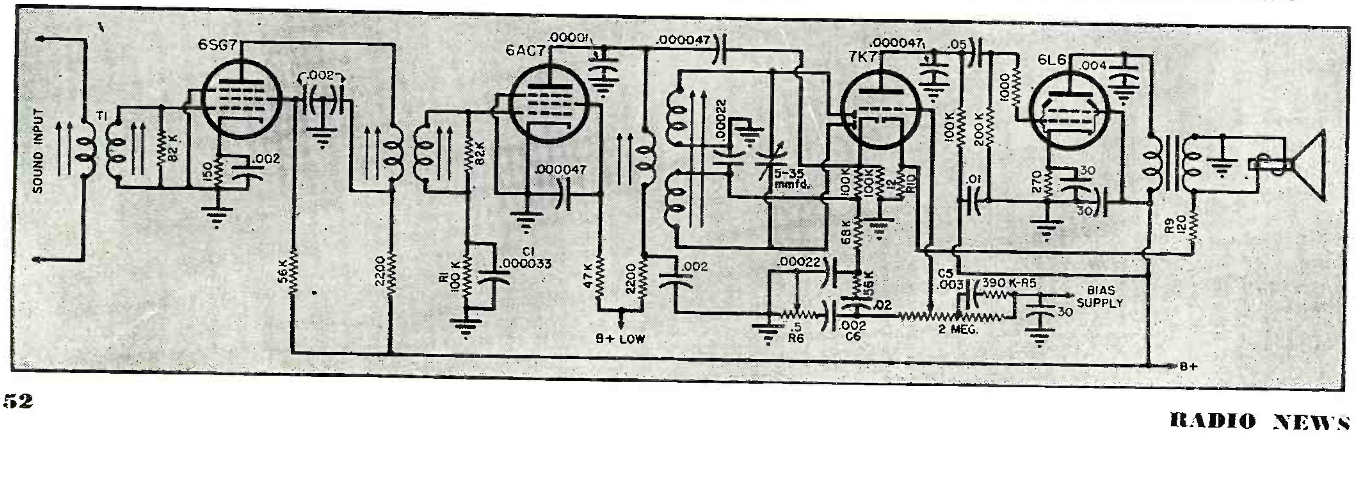
In the Model 90, the sound i.f. signal is removed from the suppressor grid circuit of the combination picture and sound i.f. amplifier which follows the mixer, and is applied through transformer T_1 to the control grid of the first sound i.f. amplifier. This stage increases the amplitude of the sound signal which, then, reaches the grid of the limiter through the tuned transformer.

Limiter Stage

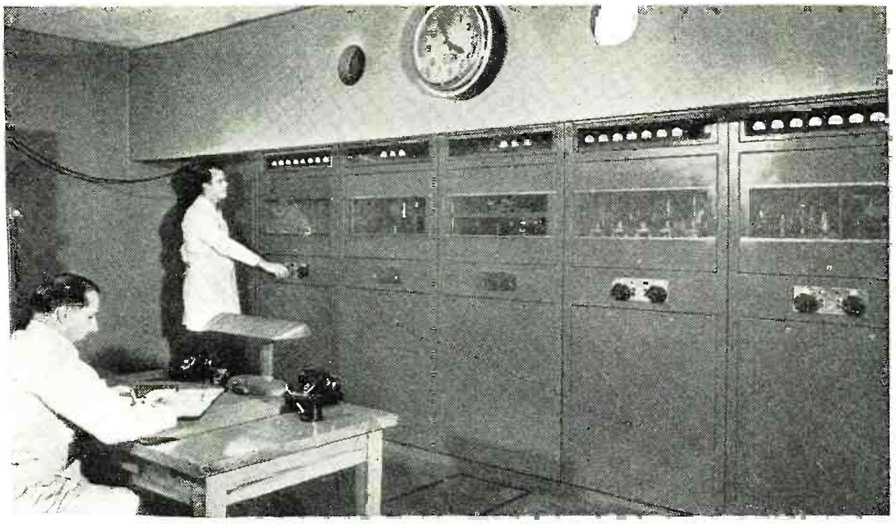
The limiter levels the amplitude variations of the i.f. signal in the sound i.f. channel. Since noise is predominantly amplitude modulation, noise is also removed when a sound carrier is received. This action is apparent when listening to the output of an FM receiver. With no received signal or carrier, the output of the receiver is noisy; however, as soon as carrier is received (even though it is unmodulated) the limiter goes into action, quieting the receiver. If the received signal is weak and not great enough in amplitude to operate the limiter, some noise is present. The use of two limiter stages permits limiting of weaker signals and the consequent improvement in noise reduction. A conventional i.f. tube having a sharp cutoff characteristic is generally used as a limiter. The three features which distinguish the limiter from the ordinary i.f. amplifier are; low plate and screen voltages, zero bias on the tube (no fixed bias or cathode resistor), and a grid circuit resistor-capacitor combination. Thus the limiter stage of the Model 90 sound i.f. system, the 6AC7 tube, has low plate and screen voltages, has its cathode grounded, and has resistor R_1 and capacitor C_1 in the grid circuit.

When the positive alternation of the i.f. signal is impressed on the limiter grid, it immediately swings positive and, as might be expected, the plate current begins to rise. However, the grid does not go as far positive as might be expected, for it draws current which passes through R_1 in the proper direction to develop grid bias across R_1 which opposes the rise in grid voltage. Consequently, the grid signal is held down or clipped to a certain extent because the rise in grid voltage is counterbalanced by an increase in grid bias. Likewise, the plate current and, in turn, the output plate voltage levels off, for there is no longer an increase in plate current with an attempted rise in grid voltage after the grid swings slightly positive. Therefore, any amplitude variations on the positive alternations of the sound i.f. signal applied to the limiter

Fig. 1. Schematic diagram of the sound i.f. and audio system employed in the General Electric Model 90 home television receiver.



grid, are clipped off. Although it appears as though the entire positive alternation is clipped, an average charge remains on capacitor C_1, setting the limiter bias at some negative value which depends on the strength of the signal. Thus, a signal of greater amplitude will develop a greater average bias, increasing the voltage gradient between the average bias point and the positive level at which the grid clips. This does not mean that the grid is driven a great deal more positive when a strong signal is applied, but instead, means that the little bit further positive the grid is driven causes an increase in grid current sufficient to add an appreciable bias. These points are demonstrated in Fig. 2, which shows the increase in bias caused by a larger signal. Notice that the grid swings only slightly more positive with the increase in signal strength, demonstrating how effective grid clipping is in removing severe amplitude variations. Fig. 2 also demonstrates the effects of the R-C grid combination in setting the bias for two different amplitude signals. In the very first r.f. cycle, almost the entire positive alternation is clipped, but as quickly as the capacitor can charge, a bias forms which sets the operating bias negative. Capacitor C_1 is charged very rapidly by grid current flow and, during the negative alternation of the input cycle when no grid current flows, attempts to discharge through R_1. Since the R_1-C_1 time constant is large in comparison to the period of the input cycle (time it takes capacitor C_1 to discharge through R_1 is many times longer than it takes one cycle of the i.f. frequency to appear on the grid of the limiter), the capacitor retains its negative charge almost in its entirety during the negative alternation. It is apparent, therefore, that the grid bias drops only an insignificant amount during the negative alternation before it is reinforced by grid current drawn on the next positive excursion of the input cycle.

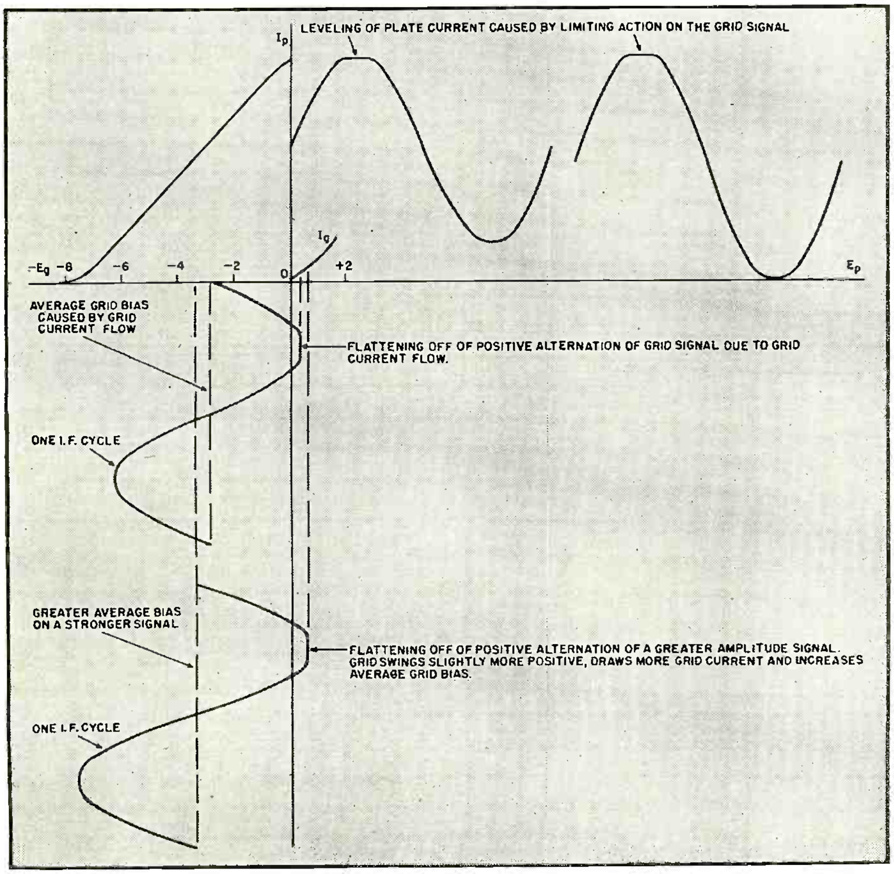


WBKB's DuMont audio-video transmitter of four kilowatt rated capacity located below a 200 foot steel antenna tower erected on the roof of the State-Lake Building in Chicago's Loop. Station WBKB operates on Channel 2 with a video frequency of 61.25 megacycles and an audio frequency of 65.75 megacycles.

Likewise, the low plate and screen voltages reduce the grid bias level at which the plate current cuts off, and, if the signal is great enough in amplitude, the negative alternations of the input cycle are cut off. Thus, the limiter levels amplitude variations on both the positive and negative alternations of the input cycle. Fig. 6 shows the effects on plate current of driving the grid beyond cutoff on the negative alternation. It is apparent that the applied signal can vary considerably in amplitude, but that the output plate voltage is confined between the narrow limits set by the plate current cutoff point and the point at which a further rise in instantaneous grid voltage causes no further increase in plate current. Furthermore, if plate and screen voltages are reduced further, the signal can be confined within a narrower region, as demonstrated in Fig. 7, and there will be limiting action on weaker signals. However, operating in this manner reduces the gain of the stage. A remedy, of course, is to use two stages of limiting, or to use more i.f. stages and do some limiting in earlier stages.

Leveling of the amplitude variations on an i.f. signal is demonstrated in Fig. 5. First the positive variations are leveled in the grid circuit by grid current flow, while the negative variations which swing the grid beyond cutoff are leveled by plate current cutoff. Thus, both sides of the modulation pattern are leveled. While at first it appears as though each cycle of the i.f. signal is being distorted (clearly shown in Figs. 2, 6 and 7, which show single cycles at the i.f. frequency), it must be remembered that the useful information for the frequency modulation detector is the frequency modulation, or variations in the frequency of the intermediate frequency, and not in its amplitude variations which the limiter is flattening off. Also the tuned resonant circuits and inherent capacities of the

Fig. 2. Curves illustrate grid leveling operation occurring in limiter stage.



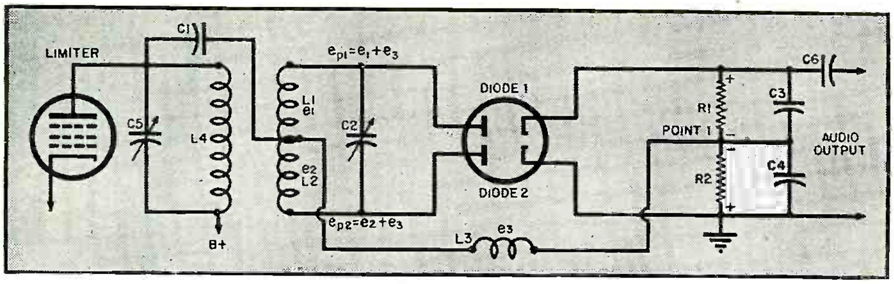


Fig. 3. Diagram of basic discriminator circuit employing a single dual-triode tube.

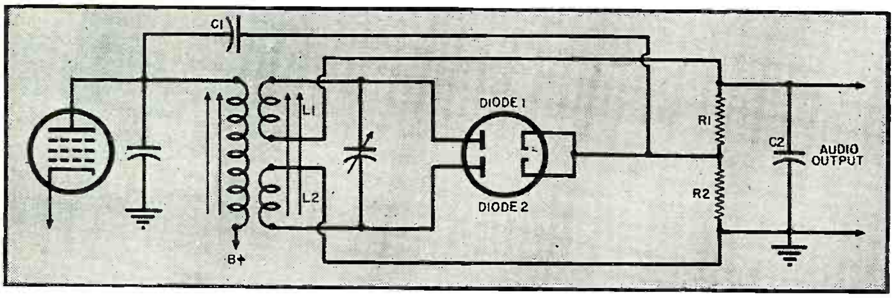


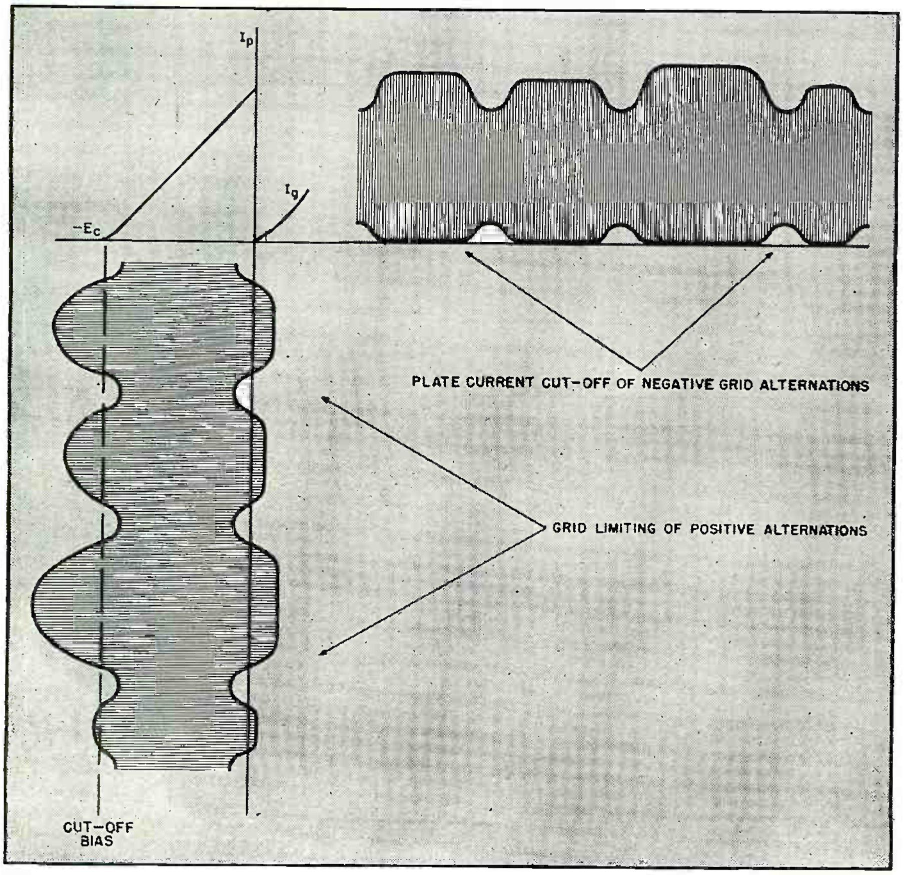
Fig. 4. Equivalent diagram of the discriminator employed in G.E. Model 90 receiver.

stages restore most of the original sine-wave characteristics to the i.f. signal. The time constant of the resistor-capacitor combination in the grid circuit of the limiter must have some optimum value which is not too long to prevent limiting of sharp impulse noises and not too short to prevent holding the grid bias constant during the negative alternations of the input cycle.

Discriminator

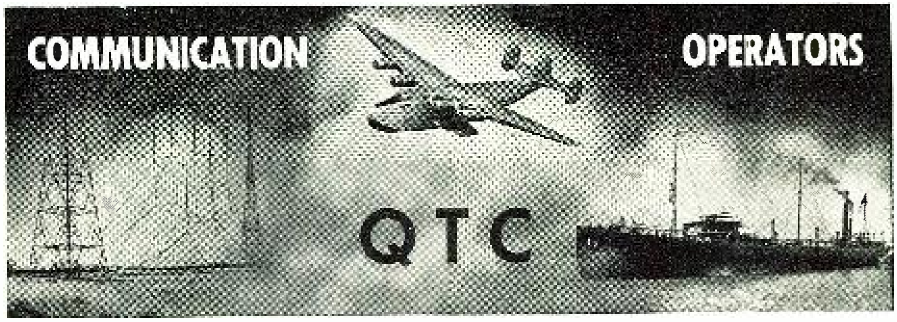
The FM discriminator converts frequency variations of the i.f. frequency to audio variations. The amplitude of the audio signals is proportional to the extent of the frequency deviation from the center frequency (8.25 mc.); the frequency of the audio signal, on the rate of deviation. Thus, if the i.f. frequency deviates between 8.2 and 8.3 megacycles (8.25, ± .05 mc.) four hundred times per second, a four-hundred-cycle audio tone of a given amplitude appears at the output. Now, if the same signal deviates between 8.15 and 8.35 megacycles (8.25, ± .1 mc.) four hundred times per second, a four-hundred-cycle tone of a greater amplitude appears at the output. Likewise, if the deviation is the same but the rate of deviation increases to six hundred times per second, a six-hundred-cycle tone appears in the output.

Fig. 5. Modulation envelopes used in illustrating how the leveling off of the amplitude variations on an i.f. carrier is obtained by the action of the limiter.



To understand the operation of the discriminator, first consider the action of the stage when an equal voltage is applied to each diode plate. Refer to Fig. 3. If there is plus ten volts applied to diode #1 plate, rectified diode current flows through L_1, L_3, R_1, back to the cathode, developing a positive voltage across resistor R_1. If, at the same time, positive ten volts is applied to diode #2 plate, rectified current flows through L_2, L_3, R_2, back to cathode, developing a negative voltage (electrons always proceed toward the positive terminus) across resistor R_2. If the circuit is balanced, therefore, it means that both voltages cancel across the output of the discriminator. Now, if we impress equal amplitude radio-frequency cycles on each plate, the same condition exists, although one plate may be going negative at the instant the other one is going positive. This becomes apparent when the action of capacitors C_3 and C_4, which filter any r.f. variations, is considered. Consequently, the current flowing through R_1 and R_2 is an average current and, as long as equal amplitude r.f. cycles are applied to both diode plates, there is still no output from the discriminator. Equal voltages appear on both plates when the applied signal is the same frequency as the resonant frequencies (center frequency) of the limiter plate tuned circuit L_4 and C_5, and the discriminator tuned circuit L_1, L_2, and C_2. When the input frequency departs from resonance, a greater r.f. voltage is impressed on one diode plate than on the other, producing a greater average diode current flow in one diode circuit than in the other. Thus, if the greater voltage is applied to diode #1, a larger voltage is developed across R_1 than across R_2, and the differential voltage or output voltage is positive. If the greater voltage is applied to diode #2, the voltage across R_2 is the larger, and the differential or output voltage is negative. This is exactly what occurs when the i.f. frequency is varied at an audio rate, for on the positive alternation of the audio modulation, the i.f. frequency swings to one side of the center frequency, placing a greater voltage on diode #1, and causing a positive audio alternation at the output; on the negative alternation of the audio modulation, the i.f.

(*Continued on page* 138)



By CARL COLEMAN

THE Federal Communications Commission reported recently a proposal to extend the present standard broadcast band by the addition of a ten kilocycle channel to the lower end of the band. This addition would extend the present band from 1600 kc. to 540 kc., the present limits being 1600 kc. to 550 kc. This increase would allow for one extra frequency assignment; in the report, FCC said that about 54 percent of the present receiving sets will be able to tune in on programs from stations which might operate on the 540 kc. channel. This frequency is now used for government services and it is not known how soon it can be made available for broadcasting use. Also in the proposal were provisions for 120 radio channels, some of which would be available to the United States; for direct international short wave broadcasting, allocations of frequencies for use by amateurs and others during times of disasters such as hurricanes, floods, etc., and increased emphasis on the use of radio by aviation communications such as navigational aids after the war. Also suggested was the establishment of a larger number of distress frequencies for use by aircraft and small surface vessels in distress and to provide more reliable coverage over long distances on radio distress calls. The above proposals were included in FCC's plan for allocation of frequencies to non-government radio services operating below 25,000 kc.

AFTER the completion of hearings in late June, the commission will issue a final allocations report covering non-government services in the range below 25 mc. FCC pointed out that frequencies below 25 mc. are so overcrowded it has been impossible to meet the requirements of all radio services in this range and added that wherever possible radio services are expected to move into the very-high and ultra-high frequency bands. At present there are 928 standard broadcast stations and there are 23 more under construction, and FCC has 180 applications pending for new stations as soon as materials and manpower are again available.

NATIONAL MARITIME DAY was observed throughout the country on May 22. . . . Secretary of the Navy Forrestal paid tribute to the men of the merchant marine saying "Without them, victory in Europe would not be an accomplished fact . . . with them and their task of transporting men, materials and weapons of war to strike the Jap, go the faith and trust of the men and women of the U. S. Navy, Coast Guard and Marine Corps." Observances were held in New York during the entire day from 10 a.m. until midnight. . . . Commodore F. G. Reinicke, Port Director of New York, speaking at the Maritime Service training station at Sheepshead Bay said that, "In a very real sense it was the Liberty ship, together with the tanker which beat Germany to her knees." "In no other war in history has the merchant marine played so powerful a role," "we cannot afford to gamble with the destiny of America. We can't afford to put the clock back." Commodore Reinicke added that "a strong America demands a strong merchant marine." The Port Director told an audience, which included more than 5,000 apprentice seamen, that three of every 100 men in the U. S. Merchant Marine have given their lives since the war began in transporting men and materials to war fronts.

K. LARSEN was in at an East Coast port recently aboard his cargo ship after a long voyage. Ted Dunal was in town having completed a trip aboard a tanker for a change. F. MacDonald has taken out a cargo assignment and expects to be gone for some time. S. Risken took out a freighter. O. Rone has been assigned a tanker.

MAYOR LA GUARDIA spoke at the Customs House following a parade of 800 men from the New York State Maritime Academy. The many speakers, both those representing government and shipping interests brought out the vital necessity of maintaining an adequate U. S. Merchant Marine. Prior to the United States entry into this second world war, the merchant fleet of this country was of relatively small importance, as merchant fleets go, carrying only about one seventh of the world's commerce as late as 1939. . . . In 1937 the United States embarked on an expansion program to cover some ten years during which time the merchant fleet was to be increased by the addition of some five hundred ships. This, however, would also have been totally inadequate for a nation of our size. In the meantime however, the war in Europe broke out, which we subsequently entered and the problem of transporting the necessary men and materials to the battlefronts via the Atlantic became of prime importance to us, causing a very rapid expansion of our merchant fleet until today the United States finds itself carrying two thirds of the world's shipping which amounts to a near monopoly of world commerce. Such a fleet is a necessity to this country in time of war to carry the vast quantities of men and materials needed to carry on a war thousands of miles away. A merchant fleet such as this should never be allowed to deteriorate to the low standard set after the last war when ships were tied up in "graveyards" to slowly rust away or be sold for near nothing to foreign shipping companies who were able, in many cases, to run our firms from the high seas with their lower rates due to cheap labor. Our present merchant fleet must be kept up and maintained in order for immediate use as an auxiliary to the military and naval forces of this nation . . . successful maintenance of peace can only be achieved through being powerful enough to resist attack, through being powerful to the

(*Cont. on page* 60)

"I guess we'll have to use more primitive methods. there seems to be something wrong with the capacitor!"

PLOTTING of ENGINEERING DATA

By R. G. MIDDLETON
Eng., Fen-Mar Co., Inc.

The author presents many important points to bear in mind when plotting engineering data in its simplest possible form.

OBSERVATIONS from an experimental or test set-up may be plotted on Cartesian coordinate paper, and a smooth curve drawn through the datum points. While such curves are always "true" providing a sufficient number of points have been determined, such curves may not always display their information in a useful form.

Various kinds of coordinate paper are available for engineering work, such as Cartesian-rectangular, semi-log, log-log, polar, triangular, and many special rulings.

As rectangular-linear coordinate paper is not always the most advantageous for experimental data, it is likewise not always the best ruling for theoretical reference charts, such as decibel curves, as will be seen.

An equation which plots as a straight line in Cartesian coordinates does not plot similarly upon other rulings, but appears as a curve. Conversely, curved graphs in Cartesian coordinates will plot as straight lines upon the proper rulings.

Fig. 3 illustrates the graphs of a straight line and a branch of a parabola in rectangular coordinates; the straight line has the equation $y = x$, and the parabola has the equation $y = x^2$. It is apparent that reading the graph and interpolating is easier in the case of the straight line.

Now the equation $y = x^2$ would be of the general form of a linear function if its logarithm were taken:

$$\log y = \log x^2 = 2 \log x$$

This is the same equation and says the same thing as $y = x^2$, but the information is merely presented in another form which renders the variables of the same order. The straight line ($\log y = 2 \log x$), Fig. 3, illustrates the graphical result.

We are primarily interested in y and x themselves rather than $\log y$ and $\log x$, and if Cartesian coordinates are retained the advantages of linearity will be outweighed by the necessity of logarithmic manipulation.

The logarithmic operations required may be performed automatically by using a logarithmic ruling rather than a linear ruling. In Fig. 4, it is illustrated how $y = x^2$ may be made to appear as a straight line, while y and x themselves are read directly from the coordinates. This ruling is log-log in which each successive division is ruled in logarithmic intervals. Any equation of the form $y = kx^n$ appears as a straight line on log-log paper.

It frequently happens that $\log y$ will be desired rather than y itself; that is, the equation which we want to plot may be of the form $x = \log y$. This type of equation will plot as a straight line on semi-log paper.

Fig. 1 graphs $x = \log y$, with $x = y$, etc., for comparison. Semi-log paper is ruled linearly along one axis, and logarithmically along the other axis. The linear variable should be taken along the linear intervals, and the logarithmic term along the logarithmic intervals.

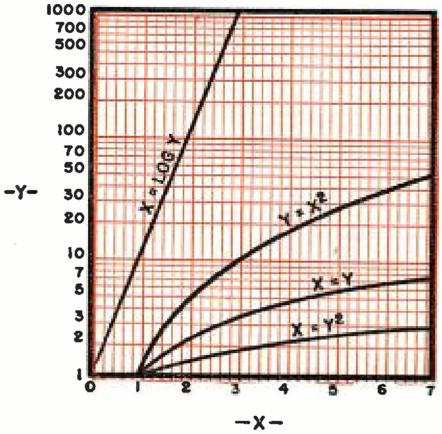
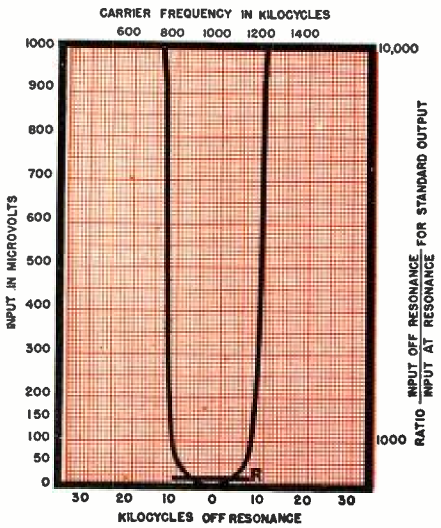


Fig. 1.

Fig. 2.



How semi-log paper may be put into practice is illustrated by Figs. 5 and 11. These are graphs for the decibel equation, plotted in both Cartesian and semi-log coordinates. It is at once apparent that the information presented in Fig. 11 is in far better form. It may be noted that one decibel is about the smallest volume change which is perceptible to the ear. V_1/V_2 is left as a ratio and regarded as a new variable. Thus, the decibel can have no absolute value until the reference level is specified, such as 1.9 volts in 600 ohms.

How log-log paper may be applied practically is shown in Fig. 6. A formula of the form $xy = k$ may evidently be linearized by taking logs, since $\log x + \log y = \log k$. The ratio of the ripple voltage across the first capacitor of a capacitive input filter to the d.c. ouput voltage is given to a good approximation by

$$\frac{\text{RMS ripple}}{\text{DC ouput}} = \sqrt{2}/(2\pi fRC)$$

where R is the load into which the filter works and f is the ripple frequency under consideration.

It is evident that this information can be most usefully presented by plotting on log-log paper, since the graphs are then linear as in Fig. 6. Filter design may be outlined rapidly with charts prepared in this manner.

When graphs are plotted from empirical data, the equation is usually unknown. To determine if such a set of data corresponds to an equation of the general form $y = kx^n$, the observed values may be plotted on log-log paper and connected with a straight line if possible. If a straight line runs through the points, the equation is determined and the exponent of the independent variable is equal to the slope of the straight line. Next, let $x = 1$, and k will equal y.

If the graph is not a straight line, but an upward curve, the equation may be of the form $y - k' = kx^n$; on the other hand, if the graph is a downward curve, the equation may be of the form $y + k' = kx^n$. If neither of these equations fit the curve, $\pm k'$ may be added to x, thus leading to equations of the forms $y = k(x \pm k')^n$.

The sensitivity and fidelity of radio

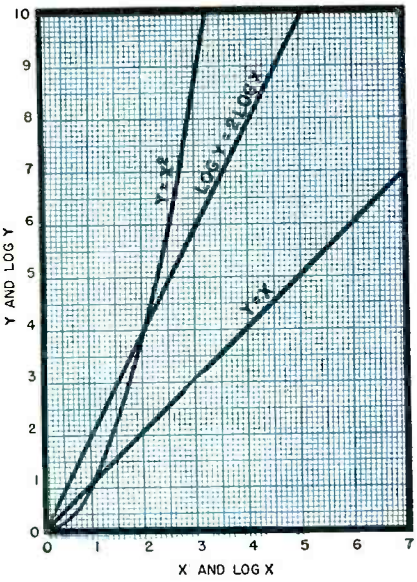


Fig. 3

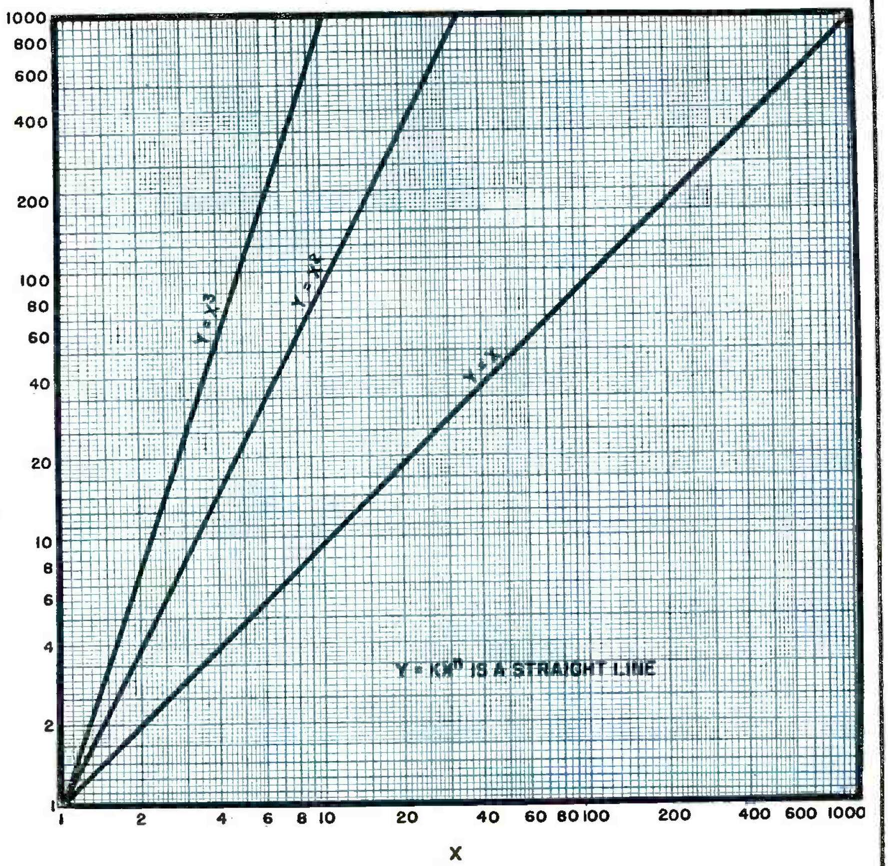


Fig. 4

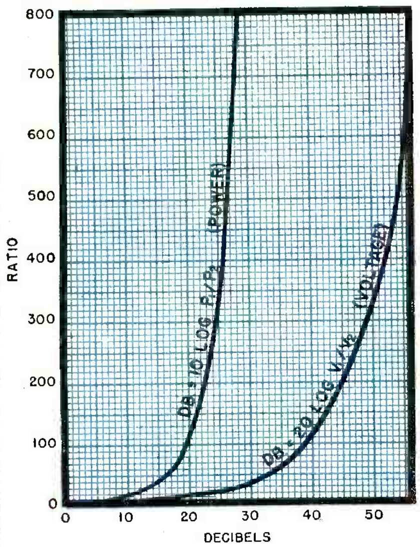


Fig. 5

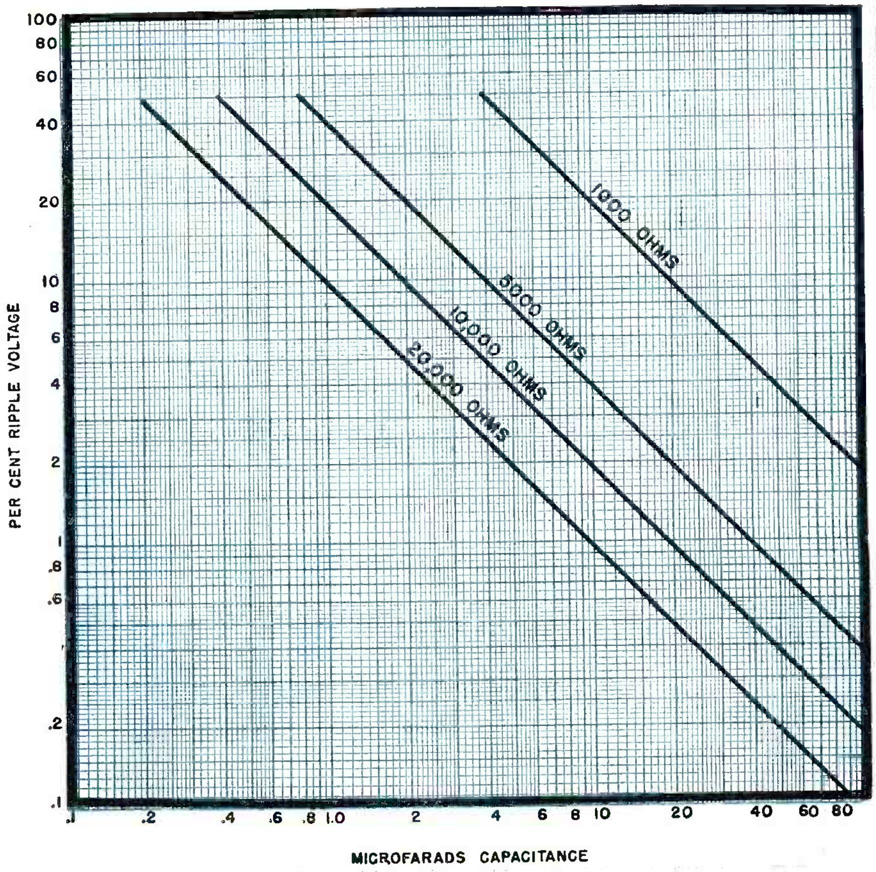


Fig. 6

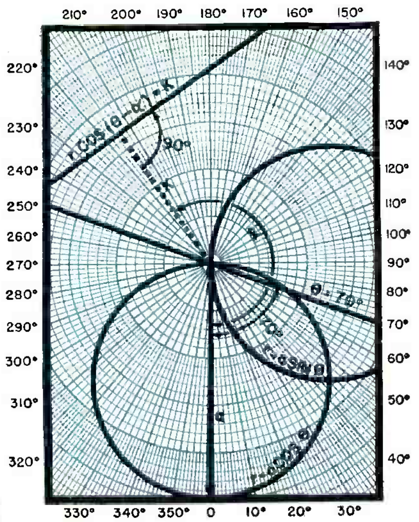


Fig. 7

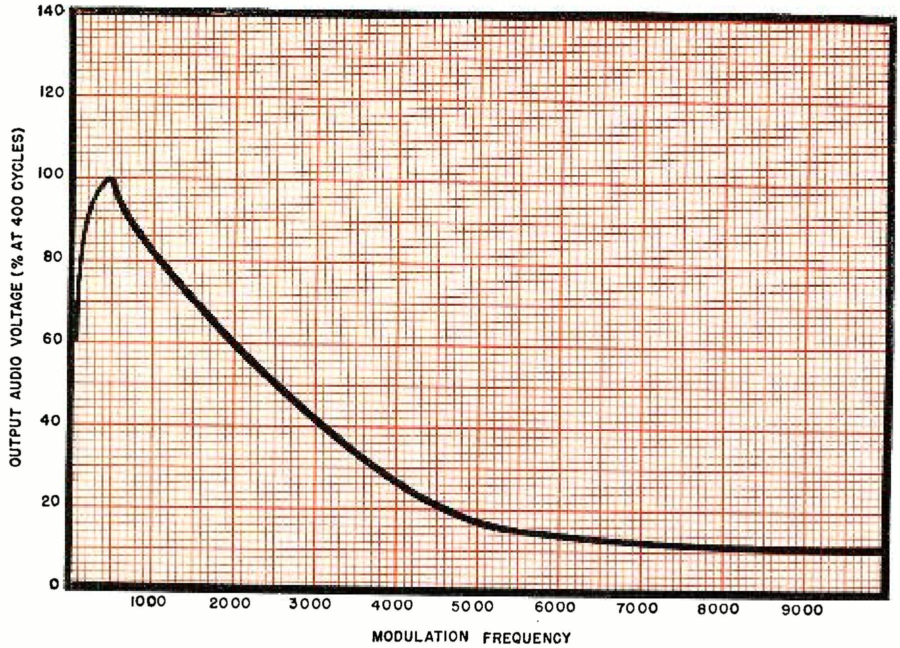


Fig. 8.

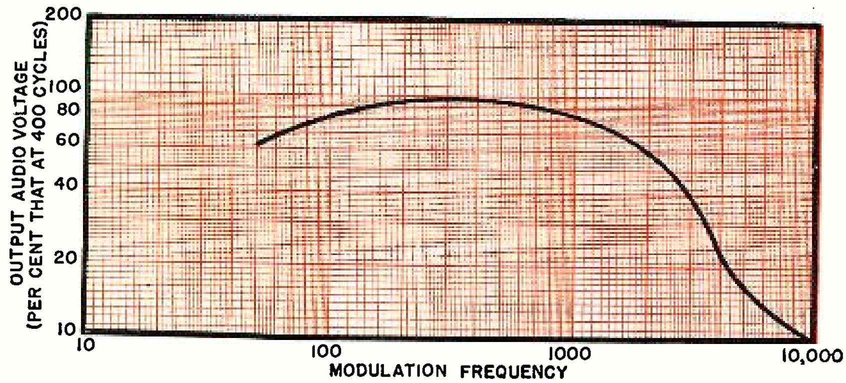
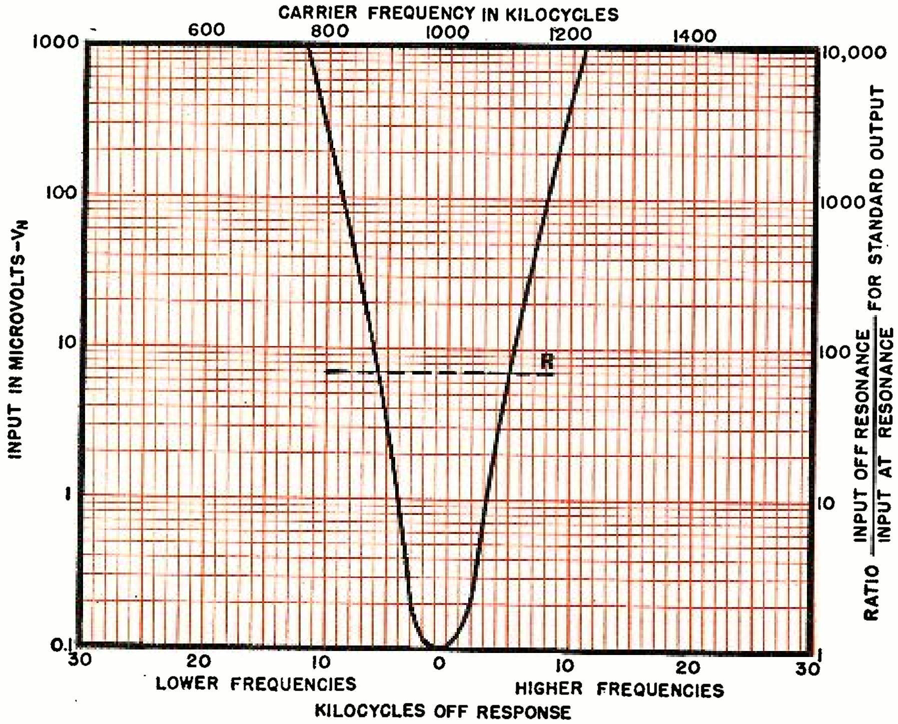


Fig. 9.

Fig. 10.



receivers are plotted on semi-log paper, although the fidelity may also be plotted on log-log paper. Fig. 10 shows the type of graph which may be expected. It is observed that the resonant response is not symmetrical about the center frequency. Neither is it the flat-topped band-pass characteristic that yields most faithful reproduction. We are interested in the steepness of the sides, and in the shape of the graph from *R* to the peak.

The same information is plotted in Fig. 2 on Cartesian paper, from which it is apparent that the data is presented in a form which is practically useless. The portion of the curve which is of the greatest significance has been so concentrated in a small area that the investigator cannot read it intelligently. On the other hand, the information higher up on the graph may be as easily found from Fig. 10 as from Fig. 2.

The fidelity characteristics plotted in Fig. 9 on log-log paper are plotted in Fig. 8 on Cartesian paper. In the latter graph, it is noticed that the curvature is far from uniform, varying with great rapidity about 400 cycles and showing little variation from 5,000 to 10,000 cycles. In Fig. 9, the fidelity graph is smoothed out markedly through the device of plotting on log-log paper.

In all these curves, linear distances have been compared with one another. It is frequently useful to graph data or equations in terms of a distance and a direction. If we are interested in determining the radiation pattern, for example, for a simple antenna, the data should be plotted on polar coordinate paper, as shown in Fig. 12. The curve is the field strength in any direction from the antenna, in the horizontal plane containing the antenna.

The equation which corresponds to a graph in polar coordinates is a function of r and θ such that the terminus of r traces the curve as θ varies from 0 to 360°. Thus in Fig. 7, $r = a(\cos\theta)$ and $r = a(\sin\theta)$ are equations of circles. The equation of a straight line through the origin in polar coordinates is $\theta = k$ (in the figure $k = 70°$). The equation of a straight line in polar coordinates, not passing through the origin, is $r\cos(\theta - \alpha) = k$, where alpha is the angle to the normal through the pole to the line.

There are still other special rulings which find application in engineering work, such as power emission paper and triangular coordinate paper (not illustrated). The former is a curvilinear coordinate system on which the relation between cathode heating power and electronic emission plots as a straight line. Triangular coordinate paper will be found useful when the sum of three variable terms is equal to a constant.

It should be observed that selection of the proper ruling for the given

(*Continued on page* 126)

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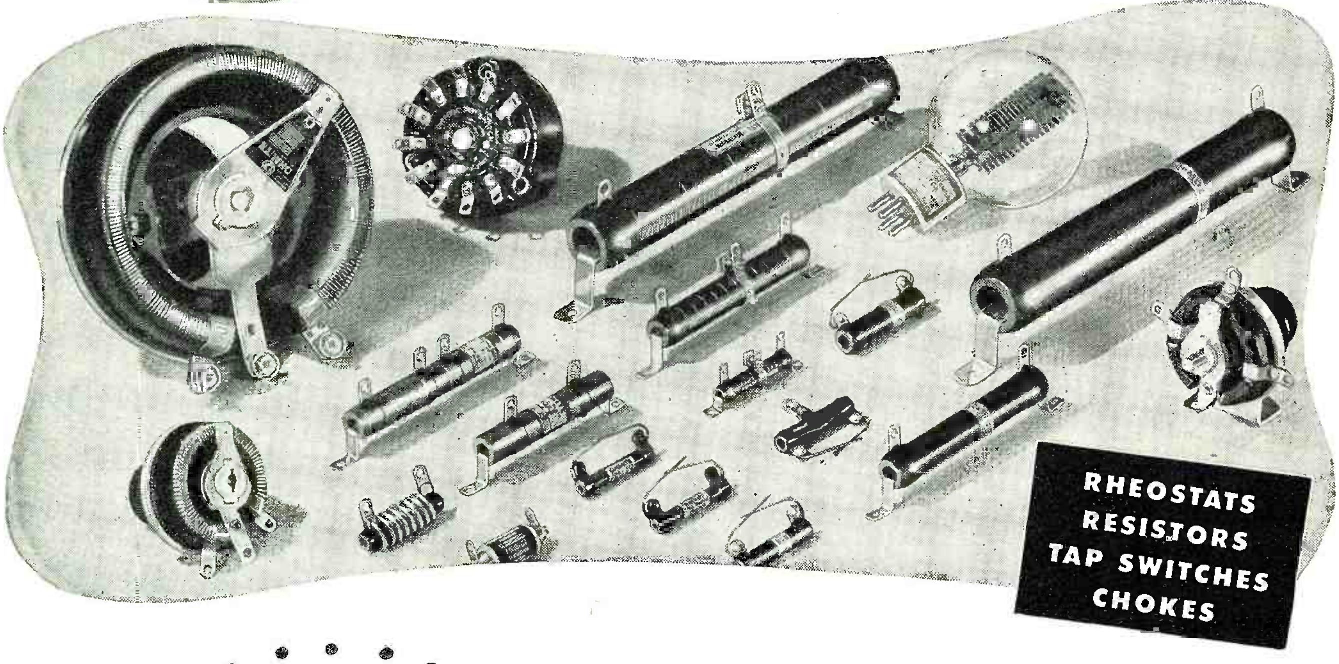

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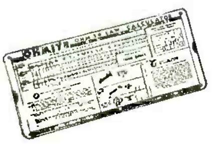

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(*Continued from page* 55)

extent where other nations would not dare attack. To operate a successful navy, it is of utmost importance that the U. S. maintain a high position with her merchant fleet which is very vital to the supply demands of a modern navy.

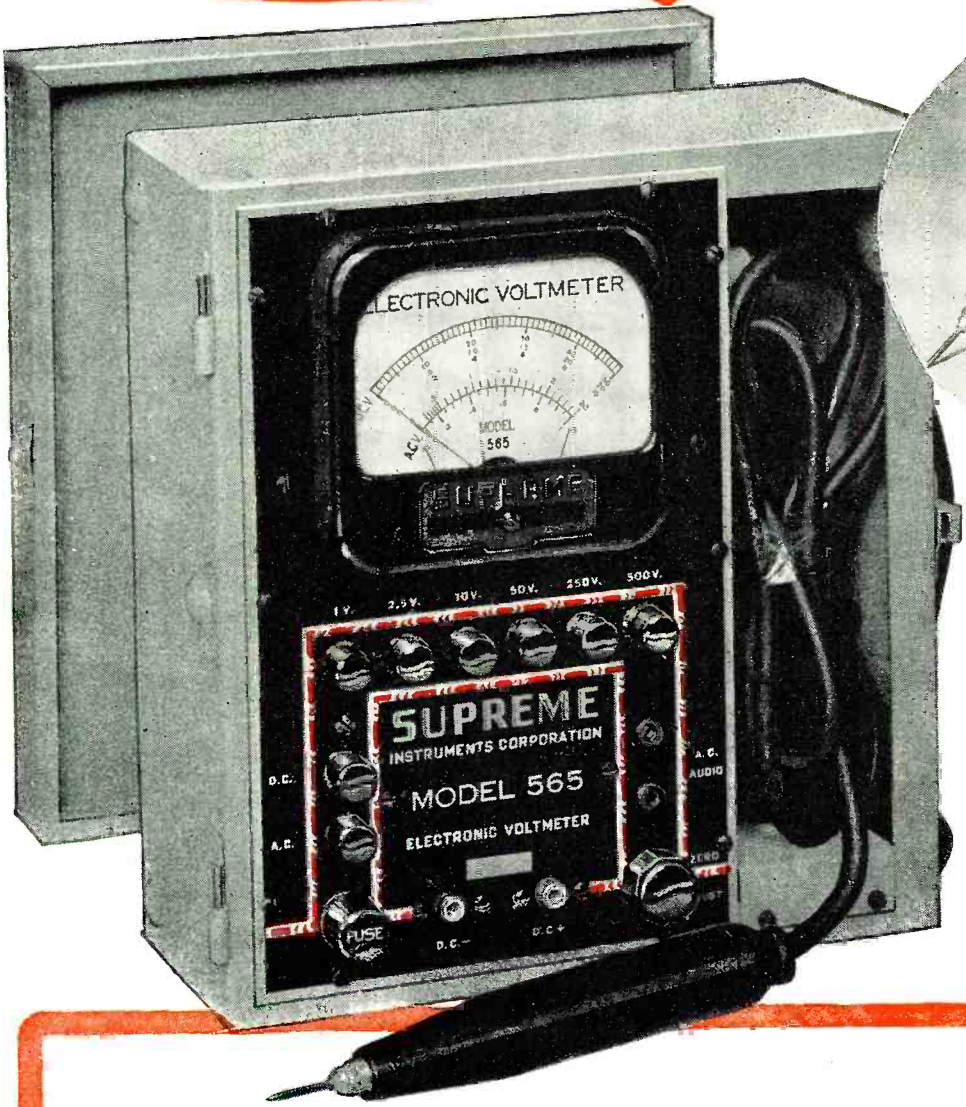
HARRY B. SMITH, Chief on a Liberty, writes from the West Coast and seems to agree with comments regarding the space, or lack of it, in the radio shack aboard the Liberty types since the addition of a short wave transmitter. Harry says he has just 2½ feet to swing around in, looks like "HB" has to start a diet shortly. P. B. Johannessen, ex-marine operator and east coast service man was in recently on a well-deserved vacation from his post with the Signal Corps way up north in the islands. W. J. Scott (Army), R. Jenkins (Navy) and B. W. Hill (Navy) are interested in getting into the merchant marine after the war and pounding brass as commercial oprs.

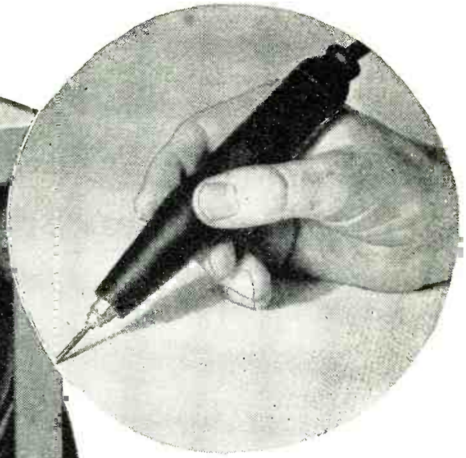
VARIOUS radio manufacturers throughout the country are getting set for post-war production of civilian equipment as cutbacks in government orders are expected and already received by some. . . . It is a possibility that a fifty percent cut in production of electronic equipment may take place; civilian and industrial customers must be found to take up the slack in this production in order to keep things going properly without long layoff periods and plant inactivity for radio manufacturing concerns. Manufacturers report that the addition of FM to the average receiver selling for over about fifty dollars would be one of the biggest improvements . . . and that better quality and tone range would be found due to this addition. Most concerns seem to feel that the phono-radio combination with the addition of FM seems to be the equipment that will be most in demand from the general public . . . better looking equipment with better tone is the general belief but it has been pointed out that the "super" radio with the fur-lined bath tubs some people seem to expect will not be in the offing for a long, long time. Television will be somewhat improved it is believed due to things learned during the war. Many things learned during war time will improve post-war equipment but there will be most likely many things of a secret nature that the government services will not release after the war.

WE HAVE received quite a few letters from the boys in the Army, Navy and other government services but very little from the fellows in the merchant marine during the last few weeks—let's hear from you. 73

Announcing THE NEW* SUPREME MODEL 565

VACUUM TUBE VOLTMETER!





New type hand-fitting probe allows ease of measurements, handles just as any ordinary test lead. Probe incorporates new high-frequency diode giving best possible frequency response. Completely new, balanced, highly degenerative bridge circuit allows higher input impedances (less detuning on RF circuits) and greater stability than ever before.

RANGES:
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EXTENDED TO 5000 VOLTS BY EXTERNAL MULTIPLIERS

FREQUENCY RANGE:
Negligible frequency error from 50 cycles to 100 megacycles.

INPUT RESISTANCE:
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AC—40 megohms on 1 volt range; 20 megohms on 250 volt range

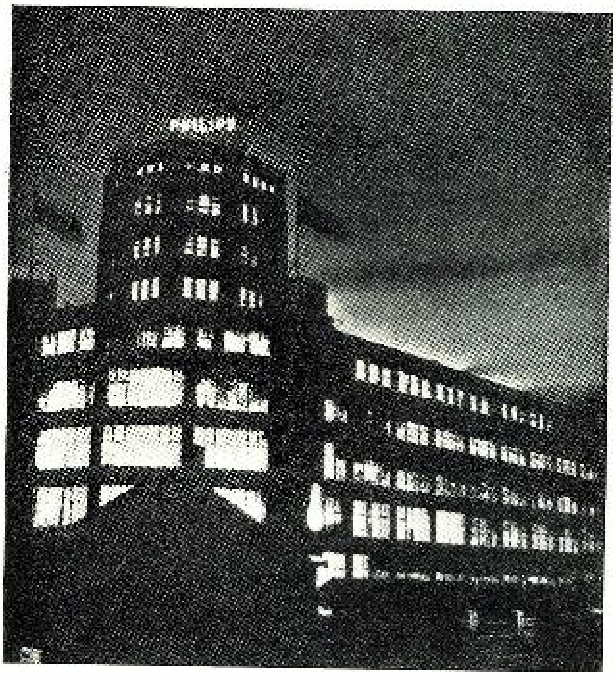
INPUT CAPACITY OF PROBE: 5 micro-micro farads

SUPREME INSTRUMENTS CORPORATION GREENWOOD MISSISSIPPI

EUROPEAN News Review

By LEON LADEN
London, England

A survey of some of the more important wartime developments in radio-electronics.



Philips' Incandescent Lamp Factory in Eindhoven, Holland.

THE snowballing demands of modern warfare have undoubtedly stimulated radio science and developed the scientific, research and manufacturing potential of the radio-electronics industry. Nevertheless, an evaluation of progress in this field of applied science reveals that wartime radio-electronic applications are generally based on well-known principles or else were developed from theories evolved prior to the outbreak of the war.

In fact, it can be assumed that no single discovery of a fundamental character bearing directly on radio and electronics has been made during this war.

Of course, this lack of new discoveries hardly belittles the tremendous wartime contribution made by radio scientists, research workers and manufacturers in providing, in the aggregate, an endless stream of equipment for the armed forces but it does emphasize once again the necessity of long-term policies of patient research and development work required for obtaining any results of scientific or outstanding commercial value.

Just how uphill a task the application of new scientific knowledge to practical engineering is, is being brought home to British physicists and radio-engineers working on the development of a new technique of communication engineering.

This new technique—which comes as the climax of a slow trend in line telephony—aims at providing a multitude of channels for telephony, broadcasting, television, and various other purposes by the aid of completely empty and hollow metal tubes equipped with small terminal aerials radiating from one end of a pipe to the other or alternatively, radiating into the open.

To the layman it might perhaps appear obvious that radio waves can be transmitted down pipes in the same way as sound waves are sent down speaking tubes.

However, as soon as it is realized that sound waves are longitudinal oscillations of air parallel to the direction of propagation and radio waves transverse oscillations of electro-magnetic variations at right angles to the direction of propagation, it becomes evident that the analogy does not hold good since a sound wave travels irrespective of tube width whereas the wavelength of a radio wave has to fit into the diameter of the tube through which it passes.

This means that only frequencies less than about 10 centimeters in wavelength (3,000,000,000 c.p.s.) can be piped through tubes without distortion.

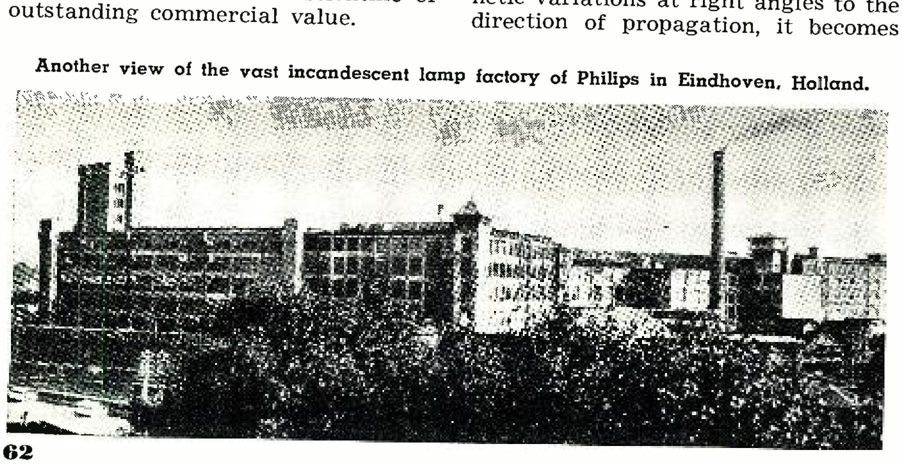
Obviously, the technical problems involved in the use of such very high frequencies are formidable in terms of practical engineering.

The replacement, therefore, of multi-wire "phantom circuits," double-wire carrier-current telephony, single-wire coaxial cables or radiators and receivers of conventional type by the new technique of "guiding" waves through pipes is bound to take time.

Nevertheless, it is generally anticipated that piped radio will be put into operation sometime after the war and make the transmission and reception of television programs to screens in the cinema and home as easy as the sending and receiving of, say, cablegrams.

In fact, it is alleged that a $25,000,000 company which was recently formed in this country for the commercial exploitation of tapped television on a grand scale has already acquired a large number of cinemas all over Britain for post-war conversion to television as well as a 10,000-acre estate near London as a site for an after-the-war British Television Hollywood.

Another view of the vast incandescent lamp factory of Philips in Eindhoven, Holland.



A 1,000-line French Television System

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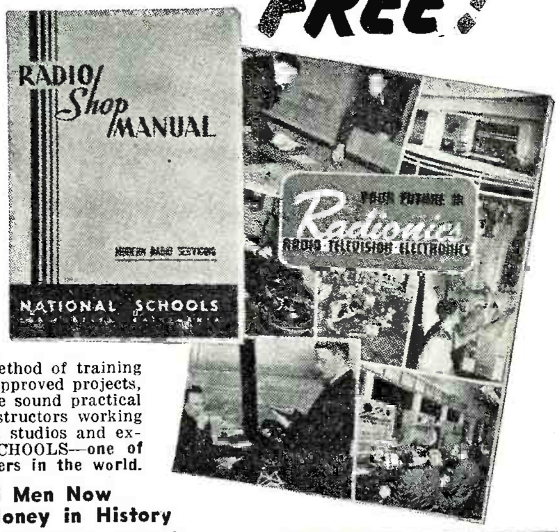
6. How to Test and Measure Voltages.
7. How to Test Speaker in Audio Stages.
8. How to Test Detector, I.F., R.F., and Mixer Stages.
9. Complete Reference Table for Locating Receiver Troubles.



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est structure in Europe, the Eiffel Tower in Paris, was used for a time by the Germans during the occupation of France for transmitting television programs to their canteens and soldiers' rest centres.

This was made possible by the fact that the Paris television transmitter —built by the *Laboratoire Le Materiel Telephonique* in 1937-8—consists of *Telefunken-Philips* equipment operating on 46 mcs. with a bandwidth of 5 mcs. and sending out 441-lines, interlaced, pictures that could be received without difficulty on German-made telesets.

Despite the occupation of their country, prominent French radio scientists and engineers managed to carry on with their research and development work at two experimental television transmitting stations at Lyons.

Important discoveries were made, in consequence, and a 1,000-line television system using direct all-electronic projection and viewing was developed by Rene Barthelmy, chief engineer of the *Companie Francaise de Television,* and his associates.

Soviet Television

The part played by radio and electronics in the Soviet Union's fight against the Germans can only be measured against the scale of that country's pre-war radio industry which was then mainly limited to the manufacture of standardised one-wave radio sets and some research and development work centred round the universities of Leningrad and Moscow.

As soon as the war broke out, however, a tremendous effort was made to improve the technical efficiency of existing equipment and to develop communication gear for special military purposes.

The intensive program of research work which was inaugurated and the new production methods which were adopted yielded excellent results.

Among the highlights of Russian mass-production of to-day are metal triode oscillators and amplifiers capable of efficient operation on centimeter wavelengths with a power output of from 4 to 6 watts and water-cooled power tubes up to a hundred kilowatts.

Special attention was also paid to the development of television—pre-war Russia had only two experimental television stations although successful experiments had been conducted in that country as far back as 1907—and Sergei Ivanov, a well-known Soviet radio engineer, was recently able to demonstrate in Moscow an all-electronic cinema-television projector casting a three-dimensional picture onto a mirror-like screen consisting of some 2,000 microscopic lenses.

These images, the inventor explained, are depicted at different angles by the aid of a special stereoscopic system throwing six to eight pairs of pictures simultaneously onto the screen and foreshortening them at various angles.

According to reports, the USSR plans to install television equipment of this type in the proposed building of the Palace of the Soviets after the war.

Swiss Large-screen Television Projector

The *Swiss Institute of Applied Physics* in Zurich has been able to develop in the course of the last few years a television projector capable of producing large screen images.

The projector is based upon the principle of the point-to-point deformation of the surface of a thin film of liquid by means of electrostatic forces.

This system deviates from other systems in that the process is accomplished by the aid of a modulated cathode-ray beam charging the surface of the liquid with electricity and thus giving rise to the forces needed to effect the deformation.

Dr. Fischer of the *Swiss Federal Institute of Technology*—under whose supervision the projector was developed—claims that this new system of television is suitable for presentation to cinema theatre audiences.

Dutch Electro-Acoustic Aids

The *Philips Research Laboratories* at Eindhoven, Holland, have carried out during the war, successful experiments with electro-acoustic methods of obtaining amplification of the sound of a solo violin playing against an accompanying orchestra in larger concert halls.

In practical application, the new method permits a musician of exceptional skill appearing as a soloist to increase the volume of sound emanating from his Stradivarius or Guarnerius without extra effort or distortion.

The basis of this method is amplification of the solo performance through multiplication by a given number of other violins.

The contraption used is simple in construction and consists merely of a special type of piezo-crystal pick-up suspended onto the dead end of the G-string of the violin bridge.

This crystal executes vibrational movements when the bridge vibrates producing piezo-crystal voltages which are amplified and fed to the bridges of a series of other violins lined up next to one another and connected together.

The bodies of these violins act as loudspeakers and reproduce in unison the sounds radiated by the strings of the solo violin.

Another wartime development of the *Dutch Philips Company* is a microphone which uses the mechanical vibrations of the throat as an exciting agent instead of the usual air vibrations which occur in front of the mouth.

This new pick-up device enables telephone conversations to take place in aeroplane cabins, boiler factories,

ship building yards, mine shafts and other places where deafening noise drowns the human voice.

Two different laryngophones — as these microphones are called—have been developed; a crystal type using Rochelle-salt for the reversal of the electric charges and a more sensitive carbon type in which the current variations are produced by pressure of the carbon grains.

Swedish Electronic-Eye Device

A Swedish company, working in close co-operation with prominent Swedish ophthalmologists, has perfected an electronically-controlled device for the removal of iron particles from human eyes.

The new device has extra fine tips for insertion into the vitreous body and combines a small air gap with a large range of the magnetic field.

It is apparently entirely automatic in operation and exceeds in strength many times electro-eye magnets of the conventional type.

Germany's Wartime Developments

A scrutiny of Germany's radio-electronic developments since 1939 discloses that as far as can be ascertained very little worth recording was produced in that country apart from automatic and remote-control radio devices for the launching of V-2 rockets and the steering into position and exploding of driverless tanks or mines.

Of course, a considerable amount of research and development work took place in Germany during the war years and there remains a remote possibility that some startling inventions of great significance were made by Nazi scientists and research workers which failed to pass the test of practical application and are still shrouded in secrecy. There is no doubt but what much of this data will be released in the near future.

However that may be, it is certain that at the beginning of the war television was fairly regularly relayed from the Rundfunk transmitter in the Berlin area by the aid of di-pole aerials picking up the 441-line images and passing them on through special cables to redistribution amplifiers installed near the top floors of larger blocks of flats.

These amplifiers were adjusted to distribute signals automatically to miniature sets equipped with post-card-sized screens manufactured by the Telefunken company installed in individual flats occupied by Nazi big shots.

As post-war Germany will in all probability be deprived of most of the 36 wavelengths she managed to secure by rather dubious means at the international radio conference in 1938 at Montreaux, Switzerland, it can be anticipated that television will not reappear in that country for some years to come.

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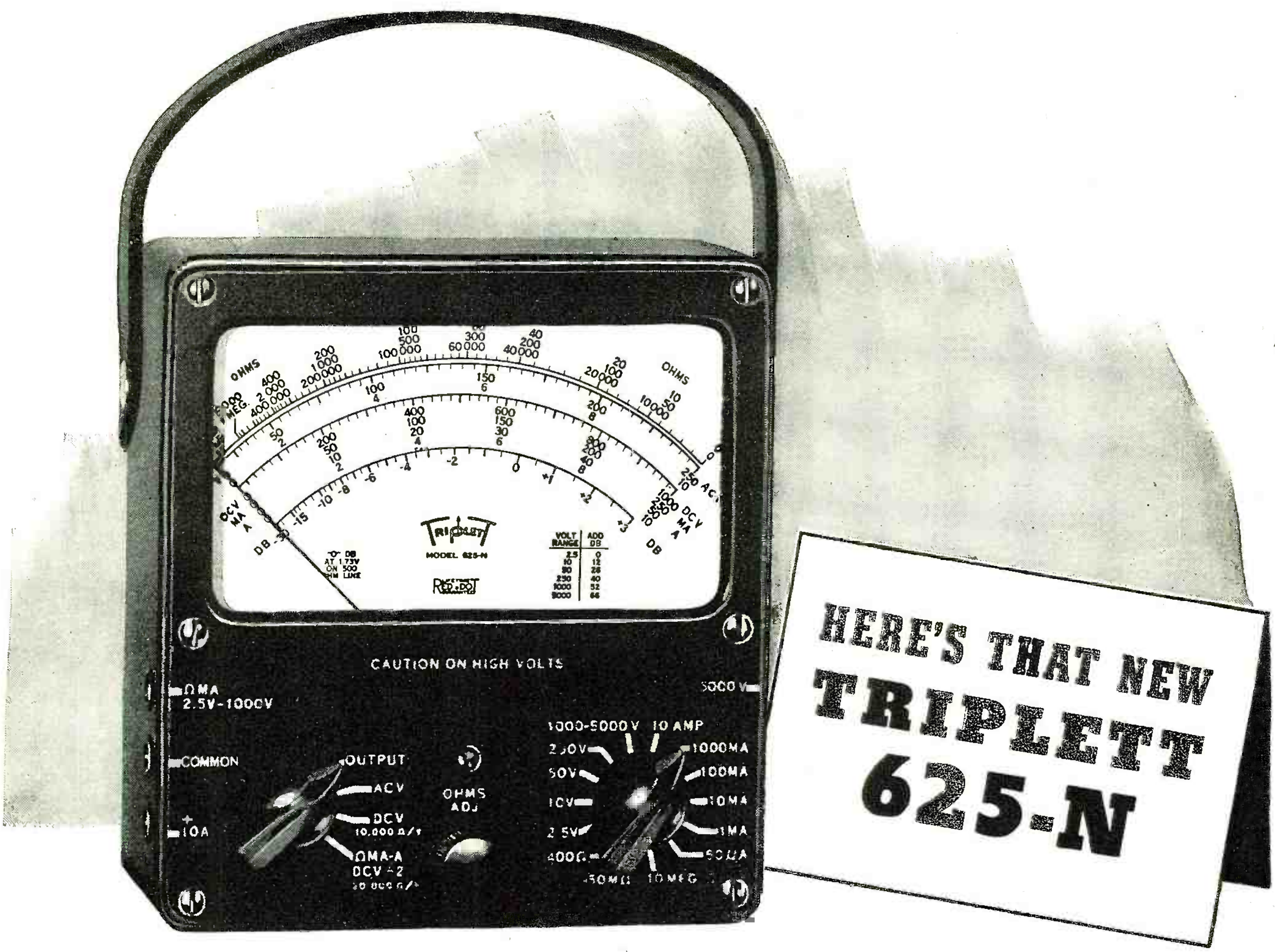

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DOUBLE SENSITIVITY
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0-1.25-5-25-125-500-2500 Volts, at 20,000 ohms per volt for greater accuracy on Television and other high resistance D.C. circuits.

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TEMPERATURE COMPENSATED CIRCUIT FOR ALL CURRENT RANGES D.C. MICROAMPERES

0-50 Microamperes, at 250 M.V.

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Size: 2½" x 5½" x 6". A readily portable, completely insulated, black, molded case, with strap handle. A suitable black, leather carrying case (No. 629) also available, with strap handle.

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WHAT'S NEW IN RADIO

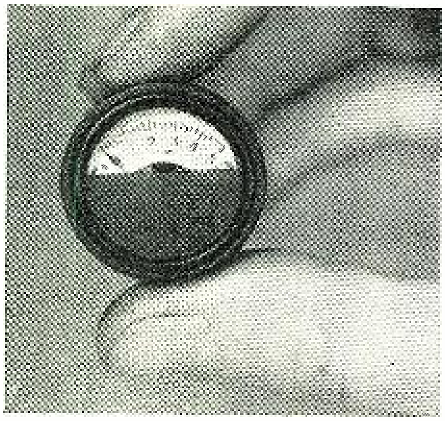
New products for military and civilian use.

The products described herein are available, in most cases, only through high priority ratings. It is suggested that readers apply for further information on company letterheads, stating full details as to priorities available.

MINIATURE INSTRUMENTS

A complete line of miniature voltmeters, ammeters, milliammeters and microammeter has been introduced by the *MB Manufacturing Company, Inc.*

These indicating instruments measure one inch in diameter and weigh



only 1¼ ounces. Of the moving coil type, these instruments are hermetically sealed in an anodized aluminum case which also has provision for hermetically sealing the instrument case to the mounting panel.

In addition to this line, a companion line of 1½" instruments is also available. The weight of these instruments is 1½ ounces.

Details may be obtained from Department S, *MB Manufacturing Company, Inc.,* Instrument Division, 250 Dodge Avenue, East Haven, 12, Conn.

NEW HEADPHONE

A new headphone and microphone assembly which incorporates several new features is being manufactured by *Aviometer Corporation* of New York.

A flexible head and chin strap allows wide latitude for adjustment of earphones to the most comfortable position on any head. The tiny lightweight anti-noise 100 ohm carbon microphone, in a plastic closure, is assembled with a swivel boom. Easy movement permits correct positioning for clear transmission and frees the hands for other duties. The microphone unit disappears from the face and rests parallel with the headband or under the chin when not in use.

The complete assembly weighs less than 12 ounces. The unit is fitted with chin slide clasp for centering ear cushions, convenient cordage, small disconnect plug and a new pistol-grip control switch.

The unit is being manufactured by *Aviometer Corporation,* 370 West 35th, New York, New York.

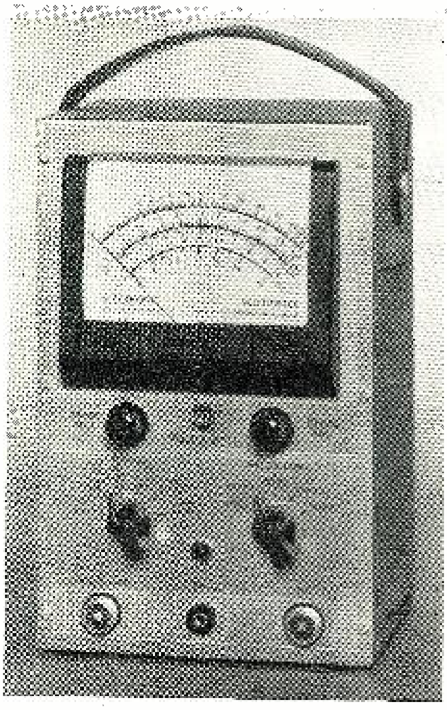
NEW VOLTOHMYST

The *RCA Victor Division* of the *Radio Corporation of America* has announced a new Voltohmyst, the RCA 195-A, which in one compact unit provides the means for measuring d.c. or a.c. voltage, resistance, audio level, and FM discriminator balance.

The Voltohmyst includes a six-range d.c. voltmeter, an ohmmeter which reads from .1 ohm to 1000 megohms, a six-range a.c. voltmeter, a linear audio frequency voltmeter, an audio level meter, and an FM discriminator balance indicator.

The six-way usefulness of this instrument is due to the use of electronic measuring circuits. The use of such circuits also provides other important advantages, including high input resistance, which makes it possible to test radio receivers with the signal present, ability to measure high values of resistance, and protection against meter burnout. Improvements over the original Voltohmyst include a diode for a.c. measurements, linear a.c. scale for all ranges, a new crystal-clear plastic meter case with one-piece unbreakable front and a shielded a.c. cable and probe.

A bulletin describing the RCA 195-A Voltohmyst can be obtained from the

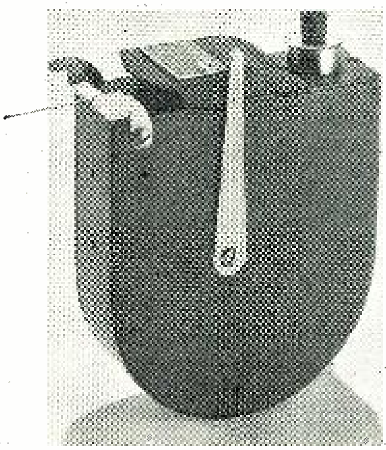


Test and Measuring Equipment Section, *RCA Victor Division,* Camden, New Jersey.

RECORDING GALVANOMETER

A new recording galvanometer which makes a direct ink on paper chart recordings of wider frequency range and greater sensitivity than heretofore attainable is being announced by *The Brush Development Company.*

This instrument embodies a low mass, 3" long tapered tube recording



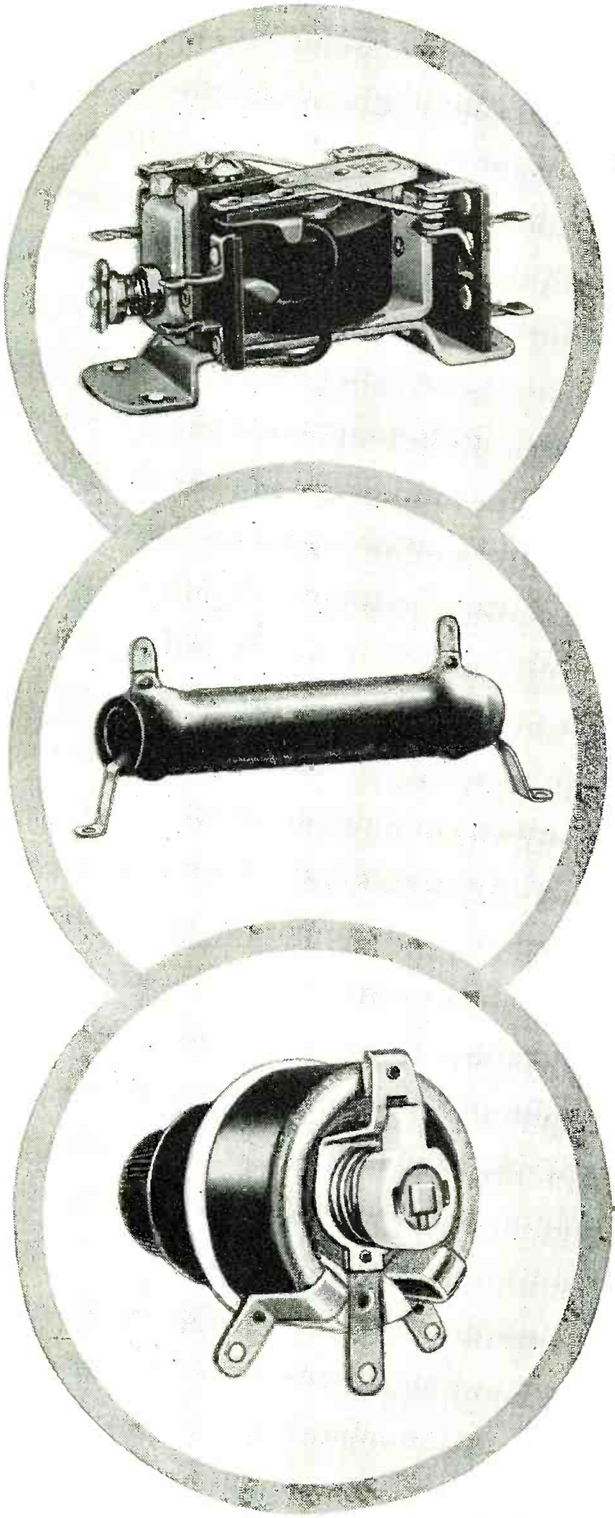
pen, actuated by a permanent magnet penmotor utilizing newly developed materials and techniques. The pyrex tipped pen records directly in ink on a moving paper chart, pressures, vibrations, strains, currents and voltages of frequencies from d.c. to 120 c.p.s. It has no overshoot up to 70 c.p.s. at a maximum swing amplitude of 20 mm. each side of center line. The frequency response is flat to 70 c.p.s., accurate to 120 c.p.s. The pen can be conveniently centered on, or raised from the chart.

Full details of this instrument will be furnished by *The Brush Development Company,* 3405 Perkins Avenue, Cleveland 14, Ohio.

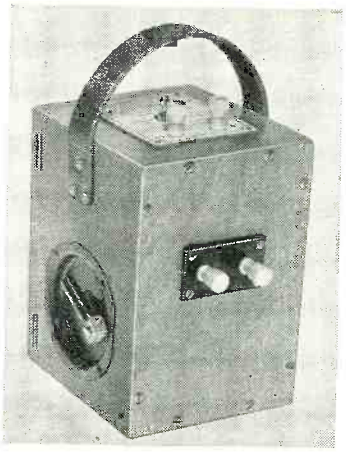
CIRCUIT TESTER

A new, self-contained, portable testing unit for acceptance tests of residential and commercial wiring has been announced by the *Connecticut Telephone and Electric Division* of *Great American Industries, Inc.*

Basically, it is used for testing insulation between wires or from wires to ground for defects or failures and the continuity of wires with audible positive answers at the point where the test is made. With a special indicator attachment, it also determines



the polarity of the wires, visually. It operates on a hand cranked generator which develops 500 volts, d.c. which is regulated to assure uniform test regardless of cranking speed. A comparatively simple instrument, this



unit contains no commutators, slip rings, gas tubes, calibrated meters, rheostats or adjustment knobs which might get out of order.

Test procedure is sufficiently simple that an inexperienced operator may use the instrument.

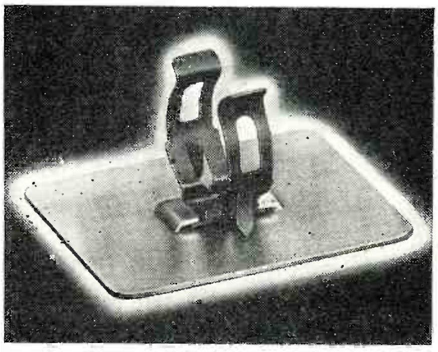
Complete information on the multi-purpose Circuit Tester will be furnished upon request to *Connecticut Telephone and Electric Division,* Meriden, Conn.

CAPACITOR MOUNTING

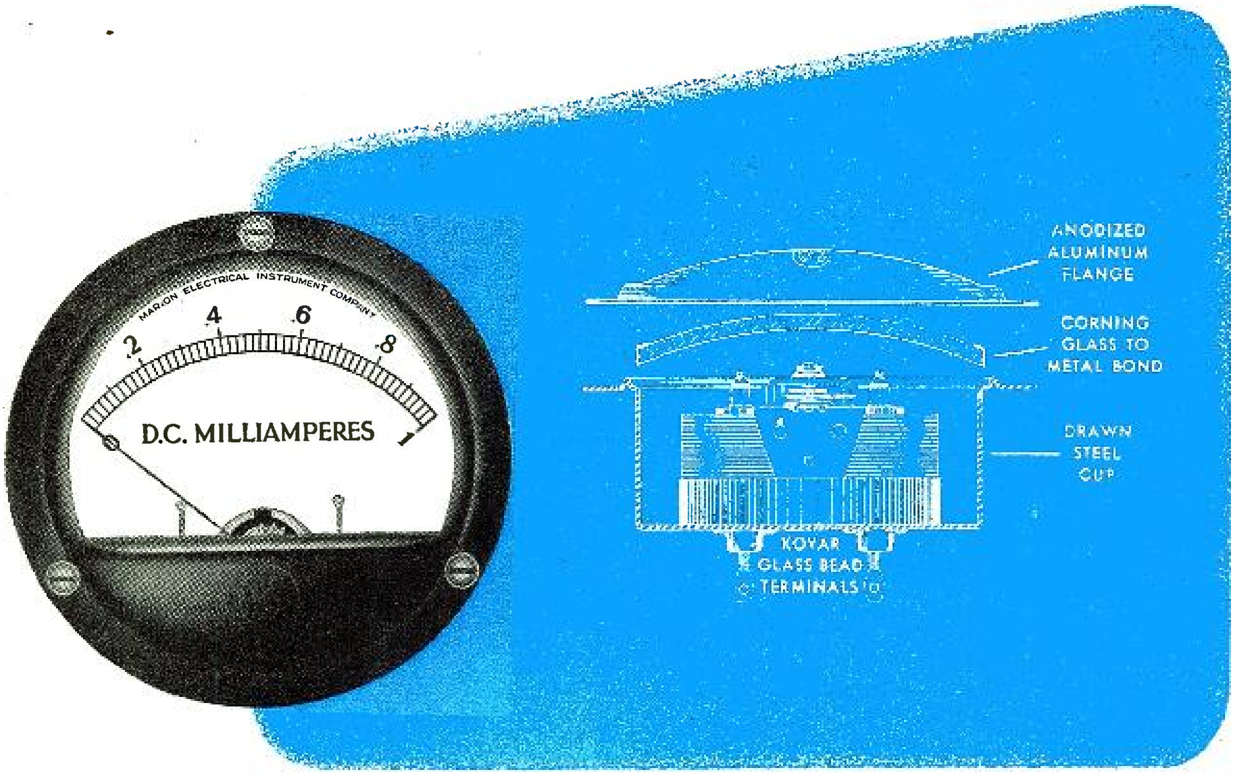
A new universal capacitor mounting clip, which can be attached to the chassis instantaneously with one simple hand motion and without assembly tools of any kind, has been announced by the *Prestole Division, Detroit Harvester Company.*

No nuts or bolts are used to attach the clip to the chassis, thereby eliminating this assembly operation. The pointed retaining tongues bite into the chassis firmly and prevent any loosening due to vibration. The clip is designed to give maximum engagement between capacitor and clip.

The only requirement for application is a provision for a simple embossure in the chassis. Blue prints of the embossure are provided by the company. Clips may also be riveted to



the chassis wherever an embossure has not been provided. All clips are designed to fit chassis thicknesses from .032 to .062 which means that all clips,



YES! *They're totally sealed.* The Marion design and glass-to-metal sealing process assure true hermetic sealing. And the bond between the metallized glass rim and the steel case is capable of withstanding extreme thermal shock.

YES! *They're interchangeable.* Magnetic shielding permits interchangeability on any type of panel without affecting calibration. The Type HM 2 is directly interchangeable with AWS Types MR 24 and 25. The Type HM 3 is directly interchangeable with AWS Types MR 34 and 35.

YES! *They're priced right.* As a matter of fact, Marion Glass-to-Metal Truly Hermetically Sealed Electrical Indicating Instruments cost no more than standard unsealed instruments — yet, they'll perform more satisfactorily over a longer period of time.

YES! *They're a postwar potential.* Because they afford complete protection against the effects of temperature and humidity, these instruments can simplify many production problems, particularly in regard to export sales. Call us. Our hermetic sealing experience may be of value to you.

Marion Glass-to-Metal Truly Hermetically Sealed 2½" and 3½" Electrical Indicating Instruments

Write today for complete information. Not only do we offer these instruments in standard ranges, but we also specialize in supplying them with special and unusual characteristics for new and unusual applications.

MARION ELECTRICAL INSTRUMENT CO.
MANCHESTER, NEW HAMPSHIRE

regardless of diameter, will fit one standard chassis embossure. The clips may also be used for mounting tubes or wires in other applications.

Further information on these mounting clips will be forwarded upon request to *Prestole Division, Detroit Harvester Company,* 4500 Detroit Avenue, Toledo, Ohio.

WATERPROOF MICROPHONES

In order to overcome the previously encountered difficulties experienced with microphones and headsets during amphibious landings, *Western Electric Company, Inc.* is now manufacturing a "submersion-proof" lip microphone and headset combination for these operations.

Equipped with an especially designed gland, the *Bell Telephone Laboratories* have developed this unit which will pass air but exclude water. The new microphone is capable of withstanding a submersion cycle of 25 minutes under 10 inches of sea water followed by baking in an oven at 125 degrees F. The gland permits

equalization of air pressure under altitude changes which allows for safe transport of this equipment to the fighting fronts via cargo plane.

Not much larger than a half-dollar and less than one-half inch thick, the microphone employs the differential principle of operation. When the microphone is properly adjusted before the lips of the user, noise enters from the front and rear in phase and cancels out, thereby making the microphone relatively unresponsive to unwanted sounds, yet sensitive to desired speech.

The whole assembly, including the harness for holding the lip mike firmly but comfortably in position, weighs less than 20 ounces and affords the wearer absolute freedom of his arms.

JENSEN SPEAKER

Jensen Radio Manufacturing Company of Chicago has announced the addition of a new speaker to their line.

Known as the Type NF-300 reproducer, this unit was originally designed as a loud speaker and microphone (talk back) in ship intercommunicating systems. A unique reflex horn, the rim of which provides for

panel mounting, gives unusual compactness while carrying the protective screen assembly. The Alnico 5 permanent magnet material is used, giving exceptional field strength in minimum space. The diaphragm is of molded phenolic and the sound chamber is a combination of molded bakelite and metal castings. The voice coil impedance is 12 ohms, nominal value. The maximum power handling capacity for speech is 10 watts.

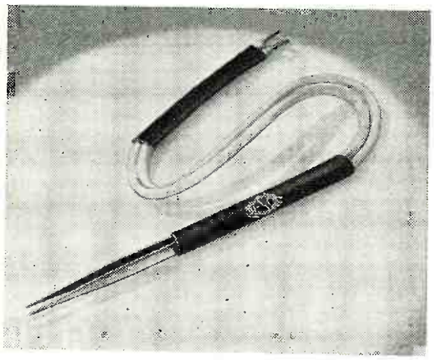
This unit is particularly recommended where there is a need for speech reinforcement, understandable through high ambient noise and where severe weather and trying operating conditions must be met.

Details of this unit will be forwarded upon request to *Jensen Radio Manufacturing Company,* 6601 S. Laramie Avenue, Chicago 38, Illinois.

WELDING TWEEZERS

A new accessory for facilitating the production of radio tube elements and other small electronic components is being offered by *New Jersey Jewelers' Supply* of Newark.

This accessory consists of a pair of insulated, forged, copper tweezers with plastic covered flexible copper leads terminating in a pair of lugs which connect in place of regular welding electrodes. Developed originally to



weld radio tube wires .003" o.d., the Spot Welding Tweezers may be applied in the manufacturing of instruments, optical goods, etc.

Electrodes may be applied to the elements to be joined. They operate

on from ½ to 1 kva. on 10 amp. current and are used with a timer which cuts the current and times the length of the weld.

The copper jaws are held like any ordinary pair of tweezers. They are brought in contact with the parts to be welded; these are lightly but firmly brought together; the foot switch is pressed, current applied and the weld is made.

Standard leads are 18", but the unit may be furnished to leads up to 36".

The tweezers will unite copper parts, nickel, steel, tin, tin alloys, brass, monel, zinc, bronze, nickel to tungsten and copper to nickel.

Details, prices and other information on these units may be obtained from *New Jersey Jewelers' Supply,* 280 Plane Street, Newark 2, N. J.

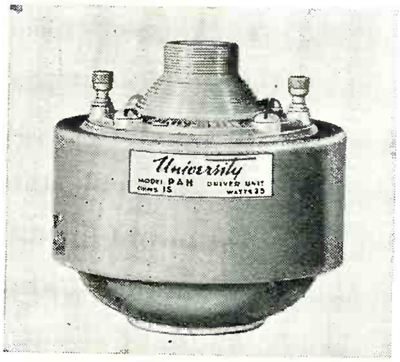
DRIVER UNITS

A new permanent magnet driver unit is being announced by *University Laboratories,* incorporating several exclusive design features.

Some of the new features include molded diaphragm flexing surfaces, heatproof voice coil suspension and hermetically sealed dust covers. The molded diaphragms outlast metal diaphragms three to one, and contribute materially to the long life of these units. The hermetically sealed dust covers are spun over the entire unit structure, resulting in permanent waterproof protection under all adverse conditions.

Another important feature is the rim centering of the voice coil assembly in the magnetic gap, instead of the use of aligning pins. The rim centering method results in permanent position of the voice coil assembly. Regardless of any shock or vibration, it is virtually impossible for the voice coil to shift its relative position to the gap walls.

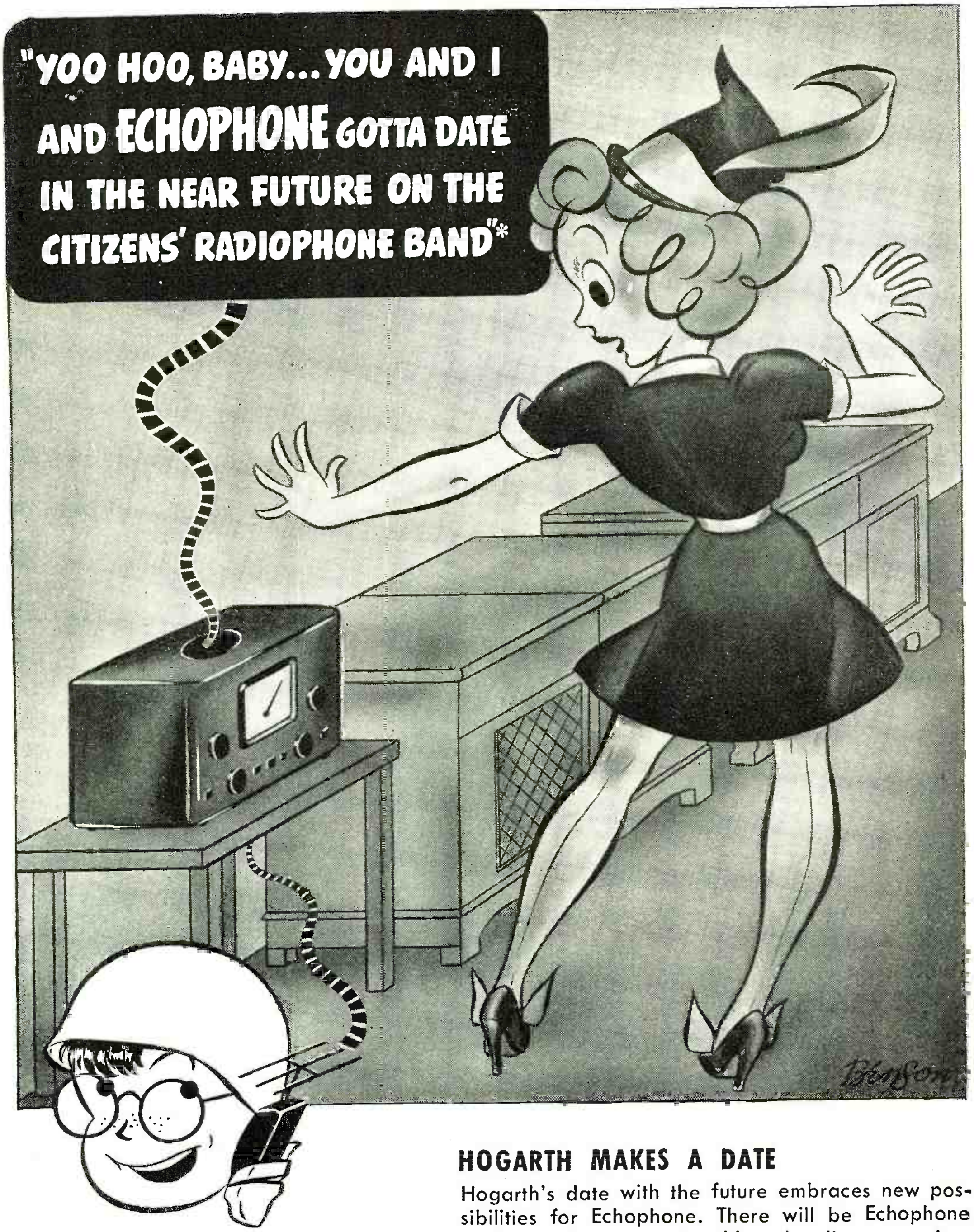
This driver unit is available in two styles, Model PAH, rated at 25 watts, 15 ohms impedance, frequency response, 100 to 6000 cycles, diameter 5¼", height 5", weight 9 pounds; Model SAH, 25 watts, 15 ohms impedance, frequency response 100 to



6000 cycles, diameter, 4½", height 5" and weight 5 pounds.

Further details of these units may be secured by writing to *University Laboratories,* 225 Varick Street, New York 14, N. Y.

(*Continued on page* 90)



HOGARTH MAKES A DATE

Hogarth's date with the future embraces new possibilities for Echophone. There will be Echophone equipment for use on the citizens' radio communications service band. It is certain to be low in price, high in performance and completely dependable. The present EC-1 covers from 550 kc. to 30 Mc. on three bands . . . electrical bandspread on all bands . . . self-contained speaker . . . 115-125 volts AC or DC.

ECHOPHONE

"The Ears of the World"

**Citizens' radio communications service band, 460-470 Mc., recently proposed by the F.C.C.*

ECHOPHONE RADIO CO., 540 NORTH MICHIGAN AVE., CHICAGO 11, ILLINOIS

The POWER behind

TRANSMITTER-RECEIVER OF THE SCR-694

VIBRATOR POWER SUPPLY FOR THE SCR-694

Working with the Signal Corps in the creation of the now famous SCR-694, RAULAND Engineers had to solve many a knotty problem. None, however, proved as tough as producing the heart of the Vehicular Power Supply . . . the *Vibrator.* That power supply had to operate from a vehicular battery at 5.4 to 8 volts, 10.8 to 16 volts or 21.6 to 32 volts while maintaining filament voltage within the limits of ±5% from nominal value. In addition it had to be fully immersion proof! The full story of how they licked a job that "couldn't be done" packs as dramatic a punch as anything in this man's war, but RAULAND *Engineers did it!* They designed and built the *highest frequency heavy-duty vibrator ever made* . . . to operate on *200 cycles ±1%.*

The development of the PE-237 Vehicular Power Supply Unit, and especially the Rauland Vibrator JV-0014, is a typical example of RAULAND engineering thoroughness . . . the kind of electronic planning and craftsmanship that will be available for full cooperation with industry after this war.

RADIO • • RADAR • • COMMUNICATIONS •

"JUKE BOX" SERVICING PROVES SUCCESSFUL

A modernistic automatic phonograph, produced by the Rock-Ola Mfg. Corp.

Helpful hints to servicemen who maintain and service juke boxes as a profitable sideline.

By EUGENE A. CONKLIN

ROY FORREST, of Johnson City, New York, has a radioshop which, like many other servicecenters, has felt the effects of war, both in personnel and replacement parts available.

Forrest has a wartime specialty which is well worth spotlighting. He devotes three nights weekly, and two full days to the servicing of "juke boxes" in restaurants, hotels, taverns, grills, and the like. Jukes are particularly important these days because they keep the war workers who patronize eating establishments happy after a lengthy day or night shift.

This serviceman charges $1.00 for a weekly inspection of the juke box—said inspection lasting from 5 to 15 minutes. Any minor headaches in its operation are alleviated during this weekly "check-over" period. If tubes or components must be replaced they are charged for at the regular retail pricing. Forrest has nearly 80 jukes which require a weekly going over.

In addition to his own community he covers smaller towns over a period of 35 miles. His "A" coupons allow him to make short trips into these regions. On these trips he also picks up radios belonging to farmers and inhabitants of small living centers too tiny to boast the service of a radioman.

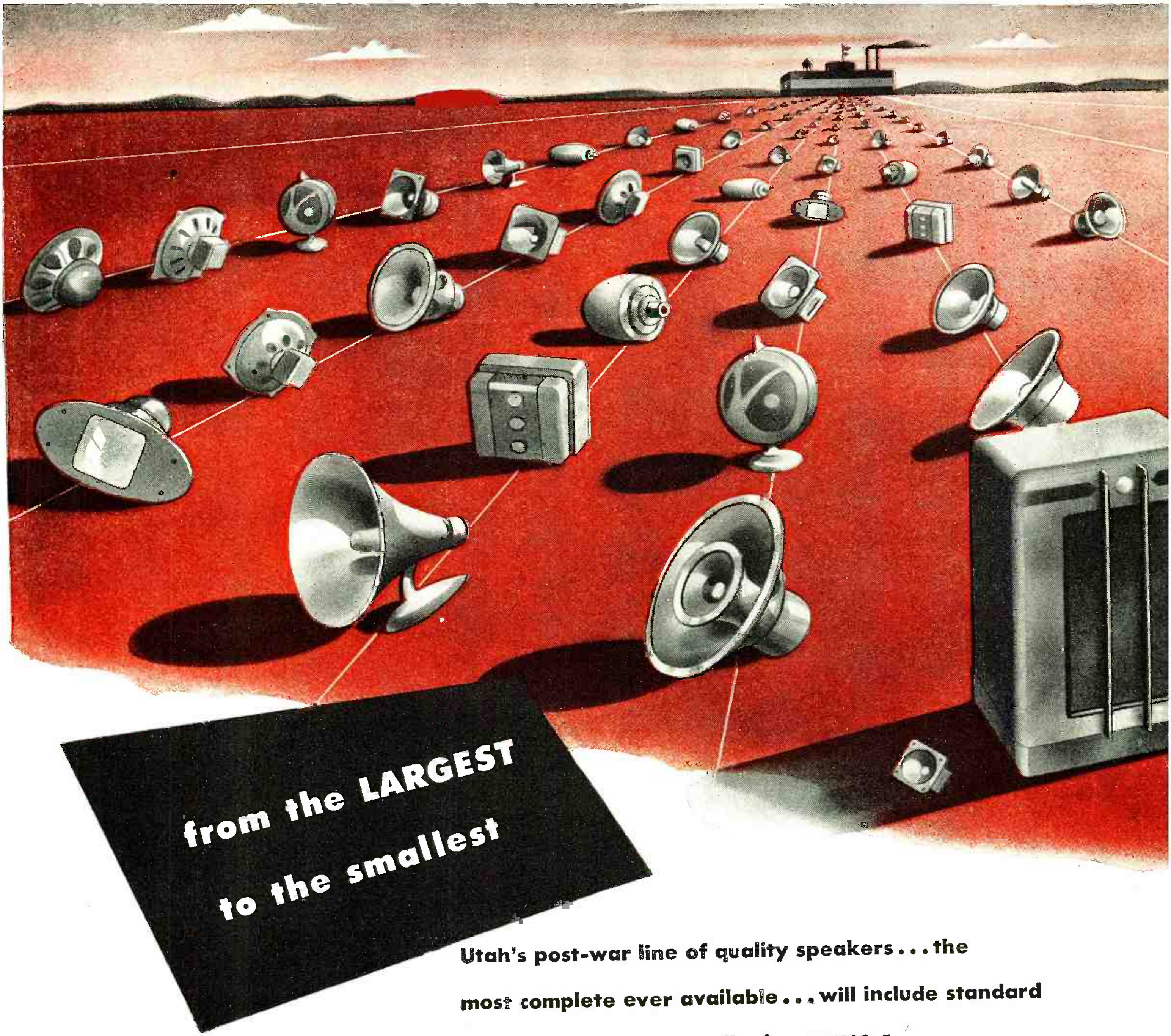
More to the point, each of these grills and restaurants act as a miniature branch of the Forrest service shop. Patrons of an eatery bring their sets there and leave them for Forrest to pick up when he calls in for his juke box inspection.

Jukes are usually owned by an operator in groups of a dozen or more which are placed in eating and drinking establishments on a percentage basis. Forrest receives his $1.00 from each restaurant or grill owner who, in turn collects it from the juke box operator. In this way Forrest receives cash on the barrelhead for each inspection he makes.

When an emergency occurs and Forrest is called back on a juke which he has inspected during the week—no charge is made for his first half-hour's labor. If replacements are needed they are made at no charge. But any labor over and above the initial half-hour period is paid for at the rate of $1.50 for each and every labor hour. Forrest is on tap at any hour of the day or night. When a juke goes on strike and refuses to play the operator loses money while the installation remains unplayable and the customers become dissatisfied.

Essentially the amplifier is the chief source of trouble when a juke becomes quiescent. Forrest reports that tubes for jukes are fairly plentiful—more so, at any rate, than those used in routine set servicing. At the same time Forrest, for an additional 50¢ gives the eatery p.a. or intercommunication system the once-over. The average establishment puts on an occasional floor show or uses a communicator between chef and outer counter.

Forrest advises that at present 75% of his weekly revenue is received from such activities. Naturally he isn't able to handle a considerable amount of standard set servicing. But after the war he believes that dining establishments will expand and will need new juke boxes of the "soundies" variety. He is running across a num-



Utah's post-war line of quality speakers . . . the most complete ever available . . . will include standard and high fidelity PM's, *all using ALNICO 5.*

Ever since radio speakers have been made, Utah has been a leader. Electro dynamic and P.M. speakers, (based on the new industry standards) . . . wide range (ideal for FM reception)...dual speakers...cabinet speakers...trumpets... whatever your speaker requirements might be, Utah can meet your needs. That's why the Utah Franchise is the most valuable franchise a radio parts distributor can own.

utah

UTAH RADIO PRODUCTS COMPANY • 820 ORLEANS STREET • CHICAGO 10, ILL.

Utah Electronics (Canada) Ltd., 300 Chambly Road, Longueuil, Montreal (23) P.Q. • Ucoa Radio, S.A., Misiones 48, Buenos Aires

ber of these "sight and sound devices" which present no special servicing headaches.

This radioman has had to acquire a knowledge of repairs extending to toasters, refrigerators, percolators, and other restaurant electrical equipment because he is frequently confronted with such items. He has secured the services of an electrician who makes the rounds with him and handles such electrical items repairs as Forrest is unable to cope with.

The combination of a radioman and an electrician make it possible to tackle many jobs which would otherwise have to be bypassed. Forrest pays the electrician a guaranteed weekly salary plus a reasonable commission on electrical item repairs above a prearranged specified level.

On such radio set repairs as he handles he charges $1.75 an hour labor plus replacements, but issues a 60-day guarantee that the set will stay playable, after a Forrest repair job. Forrest eliminates much portable radio repairing by charging a reasonably high labor fee which discourages owners of inexpensive sets.

Forrest does not issue free estimates nor does he practice flat-rate servicing of home radios. If a set is brought in for an estimate, the estimate-requester is charged $1.75 and for that amount receives correction of minor flaws and an estimate on the probable number of hours and possible replacements needed to complete the task. Few service patrons request an estimate—they prefer to trust Forrest's judgment. —30—

AN A.C.-D.C. CODE PRACTICE SET

By Sam Beatty

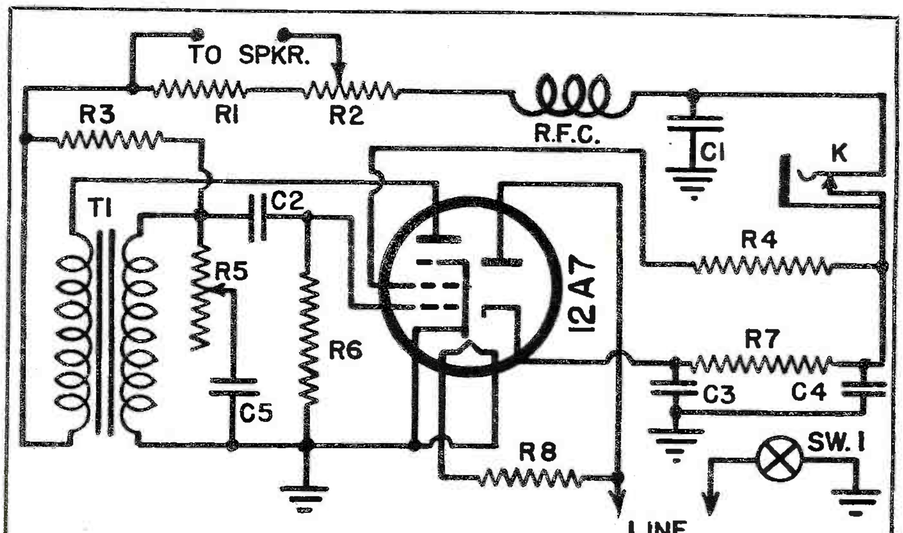
THIS set, while designed primarily for radio students and experimenters, is excellent for advanced amateurs who wish to improve their code speed. By using a small magnetic speaker it works very well for group practice. There is sufficient volume for the average room and when the volume control is turned down the signal is low enough so that it will not disturb other people. A tone control has been added for convenience in practicing.

The set built by the author was built from an a.c.-d.c. t.r.f set and the cost for additional parts was small. The experimenter can usually find most of the necessary parts by obtaining a second-hand set. This furnishes the cabinet, speaker, and many of the small parts at a minimum of expense.

The set is designed to use a 12A7 tube as a combination rectifier and oscillator. The r.f. choke and .1 μfd. condenser (C_1) form a filter which prevents key clicks from disturbing nearby radios. Potentiometer (R_5) and condenser (C_5) form the tone control. The frequency is lowered as the resistance is increased.

Resistor (R_3) is not critical and is added to raise the pitch of the note. The values of (R_1) and (R_2) are correct for a 600 ohm speaker. They may have to be varied slightly if a speaker of different resistance is used.

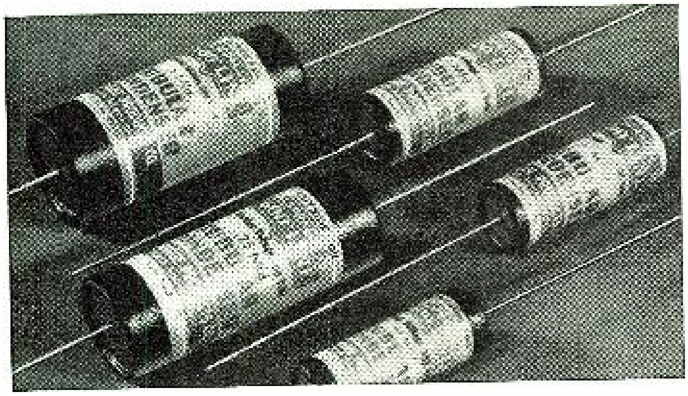
However, none of the values given are at all critical and this makes it ideally suited for construction from spare parts. —30—



R_1—500 ohm, ½ watt res.
R_2—5,000 ohm, w.w. low wattage pot.
R_3—750,000 ohm, ½ watt res.
R_4—5,000 ohm, ½ watt res.
R_5—100,000 ohm rheostat with a.c. switch
R_6—1 megohm, ½ watt res.
R_7—400 ohm, 1 watt res.
R_8—360 ohm, 35 watt, w.w. res. or line cord
C_1—.1 μfd., 200 v. cond.
C_2—250 μμfd., mica cond.
C_3, C_4—8-8μfd., 250 w.v. elec. cond.
C_5—.0002 μfd. mica cond.
T_1—Audio trans. 1-3 ratio
K—Closed circuit jack
SW_1—a.c. switch on R5
R.F.C.—r.f. choke coil
Spkr.—600 ohm, magnetic type

SPRAGUE TRADING POST

A FREE Buy-Exchange-Sell Service for Radio Men



SPRAGUE T C TUBULARS

The most famous, most widely used by-pass capacitors in the entire history of Radio. Ask for them by name!

"Not a Failure in a Million"

WANTED—Cash in advance for Hallicrafters SX-24; SX-25 or S-20R. State condition and price first letter. Warren Chase, Vermont Sanatorium, Pittsford, Vt.

BUSINESS FOR SALE—Have operated a successful radio service business for 15 years and would now like to retire. Would like to sell to a good serviceman who is doing a good business and would like to acquire a place of his own that is well established. Write for details. R. M. Rouse, 395 St. John St., Spartanburg, S. C.

WANTED—Operating instructions and wiring diagram for Radio City multitester #408 and #602. Raymond McNally, 712 Monson St., Peoria, Ill.

FOR SALE—Used 300v., 100 ma. 6v. Mallory vibrapacks with OZ4 tube. $12 ea., and used 550v., 250 ma. 12.5v. belt driven generators, $15 ea. Ben Ruyle Radio Repair, 1703 Washington Ave., Alton, Ill.

WANTED—V-O-M similar to Triplett #666 or equivalent. G. W. Nichols, P.O. Box 1473, Station A, Bremerton, Wash.

FOR SALE—12A8, 12SA7, 12SR7, 12K8, 5Y3, 80, 6D6, 6C6, 25Z5, 25Z6 tubes in sealed cartons. Murray Koch, 47 N. Main St., Patterson, N. J.

WANTED—Sig. tracer, oscilloscope, phono record player in good condition. Mayfield Radio & Elec., 3330 Lawrence St., Denver 5, Colo.

FOR SALE—Simplified Radio Service; Radio Servicing Course, Beitman; and How to Build and Repair Radio receivers, Popular Science: $4. Frank Bou, Bot. Dept., University of Pa., 38th & Woodland Ave., Phila. 4, Pa.

WILL TRADE—Weston #301 meters for photographic equipment or wireless record player. Cpl. S. Radwansk, Squadron C, Box 499, George Field, Ill.

WANTED—Audiometer, any condition. C. J. Thompson, Box 82, Bluefield, W. Va.

FOR SALE—Carrier current communication system complete with tubes; Westinghouse 0-10 milliammeter. Howard L. Funk, 41 Marlboro Court, Rockville Center, N. Y.

TO TRADE—12—7Y4, 1—7B7, 1—7S7, 1—7J7, 1—1LC6 and 2—1299 tested tubes. Want good dynamic microphone. Walter H. Lonvig, 2439 N. Parkside Ave., Chicago 39, Ill.

WANTED—V-O-M and instructions on how to use. John Impagliazzo, 73 Harrison St., Providence, R. I.

WANTED—Riders 6 to 13 complete. Also sig. gen. Don Roehning, Main St., Northome, Minn.

FOR SALE—Weston #264, $15; old sig. corps wave meter incl. 0-100 hot wire galvanometer, $7.50; SW coils. G. Kennedy, 2239—35th Ave., San Francisco 16, Calif.

WANTED—Home recorder and Superior sig. gen. #1230. L. E. Smith, Route 2, Box 217, Sommerville, Ga.

FOR SALE—Meissner 12-tube, 5-band superhet shortwave receiver. Al Diedricksen, 11 Vine St., New Britain, Conn.

WANTED—Two 25Z5 tubes. Martin McGarrity, 53 North St., West Warwick, R. I.

FOR SALE—Complete lesson texts for Sprayberry Academy of Radio and National Radio Institute. Paul Chinn, 92 N. High St., Columbus 15, Ohio.

WANTED—30 h choke coil and 6SJ7, 6SC7, 5Y3 and 6V6 tubes. John Retau, P. O. Box 628 P.E.A., Exeter, N. H.

FOR SALE—3" Westinghouse 0-1 ma. meters with copper oxide rect. Will supply V-O-M a-c scale, Gordon phono motor geared speed control, $19.50; Indust. Quietone Comm. filter, $6; Webster xtal pickup and arm, $5.25. A. O. Gioia, 41-18 29th St., Long Island City 1, N. Y.

WANTED—Tube tester for regular and GT tubes. L. M. Rockefeller, 353 Blohm St., West Haven, Conn.

FOR SALE—Triplett #1200E V-O-M; Precision #E200 sig. gen.; #P900 tube checker and analyzer; Simpson #220 rotoranger meter; #325 tube checker tests all tubes and various 2.5, 5 and 6.3v. used tubes. Leonard B. Wachsman, 1220 Shakespeare Ave., New York 52, N. Y.

FOR SALE—308 tubes in cartons; Precision E-200 sig. gen.; Solar condenser tester BQC-1-60. Paul L. Rodgers, Rodgers Appliance Shop, Red Lion, Pa.

FOR SALE—RCA #94, BP-1, 4-tube portable, pick up, battery operated receiver, less batteries. New. $10. Magnus Norgran, Box 15, Barksdale, Wisc.

WANTED—Repair parts of all kinds and test equipment. Lawrence Helms, Box 381, Ephrata, Wash.

WANTED—New or used RK6Z tubes. Paul Sirrer, R. D. #2, Brackney, Pa.

FOR TRADE—S meter, 110v. a-c generator and 110v. d-c to a-c converter. Want amateur television transmitting and receiving equipment, recorder and amplifier, commercial transmitter and receiver. K. H. Stello, 925 Monroe St., N.E., Washington, D. C.

WANTED—Echophone EC-1 or Sky Buddy and crystal pickup and motor. Will trade or sell Triumph #400 tube tester and VTVM. Gordon Boyer, 6240 Tessenden Ct., San Diego 10, Calif.

FOR SALE OR TRADE—Meissner 7-tube 110 a-c F-M converter complete with cabinet. $40 or will trade for small camera, 35mm or V.P. William Miller, 693 Union Ave., Providence, R. I.

WANTED—Meissner #10-1153 television set or kit. Radio & Television Service, 821 Porter St., Philadelphia 48, Pa.

FOR SALE—Magnetic phono-pickup, built-in matching transformer permits direct connection to grid; 12" straight metal arm, adjustable pressure, $7. J. Heitzman, 93 Hoffman St., Kingston, N. Y.

WANTED—6B4G and 6A8G tubes and service manual on all tubes; diagrams for 1, 2, or 3 tube DX-ers. Wendell Plum, Mt. Morris, Ill.

WILL TRADE—50L6, 12SA7, 35Z5 tubes for 32L7 tubes. Joseph LaRose, 6611 Maxwell Ave., Detroit 13, Mich.

WANTED—Late model tube tester. W. F. Harmon, 1301 S. 19th St., Birmingham, Ala.

FOR SALE—19 panel type meters. George's Radio Service, 420 S. 60th St., Philadelphia, Pa.

WANTED—Bogen PV-20 expander-amplifier. F. J. Henry, FCC, 609 Stangenwald Bldg., Honolulu, T. H.

FOR SALE—National all-wave receiver, $75, or will trade for tube and set tester. Also have Zenith to trade for ac-dc battery radio or sell. $30. Isaac Jackson, 18804 Roscoe, Northridge, Calif.

WANTED—Portable sig. gen. to service radio alignments and dynamic stage by stage tests; and tube tester. Frank S. Horzewski, 213 YI 47, 3324 S. Burrell St., Milwaukee 7, Wisc.

FOR SALE—1R5, 1T4, 3S4, 1S5 tubes. Mrs. Robert L. Wenk, Gen. Del., Smyrna, Tenn.

WANTED—V-O-M and late tube tester R.C.P. or Superior preferred; also condenser tester. H. R. Arnett, 820 S. Gordon St., Piqua, Ohio.

WANTED—Test charts for Million tube tester. Harry Alter & Bros., 1728 S. Michigan Ave., Chicago 16, Ill.

FOR SALE—Complete shop equipment and instruments; tubes and parts. Joe Murray, P. O. Box 411, Rantoul, Ill.

URGENTLY NEEDED—Tester for all tubes including miniatures. George L. O'Brien Jr., 641 Maple St., Fall River, Mass.

WILL TRADE—Bogen 20-watt amplifier or banjo and case. Want RCA Jr. Voltohmyst, tube tester, 3" oscillograph, recorder or automatic record changer. H. E. Housholder, Box 413, Beloit, Wis.

FOR SALE—Used Weston meters #489, 476, 506; Marion 3" sq. meters; Jewel #54, 33, 74; General Radio and 2" Ideal meters. O. C. Merkle, 4370 Somerset, Detroit 24, Mich.

WANTED—Good tube tester. Earl Woodle, P. O. Box 135, Malcom, Iowa.

FOR SALE OR TRADE—SX25 with speaker. Want retina two f:2 lens. George C. Ide, Route #1, Zillah, Wash.

FOR SALE—32v. Delco cabinet radio. Electric Shop, Forest City, Iowa.

YOUR OWN AD RUN FREE!

This is Sprague's special wartime advertising service to help radio men get needed parts and equipment, or dispose of radio materials they do not need. Send your ad today. Write PLAINLY or PRINT—hold it to 40 words or less. Due to the large number received, ads may be delayed a month or two, but will be published as rapidly as possible.

Sprague reserves the right to reject ads which do not fit in with the spirit of this service.

HARRY KALKER, Sales Manager

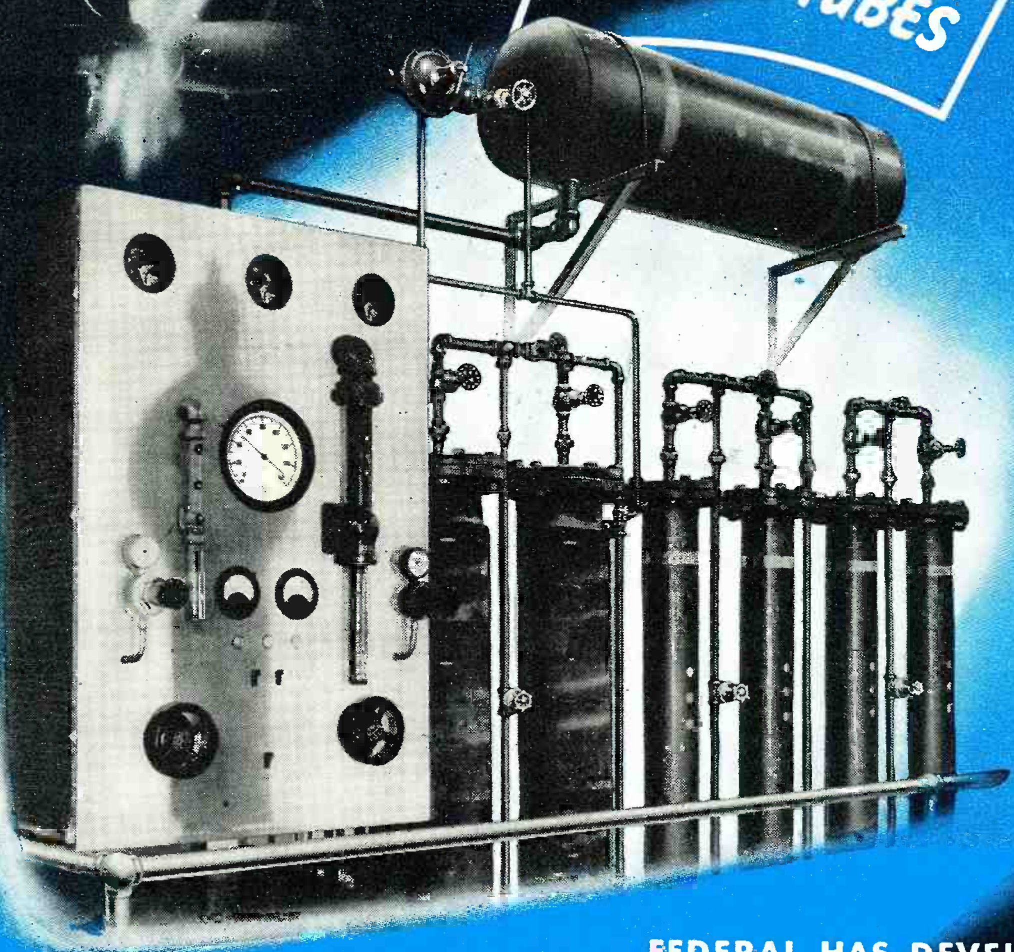
Dept. RN-85, SPRAGUE PRODUCTS CO., North Adams, Mass.

Jobbing Sales Organization for Products of the Sprague Electric Company

SPRAGUE CONDENSERS
KOOLOHM RESISTORS

TM. REGISTERED U. S. PATENT OFFICE

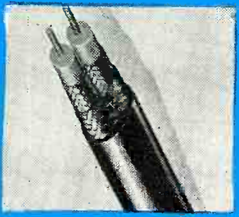
Obviously, Sprague cannot assume any responsibility, or guarantee goods, services, etc., which might be exchanged through the above advertisements



NO OXIDATION
NO CONTAMINATION
NO MOISTURE . . .

3 MORE REASONS WHY
FEDERAL MAKES BETTER TUBES

FEDERAL HAS DEVELOPED THE FIRST NITROGEN PURIFIER



Intelin Ultra High Frequency Coaxial Cable, developed and manufactured by Federal, has extreme ruggedness and meets all specifications with precision, accuracy, uniformity and dependability.

No oxidation, no contamination, no moisture!

Another Federal First adds extra performance guarantees to FTR vacuum tubes.

In a corner of the new FTR tube plant is this automatic nitrogen purifier. During the process of sealing the anode to the stem, the elements of every FTR tube are now protected from oxidation, contamination and moisture in a scientifically controlled atmosphere of automatically mixed nitrogen and hydrogen.

Here is another reason why you get higher operating efficiency and still longer life when you use FTR tubes. Another evidence of the ability, brains and *technical understanding* which have earned the reputation that "Federal always *has* made better tubes."

Now is the time to know Federal.

Federal Telephone and Radio Corporation

AN IT&T ASSOCIATE

Newark 1, N. J.

INVEST IN THE FUTURE — BUY

Spot News

(*Continued from page* 14)

ous communication difficulties. They do not shake and whip to any extent when the vehicles cover rough ground, nor do they drip water over the mast base and onto the radio set. They also are much smaller and lighter than the old type. The design for the 6-foot and 9-foot antennas replaces the clumsier design which used a mast base capable of supporting a 15-foot antenna regardless of the length actually needed. The spring of the new mast bases consists of a bundle of piano wires inclosed in a flexible metal sheath. The wires are fastened at one end while the other ends are held in a race which allows free linear movement as the antenna mast is deflected. With this type of spring, the antenna mast is quickly returned to its normal position after being deflected and the damping effect is sufficient to prevent the antenna mast from oscillating more than a few times. The flexible metal sheathing which provides lateral support of the wires is approximately ¾ of an inch outside diameter, including a 1/16 of an inch bonded neoprene covering used as a lubricant retainer and for protection against the elements.

RADIO HAMS' DEMANDS for a greater transmitting range in stations of simple construction will be helped after the war through the war-time development of a hurricane-proof radio mast of molded plywood. The height of radio masts was not always considered of great importance because short waves and skywave reflections emphasized the value of other features in the transmitter station. However, the development of ultra-high frequency (30,000 to 300,000 kilocycles) and micro-waves now stresses the need for height. This, in turn, has made the lightness and strength of masts important. The new molded plywood mast, used by the Signal Corps, is so light that a single man, using boom and tackle, can erect a 55-foot stick. Two men can raise a 75-foot or a 90-foot mast, yet they are so strong that with proper guying they can withstand a gale of 125 miles per hour.

THE FCC ANNOUNCED THE REMOVAL of FM broadcasting from its present location in the 42-50 megacycle band to the 88-106 megacycle band.

This allocation is even higher than the originally proposed 84-102 megacycle band, which has been under fire for over a month.

According to the FCC, the change in frequency will not become effective until receiving sets capable of tuning in the higher frequencies are available.

The new allocation of the frequencies in the 42 to 108 megacycle band are as follows: 42-44, non-government, fixed and mobile; 44-50, television Channel 1; 50-54, amateur; 54-60, television Channel 2; 60-66, television Channel 3; 66-72, television Channel 4; 72-76, non-government, fixed and mobile; 76-82, television Channel 5, 82-88, television Channel 6; 88-92, non-commercial, educational FM; 92-106, commercial FM and, 106-108 facsimile.

This is apparently the final decision with regards to the allocation of frequencies and thus ends the hearings, appeals, etc. which have been in session more or less continuously for over six months.

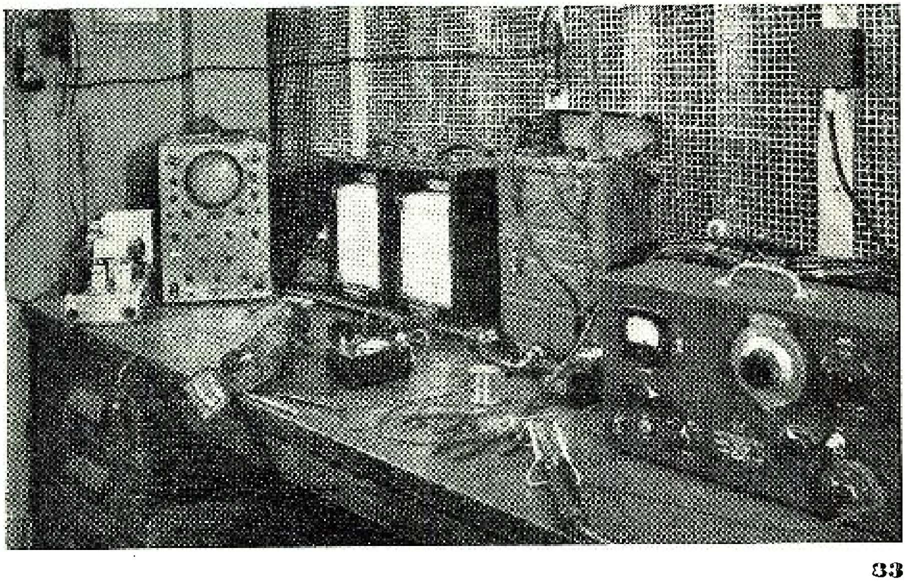
PARTS AND SET MANUFACTURERS OF RMA are now considering a proposed standard warranty for parts makers, designed for incorporation in future parts sales contracts with set companies. It has the unanimous approval of the RMA Parts Division's Executive Committee and Section chairman. Main objective is a uniform sales warranty for parts manufacturers, to avoid multiplicity of individual contract provisions.

THE SURGEON GENERAL OF THE ARMY SERVICE FORCES has approved public address systems in all Army general hospitals for both transcribed and script and the ASF is preparing programs. Technical and other information is supplied by a special RMA committee under L. A. King of Chicago. The same committee is promoting such installations in schools and other educational institutions. Signal Corps reports that 38 of the Army's 65 general hospitals in the United States will be equipped with a standard radio program distribution system by the end of 1945. The system consists of a central control point in each hospital, which offers either direct amplifier service or service to individual headphone units. Four programs can be handled simultaneously, and any type of program other than television can be rebroadcast.

Personals

Philip Fuhrmann, veteran radio time sales executive, has been appointed sales manager of DuMont television station WABD in New York . . . Following the merger of Belmont Radio Corp. with Raytheon Manufacturing Co., **Laurence K. Marshall,** president of Raytheon, announced the election of these men to the board of directors: **P. S. Billings,** president of Belmont; **Harold C. Mattes,** vice-president of Belmont; **Joseph Pierson.** founder and former president of Press Wireless; **Emmons Bryant, Jr.,** New York Manager of N. A. Woodworth Co. of Detroit; and **George L. Langreth,** for 16 years with Woods Struthers & Co. . . . **Allen B. Du Mont Laboratories, Inc.,** is conducting field tests in Washington, D. C., preliminary to establishing a television station in the nation's capital. **Dr. Thomas T. Goldsmith, Jr.,** director of research, and members of his staff are conducting tests to determine field strength and propagation data in the Washington Area . . . **David B. Smith,** director of research for Philco Corporation, and **Palmer M. Craig,** chief engineer of Philco's radio division, have just been named chairman and secretary-treasurer, respectively, of the Philadelphia Section of the Institute of Radio Engineers. —[30]—

An interior view of the Electronics Field Laboratory which is used by the Rock Island Railroad for the servicing of two-way radio equipment installed on the line. Every modern device for trouble-shooting and recording is included in this rebuilt Pullman car. The handset shown on the wall connects to a remote console and can be used to communicate with the railroad's bases and certain stations. The oscillograph is a standard unit and directly to the left is a portable audio amplifier. To the right of the oscillograph are two recording meters which make a permanent record of voltages and currents of equipment under observation. Beside the recording units is one of the Motorola walkie-talkies used to contact ambulatory personnel. 115 volt a.c. is furnished by a portable power plant.



Victory Transmitter

(Continued from page 31)

dio amplifier plugged into the keying jack, *J*, provides satisfactory cathode modulation.

Mechanical Construction

The photographs (Figs. 3 and 5) and the layout drawings (Figs. 2 and 4) show clearly the location of the various parts on the panel, above chassis, and below chassis.

Oscillator and amplifier tuning capacitors, C_2 and C_6 (seen in the top-chassis view, Fig. 3), are mounted on in a row to the right of the crystal oscillator coil, in Fig. 3. A crystal holder is plugged into the rear socket. Each of these sockets (*Millen* type 33002) requires two clearance holes and one screw hole for mounting.

Antenna coil L_5 is mounted to the left side of the amplifier (Fig. 3) and is set at right angles to the tank coil. Directly to the rear of the antenna coil in Fig. 3 may be seen the ceramic-insulated feed-through antenna terminal which passes through the rear wall of the cabinet.

Both tubes are mounted to the rear of the chassis, where holes have been cut in the cabinet for ventilation.

The cabinet handles are plated, two-

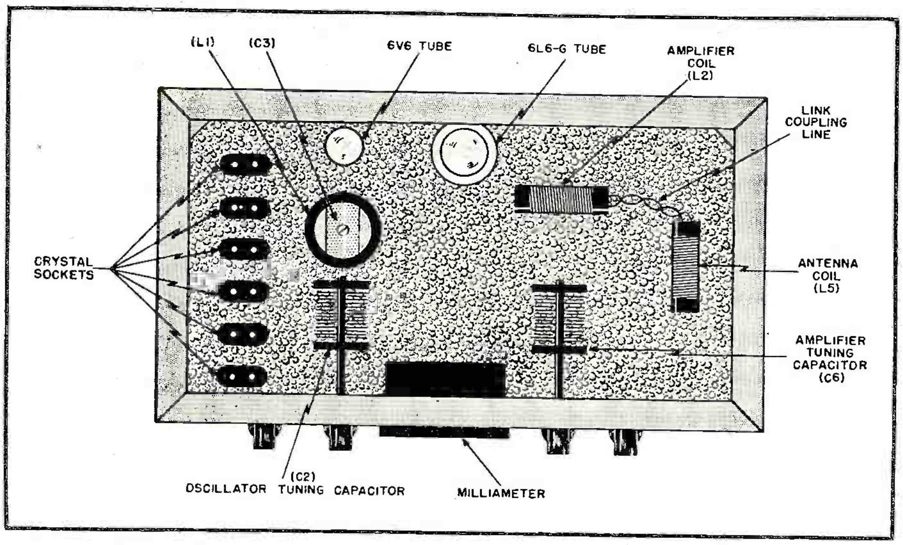


Fig. 4. Chasis layout showing proper placement of component parts.

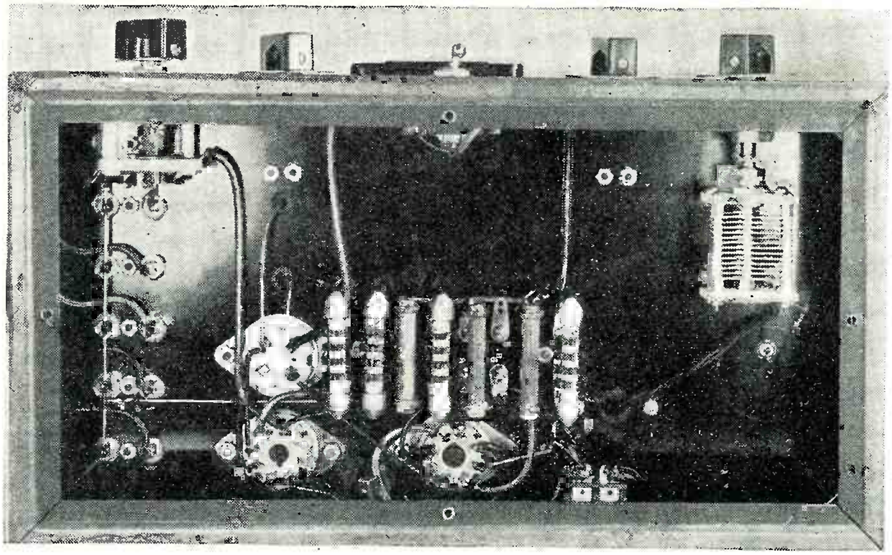
short ceramic standoff insulators. Busbar leads connect C_6 directly to the plug-in base of L_2. However, spaghetti-covered busbars from C_2 pass through grommet-lined clearance holes in the chassis to bottom contacts on the 4-pin coil socket holding coil L_1.

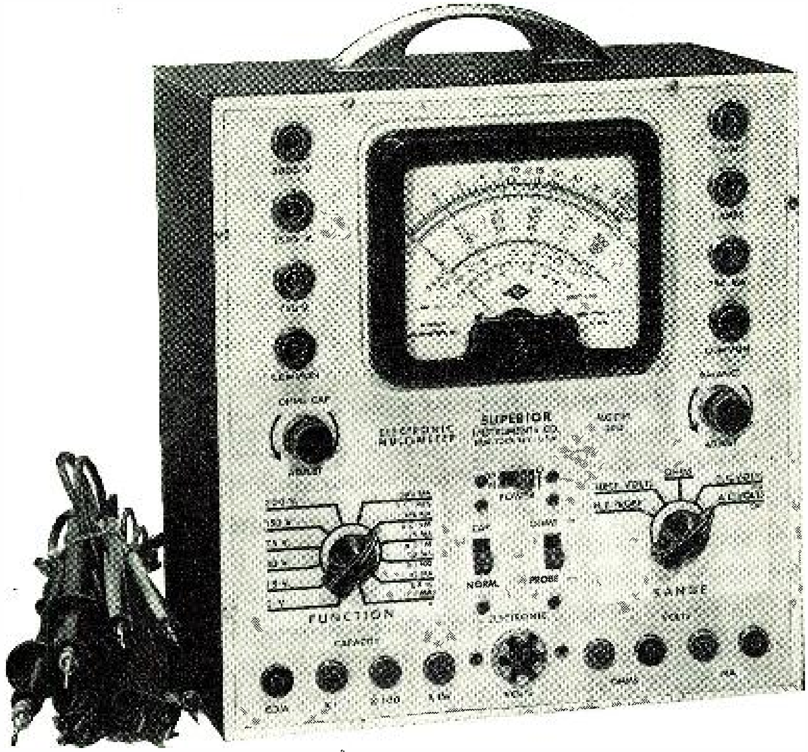
The six crystal sockets may be seen color drawer pulls obtainable at hardware and ten-cent stores.

The under-chassis view (Fig. 5) shows how the four pi-wound r.f. chokes and three of the four resistors used in the circuit are mounted on a small subpanel.

The variable capacitor in the upper right-hand corner in this photograph

Fig. 5. Bottom view of completed unit emphasizes neatness in assembly.





L_1—2-6 mc.
46 turns of No. 22 enamelled wire closewound on 1½" diameter form.

L_1—6-20 mc.
11 turns of No 20 enamelled wire spaced to winding length of 1¼ inch on 1½" diameter form.

L_1—10-30 mc.
4 turns of No. 14 enamelled wire spaced to winding length of 1 inch on 1½" diameter form.

L_2—Same as L_1 for each frequency coverage, except tap center turn.

L_5—Same as L_1.

L_3 & L_4—Each 2 to 3 turns of No. 18 enamelled wire wound around "cold" end of L_2 and L_5. These link windings must be separated from the main coils by not more than ¼ inch.

Table I. Coil specifications.

is the antenna tuning unit, C_7. Spaghetti-covered leads from C_7 pass through grommet-lined clearance holes in the chassis to the antenna coil, L_6, mounted above chassis.

The crystal selector switch, which also is mounted below chassis, is seen in the upper left corner of the picture; and the protruding connectors of the crystal sockets, together with their mounting nuts, are seen directly to the rear of the selector switch.

The meter changeover switch may be seen in the center of the panel in the under-chassis view, directly under the milliammeter.

Construction of the victory transmitter must be solid, in order to prevent shifting of adjustments or loosening of connections. Heavy hookup wire must be employed in all parts of the circuit where flexible wiring is used, but the r.f. circuits (leads from tank coils and tank tuning capacitors, coupling leads, antenna leads, etc.) must be wired with No. 12 busbar. All bus lines must be covered with high-grade spaghetti to prevent acci-

NEWS FOR THE AMATEUR

A RECENT communication from George E. Sterling, Chief of the RID, gives some interesting information, and requests data on listings.

Mr. Sterling reports that of the G7's now operating in the 7 and 14 mc. bands that the calls G7FA through G7FK are operating under special authorizations from the British, as is 12BM.

The RID representative in Brazil advises that the amateurs in that country have been authorized to operate on 56-60 mc. and on 112-116 mc. on an experimental basis. The LABRE station in Rio is operating on 1800 to 3500 kc. one hour per transmission, three times per week. Traffic or communication with any station beyond the border of Brazil is prohibited.

Mr. Sterling requests that information on any listings of amateur calls heard, together with the frequencies, times and dates of operation be forwarded to him. Communications should be addressed to Mr. George E. Sterling, Chief, Radio Intelligence Division, Federal Communications Commission, Washington, 25, D. C.

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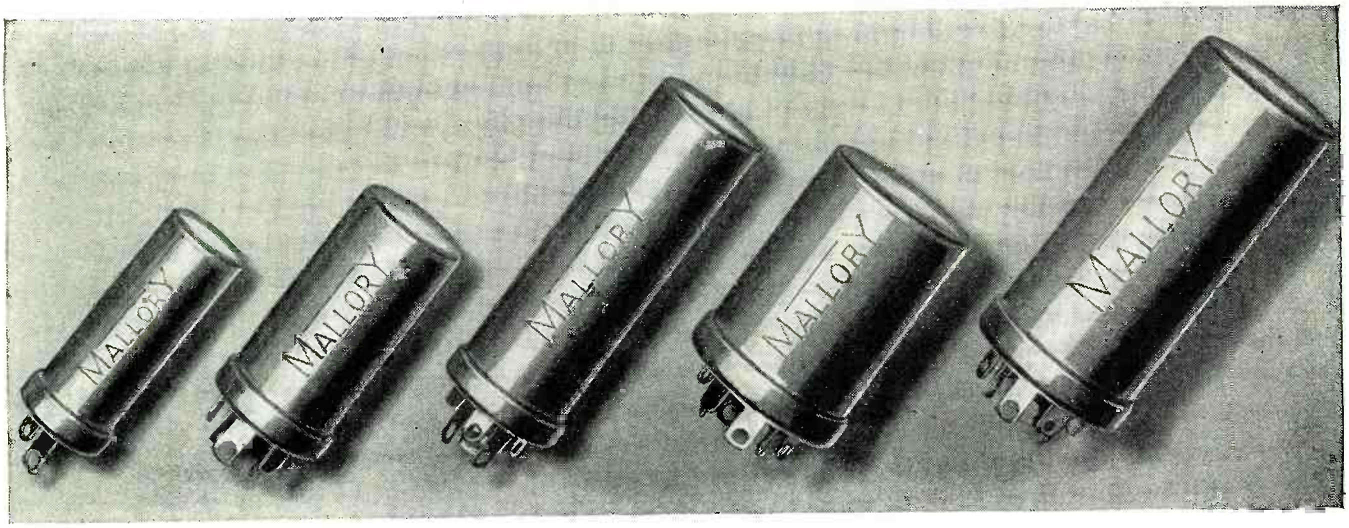
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dental contact as they pass through chassis clearance holes. All clearance holes must be at least six times the diameter of the lead and should be lined with rubber grommets.

Operation

To adjust transmitter: (1) Plug-in crystal and coils for desired frequency. (2) Set C_3 at half maximum capacitance. (3) Throw switch S_2 to left-hand (oscillator) position. (4) Connect power supply and turn on heater voltage. (5) After waiting about 1 minute for tube heaters to come up to normal operating temperature, switch on d.c. plate power, noting that milliammeter is deflected. (6) Adjust C_2 for plate current dip and continue adjustment beyond point of minimum deflection until meter pointer rises slightly out of dip. (7) Switch milliammeter to amplifier circuit by throwing S_2 to right. (8) Adjust C_6 for plate current dip. (9) Switch S_2 back to left-hand position and readjust oscillator tuning capacitor C_2 for greatest plate current dip, then return milliammeter to amplifier circuit and readjust C_6 for minimum plate current. (10) Adjust C_3 for still lower dip in amplifier plate current. (11) Connect 50-watt incandescent lamp bulb to antenna output terminals and adjust variable capacitor C_7, noting that dip occurs higher on milliammeter scale (indicating loading) and that lamp reaches maximum brilliance at lowest plate current dip. Transmitter now is in operation and is loaded, in accordance with F.C.C. regulations, by a dummy antenna. (12) To test keying, insert key plug into jack *J*. (13) If oscillator goes out of operation during keying, readjust C_2 so that oscillator plate current is slightly on other side of complete dip—Check keying by listening in on oscillating receiver or c.w. monitor coupled *very loosely* to one of antenna output terminals. (14) To check modulation; insert output plug from 500-ohm terminals of 5-watt audio amplifier into jack *J*, speak into amplifier microphone, and listen to radiophone signal with non-oscillating receiver or 'phone monitor coupled *very loosely* to one of the antenna output terminals.

When checking either c.w. or 'phone operation, as described above, the dummy antenna (electric light bulb) must be connected. The dummy antenna must be in operation at all times when this transmitter is being adjusted or tested. An inside or outside antenna or ground wire must not be connected to the transmitter while the latter is in operation until such time as amateur station operation has been re-authorized by the Government and even then only when the transmitter has been duly covered by an amateur station license, is being adjusted by a licensed radio operator, and when the station call letters are actually being signed to the test signals.

Conclusion

We feel that the little victory transmitter described in this article will have a particular appeal to the man who has disposed of his regular rig, but would like to assemble a low-powered transmitter, in anticipation of the re-opening of amateur radio, from spare parts or from components that are readily obtainable. The design is such that it is not mandatory to use the specified parts. The ingenious builder who reads the technical description will see immediately how

CHICAGO HAMFESTERS RADIO CLUB

THE twelfth annual picnic of the Hamfesters Radio Club of Chicago will be held August 5th at Dolton Picnic Grove, Dolton, Illinois.

Long an outstanding event with amateurs of the Central Division, this year's picnic, in keeping with the tradition, will be a family affair. Games, contests, good eats, and demonstrations of WERS equipment will be features of the day.

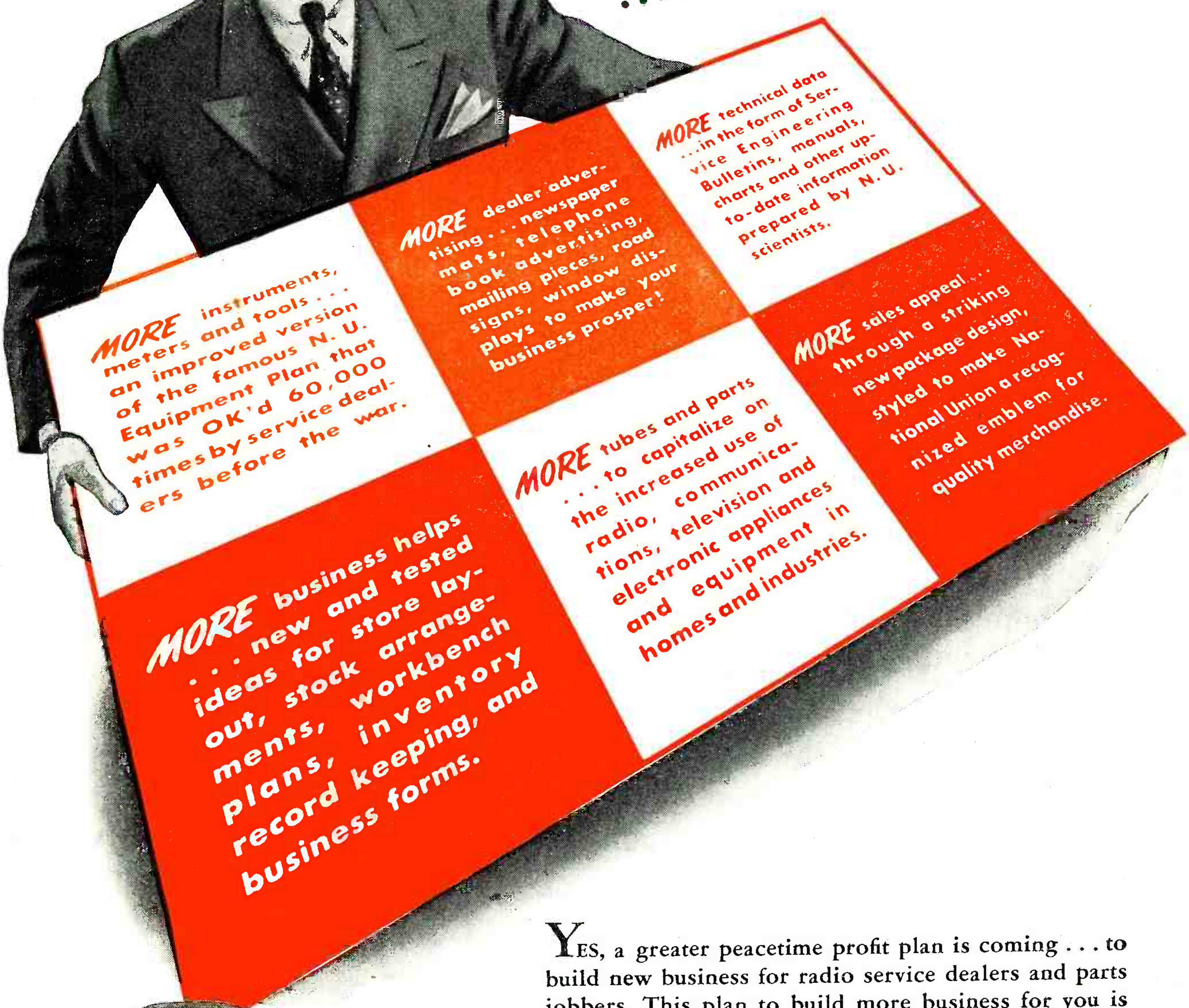
Dolton may be reached by South Suburban Safeway Busses which leave the depot at 20 East Randolph Street every 40 minutes after 8 AM and will stop at the grove on request. The best automobile route is south on Halsted, east on 147th, and north on Chicago Road to the picnic grounds.

All hams, ex-hams, going-to-be-hams, WERS operators and SWLs are cordially invited. Bring your family, come early and spend the day!

—30—

AFTER THE WAR—
MORE THAN BEFORE!

. . . FROM NATIONAL UNION TO YOU . . .



YES, a greater peacetime profit plan is coming . . . to build new business for radio service dealers and parts jobbers. This plan to build more business for you is backed by the resources of a great and growing company, with front rank engineering and production facilities. National Union can and does *assure* you . . . *"After the War,* More *than Before!"*

NATIONAL UNION RADIO CORPORATION
NEWARK 2, NEW JERSEY

NATIONAL UNION
RADIO AND ELECTRON TUBES

Transmitting, Cathode Ray, Receiving, Special Purpose Tubes • Condensers • Volume Controls • Photo Electric Cells • Panel Lamps • Flashlight Bulbs parts that he has on hand may be substituted and a transmitter of equal efficacy obtained.

Specifications given in Table I are for coils with wide frequency coverage, so that they might be expected to fill the bill regardless of the actual values of low frequencies to be dealt out to the hams. If the frequencies differ markedly from those we used prior to the war, then many hams will find it convenient to re-grind a few of their old crystals and to match them in the victory transmitter with the specified coils.

—30—

What's New
(*Continued from page 74*)

MILITARY HEADSETS

A new type of headset for the Armed Forces is now being produced by *National Scientific Products Company* of Chicago.

This unit was designed and developed in cooperation with the U.S. Signal Corps to fit under military helmets, and meets all requirements outlined in T.B. SIG. 109.

Detailed information on the new headset may be obtained from *National Scientific Products Company,* 5013-25 N. Kedzie Avenue, Chicago 25, Illinois.

RCA LIFEBOAT RADIO

New lifeboat radio equipment which automatically transmits SOS and radio direction-finder signals has been developed by *Radiomarine Corporation of America.*

This model which is capable of operating over distances of 1000 miles or more was designed to meet the wartime demand for dependable communication between victims of maritime disasters and the rescue forces. the hand-driven power generator, which replaces storage batteries, and its two-way radio telegraph and telephone facilities are combined in a single waterproof housing.

The transmitter, which may be used for either voice or code communications, delivers five watts of power to the antenna on frequencies of 500 and 80 kc.

When two-way communication is desired, the radio receiver which is

HOW WE SAVE 45 MINUTES OUT OF AN HOUR

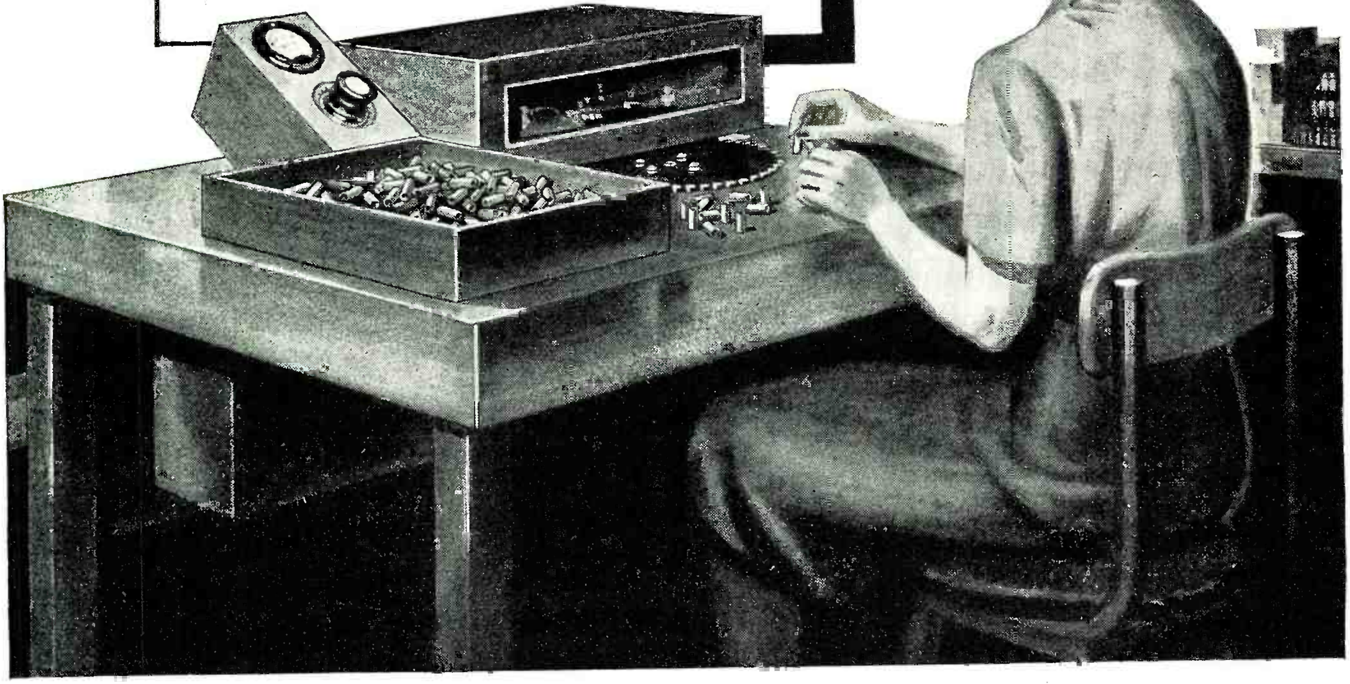
When Connecticut Telephone & Electric Division began to make aircraft ignition terminals for a famous engine manufacturer, we knew that standard testing procedure could not keep pace with our mass production methods. Even a score of trained inspectors, each equipped with high-voltage testing equipment, would soon fall hopelessly behind.

Again Great American Industries engineers overcame a stubborn wartime bottleneck. They designed an electro-mechanical tester which accurately checks four parts faster than former methods could check one. Five such testers, operated by unskilled persons, have a capacity of 12,500 tests an hour . . . with a degree of error almost too small to measure.

This is but one of many new methods, contributed by G. A. I. engineering to speed the war effort. It will be equally important to efficient electrical manufacturing in time of peace.

HERE'S HOW IT'S DONE

Operator places terminals to be tested in slots at edge of turntable. As each part reaches test point, one electrode of a 10,500 v. circuit contacts the conductor element of the terminal . . . while another encircles its insulating shell. Current leakage through minute cracks or porous sections of the insulation operates a relay which ejects the faulty piece. If the terminal meets specifications, it automatically falls into a chute and is conveyed to the packing bench. This swift, foolproof tester lends itself to many production tests of insulation.



CONNECTICUT TELEPHONE & ELECTRIC DIVISION

GREAT AMERICAN INDUSTRIES, INC. • MERIDEN, CONNECTICUT pretuned to the international distress frequency of 500 kc. is brought into use. It can also be tuned to sweep the short-wave band from 8,100 to 8,600 kc. Once communication has been established, the two-way feature permits the boat's occupants to exchange information that will expedite rescue operations. These units may be operated by untrained personnel by following instructions attached to the equipment.

The lifeboat radio is a product of *Radiomarine Corporation of America*, a subsidiary of *Radio Corporation of America*, 30 Rockefeller Plaza, New York 20, New York.

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Visual and Oral Reception

(*Continued from page* 34)

With a sizeable slice of the band before him, the unique rhythm of a CQ will be just as evident in a pulsating panoramic deflection as it is to the ear. Just think of the operator being able to watch for CQ's without touching the receiver tuning dial!

The Panadaptor will spot residual frequency modulation on an amplitude modulated signal, and check the other fellow's quality at a glance, because it will perform just like an oscillograph when the sweepwidth is reduced to zero. No guess work will be necessary to figure out his percentage modulation, either. The adaptor will measure it for you! And along the same lines, the operator can tell immediately from the screen what kind of QRM is blanketing his reception during a QSO, and can advise the transmitting end just how much, and where, to shift frequency.

In reading signal strength, the Panadaptor provides a lagless, accurate, and sharp indication of how great the strength of a received signal is compared to any chosen. It represents an unbeatable way to help friends adjust output stages and directional antennas for maximum efficiency.

For the logging of friendly frequencies, a strip of paper, lightly cemented to the screen, just below the panoramic baseline will enable the operator to indicate the place where friends appear on the screen when the receiver is set on a predetermined frequency. In exactly the same manner, schedules become visible without any manipulation of the receiver.

For a more detailed explanation of panoramic theory, send for Panoramic Radio Corp.'s free booklet "Panoramic Reception." Write to 242-250 W. 55th Street, New York, N.Y.

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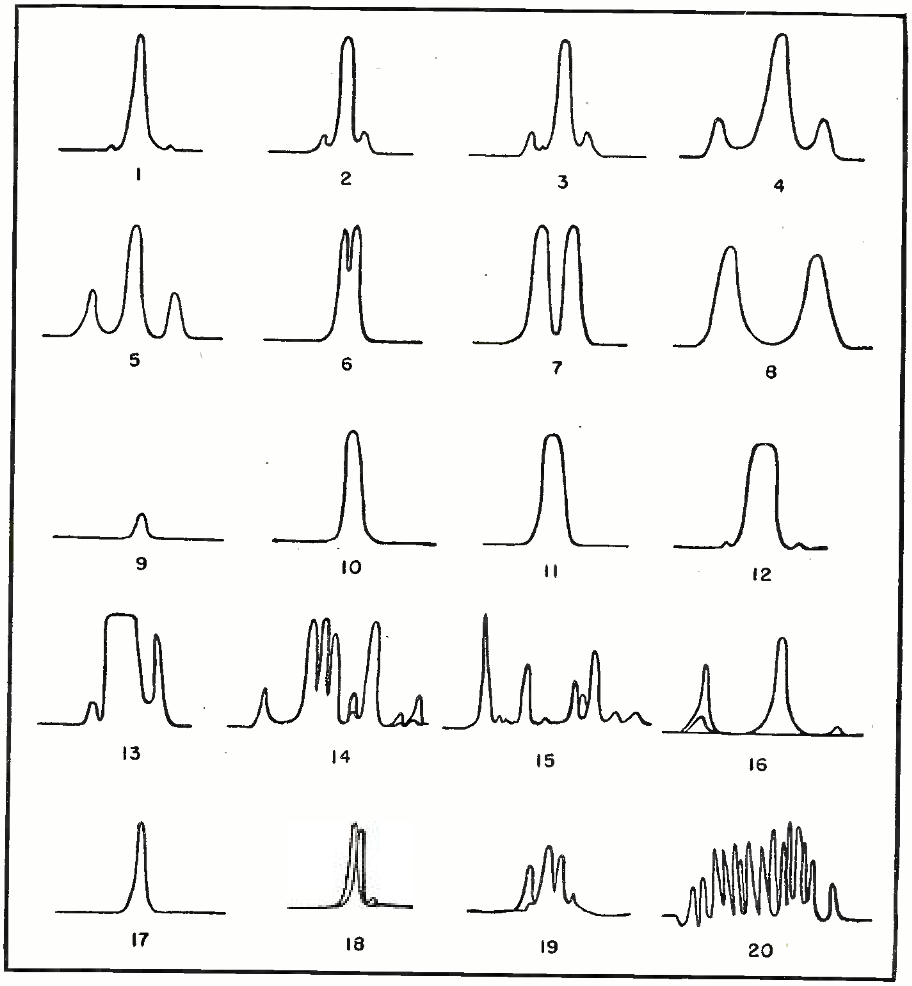
Fig. 5. Reproductions of photographs of the panoramic screen showing typical signals that operators may find when they tune to the bands indicated.



Practical Radio Course

(*Continued from page 49*)

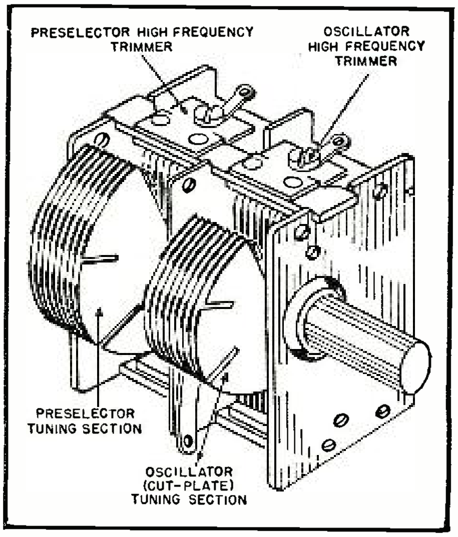
oscillator tuning capacitance required to maintain the *constant frequency difference* (i.f.) between the preselector and oscillator tuned circuits is obtained.

From the discussion of tracking requirements already presented here (see Fig. 1 and Fig. 4) it is evident that the plates of the oscillator tuning capacitor must be so shaped that its capacitance varies *less rapidly* than does that of each preselector section. The general relationship between the required plate shapes of the preselector and oscillator tuning sections of the gang capacitor will be somewhat as illustrated at (*A*) of Fig. 5. The exact plate shape required for any given receiver design and i.f. usually is arrived at by mathematical computation checked by actual trial. If the design is right, close tracking can be obtained with this arrangement, and the ideal oscillator and preselector tuning curve relationship shown at (*C*) of Fig. 5 will be approximated. Notice that the oscillator frequency is maintained exactly 455 kc. *higher* than the preselector (signal) frequency throughout the entire tuning range. This means that the desired signals passed by the preselector will always be heterodyned to the correct i.f. value of 455 kc., to which the i.f. amplifier tuning circuits are peaked, and will therefore receive maximum amplification.

Disadvantages of Cut-Plate Tracking Method

This method of oscillator tracking appears to be ideal, yet it has certain disadvantages. A gang capacitor containing one section with plates of a special accurate size and shape is more expensive to manufacture than is one employing similar plates in all sections. Also, a tuning capacitor having an oscillator tuning section with cut plates of a special shape designed for a receiver employing one value of i.f. is not suitable for use in another receiver model made by the same manufacturer but employing a different value of i.f., for the relative difference between the plate shapes required for the oscillator and the preselector capacitor is a function of the frequency-difference to be maintained—that is, the i.f. employed in the receiver. Cut-plate capacitors rarely are used for capacitor-tuned multi-band receivers providing more than two receiving bands—and even then, only when the two frequency bands are such that the preselector and oscillator inductances required for them can be so proportioned that the ratio is almost the same for each band. Otherwise, a different oscillator-section plate shape is required for the different set of coils employed for each band. The reason for this is that any change in the ratio of preselector circuit inductance to oscillator circuit inductance necessitates a change in the shaping of the cut-plates — even though the frequency difference (i.f.) is to remain the same. Naturally, it would not be economical in space or cost to provide a separate gang tuning capacitor for each tuning band.

Fig. 3. Two-gang tuning capacitor having oscillator-tuning section provided with specially shaped plates (cut plates) to give proper preselector-oscillator frequency tracking over the entire tuning range.



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Templetone Radio Manufacturing Corporation, New London, Conn.

"WHERE **FM** WILL ALSO MEAN **F**INEST **M**ADE"

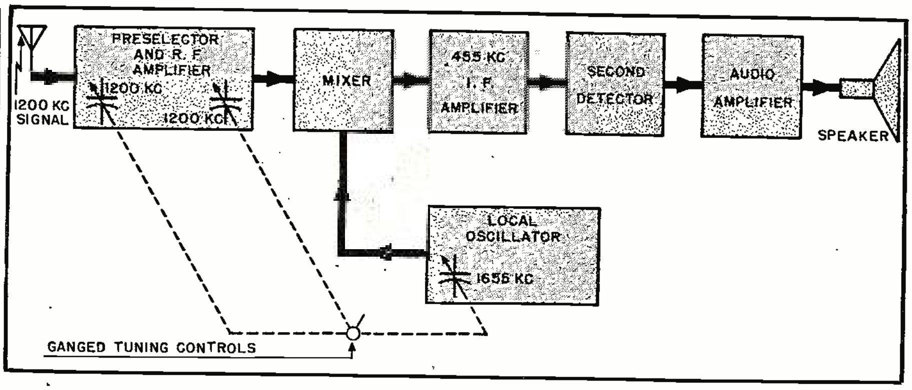


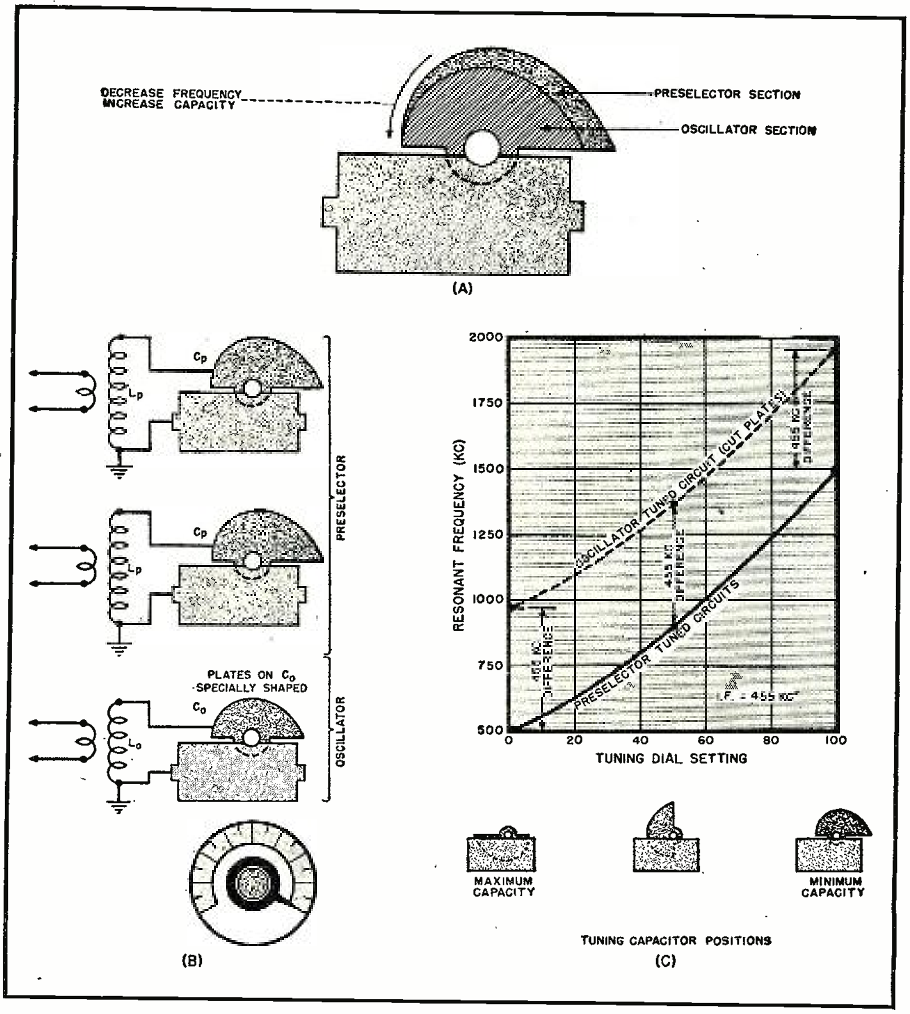
Fig. 4. Ganged tuning controls, and resonant frequencies, in a superheterodyne.

For these reasons, the cut-plate tuning capacitor method of obtaining oscillator-preselector tracking is not generally employed in multi-band receivers. It has been employed in many single-band receivers, especially in auto-radio receivers where it is advantageous to reduce to a minimum the number of trimmer and padder capacitors used, since they are susceptible to adjustment changes caused by the car vibration and to capacitance changes caused by the necessarily widely varying temperature conditions under which they must operate.

Although they have been omitted from the circuit diagrams in (*A*) of Fig. 2 and (*B*) of Fig. 5, for clarity, the usual midget trimmer capacitor is provided across each section of the tuning capacitor, or, directly across each tuning coil. This enables the preselector tuning circuits to be aligned with each other, and the oscillator tracked correctly with them, at the high-frequency end of the tuning range. Hence they usually are referred to as the *high-frequency trimmers* and are generally mounted directly on most gang condensers.

The third, or series-padder, method of correctly tracking the oscillator

Fig. 5. How correct oscillator tracking may be obtained by employing an oscillator capacitor with specially shaped plates of smaller area than those of the preselector.



frequency is an *electrical* method, and is the more widely used of the three. It will be explained in the next lesson of this series.

(*To be Continued*)

Tone Control Circuits
(*Continued from page* 47)

ground, the amount of compensation is decreased. R_1, C_1 tend to give a bass boost while C_2 increases the high frequency boost as the volume is decreased. This circuit is in common usage in commercial radios.

Fig. 4 presents a different approach to the problem. Here we effectively build an amplifier stage for low frequencies, and an amplifier stage for high frequencies, and we mix their outputs, and we connect their inputs to a common source. We merely vary the gain of each circuit to vary the amount of high or low frequency response. In Fig. 4, R_x would control the high frequency response, while R_y controls the low frequency boost or attenuation. This circuit has many variations such as resonant *LC* networks in the plate circuits of the first 6SL7. Then we come to the *LC* types of tone control circuits. The difficulty in obtaining iron core inductances at this time decreases their desirability and makes the *RC* type easier to procure the parts for.

The circuit in Fig. 6 can be used, however, and old audio transformers or a.c.-d.c. chokes substituted for the proper chokes. The *Thordarson Company* make several inductors for this purpose which resonate at 40 and 5000 c.p.s., respectively, with the two recommended values of condenser C_1, C_2. R and R_1 vary the amount of boost at each frequency. Three or more inductors could be used so that several frequencies could be boosted at will to compensate for the combined deficiencies of a poor pickup and a small speaker.

All in all, however, these *RC* tone control circuits may be applied to nearly any audio circuit, and will give very satisfactory control of high and low frequency response.

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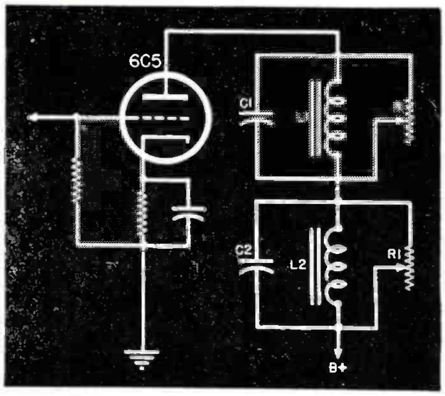
Fig. 6. Tone-control circuit, employing inductors and capacitors.



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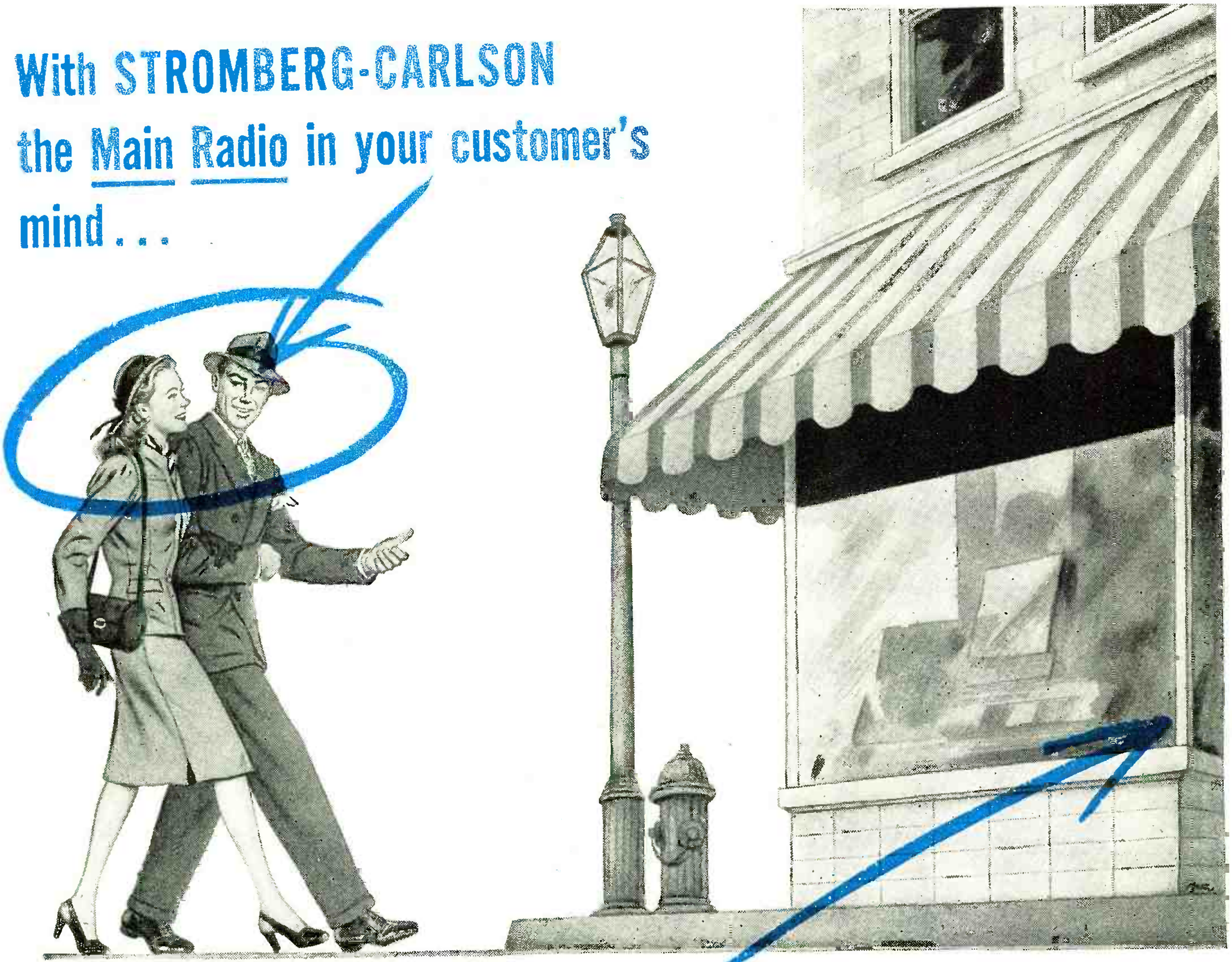

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—the important radio unit—the radio unit carrying real profit opportunity
—the radio unit with easy-selling public acceptance.

Become an Authorized Dealer now, and organize your postwar business around the Stromberg-Carlson *main radio*—a consistent profit maker whether in an outstanding table model, console, or radio-phonograph combination.

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RADIOS, TELEVISION, TELEPHONES, AND SOUND EQUIPMENT

Line Cord Voltage Bank

By Sgt. H. L. DAVIDSON

WHILE the voltage bank described in this article was designed especially for the beginner and experimenter, this unit may also be used to advantage by the radio serviceman.

The small voltage bank drops the a.c. line power voltage to the proper value for receivers, experimental uses and for servicing radio receivers that employ line-cord resistors.

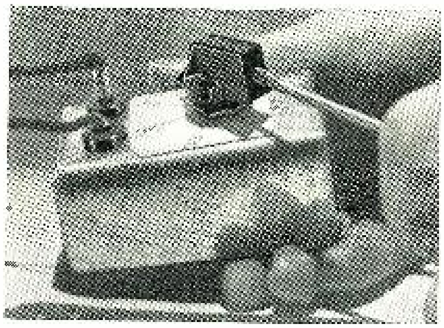
The unit is very simple in design and construction. A universal line cord is used with a single-pole, four-position switch and three small insulated phone jacks. The universal cord contains six flexible wire leads, the leads being color coded as follows: long brown lead, 330 ohms; yellow wire, 308 ohms; blue wire, 264 ohms; and the green wire, 176 ohms. The other two leads are black and red. The red terminal is internally wired to the resistance side of the line, while the black wire is the other side of the line.

The wiring of the voltage bank is very simple and may be completed in a few minutes. After the unit is wired, it is ready for a performance test. One excellent method of checking the wiring is to use a small ohmmeter with one terminal lead in No. 5 and the other ohmmeter lead in the resistance jack. The small switch can then be rotated and the ohmmeter will indicate the actual resistance.

If a small ohmmeter is not available, vacuum tubes may be used to indicate correct application. At terminal 4, as shown in Fig. 1, the voltage drop is 52.8 volts at .3 amperes, allowing 57.2 volts for external application. For example, it would be possible to use two 25-volt tubes plus one 6.3 volt vacuum tube, or five 6.3-volt tubes plus one 25-volt vacuum tube to obtain the correct heater voltage drop. Of course, all of these tubes are wired in series and must have the same current drain. Equivalent diagrams are shown in Fig. 2. This small unit was constructed primarily for .3 ampere vacuum tubes.

At terminal 3, which equals 264 ohms, the line voltage drops to 30.8 volts with a drain of .3 amperes. Here, a 25-volt tube could be used, plus one 6.3-volt vacuum tube or five 6.3-volt tubes. Terminal 2 contains 308 ohms which drops the line voltage to 17.6 volts. With this setup, three 6.3-volt tubes could be heated. Terminal 1 has the greatest resistance in ohms and thus the greatest voltage drop, decreasing the a.c. line-cord voltage down to 11 volts. At this switch position, two 6.3-volt vacuum tubes could be used.

If it is deemed desirable to connect,



The completed unit shows simplicity of construction and its compactness.

in series, tubes which have different current and voltage ratings, the following formula may be used to find the required shunt resistance. This shunt resistance goes across the vacuum tube having the smallest current rating. The correct formula for such a determination is:

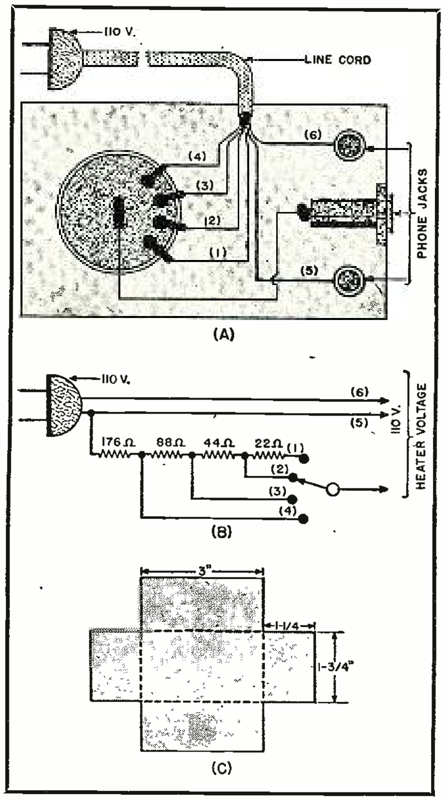
$$R_s = \frac{E_1}{I_2 - I_1}$$

where R_s is the shunt resistance

E_1 is the filament voltage of the vacuum tube with the lowest current drain

I_2 is the current drain of the tube with the highest drain

Fig. 1. Wiring diagram.



10 POINTS OF *Superiority*

10. THICK, ROUNDED EDGE, ALUMINUM PLATES FOR MECHANICAL STABILITY AND INCREASED VOLTAGE BREAKDOWN.

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1. REMOVABLE BRACKETS FOR MOUNTING COILS ON TOP OR MOUNTING CONDENSER INVERTED

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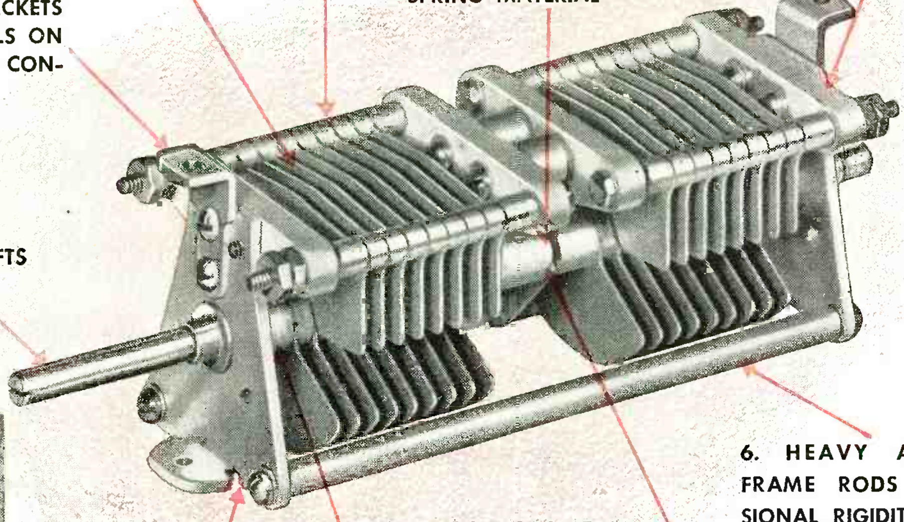


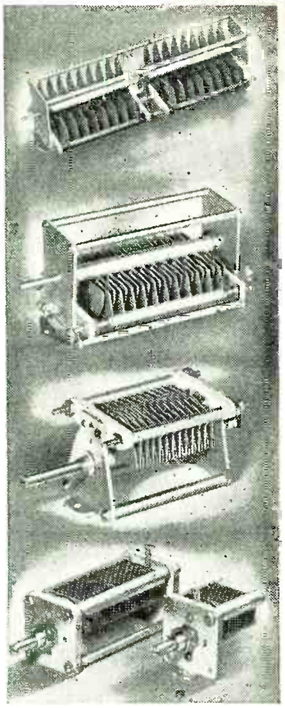
6. HEAVY ALUMINUM FRAME RODS FOR TORSIONAL RIGIDITY.

CATALOG NO. 100FD20

3. HEAVY END PLATES FOR STRENGTH

5. CENTER CONTACT BETWEEN SECTIONS FOR SHORT R. F. LEADS

4. PERFECTLY ALIGNED ROTOR SHAFTS FOR CALIBRATION ACCURACY



C -	Plate spacing	.125" - .500"
	Maximum frame dimensions	5½" x 5-13 32"
D -	Plate spacing	.080" - 250"
	Maximum frame dimensions	4½" x 4"
E -	Plate spacing	.045" - .125"
	Maximum frame dimensions	2⅝" x 2-19 32"
H -	Plate spacing	.030" & .080"
	Maximum frame dimensions	1½" & 1-9 16"

Type "F" single and dual condensers are stocked with plate spacings of .045 to .075" in 19 different models. Maximum capacity range is from 34 mmf. to 255 mmf. and the ratios of maximum to minimum run from 7:1 to 15:1. Maximum frame dimensions 2-1 16" by 2".

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I_1 is the current drain of the tube with the lowest drain.

For example, consider two tubes connected in series, such as a 12SA7 and a 6J5. The required line-cord voltage bank is 308 ohms, which is terminal 2 or the yellow wire. The 6J5 draws .3 ampere of current, while the 12SA7 draws .15 amperes from the line. Using the formula given above, the required shunt resistance for the 12SA7 is 80 ohms.

To determine the amount of resistance needed to drop the voltage to the proper value for the vacuum tubes being used, the Ohm's Law formula should be applied. The tubes to be hooked in series must have the same current rating or employ a resistance shunt. The voltage drops of the various tubes must first be added together, this value is then subtracted from 110 volts and the result is then divided by the same current value to find the correct dropping resistance. A tube manual is a handy reference for this purpose.

The line-cord resistance will get fairly warm, but this condition should not be considered abnormal.

The constructional data for the chassis is given in Fig. 1. The chassis material is soft aluminum. The allover size of the unit is extremely small. A small black pointer knob adds to the appearance of the voltage

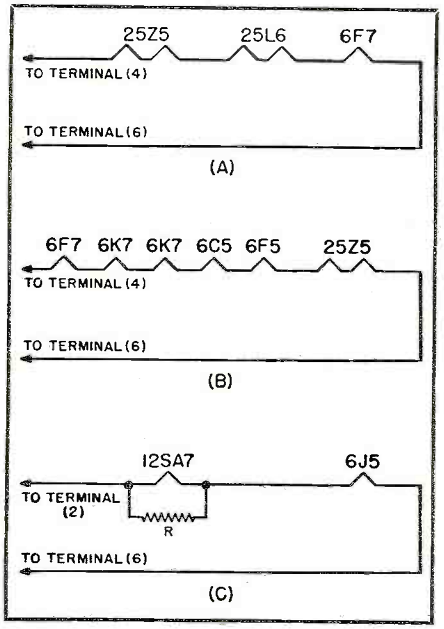


Fig. 2. Typical series filaments that may be operated directly from this unit. Other tube combinations may be used.

bank. Two red, insulated phone jacks and one black jack gives the unit a commercial appearance.

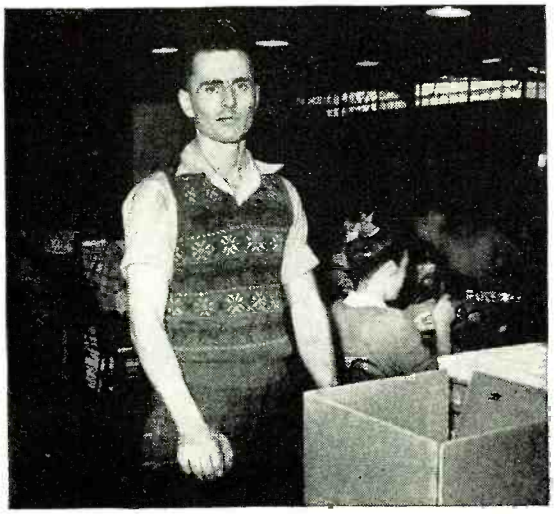
This unit is valuable for the serviceman as well as the beginner and experimenter. When a line-cord resistor goes out on an a.c. receiver, this unit can be switched into the circuit rapidly. The required dropping line-cord resistance can then be read directly from the voltage bank dial.

—30—

PRECISION is a weapon in MT. CARMEL, ILL.

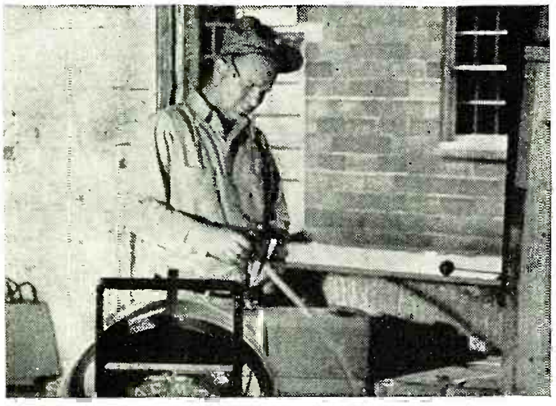
They use it effectively, too, these men and women who make up Meissner's *precision-el,* for many of them have sons, brothers and loved ones on the battle fronts. The photographs on this page show a few of these precisioneers who fight on the home front with precision and electronic skill as their weapons.

Precision is a family affair at Meissner. Here a letter from the front lines affects two families, and you can see that it's good news that will be reflected in the quality of their work when their rest period is over.

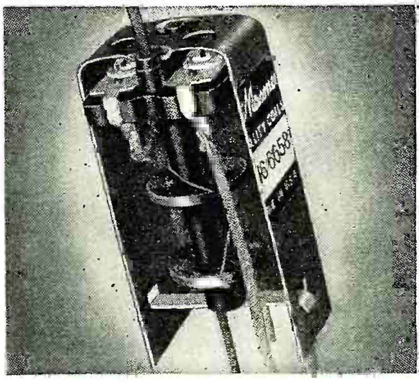


He's a veteran back from active service in the Pacific, but he's still fighting—this time on the home front with the men and women of Meissner. The traditions of precision quality he's learning here will be a weapon he can use after peace.

He splits thousandths of an inch as he does his war job. The "know how" that he and hundreds of Meissner *precision-el* have acquired is one more reason why you will be able to depend on Meissner quality after V-Day.



On the way to battle are thees cartons of electronic war equipment. He sends them off with a smile, for he knows that the work of Meissner's *precision-el* will help bring his family together again soon.



"Step Up" Old Receivers!

These Meissner Ferrocart I. F. input and output transformers are getting top results in stepping up performance of old worn receivers. Special powdered iron core permits higher "Q" with a resultant increase in selectivity and gain, now available for frequency range 127-206. Ask for numbers 16-5728 input, 16-5730 output. List $2.20 each.

MEISSNER

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ADVANCED ELECTRONIC RESEARCH AND MANUFACTURE

***Export Division:** 25 Warren St., New York; **Cable:** Simontrice*

Manufacturers' Literature

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

In view of the present paper shortage, a limited number of copies of the booklets described herein are printed. Manufacturers will endeavor to comply with all requests; however, if your copy is not received after proper request has been made, it most likely will indicate that the supply is exhausted.

C-D CATALOGUE

A new catalogue covering all types of replacement capacitors has been issued by *Cornell-Dubilier Electric Corporation.*

Known as Catalogue No. 195, this 24-page book contains complete data on capacities, sizes and prices of *Cornell-Dubilier* electrolytic capacitors, can-types and cardboard tube types, paper capacitors, wax impregnated and Dykanol tubular capacitors, drawn metal shell units, replacement paper units, photo-flash units, auto radio units and transmitting paper types, also various types of mica capacitors. Capacitor test instruments and interference filters are also included.

Copies of Catalogue No. 195 may be secured by requesting them from *Cornell-Dubilier Electric Corporation,* South Plainfield, New Jersey.

SLIDE RULE

Standard Transformer Corporation of Chicago has issued a new, enlarged slide rule which incorporates many features of value to the engineers and technician.

In addition to the values of the regular slide rule, eight mathematical tables have been included to facilitate necessary computations.

This new Multi-Slide Rule is available from Stancor jobbers only and orders for the rule must not be sent to the company. The slide rule, complete with carrying case is priced at one dollar. Stancor jobbers have supplies of this rule on hand now.

SPRAGUE RESISTORS

A new catalogue featuring *Sprague* Koolohm Resistors for all radio and general service uses has just been issued by the *Sprague Products Company* of North Adams, Mass.

All resistors listed are the new Koolohm types having the "Tropicalized" glazed outer protecting shell and new type moisture-proof end seals which make them applicable for use under any climatic conditions.

A copy of the new catalogue which gives details on 5, 10, 25, 50 and 120 watt fixed as well as 10 watt adjustable types will be sent on request. Address such requests to *Sprague Products Company,* North Adams, Mass.

UNIVERSAL BULLETINS

Universal Microphone Company of Inglewood, California, has two new bulletins available for distribution.

Both bulletins are four-pages in length and illustrated in two colors. Nineteen different models of microphones are described including technical data and price lists. The listed items are either currently in production or are scheduled for production in the immediate future.

These bulletins are issued in lieu of the 1945 catalogue which will not be published this year.

Bulletin No. 1463 is for general trade distribution, while No. 1465 is for jobbers only. Requests for the bulletins should be addressed to the company at Inglewood, California.

RESISTOR CATALOGUE

A new 32-page resistor catalogue, describing and illustrating various types of units, has been issued by *Ward Leonard Electric Company.*

Data on the proper selection of resistors, sizes and ratings and other pertinent information is included in easy reference form. This catalogue will be of assistance to engineers and designers.

A copy of this catalogue will be sent upon written request to *Ward Leonard Electric Company,* Mount Vernon, New York.

PRECISION CATALOGUE

Precision Scientific Company of Chicago has recently issued Catalogue 325 listing various types of constant temperature equipment manufactured by the company.

Included in this 48-page illustrated booklet are standard cabinets for electric drying operations, humidity control cabinets, paraffin embedding ovens, as well as many other types for the heating of plastics, etc. The company is equipped to design and manufacture special units for specific applications.

A copy of this catalogue will be forwarded upon request of *Precision Scientific Company,* 1750 N. Springfield Avenue, Chicago 47, Illinois.

SHALLCROSS CATALOGUE

A complete guide to accurate fixed wire-wound resistor selection and use in all types of modern equipment has been incorporated in the 28-page engineering bulletin recently issued by the *Shallcross Manufacturing Company.*

In addition to a complete listing of all *Shallcross* Akra-Ohm Resistor

OWI uses RAYTHEON tubes IN UNIQUE MOBILE RECORDER

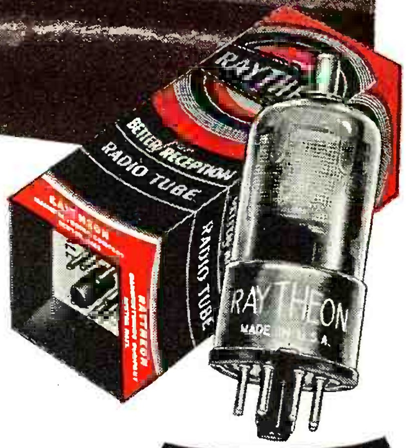
● This "traveling recording studio" of the Office of War Information has *everything* for making recorded pickups for broadcasting on international short wave. Such important equipment must be the finest that science can provide, so Raytheon High-Fidelity Tubes are used to assure the highest quality reception.

Wherever they are employed, Raytheon Tubes live up to their reputation for fine performance. That is why they are first choice among electronic engineers planning post-war products . . . and first choice among radio service-dealers who are building soundly for the future.

There's a real promise of greater profits and greater customer-satisfaction for service-dealers who feature Raytheon Tubes. And there's a revolutionary Raytheon merchandising program planned, too . . . to help you be more successful than ever before.

Switch to Raytheon Tubes *now!*

Increased turnover and profits, plus easier stock control, are benefits which you may enjoy as a result of the Raytheon standardized tube type program, which is part of our continued planning for the future.



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High Fidelity
ELECTRONIC AND RADIO TUBES

DEVOTED TO RESEARCH AND THE MANUFACTURE OF TUBES FOR THE NEW ERA OF ELECTRONICS types, the bulletin includes information on resistance alloys, maximum resistance and temperature coefficient charts, dimensional specifications, mountings and terminal designs, power dissipation, moisture and fungus-proofing data, hermetic sealing information and resistors designed to meet JAN-R 93 specifications.

A copy of this bulletin will be forwarded upon request to *Shallcross Manufacturing Company,* Collingdale, Pa. Please specify Engineering Bulletin R.

BELT AND CABLE BOOK

A new pocket size, 68-page book containing several thousand radio dial belt and drive cable listings and specifications has been published recently by the *General Cement Mfg. Co.*

In addition to the listings, the new G-C No. 345 book contains many time-saving dial belt and drive cable service instructions as well as detailed information about the repair of finishes on radio cabinets.

The book is available without charge to radio men by writing *General Cement Co.,* Rockford, Illinois, or by contacting *General Cement* jobbers direct.

RELAY MANUAL

An elaborate 55-page catalogue describing the company's complete line of relays has been issued by *Guardian Electric Manufacturing Company* for the guidance of engineers and equipment designers.

Information on relays for different applications and uses is given completely in tabulated form, along with dimensions and blueprint drawings.

Included in the manual are a.c. relays, mercury switch relays, d.c. relays, snap-switch relays, telephone type relays, interlocking relays, ratchet and stepping relays, to mention a few.

Copies of the manual are available upon request to *Guardian Electric Manufacturing Company,* 1400 W. Washington Boulevard, Chicago 7, Illinois.

TEST EQUIPMENT

A four-page bulletin, containing data regarding four types of test equipment, has been issued by *Metropolitan Electronic and Instrument Company* of New York.

Included in this bulletin are a signal tracer, signal generator, resistance-capacity bridge and a Speed-O-Meter which is a multi-purpose unit.

Copies of this bulletin will be forwarded to servicemen, maintenance men and engineers who request it. The equipment described in the bulletin is currently available on priority. Requests for the folder should be sent direct to *Metropolitan Electronic and Instrument Company,* 277 Broadway, New York 7, New York.

PLASTIC BOOKLET

A new publication, entitled "A Businessman's Guide to the Molding of Plastics," has been issued by *Kurz-Kasch, Inc.,* for the guidance of executives faced with problems in the molding of plastics.

The story is told in question and answer form and much valuable data regarding methods, engineering, and advantages of using plastics in some applications is included.

Various types of plastics are listed, along with their molding properties and applications for various types of requirements.

Copies of this booklet may be secured by writing on business letterhead to *Kurz-Kasch, Inc.,* Dept. 7R, 1415 South Broadway, Dayton 1, Ohio.

SOCKET CATALOGUE

Lenz Electric Manufacturing Company has recently issued a new catalogue of their line of dial light sockets for radio receivers, transmitters, test instruments and various types of electrical equipment.

This fourteen-page catalogue includes specifications and dimensions for 28 different standard mounting brackets. Four different styles of *Lenz* Dial Light Sockets are described and illustrated.

The Catalogue No. 101 is available to engineers and purchasing agents upon request to *Lenz Electric Mfg. Company,* 1751 N. Western Avenue, Chicago 47, Illinois.

TROPICALIZATION

Zophar Mills, Inc., manufacturers of tropicalized waxes, has issued a new technical bulletin for the information of engineers and plant executives.

The results of various laboratory tests for humidity, toxicity and applications are included in this bulletin.

Copies of this publication will be forwarded upon request to *Zophar Mills, Inc.,* 112-30 26th Street, Brooklyn 32, New York. Please specify the bulletin entitled, "More About Your Needs for Tropicalized Wax," when making requests.

CALCULATOR

A new parallel-resistance and series-capacitance calculator has been released by *Allied Radio Corporation* of Chicago.

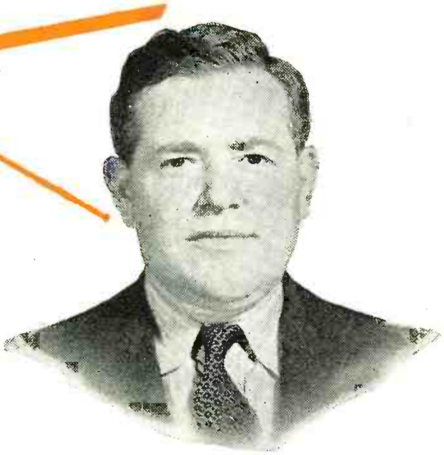
This new calculator is essentially a slide-rule device, designed to provide a rapid and accurate means of determining the reciprocal of the sum of two reciprocals as expressed by the formula: $1/x = 1/a + 1/b$. A single setting of the slide automatically aligns all pairs of a and b values which will satisfy the equation for any given value of x.

This calculator indicates in one setting the numerous pairs of resistances which may be connected in parallel, or capacitances in series, to provide any required resistance or capacitance value. The range is from 1 ohm to 10 megohms; 10 $\mu\mu$fd. to 10 μfd.

The slide rule is available from *Allied Radio Corporation,* 833 West Jackson Blvd., Chicago 7, Illinois. The price is $0.25.

—30—

"Supervisory control helps put the finger on trouble" ★



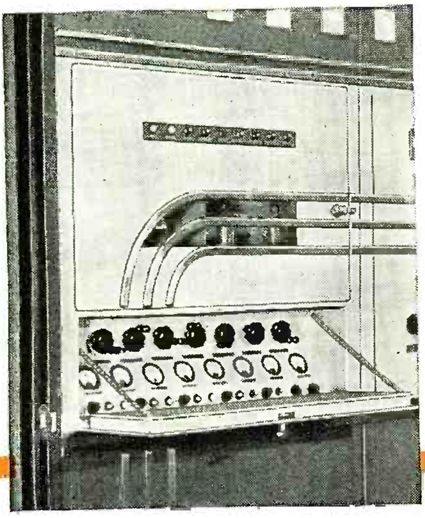
C. W. Burtis, Chief Engineer
WPEN, Philadelphia

This statement by Mr. Burtis, on the value of well-designed supervisory control, brings into sharp focus the extra dependability featured in all Westinghouse transmitters. *For Westinghouse transmitters have more supervisory control than any other type manufactured today.*

Indicator lamps, for example, tell at a glance which circuit has been overloaded, even though the transmitter has returned to the air. "De-ion" circuit breakers supply full overload and undervoltage protection, automatically reduce outage time. Controls reset automatically. Circuit checkup is simplified.

This dependability and efficiency in Westinghouse transmitters are products of on-the-job knowledge gained in 25 years of building and operating radio stations. Your nearest Westinghouse office can give you all the facts on Westinghouse transmitters . . . 5, 10 and 50 kw, AM, and 1, 3, 10 and 50 kw FM. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-08117



★ "Without a doubt, supervisory control is one of the more worth-while additions to the indication devices on a transmitter. It definitely helps put the finger on any trouble that develops by approximating the sphere of that trouble."

(*Signed*) C. W. Burtis

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Electronics at Work

XXV RADIO'S 25th ANNIVERSARY KDKA

Practical Radar

(*Continued from page* 41)

The three wave forms shown graphically in Fig. 3 represent the same basic r.f. pulse wave form. And the above relationships are illustrated by wave forms *A* and *B*, the envelope of *B* representing one half the full envelope value of wave form *A*.

A complete radar operating cycle can be considered in terms of the fraction of the total time that the r.f. energy is radiated, and this time relationship is known as the *duty cycle*. Thus:

$$\frac{\text{pulse duration}}{\text{pulse recurrence time}} = \textit{duty cycle}$$

For example, assume that a 1 microsecond pulse is radiated by a radar transmitter at the rate of 1000 times per second. Since the time for one complete radar cycle is 1/1000 second, or 1000 microseconds, the *duty cycle* (by the above equation) will be 0.001.

In a similar manner, the ratio between the average power and the peak power may be expressed in terms of the *duty cycle*.

$$\frac{\text{average power}}{\text{peak power}} = \textit{duty cycle}$$

Referring to our example again, assume the peak power output of the radar transmitter to be 500 kilowatts. Therefore, during 1 microsecond 500 kilowatts of power are being radiated, and during the following 999 microseconds no power is being radiated. A restatement of the above equation shows that the average power output is equal to the product of the peak power and the *duty cycle*. Thus, the average power being radiated by this radar transmitter will be only 0.5 kilowatts, or 500 watts.

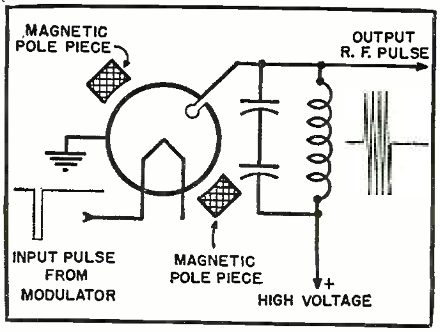
All of these power relationships are illustrated by wave form *C* in Fig. 3.

It should be noted that a high value of peak power is necessary to produce strong returning echoes from targets within range of the radar set.

A low *average power* requirement of a radar transmitter enables the output tubes and circuit components to be made physically smaller. For this reason it is advantageous to have a low *duty cycle*.

The total amount of *peak power*

Fig. 8. Basic magnetron circuit.



"HYTRON Tubes Are Good—SO WHAT!"

Sure, Hytron tubes are good — so what! All tubes made for Uncle Sam are good. They have to be, or he wouldn't accept them.

But Hytron goes further. Not satisfied just to meet Uncle Sam's JAN-1A specifications, it always sets factory testing specifications to tighter tolerances than the Services require. In this way, Hytron assures top quality despite slight meter inaccuracies and the human element. When more uniform adherence to specifications can be attained, tests simulating actual equipment performance are added.

This same insistence on the best will continue after the war. Then, too, we shall say, "Hytron tubes are good — so what! They have to be good to be good enough for you."

OLDEST EXCLUSIVE MANUFACTURER OF RADIO RECEIVING TUBES

HYTRON

RADIO AND ELECTRONICS CORP.

MAIN OFFICE: SALEM, MASSACHUSETTS
PLANTS: SALEM, NEWBURYPORT, BEVERLY & LAWRENCE

BUY ANOTHER WAR BOND

which can be developed is dependent upon the interrelation between peak power and average power, pulse duration and pulse recurrence time, or duty cycle.

Actual values of peak power output for different radar sets will vary over a considerable range. Some lightweight, portable sets require less than a few hundred watts of peak power while larger radar sets may generate peak power in excess of a megawatt.

Modulating the Transmitter

The transmitter component of a radar set normally consists of two separate stages: a *modulator* and a *radio-frequency oscillator*, as shown in Fig. 4.

The r.f. oscillator is always the final or output stage of the radar transmitter. The purpose of the r.f. oscillator is to generate pulses of u.h.f. energy at a fixed frequency of repetition. And since no further amplification is possible at such a high frequency of operation, the r.f. oscillator must also deliver tremendous amounts of peak power.

Under ordinary circumstances the voltage control pulse from the electronic timer does not possess sufficient power to control the operation of the r.f. oscillator. And therefore, additional amplification of the control pulse is necessary before it can be used to modulate the output stage of the transmitter.

This power amplification of the control pulse is performed by the modulator stage, which supplies a high-amplitude rectangular pulse of the same duration and the same p.r.f. as the original control pulse.

The application of this high-amplitude rectangular pulse to the r.f. oscillator stage permits the output tubes to generate an ultra-high radio frequency determined by the electrical constants of the tubes and the output stage. The length or duration of these u.h.f. oscillations may be determined by the duration of the rectangular power pulse from the modulator.

There are several methods of applying a modulator pulse to an r.f. oscillator stage.

One method requires that the r.f. oscillator tubes normally be biased by such a high negative voltage that it is impossible for the tubes to oscillate. Then, when a high-voltage, positive-going rectangular pulse from the modulator stage is applied to the grids of the r.f. tubes, they are permitted to oscillate for the duration of the modulator pulse. Then the r.f. tubes cease to oscillate until another strong positive-going pulse from the modulator is received.

Another method of controlling the r.f. oscillator requires that the full value of plate voltage normally not be applied to the output tubes, thus preventing the tubes from oscillating. Then, when a high-voltage, positive-going rectangular pulse is applied to the plates of the r.f. tubes, the plate voltage is raised to its normal value and the tubes will oscillate for the duration of the modulator pulse.

In some cases a *negative*-going modulator pulse may be applied to the cathode or filament of the r.f. oscillator tubes, so that the output stage is permitted to oscillate under optimum operating conditions.

Thus, the modulator can be considered as a sort of powerful electronic switch which directly controls the operation of the r.f. oscillator tubes.

The modulator stage may appear in any of several different forms.

The simplest type of modulator consists of one or more power amplifier stages which introduce little or no distortion to the pulse form they amplify. Any of a large number of types of power-amplifying vacuum tubes may be used for this purpose, since radio frequencies are not required to be handled by the modulator.

Another type of modulator employs a fixed or rotary spark gap and a pulse-shaping line to create high-voltage pulses suitable for modulating the r.f. oscillator stage. The basic circuit for this type of modulator is shown in Fig. 5, and is equivalent to the rotary-spark-gap timer described last month. A control pulse from the electronic timer causes the fixed or rotary spark gap to charge a pulse-shaping line consisting of a number of series coils and shunt condensers arranged in a pi- or H-ladder network. This energy is reflected back from the short-circuited charged line as a very steep-sided high-voltage pulse having a duration dependent only upon the electrical constants of the pulse-shaping line. This high-voltage pulse can then be used to modulate the r.f. oscillator stage of the transmitter.

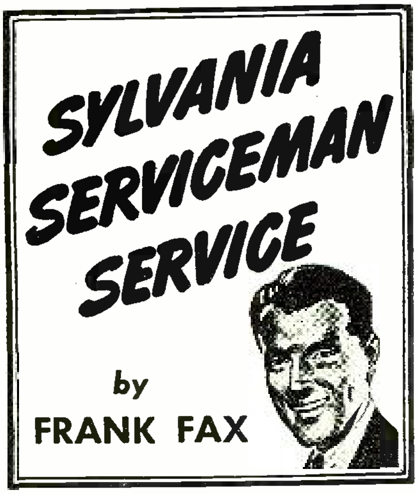
Another type of "tubeless" modulator stage employs a *saturable inductance* as a switch to charge and discharge a pulse-forming network. This network is *not* the same as the pulse-shaping line described above, and the output of the network is a distorted rectangular wave. The basic circuit for this type of modulator stage is shown in Fig. 6. The saturable inductance L functions as an electronic switch since it has either a very high or a negligible impedance, depending upon its operating conditions. These operating conditions—which control the saturation of the inductance—can be controlled by the input wave from the electronic timer. The output pulse form is developed across the condenser C (Fig. 6) and then used to modulate the r.f. oscillator stage.

The principal advantage of using either spark-gap or saturable-inductance modulation is that modulator vacuum tubes—with their very heavy filament drain—are not required to drive the r.f. oscillator stage.

However, a more important disadvantage of both the spark-gap and saturable-inductance methods of modulation is that there is no opportunity to control or improve the shape of the

SYLVANIA NEWS
RADIO SERVICE EDITION

AUGUST *Published by* SYLVANIA ELECTRIC PRODUCTS INC., Emporium, Pa. 1945



As another service to servicemen, and in further support of Sylvania's big advertising campaign designed to broaden the postwar radio market, Sylvania Electric is widely distributing to the public the new booklet "They Know What They Want."

In it the radio serviceman will find the answers to questions concerning Television, F.M., how many people are planning to buy new radios after the war, and many more — giving him a variety of pertinent facts that are bound to bear directly upon his future welfare.

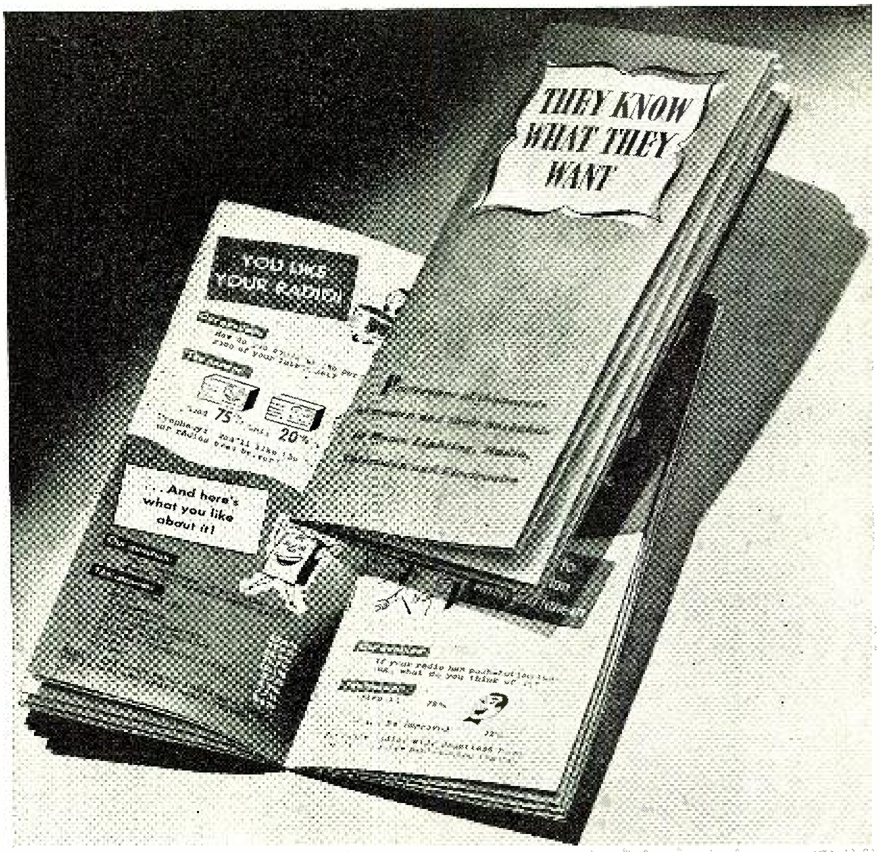
In addition, "They Know What They Want" is being widely circulated to consumers in response to inquiries stimulated by the questionnaire-type advertisements appearing in national magazines — advertisements through which Sylvania Electric is continuing its study of public preferences in radio. This general distribution is expected to maintain popular interest in postwar radio sets — an interest that will gradually influence the number of sets that will need servicing in the postwar years to come.

Send for your copy now.

NEW BOOKLET SUMMARIZES AND STIMULATES POSTWAR RADIO MARKET

Servicemen Can Obtain Helpful Information On National Radio Trends

Here is a booklet that gives a handy summary of the public's postwar radio wants—a result of Sylvania's nationwide survey and questionnaire-type advertisements. Copies for servicemen are available on request—*Sylvania Electric Products Inc., Emporium, Pa.*



SYLVANIA ELECTRIC

Emporium, Pa.

MAKERS OF RADIO TUBES: CATHODE RAY TUBES: ELECTRONIC DEVICES: FLUORESCENT LAMPS, FIXTURES, ACCESSORIES: ELECTRIC LIGHT BULBS output pulse after it has been generated in the charged line or network. For this reason it is desirable, whenever practicable from the standpoint of physical size, to employ vacuum tubes to modulate the r.f. oscillator stage of the transmitter.

It should be noted that the output pulse shape from any type of modulator may be either positive-going or negative-going, depending upon the requirements of the r.f. oscillator tubes. Magnitude of the output pulse is important, but not its polarity—since positive-going and negative-going pulse shapes can be considered equivalent, if all other characteristics of the pulses remain constant.

U. H. F. Technique

The generation of ultra-high-frequency oscillations in the output stage of the radar transmitter involves a number of u.h.f. techniques which we should consider before discussing the types of r.f. oscillators.

In working with ultra-high frequencies it is desirable to have a visual conception of the actual wave lengths being generated and transmitted, because the physical size of the oscillation and transmission circuits is inevitably of the same order as the actual wave length.

Every piece of connecting wire—no matter how short—acts as some portion of a transmission line at these ultra-high frequencies. Lumped inductance and capacitance are of less importance than distributed inductance and capacitance. Tuned sections of transmission lines are usually used as oscillatory or "tank" circuits. And a coaxial cable or wave guide is used to transfer u.h.f. energy from the r.f. oscillator to the transmitting antenna to prevent radiation losses.

For these reasons ultra-high-frequency circuits are generally analyzed from the standpoint of transmission lines.

Ordinary vacuum tubes will not generate oscillations at the frequencies required by radar. And frequency doubling, tripling, or quadrupling have no practical value due to the losses, complexity, and relatively low output power of such circuits.

Important factors influencing the operation of a vacuum tube oscillating at an ultra-high frequency are; (1) the electron transit time from cathode to plate, which increases the effective grid conductance of the tube and shifts the phase of the plate current with respect to the input grid voltage; (2) the high power losses of the tube's circuit because of skin effect, electromagnetic radiation, lead inductances, and stray capacitances; (3) the dielectric losses in the tube base; and (4) the limitation of the upper frequency of oscillation by the minimum possible physical size to which the tube and its associated oscillating circuit can be reduced.

A consideration of the above factors has led not only to the development of new types of u.h.f. tubes but also new u.h.f. circuit techniques, all much too involved and lengthy for this discussion.

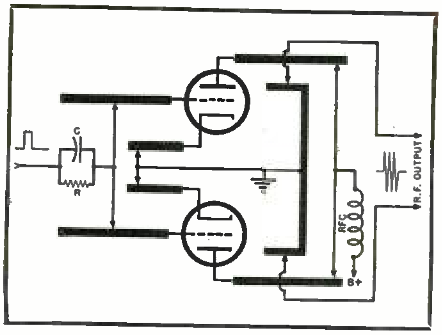


Fig. 9. Tuned-grid tuned-plate u.h.f. oscillator with load coupled to plate circuit.

Among the many tubes developed for operation at ultra-high frequencies are the types 832, 834, 887, 888, and 1628. Tubes of radically new or special design include the *W.E.* types 316A and 368A, the *G.E.* Lighthouse, the *Sperry* Klystron, and the magnetron.

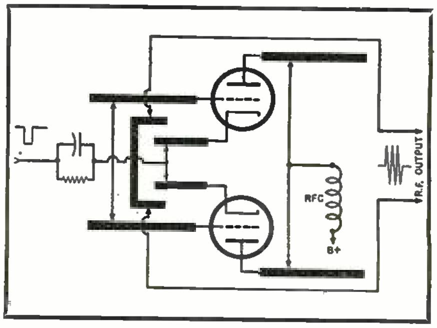
Because of the important output requirement of extremely high power, however, only a few of these tubes would seem to have any practical use as generators of ultra-high-frequency radar pulses.

For generating r.f. oscillations in the lower u.h.f. band with relatively high peak power, high-frequency triodes may be used—the tubes functioning as negative-grid oscillators in tuned-grid, tuned-plate circuits. Two tubes are connected in push-pull, or any number of *pairs* of tubes can be connected in series push-pull. The high-frequency triode becomes impractical at the extreme higher frequencies, however, due to troublesome interelectrode capacitances, lead inductances, and miscellaneous distributed or stray capacitances.

A special type of triode known as the Lighthouse triode can be used to generate r.f. oscillations in the lower range, but the output pulse is of fairly low power, and the use of the tube would thereby be limited to extremely small radar sets requiring no great amount of peak output power.

The Barkhausen-Kurz and similar positive-grid triode oscillators are probably not used in radar sets, because of their low efficiency and extremely small output power.

Fig. 10. Tuned-grid tuned-plate u.h.f. oscillator with load coupled to grid circuit.



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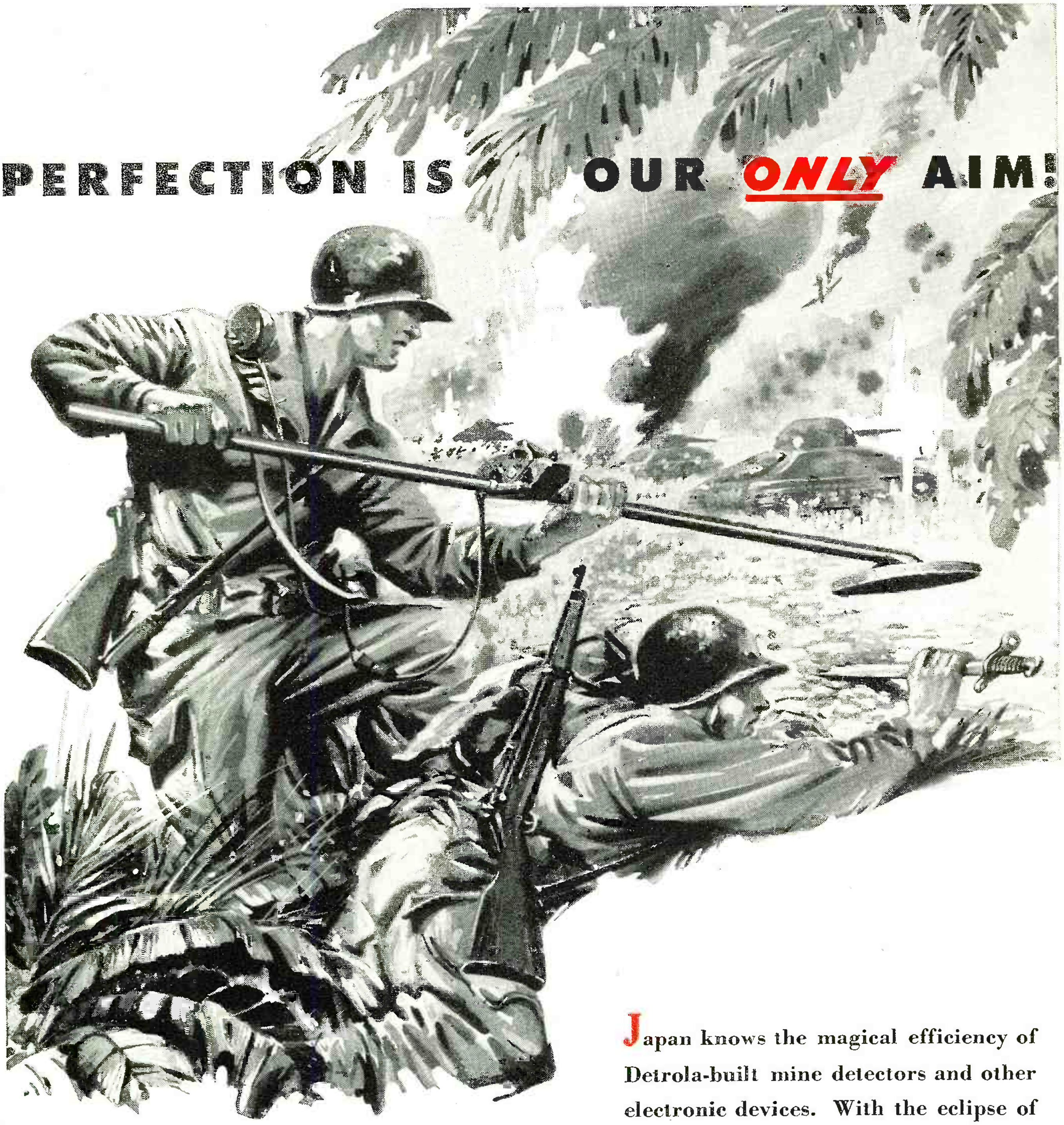

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Velocity modulated tubes—such as the *Sperry* Klystron, the Hahn-Metcalf tube, and the Haeff tube—can be operated as fairly efficient u.h.f. oscillators, but the relatively low power output of such circuits makes doubtful their use as r.f. generators in the output stages of radar transmitters.

A single solution to the problem of generating large amounts of power at radio frequencies high in the megacycle range is a device called the magnetron. The magnetron is capable of producing r.f. oscillations at any given frequency up to and exceeding 20,000 megacycles, with any required peak output power up to one megawatt.

Triode Oscillators

Negative-grid triode oscillators are widely used in radio transmitters for generating large amounts of peak power at low megacycle frequencies.

A negative-grid triode oscillator is a u.h.f. oscillator in which the *average* voltage on the grid of the tube is negative with respect to the cathode. The triode is used in some form of tuned-grid, tuned-plate circuit to sustain oscillations at the required resonant frequency.

A basic tuned-grid tuned-plate oscillator circuit is shown in *A* of Fig. 7. The grid and plate circuits are coupled through the interelectrode capacitance of the tube, and therefore part of the plate energy is fed back into the grid circuit. The tube thus supplies its own input, fulfilling the initial requirement of any oscillator, and the stage oscillates at a frequency determined by the grid and plate "tank" circuits.

To increase the operating frequency of a tuned-grid, tuned-plate oscillator, the value of the components of the two "tank" circuits must be decreased. This generally requires that the physical *size* of these "tank" circuits also be reduced.

This size reduction and considerable stabilization of the oscillator circuit may be effected by the use of quarter-wave concentric lines. A basic u.h.f. oscillator using concentric lines is shown in *B* of Fig. 7.

From the standpoint of stability, efficiency, and power output, however, the most satisfactory u.h.f. tuned-grid, tuned-plate oscillator uses one or more pairs of triodes in a push-pull circuit, the "tank" circuits of which are composed of short-circuited sections of two-wire transmission lines. These sections are usually quarter-wave parallel *rods*, as shown in *C* of Fig. 7.

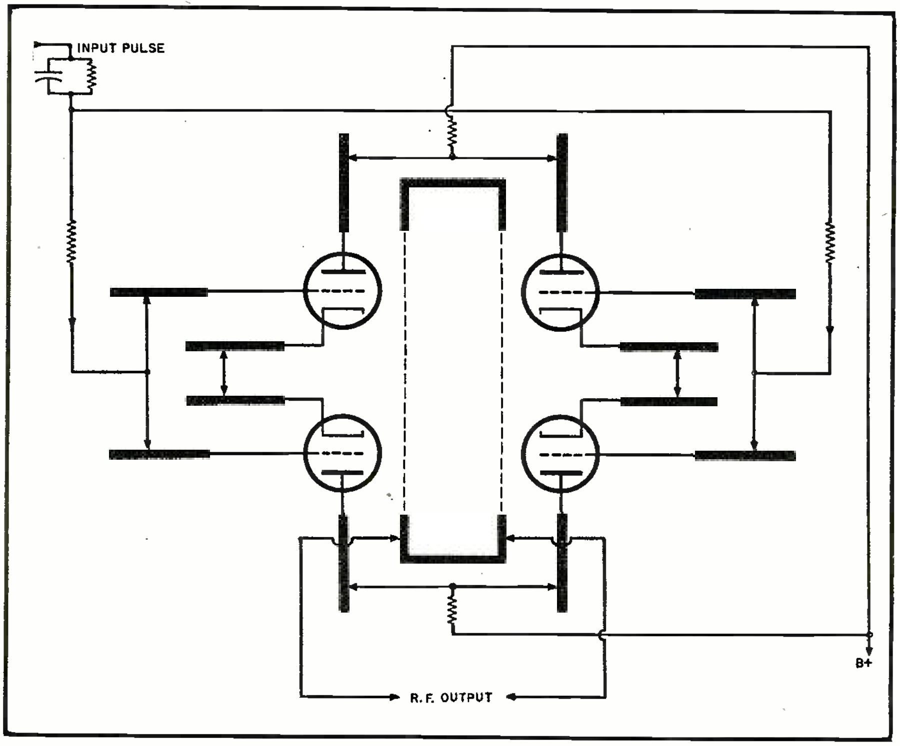
The grid and plate, and even the filament circuits, of such a u.h.f. oscillator can be tuned individually. The grid shorting bars may be varied to obtain maximum stability; the plate bars can be adjusted for maximum output, and the effect of troublesome filament-lead inductance is virtually eliminated by making this inherent inductance a part of a tuned line.

Even though the two triode plates (*C* of Fig. 7) are connected directly to the ends of the shorted lines, the loading effect on the plate lines is of no consequence since the tubes appear to be operating as if in series.

Radio frequency oscillations may be inductively coupled out of the u.h.f. oscillator from either the filament, grid, or plate circuit.

Two simplified tuned grid, tuned-plate u.h.f. oscillator circuits are shown in Figs. 9 and 10.

Fig. 11. A typical ring type oscillator.



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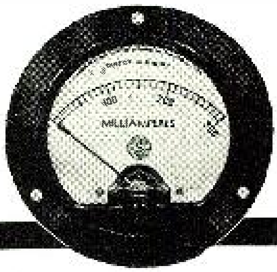


During quiescent periods between pulses from the modulator stage the oscillator, shown in Fig. 9, cannot function, because a fixed negative bias of several hundred volts is applied to the grids of the tubes. However, when the control pulse from the modulator is applied to the grid circuit, the high voltage of the positive-going pulse nullifies the fixed bias on the tubes and the triodes are permitted to oscillate at a resonant frequency determined by the system of tuned transmission rods. The r.f. oscillations take place only for the duration of the input control pulse, ceasing abruptly when the modulating pulse is removed.

The input capacitance-resistance network of the circuit (Fig. 9) consists of a grid leak of fairly low value and a blocking condenser of several hundred micromicrofarads. There is no grid blocking action by this network.

The u.h.f. output pulses from this oscillator (Fig. 9) are coupled inductively from the plate circuit, and can then be passed to the transmitter antenna by means of a transmission line or, more probably, a wave guide.

A slight variation of the circuit shown in Fig. 9 permits the oscillator to control the *duration* of the u.h.f. oscillations after the leading edge of the modulating pulse has triggered the circuit into operation. To accomplish this, a higher value of grid-leak resistor and a much lower value of blocking condenser are used in the input capacitance-resistance network of the oscillator grid circuit. When the modulator pulse is applied to the grid circuit, the triodes are permitted to oscillate as previously described. However, at the same time a charge is quickly built up on the condenser of the network, causing the grids of the triodes to become more and more negative with respect to the cathodes. And the condenser rapidly acquires sufficient voltage to stop or block oscillations completely.

This damping or grid-blocking action is known as "squegging," and such an r.f. oscillator as described above is more popularly known as a *squegging oscillator*.

The principal effect of this squegging action on the r.f. output pulse is that the u.h.f. oscillations do not cease abruptly but have a damped or attenuated effect, resulting in the appearance of a "tail."

In the basic oscillator shown in Fig. 10, the filament and plate circuits are unbalanced with respect to each other. During quiescent periods between modulator pulses the oscillator is unable to function, because the potential difference between the filament and plate of each tube is not sufficient for the tubes to operate. Several hundred (positive) volts on the plates may be required to permit oscillations. This unbalanced condition can be rectified, however, when a negative-going modulation pulse of several hundred volts is applied to the filament circuit. Since allowance is made for balancing the grid circuit accordingly, this procedure is exactly the same as applying a high-voltage positive-going pulse to the plate circuit.

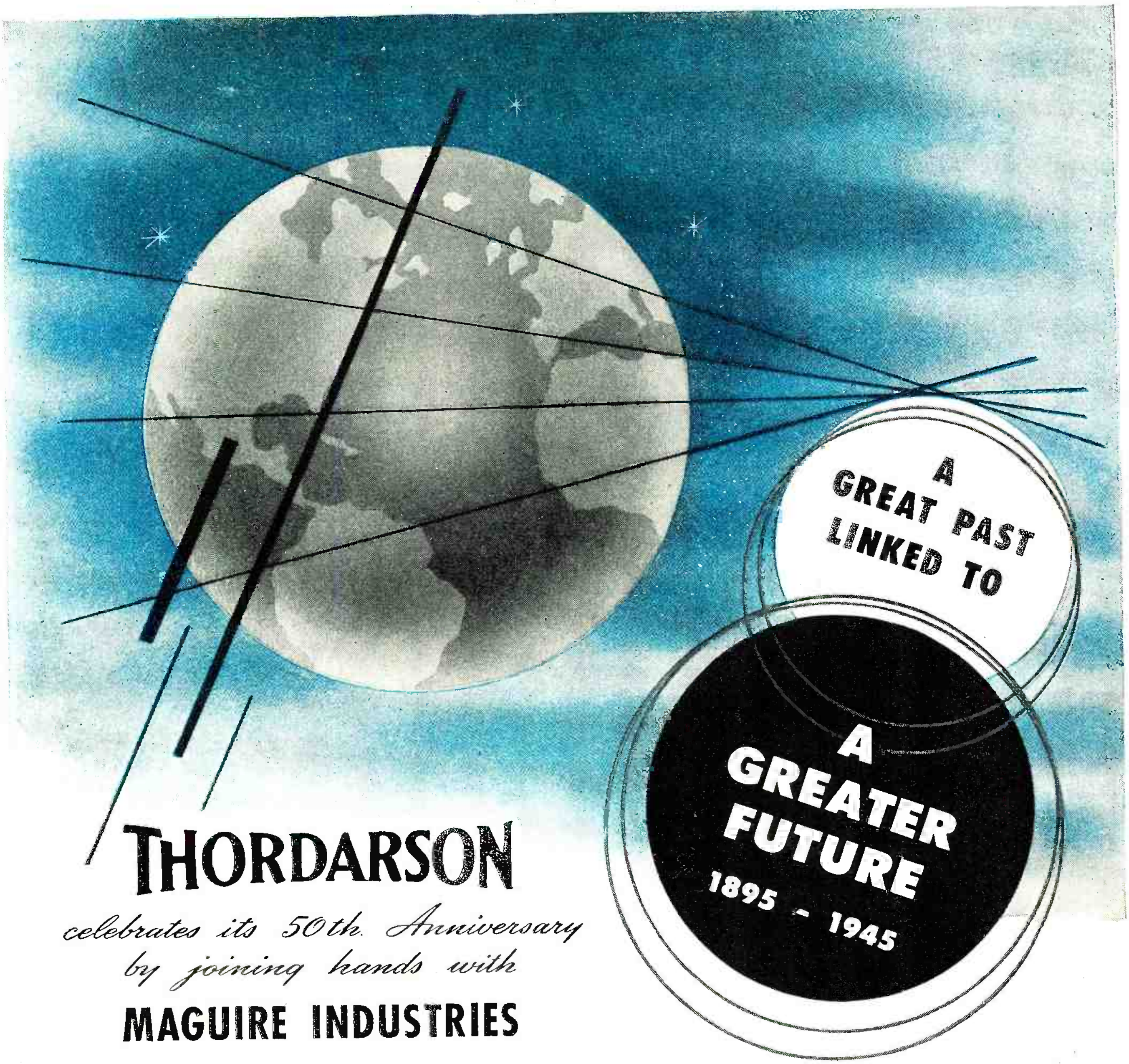
In either case the potential difference between the filament and the plate is corrected, and the circuit is permitted to oscillate at a resonant frequency determined by the tuned transmission rods. The u.h.f. oscillations will take place only for the duration of the modulator pulse, and will cease abruptly when the control pulse is removed.

The r.f. output pulses from this oscillator (Fig. 10) are coupled inductively from the grid circuit, and can reach the antenna by means of a transmission line or a wave guide.

There are several variations of the two basic r.f. oscillators described above (Figs. 9 and 10), but they all function in much the same manner; the ultra-high frequency oscillations being controlled by a high-voltage control pulse from the modulator stage of the transmitter.

Ring Oscillators

The power output of a single pair of triodes arranged in a push-pull tuned-grid, tuned-plate oscillator will be limited by the plate current that can flow in the tubes and by the power dissipation of the triode plates.



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If this power output is not of a sufficient value, it may be raised by enlarging the current-carrying capacity of the tubes or, more simply, by increasing the number of tubes in the oscillator circuit.

Additional pairs of triodes may be connected in series, creating a u.h.f. oscillator with almost any desired high output power. Such an arrangement of four triodes is shown in the basic circuit of Fig. 11.

When more than one pair of triodes is used in this manner, the resulting circuit is known as a *ring oscillator*—since the tubes are physically arranged in a circle or ring with the plate tank circuits on the inside of the circle.

This mechanical arrangement permits symmetrical connections between tubes and other elements of the circuit, and considerably simplifies the problem of coupling the output of the r.f. oscillator to a transmission line or wave guide.

The interelectrode capacitances for a number of pairs of tubes in a ring oscillator are considerably lower than for a single pair of tubes connected in a push-pull circuit. Therefore, the addition of pairs of tubes to the ring oscillator permits any given type of triode to be used at much higher operating frequencies.

The ring oscillator functions much in the manner of the basic tuned-grid, tuned-plate oscillator previously discussed. But, of course, the ring oscillator circuits are more complex and require a high degree of adjustment.

The Magnetron Oscillator

The magnetron is widely used as a generator of ultra-high frequencies for two very significant reasons. It can produce stable r.f. oscillations of any frequency up to and exceeding 20,000 megacycles. And it can produce radio frequency pulses having phenomenally large amounts of peak power.

Certain types of magnetrons have an output exceeding a megawatt when operating at wave lengths of only a few centimeters. And the output of most other magnetrons is seldom less than 500 kilowatts at *any* operating wave length or frequency.

All of this is possible because of the magnetron's unique manner of operation: *the control of electron movement by means of an electromagnetic field.*

The magnetron is essentially a diode having a cylindrical anode, along the axis of which is located the filament of the tube. When the ends of the cylinder are closed, the interior of the device acts as a resonant chamber.

Around the outside of the magnetron is wound a coil capable of producing a very strong axial field. The lines of magnetic force are approximately parallel to the axes of the filament and the anode, and the magnetic field functions much in the manner of a grid in retarding the passage

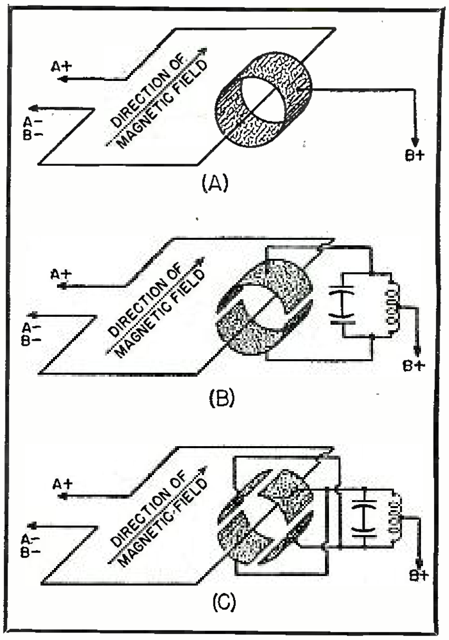


Fig. 12. Three basic types of magnetrons—(A) single anode, (B) split anode, (C) slotted anode.

of electrons to the positively charged plate or anode.

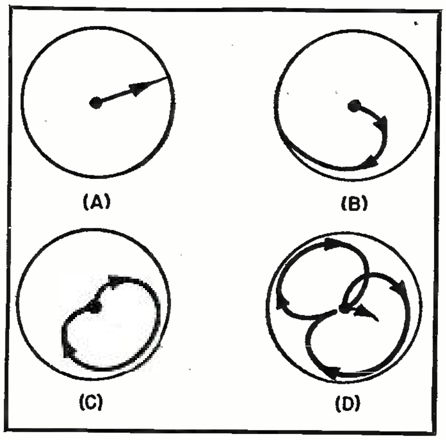
Although some types of magnetrons have complex filament and anode structures, the physical structure of the basic magnetron, in general, is fundamentally simple, as shown in *A* of Fig. 12.

Sometimes the anode is divided into two segments (*B* of Fig. 12), and the tube is known as a *split-anode magnetron.* When the anode is divided into four segments (*C* of Fig. 12) or a greater number of segments, the tube is known as a *slotted-anode magnetron.* But regardless of the number of anode segments, the practical operation of the device remains much the same.

Electron paths viewed from the open end of a simple magnetron are shown in Fig. 13.

In the absence of a magnetic field

Fig. 13. Electron paths within a magnetron employing static fields. (A) Electron path with no magnetic field. (B) Path of electron with slight magnetic field. (C) Electron path with magnetic field at critical value. (D) Path of electron with magnetic field well beyond critical value.



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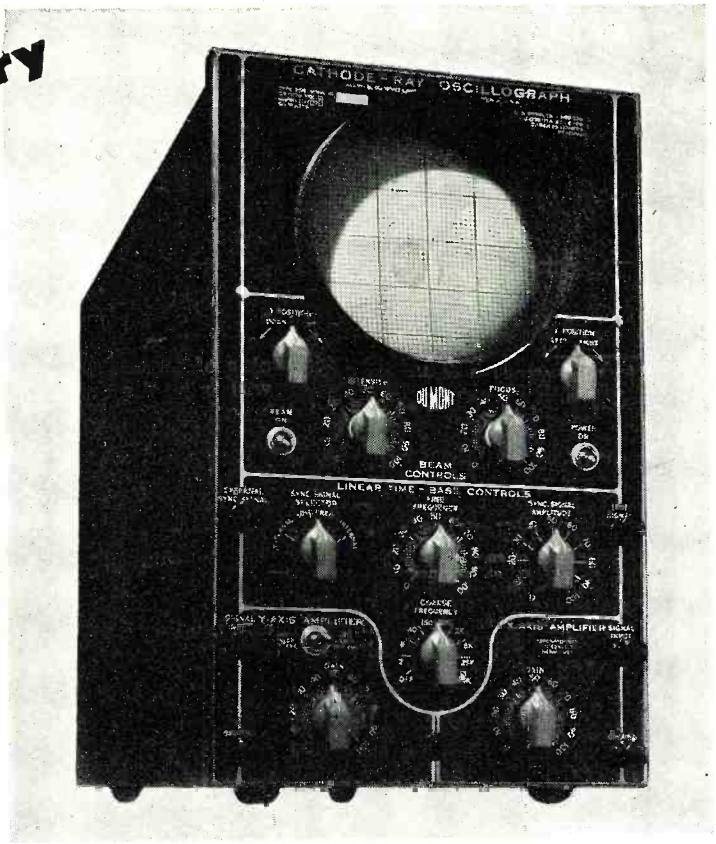
- Use of mineral-oil-impregnated, hermetically-sealed, paper capacitors.
- Increase in voltage rating of certain capacitors for greater factor of safety.
- Addition of mounting straps on capacitors subject to breakage in transit.
- Use of high-voltage wire in high-voltage circuits in place of previous standard wire.
- Addition of tube clamps for tubes subject to jarring loose in transit.
- Addition of flange on chassis assembly to provide extra strength against rough handling.
- Addition of four bank supports to prevent breakage of banks during rough handling.
- Numerous mechanical refinements – better sockets, elastic stop nuts, rolled bead on cathode-ray tube shield, additional brackets.
- Change of negative rectifier from Type 1V to Army-Navy preferred Type 6X5GT/G.
- Change from 1/4-watt neon tube to Army-Navy preferred Type 991 voltage regulator tube for greater stability.
- Inclusion of frequency range adjustment potentiometer in time base as a factory adjustment, for accurate time-base frequency setting.
- Change from Type 6F8G tubes to Army-Navy preferred Type 6SN7GT, with improved performance.
- All composition resistors operated at less than 40% of power rating; capacitors at less than 80% of voltage rating.



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DUMONT *Precision Electronics & Television*

ALLEN B. DUMONT LABORATORIES, INC., PASSAIC, NEW JERSEY • CABLE ADDRESS: WESPEXLIN, NEW YORK around the tube, the electrons will travel in a straight line from the filament to the anode according to *A* of Fig. 13. But the introduction of a slight magnetic field—of small but stable value—will cause a curvature in the electron path (*B* of Fig. 13). The stronger the magnetic field, the greater the curvature of the electron path and the longer it will take for an electron to reach the anode—since the electron is being affected by two forces at right angles to each other.

The strength of the magnetic field can be slowly increased until, at a critical value of the field strength, the electron will miss the anode cylinder completely (*C* of Fig. 13) and, after describing a heart-shaped circular path, will return to the filament.

If the magnetic field intensity is increased beyond this critical value, the electron may be repelled by the cathode *after* completing its heart-shaped orbit. The electron may then make one or more excursions between the filament and the plate—each time following orbits in the interelectrode space—before finally coming to rest at the filament. This phenomena is illustrated by *D* of Fig. 13.

When the magnetron is operated with a magnetic field intensity just above the critical value, an electron will leave the filament, circle the resonant chamber, and return to the filament. Then the process will be repeated by the electron, and in this manner oscillations will be sustained.

One cycle is equivalent to an electron's journey out toward the anode and back to the filament, thus establishing the resonant frequency of the sustained oscillations.

By increasing the anode voltage of the magnetron, the electron can be speeded up. And thus, after a suitable readjustment of the magnetic field intensity, the magnetron can be made to sustain oscillations at any given frequency.

The action of a single electron in the resonant chamber of a magnetron is the identical action of the countless numbers of electrons actually emitted by the filament. In practical operation, the resonant chamber of a magnetron is dense with many electrons; each describing its own heart-shaped orbit, each moving at the same speed, and each taking the same amount of time in completing its interelectrode journey.

The combined result of this electron movement is a stable u.h.f. oscillation of very high power.

This output of the magnetron can be taken by means of a small loop inserted in the interelectrode space between the filament and anode.

A basic circuit showing the use of the magnetron as an r.f. pulse generator is given in Fig. 8.

In practical operation the magnetron does not oscillate during the quiescent period between modulator pulses, because the potential difference between the filament and the anode is not of sufficient value to sustain oscillations in the resonant chamber of the tube. However, when a high-voltage, *negative-going* control pulse from the modulator is applied to the filament of the magnetron, this has the same effect as applying an equally high positive voltage to the anode. With operating voltages and the magnetic field intensity at their optimum values, ultra-high-frequency oscillations will take place in the resonant chamber of the magnetron. When the modulator pulse is removed from the filament, the magnetron will cease oscillating.

It is important to note that the modulator pulse applied to the magnetron must rise to its full voltage value as soon as possible, remain at that full value for the duration of the pulse, and then decrease to zero as soon as possible. In other words, a very steep-sided, flat-topped, rectangular pulse form is required to control the oscillation of the magnetron.

The magnetron is a highly efficient u.h.f. oscillator, delivering r.f. pulses of extremely high power to a transmitting antenna.

(*To be continued*)

Television for the Amateur

(*Continued from page* 35)

erably higher than the bands on which the amateur is accustomed to operate, many of the circuits have become more or less conventional because of the much improved efficiency of the miniature and lighthouse type tubes, and the improved quality of insulating materials. Thus, the amateur can start out using essentially conventional circuits on the lower-frequency television bands, and, as his experience increases and his knowledge improves, he can gradually convert to waveguides and resonant cavities and progress to the higher frequencies.

It would be of great benefit to the amateur and possibly to television itself, if the FCC would allocate two or three television channels for the amateur in the 200-megacycle region. Here his range would be greater and his r.f. circuits absolutely conventional, permitting him to concentrate almost entirely on the television concepts. At the start, the FCC should also permit the amateur to establish his accompanying sound on some prescribed lower frequency channel. This leniency would considerably reduce equipment costs for the amateur and would avoid the additional complexities arising from possible interaction between picture and sound transmitters. In fact, a small "peanut whistle" on 5 or 160 meters would adequately cover the same range as the television transmitter. At some later date, when cost of high-frequency equipment is less, the sound transmitter can be moved up adjacent to the picture transmitter. The above allocations and regulations would encourage amateur television experimentations, because it holds the initial cost down.

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While production for civilian users may increase gradually, by far the greater part of our production will continue to be required for U.S. Armed Forces. We must and will meet all of their schedules on time.

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Once started, the amateur is certain to contribute to the sum total, just as he has in the war, and will progress to high-definition television and, some day, color television.

The Amateur Station

The amateur station need not be expensive. A complete station can be constructed for approximately $200, if there is a standard home television receiver available. Considerable sums can be knocked off this total if the amateur has an elaborate junk box, some power supplies, and a generous supply of resistors and capacitors.

The transmitter of the television station is most likely to be some sort of stable high-frequency oscillator, frequency multiplier, and final amplifier. The oscillator will have a resonant chamber or concentric tuned circuits for stability. The final amplifier will have transmission-line sections as tuned circuits and, generally, will be grid modulated by the composite television signal. Fortunately, there is no necessity for high power at these frequencies, as long as sufficient signal is delivered to the receiver input to overcome inherent tube noises. In fact, because of line-of-sight limitations, radiation at these frequencies is primarily an obstacle course and is more dependent on antenna placement and efficiency than on radiated power. The amateur has a fertile field for antenna experiments because the physical size is small and the cost of materials low. Highly directional transmitting and receiving antennas will greatly improve signal strength, and reduce interference. Field work (glider meets, etc.) with mobile and portable equipment will arouse considerable interest.

The most costly items of the video and pulse circuits of the transmitter are the iconoscope, special transformers, and tubes. The video amplifiers and sync generator, while reasonably complex and delicate of adjustment, contain relatively inexpensive component parts. An oscilloscope is almost a must in tuning up these circuits, although a television receiver known to be in good operating condition can be used as a satisfactory test circuit.

The receiver can be a very simple and effective piece of gear if the amateur has a home television receiver. To receive the signals from a higher frequency, an additional mixer, local oscillator, and possibly an i.f. amplifier is attached ahead of the home receiver. This double-superheterodyne television system performs satisfactorily if the composite television signal is properly constructed at the transmitter. Under certain circumstances, the signal construction at the transmitter can be simplified and still a satisfactory picture received, if a few minor adjustments and changes are made on the receiver. Some sort of a switching arrangement can be used to change over between amateur and commercial reception. Consequently, if the received signal is on 430 megacycles, the local oscillator is set on 497¼ megacycles, producing a 67¼-megacycle i.f. frequency which is amplified and fed into the antenna input of the home receiver. This frequency is the picture carrier frequency when the receiver is set on commercial channel three. If the amateur has no receiver available, he can build his own and adapt it for both amateur and commercial use.

Study Outline

What is an effective study outline for the amateur in preparation for ham television?

A. Review fundamentals. Stress the following:

1. Voltage distribution as frequency varies, for any arrangement of resistors, capacitors, and inductors, or shunt and series combinations of them. Effect of time constants on instantaneous voltages.
2. Properties of series and parallel resonant circuits.
3. Principles of vacuum-tube operation.

B. Operation of the cathode-ray oscilloscope.

1. Understand vertical and horizontal amplifiers, sweep circuits, and synchronization.
2. Oscilloscope operating circuits and power circuits.
3. Origin and information contained in various scope patterns.
4. How to use the test oscilloscope to its fullest.

C. High-frequency techniques.

1. Understand high-frequency oscillators, r.f. amplifiers, class C amplifiers, and methods of modulation.
2. Importance of correct physical layouts for high-frequency equipment. Be familiar with quarter-wave tuned lines, resonant chambers, transmission lines, and high-frequency antenna techniques.

D. Special circuits. Understand basic principles of the following:

1. video amplifier.
2. wide-band r.f. and i.f. amplifier.
3. wide-band antenna.
4. sawtooth generator.
5. pulse and sawtooth amplifiers.
6. pulse separator.
7. counter circuit.
8. multivibrator and blocking-tube oscillator.
9. d.c. restorer.
10. direct-coupled amplifier.
11. scope operating circuits.
12. clippers, limiters, and shapers.
13. keying circuits.
14. mixer and combining circuits.

E. General over-all function of the television system.

1. Trace the various signals from iconoscope to picture tube.
2. Contents and construction of the composite television signal.

F. Detailed circuit-by-circuit study.

1. Study each circuit carefully. Know how it operates and how it fits into the entirety.
2. Review and expand. Keep up with the latest developments.

—30—

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Belmont will offer the magic of television on large screen receivers. There will be Belmont radios inspiring in performance and beauty. Music lovers will be able to enjoy new worlds of tone delight with Belmont FM receivers and Belmont Radio and Phonograph combinations. Keep your eyes on Belmont! Belmont Radio Corp., 5929 W. Dickens Ave., Chicago 39, Illinois.

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LETTERS FROM OUR READERS

MORE PROS AND CONS

"FOR some time I have been reading the various articles and letters appearing in your magazine concerning screwdriver mechanics, licensing, etc.

"For a long time I have kept my thoughts to myself, but now I feel moved to make some comment.

"I was in the radio repair business before the war and I intend to be in it after the war. Screwdriver mechanics, local unions or cliques, licenses, etc., have never bothered me. I have attended to my own business and tried to be an honest and progressive businessman. Anytime I could be of service to my customers and business associates, I was always ready. From experience I know that servicemen can be of great help to one another if they so desire. So why maintain an unfriendly attitude toward your competitors? Down in your heart you may class him as a screwdriver mechanic and he may class you the same. This is no insult. We all started out as screwdriver mechanics.

"Truly I am not in favor of licensing radio servicemen. However, if it should come to pass, I feel that all legitimate servicemen can take it in their stride.

"However, I am in favor of local associations similar to the RETA of Indiana. It sounds like a good deal and should be of great service to the public as well as the service business.

"Here are a few lines to express my feelings for my chosen profession.

"I am proud of my profession, therefore, I will strive to make my profession proud of me.

"I am proud of my ability to service electronic equipment, consequently, I am going to keep up with my electronic education in order to maintain a high standard of service.

"I am proud of my shop and my test equipment and I will always keep it clean and up-to-date.

"In other words, I am going to have a good shop, do good work, use good parts, be honest with my customers and get a fair price for my work."

W. F. Babcock, W.O. (j.g.)
Somewhere Overseas

* * *

"MAYBE I'm pretty late with this, but if the big howl about 'screwdriver mechanics' is still raging, I'd like to throw my 'two cents' in.

"I think that the average neutral observer reading both sides of the argument as presented by the letters you have published, would agree that two distinct types of 'screwdriver mechanics' are under discussion. Those who are opposed to them are probably thinking of the type of serviceman who doesn't know his beans, who is a gyp like those who precipitated onto the trade the unfavorable glare shown by the *Reader's Digest*. Those who support the screwdriver mechanic are for the most part thinking of the serviceman who has no expensive equipment or a shop, no spare parts supply, no manuals and does most of his work with perhaps a half-dozen tools and a multimeter.

". . . The serviceman with all the equipment in the world may not know the fundamentals of servicing while the home tinkerer with a screwdriver and a meter, buying his parts from dealers as he needs them may be very adept at fixing sick sets.

"Of course, the majority of servicemen with established shops are capable. Many home tinkerers are incapable, but on the whole, I don't believe they are harmful. They certainly don't get a huge cut of the trade, nor are they too well trusted. The inexperienced home tinkerers should practice on their own sets or construction kits until they know their stuff and on the other side, no serviceman should practice a regular shop business unless he knows what he is about.

"I think licenses, if properly applied and possibly in graded qualifications, with two or more license ratings, could be very beneficial to the trade. Their objective should be not to eliminate the tinkerers, but the people who *don't know how,* whether established radio men or ignorant tinkerers."

Ted Chisholm, A/S USNR
Ithaca, New York

* * *

"I GET quite a bang out of the letters about the licensing of radio servicemen.

"We once had a proposal like that brought before the Washington legislature—but it did not pass.

"The writer is 46 years old and built the first tube radio in this town in May, 1922. I have been repairing radios off and on for 23 years.

"Most of my customers would tell you that I fixed up their sets pretty well, and an occasional one would tell you his set played better than when he first purchased it.

"In 23 years of servicing, I have never ruined anyone's set, although I can remember in the old days of burning out a tube occasionally. (Let all those who haven't, please stand.)

"One of my best recollections is of being called to a house to repair a radio. When I arrived, I found the electrical engineer of a large movie theater who was visiting these people at the time and he had attempted to repair the set; a battery Atwater Kent. He was unsuccessful. I found the trouble in a few minutes and charged the lady 25 cents. This engineer drew a salary of $300.00 per month.

"I got my first radio instruction

How to make BIG plastic parts seem LITTLE

Radio cabinets, housings, washing machine agitators and such—all the larger and more complicated pieces we used to mold before the war—all will go on the production schedules of smaller, simpler pieces when we get into normal production again. They will have better finishes, more uniform cure, truer color and freedom from internal stress. In other, shorter, words, "Happy Day!"

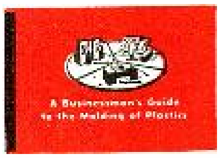
All we'll have to do is hook up our battery of Heatronic units (*first* in the industry—and still growing) to serve our 500-ton presses.

Better start figuring now on how Plastics plus Heatronics can fit into *your* postwar production plans. But figure it with a custom molder whose reputation for molding already combines with real Heatronics knowledge—a molder like Kurz-Kasch. We mold all materials by compression and transfer—we handle the whole job from design to delivery—our experience with Heatronics dates back to the first unit RCA sold—and we've been growing with the plastics industry since it began.

Isn't that the kind of organization you'll want for your plastics production? Yes? Just write!

"A Businessman's Guide to the Molding of Plastics"

Send for your free copy of this illustrated brochure. Just write to Dept. 7 on your letterhead and we'll send it with our compliments.



Kurz-Kasch

For over 28 years Planners and Molders in Plastics

Kurz-Kasch, Inc., 1429 South Broadway, Dayton 1, Ohio. *Branch Sales Offices:* New York • Chicago • Detroit Indianapolis • Los Angeles • Dallas • St. Louis • Toronto, Canada. *Export Offices:* 89 Broad Street, New York City from the *Portland Oregonian* and from Radio News and other magazines and from hard experience. I know I am no wonder at radio, but I also know that I am no worse than some of these radio designers who certainly must get on an awful binge before designing a set.

"Why don't radio designers build a "mock up" and then try to repair it before turning it out on the public?

"I hope no American radio company will ever turn out a set again with a dial cable. Geared dials with split gears and springs to spread the teeth to stop back lash are best.

"Also, no more tubes with caps to pull off the top, I hope.

"Now, it may interest these licensing boys to know that the writer has been a bedfast invalid for the past three years, but I have never stopped servicing radios except when I was too ill."

Ellsworth Price
Castle Rock, Washington

* * *

"READING over the letters published in your last issue and noting that you ask for more, I am taking this moment to do a little advising on my own account.

"My complaint is against all manufacturers of radio receiving sets. To begin with, an ordinary useful radio set is a piece of apparatus used to bring in an intelligible signal which should be as near like that transmitted as possible. Nothing more or less. We have displayed several thousands of ways of doing this, one no better than the other in the aggregate. This causes quite a lot of useless trouble to the serviceman in small communities as he has to be almost a radio engineer for every factory in the whole United States.

"I note pages and pages in Riders for many big manufacturers which all bring the same results. (Let me state right here that it is impossible to service any radio without Riders Manuals and fourteen volumes are expensive for the small radio shop.) There seems to be no standard place for putting any of the parts.

"There never was any need of manufacturing so many different tubes. The tube manufacturers seem to have used this method of forcing upon the distributor a lot of useless tubes which is reflected on down to the serviceman's cost.

"I have been running this small, out-of-the-way radio shop ever since the WD 11 came onto the market. I now have on hand one of these tubes. In all these years, I have managed to keep my friends' and neighbors' radio sets going. I am past sixty-five now and getting ready to quit within the next ten years. I have never found it good policy to knock a competitor. The 'knockers' have drifted off into nothingness. I have seen some screw driver radio men turn out to be experts in the line and for that reason, I believe this licensing scheme is all 'bosh.' I have learned much from these so-called screwdriver mechanics and I have given quite a few of them a leg up. More strength to them. At present I have all the work and more than I am physically able to do, and I am looking forward to the time when the boys will be back to take over."

W. Harvey Merwin
Jensen, Florida

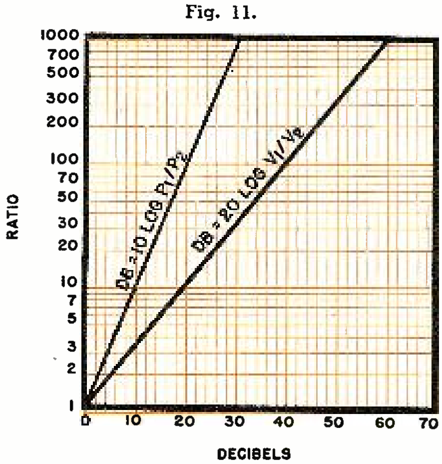
—30—

Plotting Eng. Data

(*Continued from page* 58)

graph involves less labor in preparation as well as greater utility in reading. Referring to Figs. 5 and 11, the former may be drawn precisely only when a large number of points are known; two accurately determined points will enable the curve to be

Fig. 11.



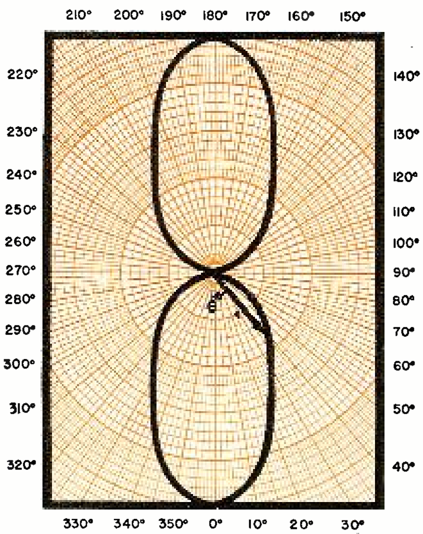


Fig. 12

drawn as that illustrated in Fig. 11.

A few minutes spent to analyze the data from the standpoint of graphic display frequently saves much time in the end, and almost always results in greater utility.

—30—

5″ Oscilloscope

(*Continued from page* 38)

Vertical Input. When switch S_2 is in the "EXT" position, the vertical deflection plates of the oscilloscope tube are connected directly to the vertical input terminals, "V" and "COM" and are in position to receive a signal directly without amplification. When S_2 is at "AMP," vertical input terminal "V" is connected to the grid of the vertical amplifier tube, V_6, through coupling capacitor C_{23} and gain control R_{21}. The vertical deflection plates then receive their excitation voltage directly from the output of the amplifier. The degree of amplification of the input signal may be adjusted by gain control R_{21}.

Horizontal Input. The horizontal input terminals, "H" and "COM," are connected directly to the horizontal deflection plates of the oscilloscope tube when switch S_6 is in the "EXT" position. The horizontal plates thus may receive a signal directly from the input terminals without amplification. When S_6 is at "LS" (linear sweep), the horizontal deflection plates are connected to the plate-output circuit of the horizontal amplifier, V_5, through coupling capacitor C_7. In the grid circuit of this amplifier is located switch S_5 which in the "LIN" (linear sweep) position selects linear sweep voltage from the saw-tooth oscillator, V_4. When S_5 is at "EXT," the grid of the horizontal amplifier is connected through coupling capacitor C_{19} to terminal "ESA" (external sweep amplifier) to which, in turn, may be connected a source of ordinary or special sweep voltage. This sweep voltage then will be amplified by V_5 before it is applied to the horizontal deflection plates.

Sweep Oscillator

Linear Sweep Oscillator. The linear sweep (linear time base) circuit is the saw-tooth oscillator comprised by the gas triode V_4, the coarse frequency control consisting of rotary selector switch S_1 and the associated capacitors C_{10} to C_{16}, the fine frequency control consisting of rheostat R_8, and the synchronization control consisting of potentiometer R_{13}.

The following frequency ranges are covered by the fine frequency control (R_8) when the coarse frequency control (S_4) is in its various positions: Position 1, 20 to 59 cycles; position 2, 43 to 132 cycles; position 3, 109 to 340 cycles; position 4, 280 to 880 cycles; position 5, 670 to 2180 cycles; position 6, 1500 to 4900 cycles; and position 7, 3600 to 11,400 cycles. Position 8 is an "OFF" position, but since the inherent switch and circuit capacitance (a small value) is in the circuit when the switch is in this position, the circuit oscillates at a higher rate than that shown for position 7.

GREATER NEW YORK AMATEURS TO HOLD HAMFEST

THE North Shore Radio Club of Long Island has announced that it will sponsor the first "Hamfest" to be held in the Greater New York area since the war on Friday, August 24th, at the Community Gardens Ballroom, 215-32 Jamaica Avenue, Queens Village, Long Island, New York.

In announcing the event, Mr. John DiBlasi, president of the club, pointed out that this meeting should be good news to all those who follow amateur radio as an avocation as the meeting will provide an opportunity to discuss mutual interests. The meeting will be open to all radio amateurs in the Greater New York and Long Island areas.

While the "Hamfest" program for August 24th will feature one prominent speaker on "What the Hams Have Done in the War Effort and What They Can Expect Post-War," the evening's program will be mostly informal and will include entertainment, movies, door prizes, and an opportunity for all interested in the art to get together for exchange of ideas.

Tickets at fifty cents are available at Greater New York radio stores dealing in amateur radio equipment or from North Shore Radio Club members and at the door. Communications for the North Shore Radio Club should be addressed in care of F. A. Long, 46-41 Forest Drive, Douglaston, Long Island, New York.

—30—

Synchronization. The linear sweep oscillator may be synchronized at the frequency of an external voltage, the source of which is connected to terminals "SYNC." and "COM.," by throwing switch S_3 to "EXT." and adjusting potentiometer R_{13}.

Synchronization may be obtained at 60 cycles by throwing S_3 to the "60-CYCLE" position and adjusting R_{13}. In this position of the switch, a 60-cycle voltage, supplied by the 5-volt secondary of transformer T_1, is delivered to the grid of the gas triode through the coupling capacitor (C_8), gain control (R_{13}), and limiting resistor (R_{12}).

If an input signal (at the vertical input terminals) is to synchronize itself, an external jumper must be run between the "V" and "SYNC." input terminals, and switch S_3 thrown to "EXT."

Construction

Mechanical Construction. It is suggested that the layout of the complete oscilloscope follow the same lines recommended for the basic instrument (See Fig. 2). However, the chassis, panel, and case of the complete oscilloscope must be somewhat larger than in the preceding instance.

The power transformer, T_1, will occupy the same position as shown in Fig. 2. But, the extra filament transformer, T_2, will be mounted under the chassis, as will also the small filter choke, *CH*. T_2 and *CH* should not be mounted closer together than 3 inches.

The two rectifier tubes will be mounted, as in Fig. 2, toward the rear of the chassis, close to the upright back plate. The doubler capacitors (C_3 and C_4) will be in the same position as in Fig. 2, and the dual filter capacitor (C_5-C_6) as close as possible to C_3 and C_4. The amplifier and sweep oscillator tubes will be mounted near the front panel.

All of the switches (S_1 to S_6), controls (R_3, R_5, R_8, R_{13}, R_{17}, and R_{21}), and the input terminals ("H," "V," "COM," "ESA," and "SYNC") are mounted through the front panel. It is advisable to enclose the frequency range capacitors (C_{10} to C_{16}) in a can mounted directly behind the selector switch, S_4.

Shielded leads must be run from all points of switches S_2, S_6, and S_5 and of controls R_{17} and R_{21}. This is in order to minimize hum and stray field pickup.

Manipulation of Complete Oscilloscope

To place the complete oscilloscope into operation: (1) Turn brilliance control R_5 and gain controls R_{17} and R_{21} to lowest settings; (2) Set S_3, S_5, and S_6 to "EXT" positions; (3) Insert line plug into 115-volt a.c. receptacle, and throw switch S_1 to "ON" position; (4) Allow about 1 minute for tube heaters to reach normal operating temperature; (5) Advance brilliance control R_5 slowly, noting appearance of luminous spot on 'scope-tube screen—do not increase brilliance beyond point of good visibility, as a bright stationary pattern will damage the screen; (6) Adjust focus control R_3 until luminous spot is clear and sharp. Oscilloscope now is ready for use and may be used in any of the ways described below.

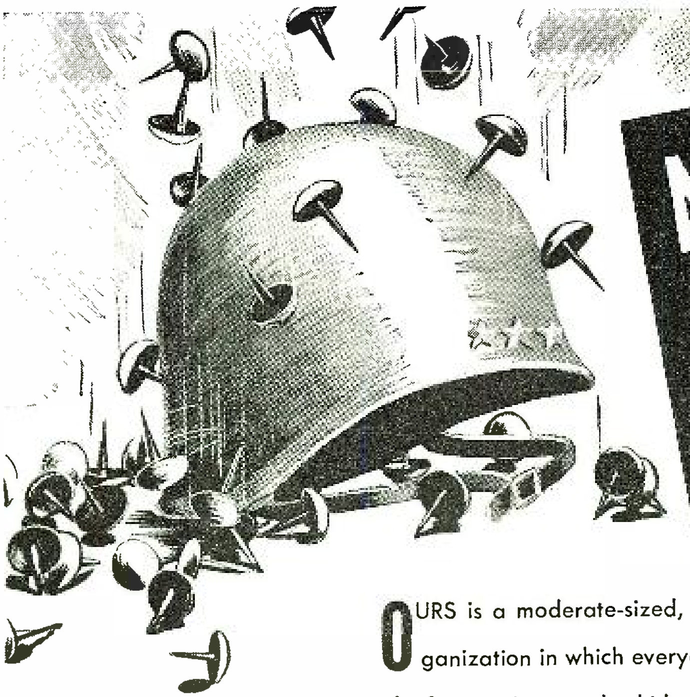
D.C. Signal—No Sweep. (1) Set R_5, R_{17}, and R_{21} to lowest positions; (2) Set S_2, S_3, S_5, and S_6 to "EXT"; (3) Insert line plug into 115-volt a.c. receptacle, and throw switch S_1 to "ON" position; (4) When tubes have heated, adjust brilliance and focus controls for clear luminous spot on screen; (5) Note position of spot; (6) Apply d.c. test voltage to vertical input terminals "V" and "COM," noting that spot is deflected upward on screen when terminal "V" is positive and downward when "V" is negative. The distance over which the spot is displaced is proportional to the value of applied d.c. voltage.

A.C. Signal—No Sweep. (1) Set R_5, R_{17}, and R_{21} to lowest positions; (2) Set S_2, S_3, S_5, and S_6 to "EXT"; (3) Insert line plug into 115-volt a.c. receptacle, and throw switch S_1 to "ON" position; (4) When tubes have heated, adjust brilliance and focus controls for clear luminous spot on screen; (5) Apply a.c. test voltage to vertical input terminals "V" and "COM," noting that spot is rapidly deflected up and down to trace a vertical line on screen (length of this line is proportional to the peak-to-peak value of the applied a.c. test voltage); (6) If a.c. test voltage is too low to produce a readily measured line on the screen, use vertical amplifier by throwing switch S_2 to "AMP" position and adjusting gain control to a predetermined value which will afford the desired gain.

A.C. Signal—Linear Sweep. Operate oscilloscope with or without vertical amplifier in manner described in the preceding section, except: (1) Switch-in linear sweep oscillator by throwing S_5 to "LIN" and S_6 to "LS"; (2) Adjust S_4 and R_8 for best sweep frequency; (3) If stationary pattern is desired, synchronize sweep oscillator. For 60-cycle synchronization, throw S_3 to "60-CYCLE" position and adjust R_{13}. For synchronization at frequency supplied by external oscillator (connected to terminals "SYNC" and "COM"), throw S_3 to "EXT" and adjust R_{13}. For self-synchronization of signal, run jumper externally between "SYNC" and "V" terminals, throw S_3 to "EXT," and adjust R_{13}.

A.C. Signal—Non-Linear Sweep. Operate oscilloscope with or without vertical amplifier in manner described in preceding sections, except: (1) Connect source of non-linear sweep voltage to terminals "ESA" and "COM"; (2) Throw S_5 to "EXT," S_6 to "LS," and S_3 to "EXT." This method is used frequently for the comparison of two frequencies by means of Lissajou's figures, one signal source being connected to terminals "V" and "COM" and the other to terminals "ESA" and "COM," as described above.

—30—



No Brass Hats Here-- JUST BRASS TACKS!

OURS is a moderate-sized, compact organization in which everyone from the chief executives to the kid who runs the blue print machine is dedicated to just one purpose. That purpose—to design and build efficient, dependable Radio Transmitting Equipment—our exclusive specialty.

We have been at it successfully since 1922—long enough to gain genuine, practical know-how in every phase of the business. That experience, plus engineering ability and precision workmanship, add up to the kind of Equipment which appeals to Engineers and Station Managers alike.

Let us tell you more about GATES Transmitting Equipment—and about the GATES Priority System for Prompt Post-War Delivery! Write today!

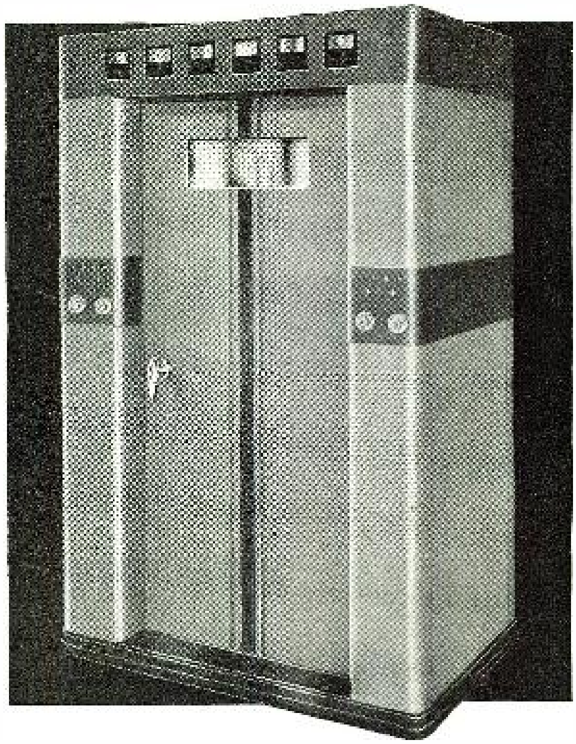
GATES RADIO CO.

GATES RADIO CO. QUINCY, ILLINOIS

GATES ONE KILOWATT BROADCAST TRANSMITTER

This new Transmitter, utilizing many wartime developments, will meet the exacting demands of peacetime broadcasting. Its proven dependability—plus its modern, streamlined appearance—fit it perfectly into tomorrow's Radio Station. Accurately engineered, with all parts conveniently accessible. The pressure-type cabinet keeps out dust and helps assure cool operation. High fidelity performance.

Detailed bulletin on the GATES 1 KW Transmitter will soon be available.



PROGRESS REPORT

Wartime limitations prohibit the sale of new broadcasting equipment without priority. Hence the above equipment is presented only to familiarize you with another new GATES development.

GATES RADIO CO. QUINCY, ILLINOIS

EXCLUSIVE MANUFACTURERS OF RADIO TRANSMITTING EQUIPMENT SINCE 1922

S. GORDON TAYLOR has joined the staff of *Murray Hill Books* as manager of the Technical Division.

For the past year, Mr. Taylor has been associated with the Columbia University Division of War Research at the U.S. Navy Underwater Sound Laboratories at New London as a member of the scientific staff and technical editor.

In 1930 he was appointed technical editor of RADIO NEWS and in 1934 became managing editor. In 1938 he established his own organization for technical writing and promotion work in the radio and electronics field.

Since the entry of this country into World War II, Mr. Taylor has been connected with the Signal Corps in various capacities.

* * *

GRENBY MANUFACTURING COMPANY of Plainville, Connecticut and *The Allen D. Cardwell Manufacturing Corporation* of Brooklyn, New York have announced the consolidation of the two companies. Both companies will maintain their present corporate identity and will continue their present management.

The Grenby Manufacturing Company manufactures precision machine tools and radar equipment, while *The Allen D. Cardwell Manufacturing Corporation* have been producers of electronic equipment for many years.

* * *

J. HARROLD BLAIR has been appointed Sound Communications Engineer for *Walker - Jimieson, Inc.* of Chicago, according to the announcement of Paul H. Chauncey, manager of the Sound Communications Department.

Mr. Blair comes to *Walker-Jimieson* from *Operadio Manufacturing Company* where he held the position of Sales Engineer. Mr. Blair has been responsible for the installation of many industrial music and paging systems in the Chicago area.

* * *

CLAROSTAT MANUFACTURING COMPANY, INC., has announced the appointment of two new sales representatives for their line of resistors, controls and resistance devices.

Wood and Anderson Company of St. Louis, Missouri, will represent the *Clarostat* line in both the industrial and jobbing fields in their territory while *Henry P. Segal Company* of Boston, Massachusetts, are to represent the company throughout the New England territory.

* * *

JOHN MECK INDUSTRIES of Plymouth, Indiana has announced the appointment of Bert L. Bethel to the post of Director of Purchases.

Mr. Bethel was formerly associated with the Bendix Aviation Corporation in the Pacific Division as Chicago and Eastern representative.

* * *

RAYTHEON MANUFACTURING COMPANY has announced that the Radio Receiving Tube Division office has been moved from 420 Lexington Avenue to the Lincoln Building, 60 E. 42nd Street, New York, N.Y.

The general sales headquarters of the division will remain indefinitely at 55 Chapel Street, Newton, Mass.

* * *

BERNARD S. TUCKER has been appointed California district merchandiser for the Radio and Appliance Division of *The Sparks-Withington Company*, manufacturers of *Sparton* Radios.

Mr. Tucker joins *Sparton* after some twenty years in the radio and appliance field. He has been associated with *Radiobar Company of America, Sherman Clay Company* and *Benwood-Linze Company* of St. Louis.

Mr. Tucker plans to make Los Angeles his headquarters for the California sales promotion work on *Sparton* Radios. His new office will be located at 3748 W. 9th Street, Los Angeles, California.

* * *

GOTHARD MANUFACTURING COMPANY of Springfield, Illinois, are erecting a new, daylight plant to house the company's engineering and manufacturing activities.

The plant will include an enlarged engineering and research department. The company manufactures pilot light assemblies for electronic and electrical equipment and appliances.

* * *

BENDIX RADIO DIVISION of *Bendix Aviation Corporation* has announced that a complete line of radios and radio-phonograph combinations for marketing in West Coast trading areas will be manufactured by the company on the Pacific Coast.

The new move, according to W. P. Hilliard, general manager of the Radio Division, will give Far Western dealers and the Pacific Coast radio

Only Cornell-Dubilier could build this Giant Tank Capacitor

When an unusual problem in capacitors arises, engineers think first of C-D. A case in point is this giant mica tank capacitor for a transoceanic transmitter. It is now in use and combines space - saving design with the capacity of much larger units.

No matter what kind of capacitor you require, C-D can design and build it for you. Discuss your capacitor requirements with our engineers. They will welcome the opportunity to help. Cornell-Dubilier Electric Corporation, South Plainfield, N. J.

FROM THE LARGEST TO THE SMALLEST — WE MAKE THEM ALL

Other plants at:
New Bedford, Brookline, Worcester, Mass. and Providence, R. I.

CORNELL-DUBILIER
First in Quality **CAPACITORS**
MICA · DYKANOL · PAPER · ELECTROLYTICS

buying public the benefits of more efficient delivery service and lower costs made possible by reduced shipping charges on both materials and finished products.

* * *

ANSLEY RADIO CORPORATION has announced the appointment of fourteen new representatives throughout the United States to handle the company's line of *Dynaphone* radio-phonographs and electronic pianos.

The following companies will be Ansley representatives: R. A. Adams of Detroit, Frank H. Barstow of Los Angeles, C. A. Clinton of Albany, New York, Reid H. Cox and Company of Atlanta, Georgia, Hal Elthorn of Chicago, W. G. Landes of San Francisco, Fillmore and Fillmore of Buffalo, Earl Goetze of Kansas City, Missouri, W. A. Leiser and Co. of Philadelphia, P. F. McMorrow of Cleveland, J. O. Olsen of Cleveland, Harry D. Schoewald of Chicago, Fred A. Siebe of St. Louis and Donald D. Wood of Dallas.

* * *

GODFREY WETTERLOW has been named Eastern sales manager of the radio-phonograph division of the *Meissner Manufacturing Company* of Mt. Carmel and Chicago, Illinois, according to the announcement of Oden F. Jester, vice-president.

Mr. Wetterlow comes to Meissner with a diversified background in radio and sales promotion. He was formerly assistant to the president of *Philharmonic Radio Corporation* of New York and for several years headed his own advertising agency in New York and Boston.

Mr. Wetterlow will make his headquarters in Greenwich, Conn., and will cover the entire Eastern seaboard for *Meissner*..

* * *

THE TURNER COMPANY, of Cedar Rapids, Iowa has appointed William A. Baldwin to the newly-created post of Comptroller.

In his new position as Comptroller for the *Turner Company,* Mr. Baldwin assumes charge of all purchasing and takes over credit and availability matters formerly handled by William J. Nezerka who has been advanced to assistant manager in charge of sales.

* * *

GENERAL TELEVISION AND RADIO CORPORATION has announced the removal of the company to a new building recently purchased at 2701-17 Lehmann Court, Chicago.

This building was formerly occupied by *Press Wireless. General Television* took possession of the property on June 10th.

* * *

HERMAN L. HIRT, assistant to the president of *International General Electric Company,* died recently of a heart attack. He was 41 years old.

Mr. Hirt joined the *General Electric* organization as a student engineer. In 1930 he became patent attorney for the company in Washington, D.C. In 1937, he was named assistant counsel of the *International General Electric Company* and five years later he was appointed assistant to the president.

* * *

R. J. WILSON has been named Sales Manager of the Jobber Division of *The Alliance Manufacturing Company,* Alliance, Ohio, according to the announcement of R. F. Doyle, General Manager of the company.

Mr. Wilson, who served as a captain in the Army, received his discharge recently and will now take on the jobber line as part of the new expansion program of the company.

Mr. Doyle also announced the appointment of John Bentia to the post of Sales Manager of the Manufacturing Division of the company.

These two appointments were the last in a series of organizational changes made by the company in preparation for the postwar period.

* * *

STUPAKOFF CERAMIC AND MFG. COMPANY has announced the appointment of *Electrical Specialty Company* as their sales representatives in the West Coast area, comprising the states of Oregon, Washington and California.

The *Electrical Specialty Company* will be agents for *Stupakoff's* complete line of insulators of steatite and other ceramic materials, Kovar metal and Kover-glass seals for hermetic sealing applications.

The main offices of *Electrical Specialty Company* are located in San Francisco, with branch offices in Seattle, Portland and Los Angeles.

* * *

W. A. PATERSON has joined the staff of *Webster-Chicago Corporation* in the capacity of mechanical and electrical engineer.

Mr. Paterson holds his Master's degree in electrical engineering from the University of Minnesota and comes to the *Webster* organization from *Victor Research Laboratories.*

He was formerly associated with *Minneapolis-Honeywell* and *National Mineral Company* as an engineer.

* * *

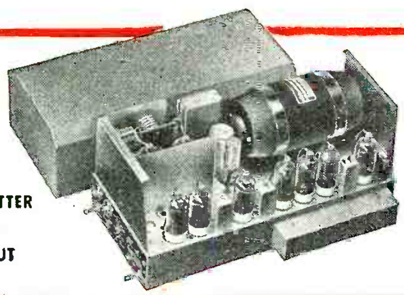
THE ELECTRONIC CORPORATION OF AMERICA has completed detailed plans for the disposal of electronic and communications equipment and components released by the Armed Forces, according to the announcement made by S. J. Novick, president of the company.

The company has acquired a six story building at 353 West 48th Street in New York which will be

KAAR makes 50 and 100-watt mobile FM practical with instant-heating tubes

Kaar engineers—who pioneered instant-heating AM radiotelephones—have done it again! In presenting the new KAAR FM-50X and FM-100X, they now give you the advantages of FM *plus* instant-heating tubes . . . greater power and range with lower battery drain! Standby current is zero. Yet the instant you press the button microphone, you are on the air with a full 50 or 100 watts output, improved voice quality, and minimum distortion—sending out a strong, clear message that insures excellent reception.

KAAR FM TRANSMITTER
MODEL FM-50X
50 WATTS OUTPUT



KAAR

ENGINEERING CO.

PALO ALTO • CALIFORNIA

Export Agents: FRÁZAR & HANSEN • San Francisco, California used exclusively as a factory and warehouse in connection with the processing and distribution of electronic equipment as an agent of the Defense Supplies Corporation.

* * *

MORRIE W. ROSENFELD, field manager of *Emerson Radio and Phonograph Corporation,* has temporarily assumed the duties of general sales manager of the company.

He succeeds Charles Robbins who recently resigned to engage in business for himself.

Mr. Rosenfeld was formerly district manager of the New England and New York State territory for the company.

In his new work, Mr. Rosenfeld is now enlarging the sales and field service staffs of *Emerson Radio* and is directing the company's distributor-dealer-salesman training program preliminary to the firm's announcement of postwar promotion campaigns.

* * *

HOFFMAN RADIO CORPORATION of Los Angeles has announced the appointment of *Radio Parts,* as the Arizona distributor for the company products.

Radio Parts is owned and operated by Kenneth Sloan and is located at 36 Madison Street, Phoenix, Arizona.

* * *

BELMONT RADIO CORPORATION has announced the leasing of additional factory space in Chicago to accommodate the surplus military electronic equipment which they will handle as an agent of the Defense Supplies Corporation. The plant, which will ultimately occupy 72,000 square feet of floor space, will serve as a regional redistribution center for electronic and radio material that is obsolete or surplus for military needs or has been salvaged.

Equipment to be disposed of through the *Belmont*-operated plant will be that released by the Signal Corps or the Navy and not returned to the original manufacturers for disposal as agents of the Defense Supplies Corporation.

The plan for the establishment of the central redistribution plants was developed by Lester L. Kelsey, executive in charge of war contracts negotiations for Belmont.

* * *

R. M. BROPHY, president of *Rogers Majestic Limited* and *Rogers Electronic Tubes, Limited,* has been reelected president of the *Radio Manufacturers Association of Canada.*

Also reelected to the vice-presidency was S. L. Capell, vice-president and general manager of *Philco Corporation of Canada, Limited.* W. W. Richardson was re-appointed general manager of the association.

In his annual report to the association, Mr. Brophy revealed that in 1944 the Canadian radio industry produced for Canada and its allies, 200 million dollars worth of electronic equipment as compared to an annual prewar production of approximately 15 million dollars.

* * *

WARWICK MFG. CORP. has announced the appointment of *Western Reserve Distributors* of Cleveland, Ohio, as distributors for the company's line of Clarion radios.

Western Reserve Distributors will handle 24 counties in Northeastern Ohio, according to Reau Kemp, General Sales Manager of *Warwick.*

In addition to the Clarion line, the company handles Deepfreeze and Crown ranges.

* * *

JOHN B. HARLOW, contract license manager of the Electrical Research Products Division of *Western Electric Company* passed away recently at his home following an acute heart attack.

Mr. Harlow, who was 61 years old, was associated with the *Bell System* for over 35 years.

He entered the engineering department of *Western Electric* in 1910 and by 1923 had advanced to telephone sales engineer. In 1936 he became contract license manager of the company, a position he retained when Electrical Research Products became a division of *Western Electric Company* in 1942.

* * *

H. H. VAN LUVEN is the new sales representative for the *Operadio Commercial Sound Division* in southern California and Arizona, according to the announcement made by F. D. Wilson sales manager of the Division.

Mr. Van Luven, who is well known in the electrical engineering field in the Los Angeles area will not only act as a sales representative but will maintain a complete line of *Operadio* equipment. He will stock Plant-Broadcasters, Flexifone inter-office communication systems, loudspeakers and amplifiers as soon as priority regulations are relaxed.

* * *

THE RADELMA COMPANY has recently been organized in New York by Harry Adelman, advertising and sales promotion manager.

The new company, which is located at 53 Park Place, New York 7, New York, will specialize in export of radio equipment.

Mr. Adelman was associated with *Sun Radio and Electronics Company* of New York for five years as advertising and sales promotion manager of the company.

The Radelma Company will handle a complete line of radio and electronic components as well as complete receivers and transmitters for the export trade.

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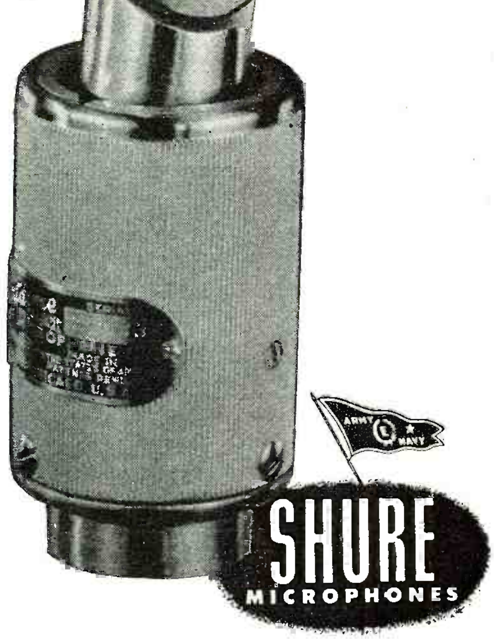

—*Your Microphone is here*

As outstanding manufacturers of microphones for war —Shure offers a complete microphone line. You will find the proper microphone for every need above. A complete description of any model will be furnished upon request.

A. Super-Cardioid Broadcast Dynamic
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Instrument Landing

(*Continued from page 27*)

actuation for the needle on the pilot's indicator. The resultant is a controlled attitude of the needle or "on-course."

The glide path equipment, which operates in the same fashion, is sited near the approach end of the runway and to one side. The antenna is rotated away from the runway to avoid the possibility of the plane's following the path into the transmitter.

Since the radiation of the localizer provides horizontal guidance its lobes are laid side by side with the usable area lined up with the runway. The glide path antennas are so arranged as to stand these lobes on end, thus placing the usable area on an inclined plane down which the plane can fly to the ground.

The markers, mounted on "jeeps," are sited as follows: The boundary marker is on the approach end of the runway and is unkeyed, providing a steady indication on the pilot's bulb; the middle marker station is driven one mile from the approach end and in line with the same runway (this position is keyed at six dots or flashes per second); the outer marker is situated in line with the runway at a distance of approximately four and one-half miles from the point of contact, and is keyed in slow dashes (two per second).

All units being mobile, they are powered by gasoline-driven power supplies and the entire system can be set up for operation on a choice of runways in one-half hour's time.

Each component unit is supplied with a frequency-modulated transceiver by means of which the operators are informed of developments by the control tower. Voice communication is used over this short range.

Pilot procedure for the system is a tribute to the efforts of the designers. Consideration was accorded to the fact that a pilot completing a combat mission would not be in the proper physical or mental condition to successfully negogiate a tedious, drawn out procedure involving critical calculations, dial manipulation and variance from his usual flight habits. The result is a simple visual checking of two needles against his directional gyro and observation of the flashing of his marker beacon bulb.

Provided a plane has been "homed" or flown to an area near the airport (as is the usual case) the pilot calls the tower and requests landing instructions.

The tower operator provides the ship with the compass or gyro heading of the runway to be landed upon. The pilot is also instructed to snap on his instrument landing equipment switch and select the crystal frequency being used. This is also accomplished by the simple expedient of snapping a selector switch.

When the plane's receivers are warmed the localizer needle will be noted for deflection.

The pilot maintains normal flight altitude and attempts to straighten up the needle by flying against it (opposite direction) and checks his compass or gyro heading with the reciprocal of that on which he intends to land. If the ship is to be landed on runway 180° or No. 18 he will first establish a heading toward 360° or No. 36.

When this heading has been established he will be flying in line with but away from the runway he intends to use for the landing. He is able to test this by checking his localizer needle for reverse action. If he flies right the needle should deflect to the left.

If he discovers he is flying in the wrong direction a standard rate 180° turn will correct same. Inspection of his gyro will serve as a double check, if desired.

As he flies the localizer course away from and in line with the runway he will note the keyed flashing of his bulb as he passes over each marker station.

After crossing the outer position (4½ miles out) he continues to fly out for an additional 45 seconds and then starts a standard rate turn and let down into his final approach. This turn is usually accomplished at approximately 1200 ft.

Heading back toward the runway and flying the localizer course again he calls the tower for final approach instructions and if cleared to land attempts to cross the outer station at about 800 ft.

At this point he adjusts his flaps and throttles as in a normal landing.

He also notes that his glide path needle (cross-haired with the localizer in true course position) is now active.

Using the localizer needle to bracket his heading and checking with his gyro he now attempts to establish an acceptable angle of glide with the aid of the needle which deflects up and down.

He is now approaching the runway and transmitters and therefore he observes true sensing or follows the needles.

It is important to note that pilots who are unable to establish an acceptable heading at this point are recommended to reject the attempt and initiate a new approach. Experience has revealed that continued effort to change the ship's attitude at this stage usually results in failure and is extremely hazardous.

After passing the two remaining markers at 200 ft. and 50 ft. respectively he adjusts his throttles as in normal landing technique and follow the needles right on down to the runway.

This complete procedure is strictly adhered to and practiced daily at Scott Field on a B-17 plane for the student's benefit.

It is through this method that he learns not only the result of his ef-

forts on the ground but more important he acquires a sense of responsibility as he becomes acutely aware of the pilot's dependence on the efficiency of the landing crew.

A contributing factor also is that he has now actually landed a plane on the system and is in a fine frame of mind to convince the skeptical of the ability of the system to do its specified job.

Perfection is the keynote throughout the course at Scott Field for there is no such thing as "fairly close" when it comes to setting a couple of tons of speeding bomber onto a narrow runway. When Scottsmen finish the instrument landing course they know they can set a plane down as gently as they would an egg, only their eggs carry a live brood.

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Television Sound Channel

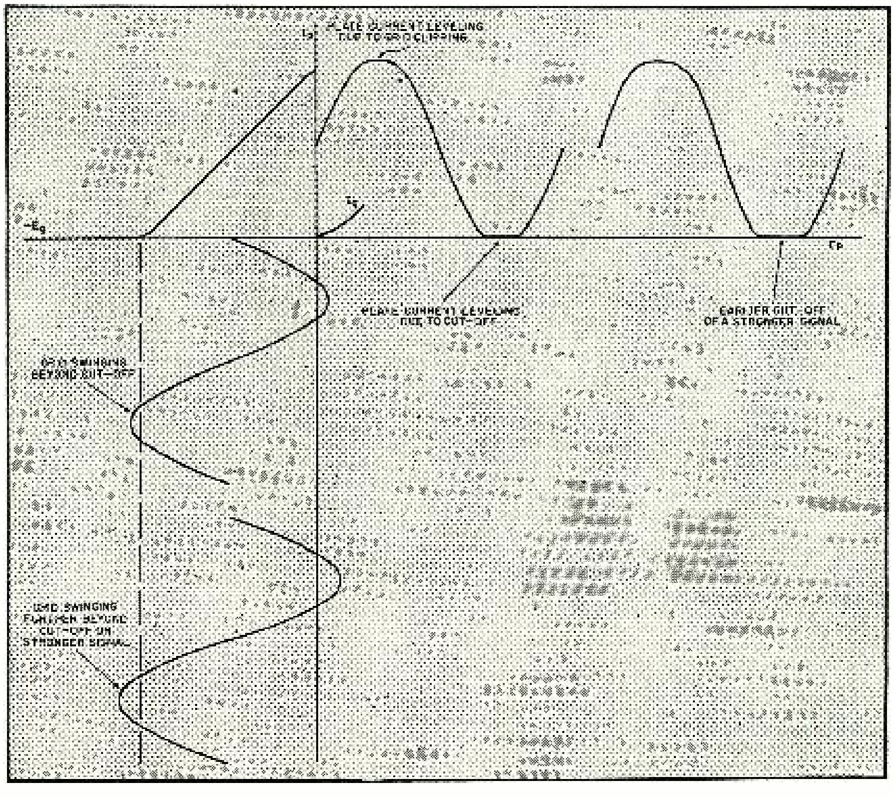
(*Continued from page* 54)

frequency swings to the other side of center frequency, placing a greater voltage on diode #2 and causing a negative audio alternation at the output. Therefore, if there is 400-cycle modulation, which means the i.f. frequency is being shifted above and below the center frequency this many times per second, one diode contributes the greater output on one alternation of the modulation cycle, and the other diode contributes the greater output, of opposite polarity, during the other alternation.

Two voltages are transferred to the input circuit of the discriminator; one a direct voltage which is capacitively coupled through C_1, and the second a resonant voltage which is induced into the discriminator tuned circuit by mutual coupling from the primary or limiter plate tuned circuit. The direct voltage appears across choke L_3 and therefore is impressed as an equal diode voltage on each plate. This impressed voltage is equal to, and in phase with, the limiter plate voltage, and can be compared rather loosely with a resistor-capacitor coupled stage in which the choke is replaced by a resistor as shown in Fig. 8. While it first appears as though the voltage across L_3 would lead the signal current, it must be remembered that L_3 has a very high reactance (L_3 is commonly called a choke) at the i.f. frequency and is in shunt with the lower reactance inductor of the plate-tuned circuit. Consequently, the voltage across L_3 assumes essentially the phase of the voltage across the tuned circuit. This voltage appears equally on both diodes, Fig. 3, and therefore, there would be no output from the discriminator if it were the only voltage in the discriminator circuit. The choke itself presents a high reactance to the i.f. frequency, but does not impede the flow of rectified diode current, improving diode efficiency.

A second voltage, which also divides equally between the two diodes, is induced by mutual coupling into the discriminator tuned circuit. This voltage divides equally, but out-of-phase, across L_1 and L_2. Here again, if it were the only voltage in the discriminator circuit, both diodes would draw the same average diode current and there would be no output, regardless of the frequency of the i.f. Thus,

Fig. 6. Leveling operation occurring in the limiter stage.



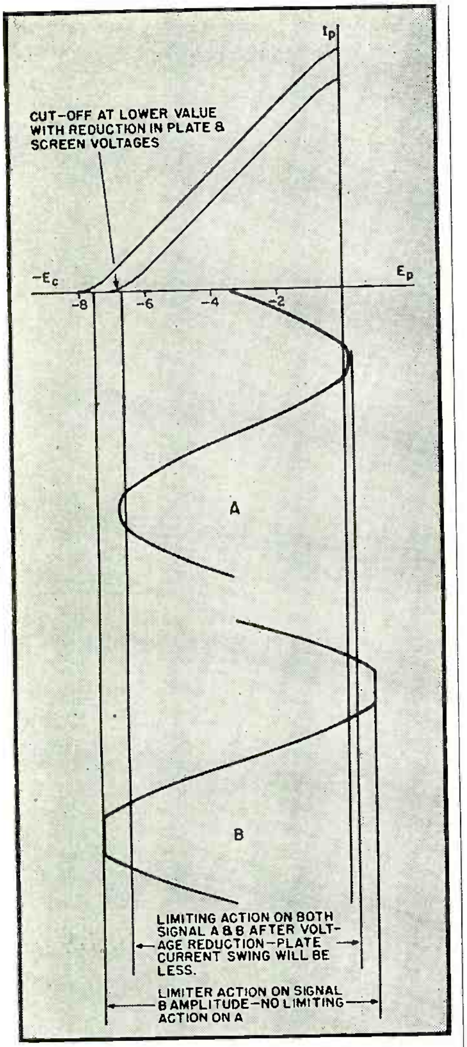


Fig. 7. By reducing the plate and screen voltages the limiting action is compressed to a narrower region.

there are two voltages, a direct and a mutually coupled, which individually contribute equal signals to both diodes, resulting in zero output; but which, collectively, because of their phase relationship, cause a greater voltage to appear on one diode than on the other when the i.f. frequency departs from resonance. At resonance, the phase relationship is such that equal voltages appear on both diodes.

When a signal of the resonant frequency is applied to the primary side of a double-tuned transformer, the secondary voltage leads the primary voltage by 90 degrees. This is substantiated when it is considered that the magnetic flux from the primary induces a current into the secondary in phase with the primary voltage. However, there is a voltage lead of 90 degrees involved while the resonant current builds up and decays through the tuned circuit inductor. Consequently, diode #1 plate voltage, e_{p1} consists of the in-phase voltage, e_3, plus the 90 degree leading voltage, e_1 ,as shown in the first vector of Fig. 9; and diode #2 plate voltage e_{p2}, consists of the in-phase voltage, e_3, plus the 90-degree lagging voltage e_2. Actually, the voltage e_2, as it appears across inductor L_2, is leading the primary voltage (same as e_3) by 90 degrees; however, so far as diode #2 is concerned, it is lagging e_1 by 180 degrees and e_3 by 90 degrees because the diode #2 conducts on the negative alternation of the induced voltage. Using the j operator, the diode plate voltages would be written as follow:

$$e_{p1} = +e_3 + j\,e_1$$
$$e_{p2} = +e_3 - j\,e_1$$

The important factor to observe from the vector is that the resultant voltages, e_{p1} and e_{p2}, are equal at resonance when the phase shift is exactly 90 degrees.

Now, at the time the frequency departs from resonance, the current induced in the secondary leads or lags the primary voltage and, consequently, the secondary voltage leads the primary voltage by more or less than ninety degrees. Thus, as shown in Fig. 9B, voltage e_2 is lagging the direct voltage e_3 by less than 90 degrees, and voltage e_1 leading e_2 by 180 degrees, leads the direct voltage e_3 by more then 90 degrees. When the resultant vector is completed, it is clear that diode #2 is receiving the greater plate voltage and the instantaneous output of the discriminator is negative. Now, if the frequency departs from center frequency, the same amount on the other side of resonance, the voltage e_2 lags the direct voltage e_3 by more than 90 degrees, and the voltage e_1 leads the direct voltage by less than 90 degrees. As a result, diode #1 receives the greater voltage and the instantaneous output of the discriminator is the same amplitude but positive in polarity. It is apparent that as the frequency deviates equally at a sinusoidal rate above and below center frequency, a sinusoidal reproduction of the frequency variation appears at the output of the discriminator.

The discriminator of the Model 90 receiver has the same basic concepts, but uses a circuit having a single cathode, permitting the use of a dual-diode triode tube as discriminator and first audio. An equivalent simplified circuit of the discriminator is shown in Fig. 4 and is taken directly from the main schematic of the Model 90 sound channel, Fig. 1. In this discriminator, the direct voltage appears equally across resistors R_1 and R_2. Capacitor C_2 holds the high side of resistor R_1 at radio-frequency ground potential, and acts as a filter. The induced voltage appears across L_1 and L_2; diode #1 draws rectified current through resistor R_1, producing a negative output, while diode #2 draws rectified current through resistor R_2, producing a positive output.

Audio Amplifier

The full capabilities of the FM sound channel are realized only if the audio amplifier is properly designed to handle linearly a wide range of frequencies (at least as high as 8,000 to 10,000 cycles). The theory and methods of maintaining a linear response over a wide range of frequencies will be detailed in next month's installment on video amplifiers.

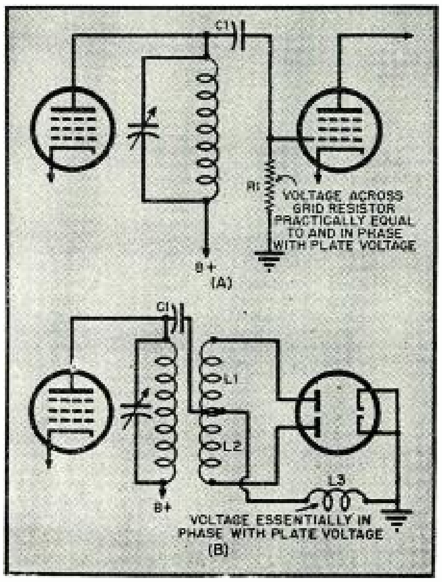


Fig. 8. Showing how the in-phase voltage is developed across coil L_3 of Fig. 3.

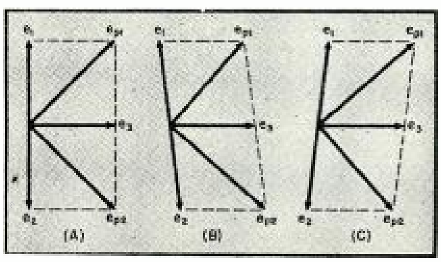
Major points to observe in the Model 90 audio amplifier are:

1. The frequency compensating network in the grid circuit of the first audio, consisting of capacitor C_5 and resistor R_5. This combination, because of its increasing reactance to low frequencies, helps to hold them up to the same level as the highs—compensating for the loss of lows across the coupling capacitors.

2. Capacitor C_6 and tone potentiometer R_6, which can be adjusted for the most pleasant response. A decrease in the potentiometer resistance increases the effectiveness of capacitor C_6 in shunting the highs to ground. The lows meet a higher reactance from C_6 and are not shunted. Consequently, the degree to which the highs are suppressed is set by adjusting potentiometer R_6.

3. The inverse feedback divider resistors, R_9 and R_{10}, which shunt the secondary of the output transformer. Since resistor R_{10} is also the cathode resistor of the first audio amplifier, a portion of the audio output voltage sets up a degenerative feedback voltage across the cathode resistor, reducing the effectiveness of the audio amplifier grid signal. The greater the output signal becomes, the more effective the feedback becomes, and consequently, the output of the amplifier is somewhat reduced, but the fre-

Fig. 9. Discriminator voltage vectors.



quency response (relative amplification at various audio frequencies) is leveled off. Another advantage of feedback taken off the secondary is that the frequency discrimination of the output transformer itself (which is always considerable) is compensated for in this arrangement.

(To be continued)

For the Record

(Continued from page 8)

department, a device has been exploited as the greatest mechanical marvel since the invention of the wheel, which is, in fact, a clumsy, faulty travesty on the commonplace timer that is a part of the cheapest auto. This thing has from 90 seconds to several minutes to make up its mind, move into position and do its simple little job of turning the pancake and lifting it up and away."

We didn't realize the American public had such patience. We are beginning to wonder if his original manuscript wasn't written back in 1920. At least, we haven't seen such a lazy mechanism as he describes for many a year. If his statement were true, there would have been little demand, if any, for radio-phonograph combinations with changers. Ask the man who owns one!

To further pour salt in the wound, he says "But the latest statistics on the subject, which I just made up and personally guarantee, reveal that 72 per cent of them haven't worked since Pearl Harbor and that, on the average, they worked only 24 times before the need arises for a mechanic at $4 an hour plus transportation to and from the job." Wow—the servicemen certainly must be wealthy. The 72 per cent that Mr. Pegler figured out must indicate that almost 72 per cent of owners of record players have young kids having a yen for mechanical things. It is very interesting to note that mechanics (servicemen) are earning $4 an hour plus transportation, isn't it? This admission—*"which I just made up and personally guarantee"* is, in our opinion, a direct confession of the inaccuracy of his statements.

He terms the procurement methods employed by the Armed Forces to secure radio and radar technicians "gaudy come-on" and belittles the training given these men comparing the results to auto mechanics employed in the automotive industry. We doubt that he has ever had the opportunity to observe the type of training given these radio technicians in the Armed Forces' schools—we further doubt Mr. Pegler's ability to evaluate this training were he given the opportunity to observe it, (we might even include a strenuous doubt that our self-made Steinmetz could pass the Eddy test).

HE ALSO intimated that the radio manufacturers were defrauding the public. In speaking of "audio radio" (this must be the stuff known as AM or FM) he says "It has victimized the public to the extent of millions of dollars, with false promises and high prices for a device whose internal works in mass production should sell profitably for a few dollars backed by reliable guarantees." We cannot help but wonder then, if this is true, why most of the newspapers of the country, including many of those carrying his column, continually solicit advertising from manufacturers within such an industry???

We suggest that Mr. Pegler have his radio fixed..................O.R.

100 MC. Transmitter
(*Continued from page* 44)

switch is placed in proper position, and C_{10} is tuned to resonance as indicated by M_6.

The next two stages are quickly tuned in order to avoid tube damage, due to overload in the out-of-resonance condition. Although a neutralizing condenser is provided for the 100-megacycle doubler-buffer, it was not found necessary to neutralize this stage.

The grid tank of the final stage is now coupled to the buffer stage and C_{27} is adjusted for maximum grid current, as indicated by meter M_2. Next, C_{32} is tuned to resonance, as indicated by a dip in grid current. This dip will not occur if, by some coincidence, the stage is neutralized. Neutralization can be accomplished in one or two ways, and the method to be used depends on the transmitter's ultimate use.

The first method is to apply grid drive and adjust C_{31} until the plate tank r.f. is at its lowest possible level. The other, or dynamic, means of neutralizing is to remove the grid drive and apply plate voltage to the final stage. Then C_{31} is adjusted so that there is no indication of grid current on M_2. If the dynamic means of neutralizing is used, r.f. will be found in the plate tank when grid drive is applied and plate voltage is removed from the final stage.

All preceding stages should be retuned after the final stage is neutralized. The crystal oscillator drifting (due to temperature) also makes periodic retuning of the entire transmitter advisable under continuous operation.

Bias on the final stage is more than adequate for class "C" operation. Plate modulation may be used, if desired. The output (comprising the hair pin and C_{44}) is moved up and down to adjust load on the output stage. In place of L.P., shown in Fig. 4, a 70 ohm coaxial cable may be used to feed the antennas.

All important circuits are protected against overloads. Relay (RY_1) is connected in the "C" bias power-supply (power supply No. 2). Plate voltage for r.f. stages Nos. 2, 3, 4 is immediately removed if the "C" bias supply fails. Overload relay (RY_2) and hold-down relay (RY_3) are connected in the (B+) lead of r.f. stage No. 5. Contacts of the hold-down relay are reset through depression of a momentary break switch connected in the circuit.

This article outlines the design and construction of a low-power 100-megacycle transmitter. By eliminating the output-measuring device and several of the meters, the entire transmitter can be placed in a 5 ft. cabinet with room to spare. The power supply requires more than half of the space available.

It should be possible to replace two of the power supply units with one having equivalent current capacity. The chassis thus left vacant could be used for audio equipment.

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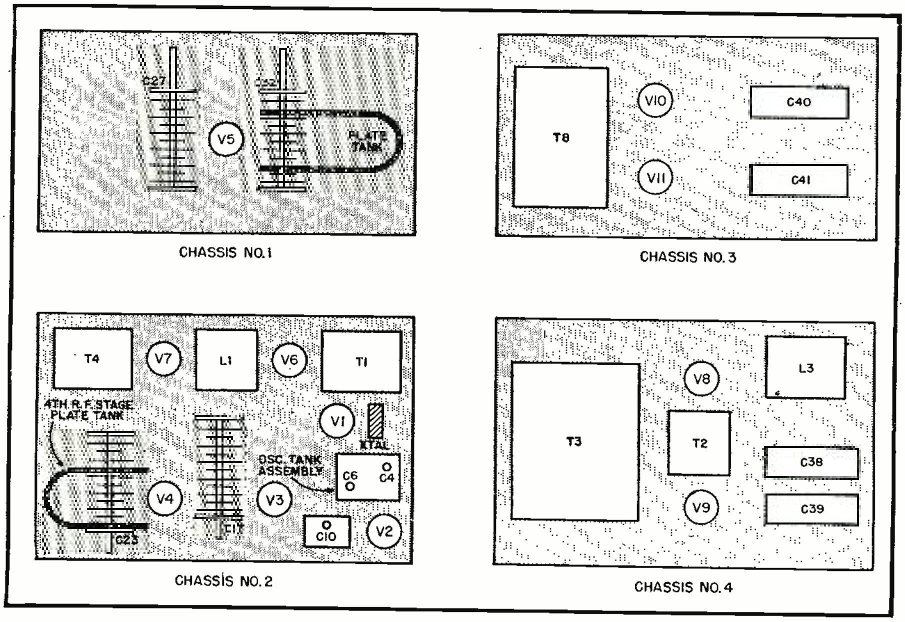
Fig. 5. Diagram shows location of component parts on their individual chasses.



TECHNICAL BOOK & BULLETIN REVIEW

"APPLIED PRACTICAL ELECTRICITY" by The Technical Staff, Coyne Electrical School. Published by *Coyne Electrical School,* Chicago, Illinois. . Seven Volumes, Price $19.75 the set.

A great deal of practical knowledge has been included in this set of pocket-sized books.

This set may be used either as a home-study course or as a reference work for practical electricians, repairmen or home owners. The material is presented in a logical sequence beginning with elementary concepts of electricity and magnetism.

The first volume deals with circuits, relays, telephone, signal systems, and rules. The second book covers construction, lighting, signs, neons, fluorescents, and appliance repair. Volume 3 covers direct current, while Volume 4 deals with alternating current. The fifth volume covers armature and stator winding, installation, maintenance, and repair, while Volume 6 treats the subjects of electrical refrigeration, air conditioning, fans, blowers, and radios. The final volume handles automotive electricity, Diesel, batteries and installation, and service.

Each volume is complete in itself, with all the material germane to the subject included. Thus, if the student or repair man wants to study all phases of a.c. circuits, appliances, equipment, etc., he could study Volume 4 and have the material at his fingertips without having to refer back to previous volumes.

The entire set is written in easy-to-understand language and the text is profusely illustrated with pictures and diagrams. The home study student should have no difficulty in mastering the subject of practical electricity from these books.

"UHF RADIO SIMPLIFIED" by Milton S. Kiver. Published by *D. Van Nostrand Company, Inc.,* New York. 228 pages. Price $3.25.

Since radio in the higher frequencies will become increasingly important in the postwar period, it is essential that amateurs, servicemen, technicians, and engineers understand the basic principles of u.h.f. theory and application.

In order to meet the demand for a basic text, Mr. Kiver has presented an interesting and highly readable book which covers all of the points necessary for the average person to know who depends on electronics for fun or profit.

The author has accomplished in this work what might be considered impossible, considering the nature of u.h.f. theory and practice, namely, a rigorous simplification of the subject. The book is almost wholly devoid of mathematics, yet by means of correlation with familiar circuits and theories, the author has achieved a clarity of presentation which will not be lost on the average reader.

The book is divided into nine chapters covering the magnetron oscillator, the Klystron, transmission lines, wave guides, cavity resonators, u.h.f. antennas, u.h.f measurements, and wave propagation, in addition to the introduction which concerns the transition from the low frequencies to the ultra-high frequencies.

Mr. Kiver is familiar to readers of RADIO NEWS as the author of a series of articles on ultra-high frequencies, and those who read and enjoyed this series, will undoubtedly wish to read his text on the same subject.

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11,500 Mile Radio Net

(*Continued from page* 50)

designed and supplied by *Pan American* engineers and consists of two types; one which permits operation of the transmitter over a cable which may be as much as 2,000 feet in length, while the other type permits complete control over a single pair of telephone wires which may be approximately 65 miles in length.

To facilitate the understanding of the r.f. circuits used in the transmitter and the methods used in the selection of the desired channel for operation of the unit, it is suggested that the schematic diagram (Fig. 1) be used in conjunction with the reading of the text.

Power to the transmitter is controlled by a main line switch (D_2) located on the front panel of the set. When closed, a control relay transformer (T_4) and its associated copper oxide rectifier (X_{1-1}) are energized. This furnishes a protective bias of 29 volts on the grids of the power amplifier tubes (V_2, V_3) and makes available current for operating the relays. When the frequency selector switch is set for any of the three available frequencies, it operates the filament contactor main power relay (S_5) which closes the line circuit to the filament and autotransformer (T_5). This transformer, which applies current to all vacuum-tube filaments, energizes the 115 volt rectifier (V_{15}) that supplies bias to the modulator tubes (V_7, V_8), and starts the time-recording meter (M_2) connected across the 10 volt modulator filament circuit and records total hours of transmitter operation.

A winding on the transformer (T_5) supplies 100 volts to the time-delay tube (V_{10}). When the filament of this tube has been in operation for approximately 25 seconds, the paralleled plate and grids will pass sufficient rectified current through the time-delay relay (S_6) to cause the relay to operate and close the 115 volt circuit through the door switch (D_4) to the high voltage contactor relay (S_7), which then completes the power circuit to the 700-volt rectifiers (V_{13}, V_{14}) and the 1600 volt rectifiers (V_{11}, V_{12}) and starts the ventilating fan in operation.

The primary winding of the filament and 115 volt bias rectifier transformer is tapped to deliver proper voltages when the supply is between 200 and 250 volts. This transformer winding also serves as an autotransformer for adjusting the line voltage applied to the high-voltage rectifier plate transformer (T_6). The proper transformer tap for any line voltage between 200 and 250 volts may be selected by means of a tap switch (D_3) and line voltmeter (M_4) located on the front of the set.

The oscillator (V_{16}) is of the Colpitts type with the quartz plate connected between ground and control grid. The plate of the oscillator tube is coupled through a stopping condenser (C_5) to the grid of the buffer tube (V_1) and this circuit is tuned to the fundamental or second harmonic of the quartz plate by means of a plug-in coil. The plate of the buffer amplifier is coupled through a stopping condenser (C_{52}) to the grids of the power amplifier stage (V_2, V_3) and this circuit is then tuned to the carrier frequency (which may be the fundamental, second or fourth harmonic of the quartz plate frequency) by means of a plug-in coil and condenser combination. The plate circuit of the power amplifier stage is tuned by means of a plug-in coil assembly (L_9) and a permanently installed dual-section variable condenser (C_{11}). Straps are provided on the power amplifier plate coil assemblies so as to select one or both sections of the variable condenser, and in channel one only an additional fixed condenser is provided for frequencies in the range between 1.6-1.715 megacycles.

However, all channels may be operated in the frequency range from 2.80 to 3.085 and from 4.00 to 13.50 megacycles. The antenna for the transmitter is coupled to the power amplifier by means of a rotatable coupling coil inside the plate coil (L_{10}).

A protective bias of 29 volts is applied to the grids of the power amplifier through two power amplifier grid leak resistors (R_{9-1}, R_{9-2}). When grid current is present, these resistors pro-

Table I. Input power to the transmitter for various operating conditions.

TYPE OF OPERATION	V.A.	WATTS	P.F.
Standby	1040	940	0.90
Full Carrier, unmodulated	1600	1440	0.89
Full Carrier, 80 per cent, average modulation	1870	1660	0.89

vide self bias necessary for proper operation.

Selection of the desired channel which connects the proper quartz plate, oscillator, buffer, and power amplifier coils to their associated circuits is accomplished by means of three frequency-changing relays (S_1, S_2, S_8) and a tank circuit switching relay (S_3) all of which are controlled by the frequency selector switch located on the front panel or by a similar switch at a remote point when the local selector is at some distant location. Operation of the selector switch to "Frequency 1" closes the 29 volt circuit to the filament contactor relay (S_5) which furnishes the power to start the transmitter in operation on channel one, utilizing quartz plate (Y_1), oscillator plate tuning coil (L_{14}), buffer tuning unit (L_{CU_1}), and power amplifier plate tuning coil (L_9). With the selector switch in "Frequency 2" position, frequency-changing relays (S_1, S_3) and tank circuit switching relay (S_3) operate to select channel two with its associated quartz plate (Y_2) and tuned circuits consisting of an oscillator plate tuning coil (L_{13}), buffer tuning unit (L_{CU_2}), and power amplifier plate tuning coil (L_{10}). In the case of "Frequency 3" the position of the switch serves only to operate an additional frequency-changing relay (S_2) which transfers the grid of the oscillator from quartz plate (Y_2) to plate (Y_3), the frequencies of these two quartz plates being within one percent of each other.

The keying of the carrier is accomplished on the plate and screen grid of the oscillator tube (V_{16}) and in the plate circuit return of the power amplifier stage. When in operation, the keying relay (S_4) removes the ground from the d.c. supply to the plate and screen grid of the oscillator tube through a 10,000 ohm resistor (R_{55}) and a 25,000 ohm buffer grid resistor (R_{56}), and thence completes the plate return circuit to the power amplifier. In the "key up" condition a high cut-off bias is applied to the power amplifier. The shaping of the keyed character is accomplished by a .1 μfd power amplifier grid by-pass condenser which tends to slow up the change in bias voltages applied to the power amplifier tubes.

The audio amplifier employs three stages: volume limiter, driver, and a class "B" modulator with an inverse feedback included between the latter two stages. With no speech applied, the volume-limiter stage adjusts itself to full gain. However, when speech voltages developed in the windings of the modulation transformer are sufficiently high to produce complete modulation of the carrier, a small amount of speech current flows through a winding in the modulation transformer, the volume limiter rectifier tube (V_9), and the time constant resistor (R_{26}) and condenser (C_{20}). The rectified voltage developed across this time constant resistor is applied to the control and mixer grids of the

(*Continued on page* 150)

QRM-A Threat

(*Continued from page 29*)

teurs who expect to be active, will have to, in some manner, change our operating system and habits to conform to whatever situation we might face.

The time has passed, I believe, when a radio amateur can use just any old procedure of operation he happens to favor. Unless we practice self-discipline on the air we shall surely throttle ourselves.

Now, many of us have seen service, in one branch or another, with the armed forces—some of us in the field of publishing or in radio communications. We have seen how efficient and smoothly these communications have functioned in spite of the complexity of the job. How could this efficiency and smoothness be created? The answer, I would say, lies in discipline, cooperation, and, above all, in a carefully worked out technique.

Most of us have had enough regimentation to last us a life-time. We certainly do not want it to continue over into our peace-time lives and especially in the pursuit of our hobby. It should not be necessary. Why cannot we practice, without force, the clean operating habits we learned (in most cases—the hard way) while working with or for Uncle Sam.

The extent of self-discipline which we must practice to insure the fullest benefits of our hobby to all participating need not mean the sacrifice of any rights or privileges. Being citizens of a democratic country, we understand the principles involved in close cooperation with our fellow-men. All of us practice daily some form of self-discipline that benefits the nation as a whole, because it first benefits us as an individual. Since amateur radio is a hobby in which anyone can indulge (provided he can fill the requirements necessary to obtain a license) the same precepts of democracy can and should apply.

Personally, I believe it would be foolhardy for any one person to attempt to outline or set up a system that would be designed to eliminate entirely such a problem as the "qrm" of pre-war ham operating. However, a word of advice from one who battled this same problem should not be thought presumptuous. I think that participation of 25 years or so in a hobby gives a person the privilege of having a few ideas and opinions. So too—the hams of lesser duration.

So then—having briefly outlined what I personally consider a real threat to happy, trouble-free ham operating I would now like to offer several suggestions, the practice of which I feel will go far in alleviating much of our difficulty.

These suggestions are merely basic and are not intended as a cure-all or a complete solution to the problem.

First: Remember the clean operating habits you picked up in the service. To you who are not acquainted with military communications procedure, these points can be stated very simply. (A) Send as little as possible consistent with getting your message through. (B) Make no unnecessary transmissions. (C) Use a dummy antenna when tuning and adjusting your transmitter. (D) Keep your transmitter tuned to peak efficiency. (E) Engineer your gear, if home built, to the highest degree possible. (This last is particularly important in the case of radio telephone. The phone bands are narrow enough and it does not take many broad phone signals on any of the bands to ruin that band for hundreds of other hams.)

Second: Choose, with care, the time best suited for the type of "qso" you want to carry on. Pick the later hours for your "DX" work, but if you are interested solely in local "rag-chewing" try to get on the air earlier. Of course, this will not be practical for all hams due to their breadwinning obligations. However, if practiced by all hams, when possible, a big difference will in all probability be noticed.

Third: Whenever possible, work in with a net. Ham nets can be roughly divided into two categories. There are the various traffic nets—organized to facilitate the handling of messages in times of emergency. These nets normally function smoothly and everyone has opportunity to chew the rag and exchange ideas with the other fellow. The experience gained in this type of operating is invaluable and it can be safely said that the aid we have given the nation in times of stress is the main reason we bask so much in the favor of our governing bodies.

The other type of net is the good old "round-table." Of this type, there were more or less permanent nets organized before the war that occupied one frequency and were in operation several times each week. Just an informal get-together. Then there were the same sort of nets that just "happened" whenever and wherever three or more hams found themselves bucking signals on the same frequency. Give these nets a try. I will guarantee they are interesting and very informative.

Fourth: Steer clear, if you can, of the more congested lower frequencies. Experiment with the "Very-highs" and let's chalk up more successes for hamdom in research and invention.

That's the story, fellows. There is nothing new in what I have written but the suggestions I have set forth here are based on experiences. If what I have suggested is practiced by the majority of active hams after the war I am sure that, while the "qrm" enemy may not be entirely licked, more hams will get more enjoyment out of their hobby—the incomparable Amateur Radio.

—30—

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(Continued from page 145)

volume limiter tubes. Thus, any tendency of speech to increase beyond the value which produces full modulation results in high bias applied to the volume limiter and a consequent reduction in the gain of this stage.

The transmitter may be modulated by means of the hand-set microphone (MK_1) located on the front panel of the set. Operation of a "press-to-talk" button located on the hand-set handle operates the carrier control relay and furnishes current to the microphone from a high voltage divider on the 115 volt bias circuit.

Also located on the front panel of the set is a test key (K_1) for locally controlling the carrier during the tuning process or for routine checking of the operation of the transmitter.

With regard to the necessary input requirements, the transmitter is normally furnished for operation on 200 to 250 volt, 60-cycle a.c. supply. When 50-cycle operation is desired, the only change necessary in the transmitter is replacing the time-recording meter (M_2) with one designed for 50-cycle operation. The input power to the transmitter for various operating conditions is shown in Table I.

The farsightedness of *Pan American Airways'* officials in procuring an adequate supply of these transmitters was dramatized in 1941, when several months before Pearl Harbor President Roosevelt directed the establishment of an aerial highway across Africa to the Middle East, the main purpose of the directive being to establish an aerial transport service by means of which defense-aid aircraft and supplies could be delivered swiftly and safely into the hands of the hard-pressed Allied forces. The service quickly became an impressive reality.

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Erratum

The screen voltages to two tubes shown in the diagram on page 102 of the July, 1945, issue of Radio News *have inadvertently been omitted. The screens should have been connected to the main "B" voltage supply.*

Radar Terms

(*Continued from page 41*)

Indicator—Any of several types of cathode ray oscilloscopes.

Indicator gate—See Gate.

Isolating circuit—A stage which passes signals in only one direction through a circuit.

Klystron—A velocity modulated tube used to produce low-power u.h.f. oscillations.

Lighthouse tube—A high-frequency triode of special design used to produce u.h.f. oscillations of medium power.

Limiter—A circuit which limits, clips, or removes either (or both) the positive or negative extremities of a wave form.

Listening period—The time during which a radar transmitter is quiescent or not radiating energy.

Magnetron—A high-frequency magnetic-field diode of special design used to produce u.h.f. oscillations of very high power.

Main pulse—See transmitter pulse.

Master oscillator—A source of timing oscillations which control or affect all other radar circuits.

Microsecond—One millionth of a second.

Modulator—A circuit which directly controls or triggers the radar transmitter.

Multivibrator—A relaxation oscillator which oscillates of its own accord (a free-running multivibrator), or which oscillates only when triggered by an external voltage.

Overdriven amplifier—Amplifier circuit in which the combination of cut-off limiting and saturation limiting of a sine wave produce a rectangular voltage wave.

Peaking circuit—A differentiator circuit used to sharpen a wave form.

Peak power—The maximum output power of an r.f. pulse at the transmitter.

Presentation—The form in which radar echoes appear visually on an oscilloscope.

Pulse—A sudden change of voltage (or current) of brief duration.

Pulse duration—The time duration of a pulse.

Pulse generator—See Electronic timer.

Pulse rate—See Pulse recurrence frequency.

Pulse recurrence frequency or p.r.f.—The timing rate of radar pulses, originating in the electronic timer.

Pulse recurrence time—The reciprocal of pulse recurrence frequency.

Pulse width—See pulse duration.

Quiescent period—See Listening period.

R.F. oscillator—Output stage of the radar transmitter in which u.h.f. oscillations are generated.

Range—The direct-line distance between a radar set and a target.

Receiver—The component of a radar set which receives, detects, and amplifies echoes reflected from targets.

Receiver gate—See Gate.

Recurrence rate—See Pulse recurrence frequency.

Repetition rate—See Pulse recurrence frequency.

Ring oscillator—Any number of pairs of high-frequency triodes operated as an r.f. oscillator in a tuned-grid tuned-plate circuit.

Rotary spark gap—A pulse-producing device in which circularly arranged electrodes are rotated past a fixed electrode producing periodic high-voltage arc discharges.

Saturation limiting—Limiting action of an amplifier when operated beyond the point where grid current flows.

Scanning—The direction of pulsed r.f. energy over or across a given region or area.

Sea return—That part of the r.f. pulse reflected by water surrounding a sea-borne radar set.

Spark gap—An arrangement of two fixed electrodes between which a high-voltage arc discharge takes place.

Squaring amplifier—See Overdriven amplifier.

Squegging oscillator—An extreme form of grid blocking in an r.f. tuned-grid tuned-plate circuit.

Synchronism—The relationship between two or more periodic or recurrent wave forms, when the phase difference between them is zero.

Synchronizer—See Electronic timer.

Tail—Attenuated decay of an r.f. pulse.

Target—Any object which produces a radar echo.

Time base—The trace produced on the screen of a cathode ray tube by deflection of the electron beam.

Time constant—An indication of the speed with which a circuit can be charged or discharged.

Timer—See Electronic timer.

Transmitter pulse—Burst of r.f. energy radiated by the radar transmitter. The pulse appears as a strong signal at the left end of the oscilloscope time base.

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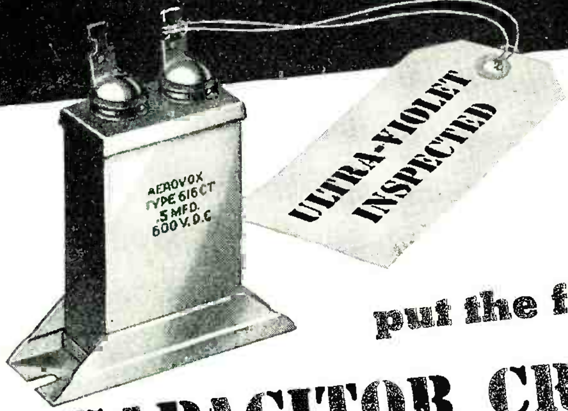

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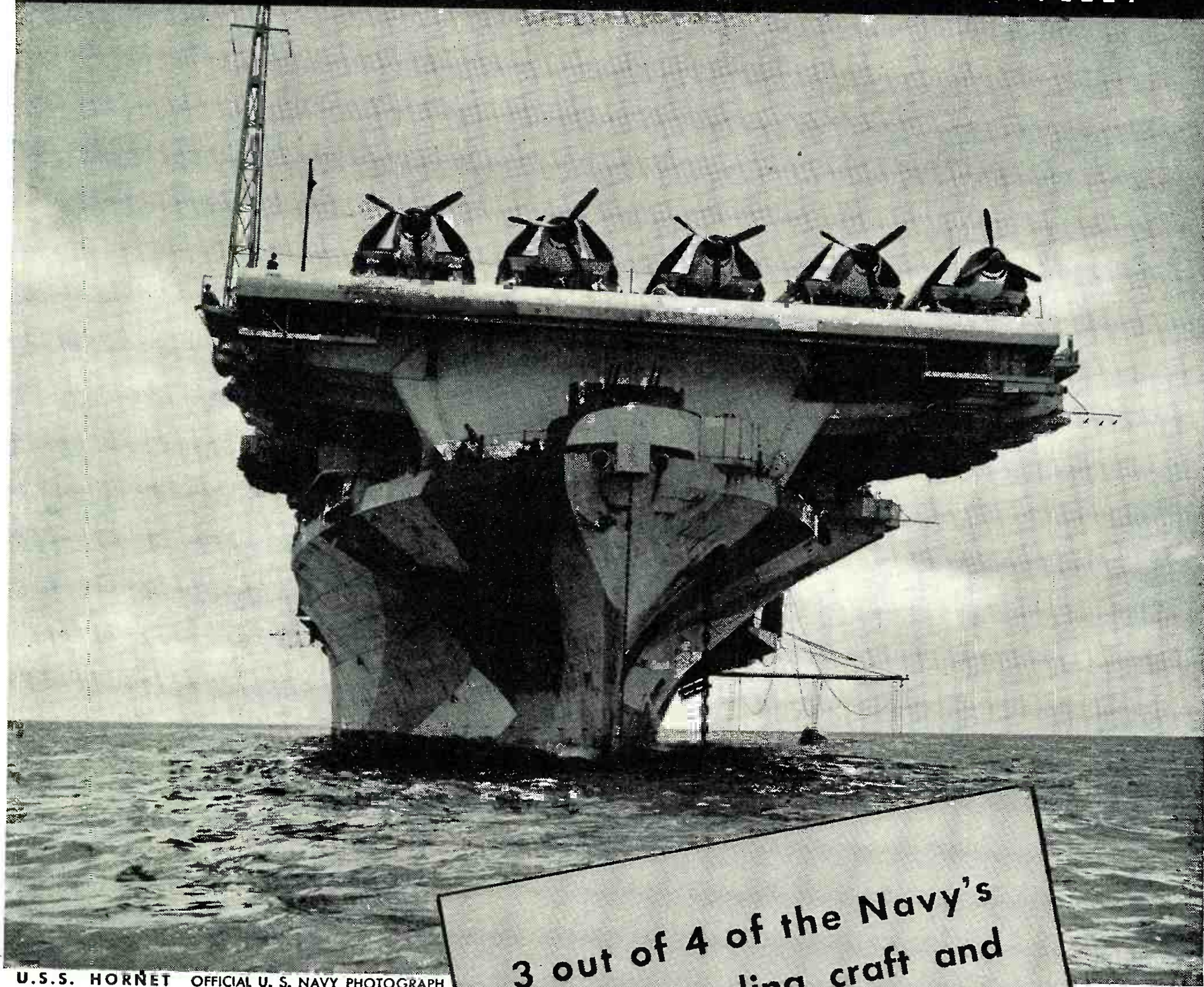

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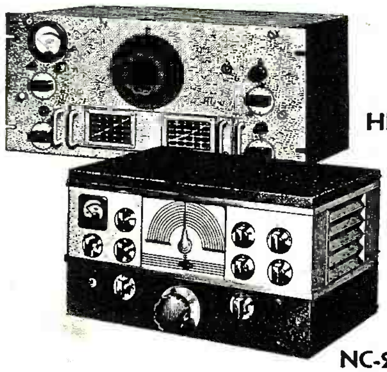

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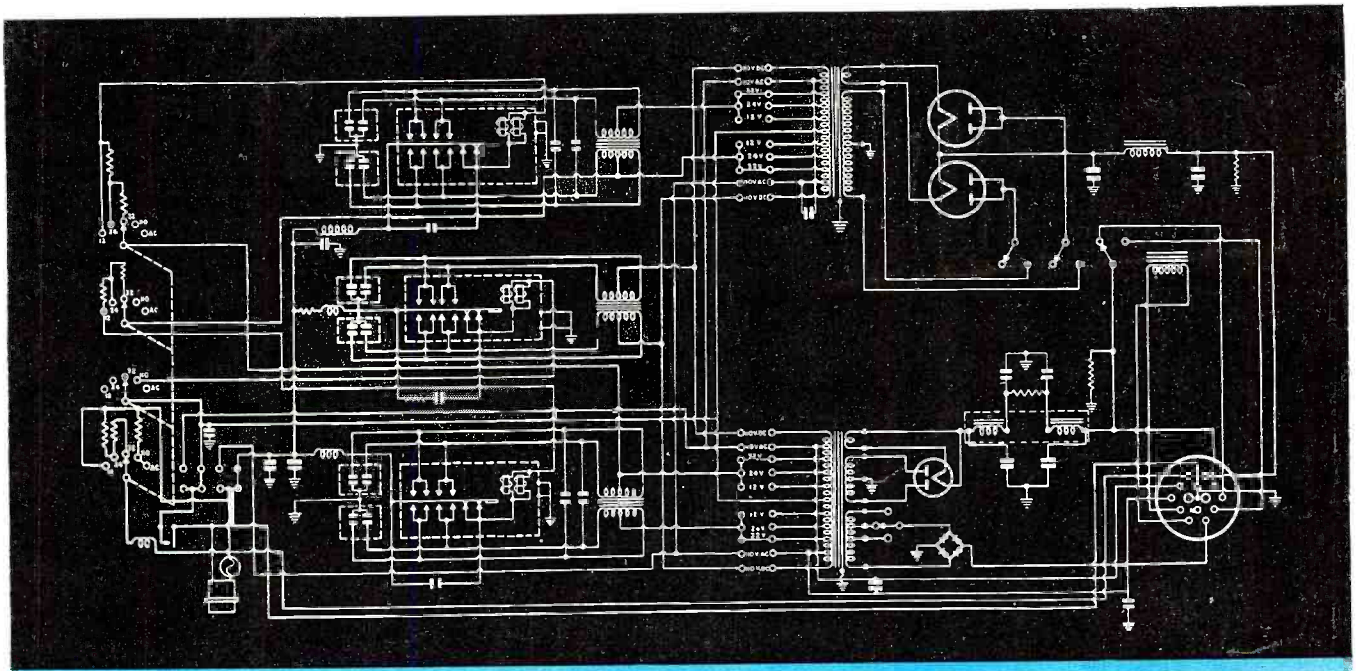

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