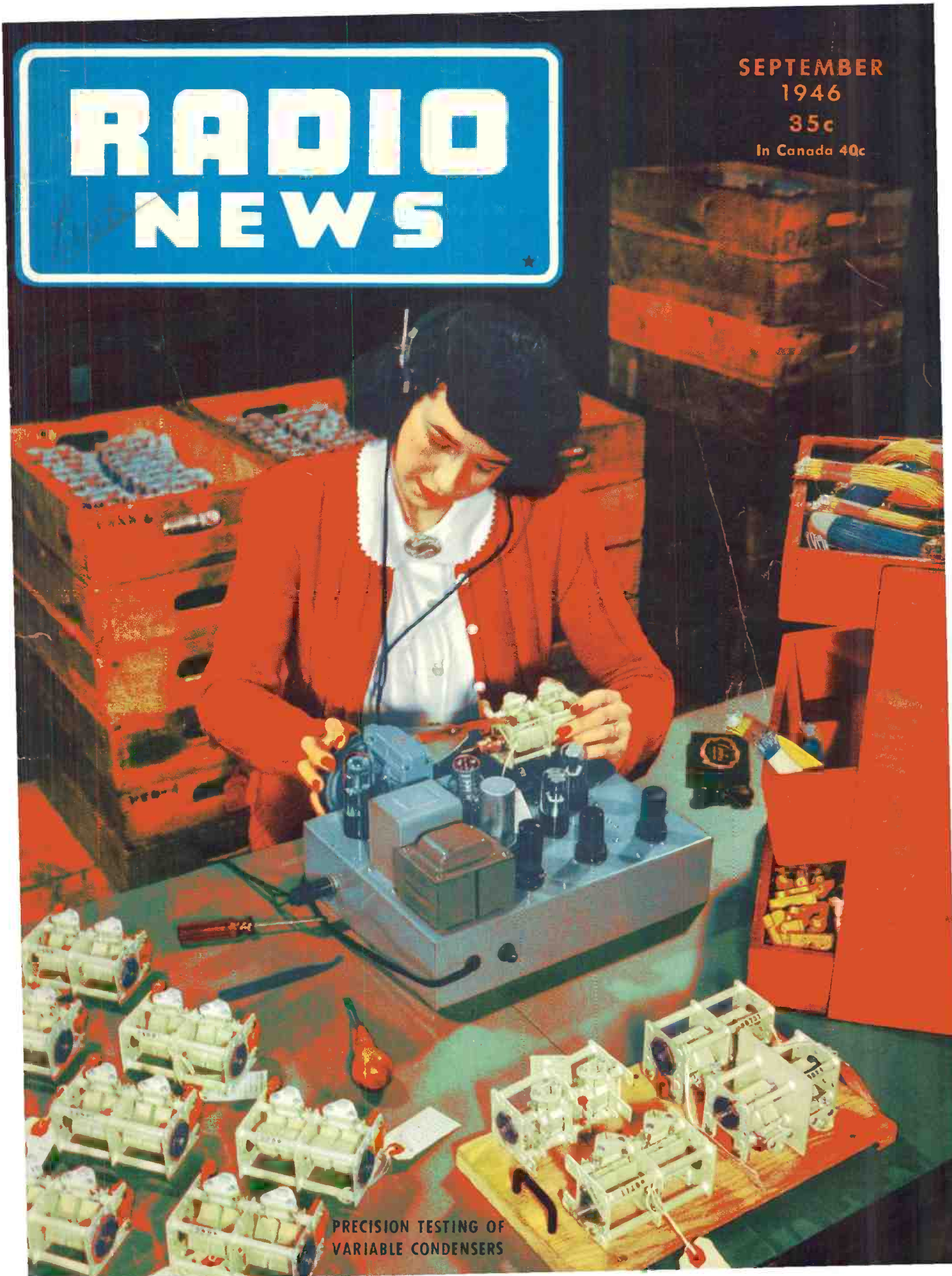
RADIO NEWS

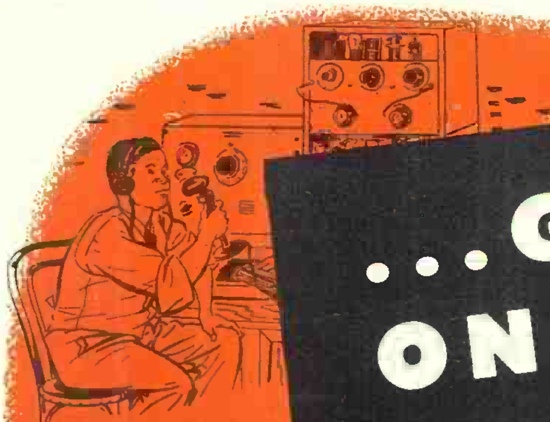
SEPTEMBER 1946

35c

In Canada 40c



PRECISION TESTING OF VARIABLE CONDENSERS



. . . GET BACK ON THE AIR

★ SAVE CONSTRUCTION HOURS

★ BE SURE AS YOU BUILD

The Simpson Model 240 was introduced in 1939. In the two short years before "Hams" went off the air, this remarkable general service instrument built itself such a reputation that the demand for it has never ceased. During the war it was supplied to the Services in limited quantities. It has undergone steady improvement as the result of test and research. Now we can offer it to you again, a vastly better instrument than before—and it was always a sensational instrument.

Completely self-contained, needing no external multipliers, with a sensitivity of 1000 ohms per volt and a maximum voltage of 3000 volts A.C. or D.C., it has all the variety of useful ranges needed to do an all-around job for you.

The 3-inch meter has a scale over ⅓ greater than before, offers greater accuracy in reading. The whole chassis is encased in heavy molded bakelite. All components and the sub-panel are mounted directly on the bakelite panel for easy servicing and greater sturdiness. All figures are engraved and filled with white enamel for greater legibility and wearing qualities.

Shock-proof, it has the famous Simpson movement with bridge-type construction and soft iron pole pieces, resistors in matched pairs to provide greatest possible accuracy for all ranges. It is furnished with test leads whose wire covering is capable of withstanding 3000 volts. Alligator clips have safety rubber guards.

Here is the instrument that will get you on the air and keep you there, helping you to build soundly and to trouble-shoot speedily and surely.

RANGES

VOLTS A. C.	VOLTS D. C.	MILLIAMPERES D. C.
0-15	0-15	0-15
0-150	0-75	0-75
0-750	0-300	0-300
0-3,000	0-750	0-750
	0-3,000	

Ohms: 0-3,000 (center scale 30)
0-300,000 (center scale 3,000)

THE NEW SIMPSON MODEL 240—THE "HAMMETER"
—1946 version of the first self-contained pocket portable instrument built expressly to check high voltage and all component parts of transmitters and receivers.

Price, complete with test leads.................................$26.50

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Simpson

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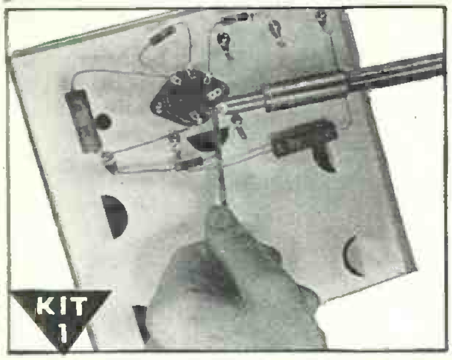
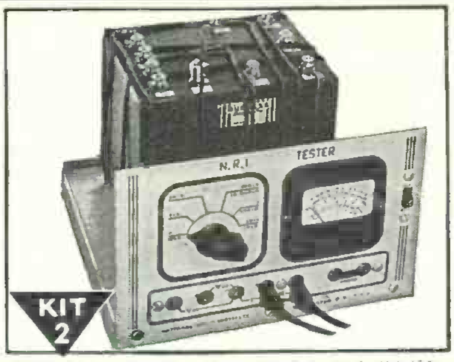
I Will Show You How to Learn RADIO by Practicing in Spare Time

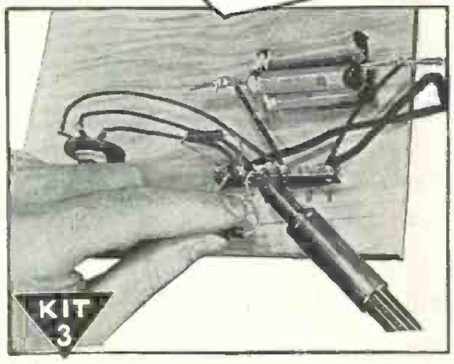
I Send You 6 Big Kits of Radio Parts



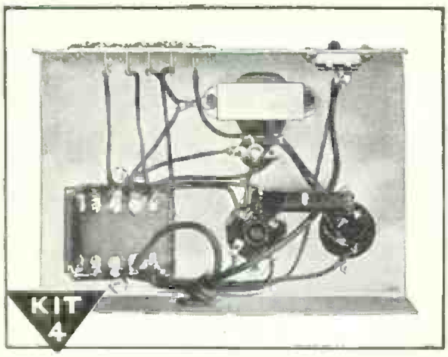
I send you Soldering Equipment and Radio parts; show you how to do Radio soldering; how to mount and connect Radio parts; give you practical experience.



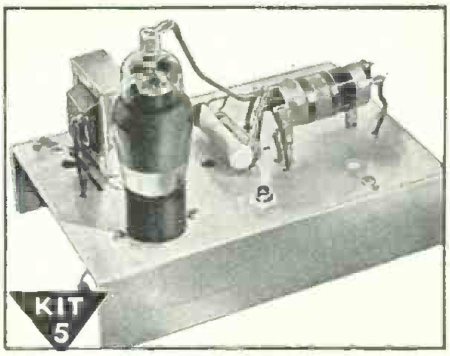
Early in my course I show you how to build this N. R. I. Tester with parts I send. It soon helps you fix neighborhood Radios and earn EXTRA money in spare time.



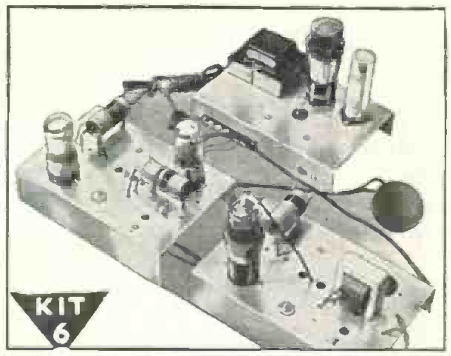
You get parts to build Radio Circuits; then test them; see how they work; learn how to design special circuits; how to locate and repair circuit defects.



You get parts to build this Vacuum Tube Power Pack; make changes which give you experience with packs of many kinds; learn to correct power pack troubles.



Building this A. M. Signal Generator gives you more valuable experience. It provides amplitude-modulated signals for many tests and experiments.



You build this Superheterodyne Receiver which brings in local and distant stations—and gives you more experience to help you win success in Radio.

I Will Train You at Home – SAMPLE LESSON FREE

Do you want a good-pay job in Radio—or your own money-making Radio Shop? Mail Coupon for a FREE Sample Lesson and my FREE 64-page book, "Win Rich Rewards in Radio." See how N. R. I. gives you practical Radio experience at home—building, testing, repairing Radios with 6 BIG KITS OF PARTS I send!

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The day you enroll I start sending EXTRA MONEY JOB SHEETS. You LEARN Radio principles from my easy-to-grasp, illustrated lessons — PRACTICE what you learn with parts I send—USE your knowledge to make EXTRA money fixing neighbors' Radios in spare time while still learning! From here it's a short step to your own full-time Radio Shop or a good Radio job!

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RADIO NEWS
REG. U.S. PAT. OFF
First in radio

SEPTEMBER, 1946
VOLUME 36, NUMBER 3

Average Paid Circulation over 130,000

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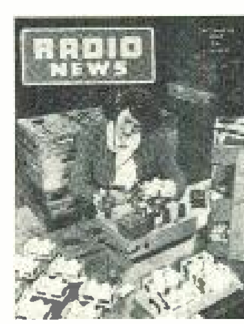

Cover Photo
By Walter Steinhard
Staff Photographer

Operator is shown making final adjustment on variable condensers at the National Company plant at Malden, Massachusetts. Condensers of this type are pre-aligned before they are used in production.

185 N. Wabash Ave., Chicago 1, Ill.

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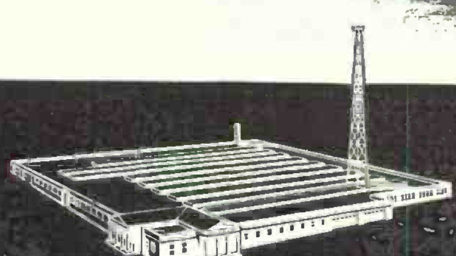

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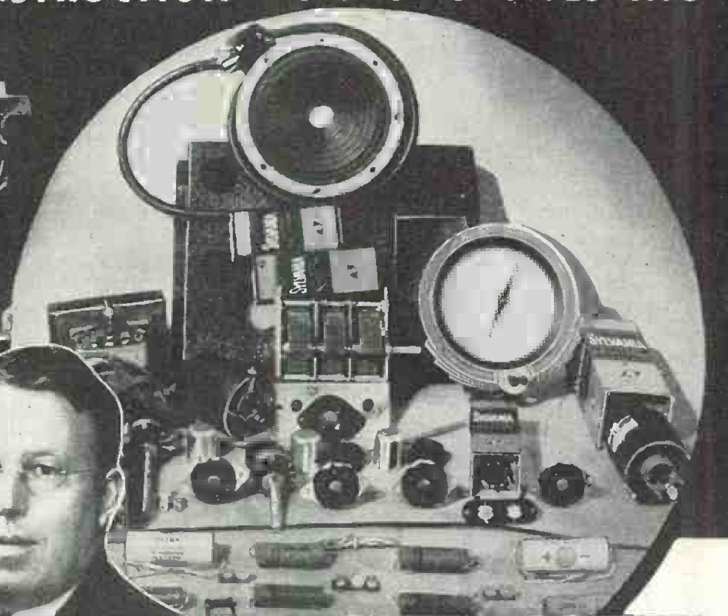

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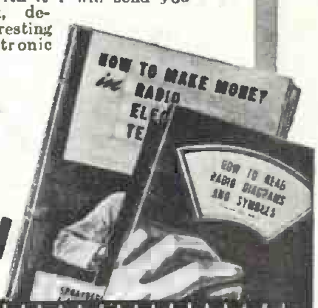

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For the RECORD

BY THE EDITOR

WE ARE gradually but surely emerging from rather abnormal times characterized by the scarcity of many parts, materials and skilled labor. Most of our cities have been crowded boom towns with an abundance of dollars floating around. Facilities and service have been loaded beyond capacity. Most servicemen have had little time or need for giving any thought to the competitive aspect of American business as in normal times. Most of you were engulfed in fast turnover and substitution problems.

As some degree of normalcy is now approaching it behooves all of us to start house cleaning and found the service business on the long term principle. In other words ask yourself the questions; "Where will I be, say, ten years from now?" "What effort am I making to hold my customers and build up a faithful clientele?" "Am I backing the radio industry in general and doing my part to help make it a true profession with honest prestige?"

The formula for real success in the radio service industry is quite simple but is often overlooked in the hustle and bustle of modern living. Every serviceman should strive to be a "good mixer" if he is to sell his services and skill to the public. You may be an electrical wizard or a little Marconi but unless you come out of your shell, become interested in the people you serve and develop a pleasing personality you will never rise above mediocrity. Know the people you serve and let them know you! Broaden your interests so you will be able to talk something besides shop if the occasion arises. Be courteous, friendly and honest in addition to doing good work. It is these traits that bring people back in the future.

You will be amazed at the results you will obtain simply by being more careful about seemingly insignificant details, such as always doing a good clean up job on every receiver. Be sure and remove dust from dials and cabinets. Take time to brighten up the cabinets with a good grade of polish. Most people are aware of the dirt and dust in their sets but hesitate to clean them because the set is electrical in nature and they are afraid to tamper with it. Always make sure the dial is properly illuminated as your customers greatly appreciate this feature.

From the electrical angle never let a customer rush you into delivering his set before you have the opportunity to test the receiver completely after making repairs, because most people expect a radio to be in A-1 condition after its trip to the shop and if it cuts up later your reputation as a serviceman will suffer. Be sure and check poorly soldered connections as these often cause annoying disturbances in the receiver. Check and double check the entire set. Do not put the receiver in the hands of the customer until you are thoroughly satisfied that you have done your best, from antenna to speaker. Keep your kick-backs at a minimum, as this is a pretty good index as to the quality of work you are turning out. *Good testing* is your insurance against most failures and kick-backs. Let the receiver play for a few hours on the bench. Do not hesitate to simulate actual performance conditions, therein lies satisfactory service.

The public is technically better informed now than ever before so do not underestimate the people you serve. They know all too well when a receiver is up to its peak of performance. Watch distortion content and sensitivity. Few things are more annoying to the ear than abnormal hum or distortion. Get the bias and filtering right and you will boost the reception quality and please your customer. Don't give them cause to say that the set has never been satisfactory since you had it. Try to straighten out all faults whether you did the previous work on the set or not.

If some receiver doesn't seem up to par, and the reason for the fault eludes you, keep it around several days and go back to it now and then. You will be surprised how many new ideas you will have on trouble possibilities each time you return to this set. Some delay is much less dangerous to your business than poor workmanship. Be honest with the set owner. If you cannot do his apparatus justice, then tell him so and he will like you for it. After all, a satisfied customer is the best advertisement you can have. Just think of the endless chain of patronage you may derive from a single job well done.

If you are experiencing difficulties in solving circuit problems always remember that an expert trouble shooter uses logical and systematical methods. *He never makes a mountain out of a mole hill. Simplicity* is usually the keynote when he approaches intricate apparatus. To avoid the all too frequent pitfalls in servicing try not to become overawed by the complexity of the circuit as a whole and its many trouble possibilities. Instead proceed in an orderly manner and test each small and simple function that adds up to the rather complex result.

(*Continued on page* 147)

HERE'S HELP
in making
FM and TELEVISION
measurements

THE TYPE WV-75A VOLTOHMYST—
a *new* member of the famous RCA line

Flat up to 250 megacycles!

A newly developed diode probe, with which it is possible to read peak-to-peak voltages up to 250 megacycles, makes the Advanced VoltOhmyst ideal for television, FM, and routine, high-frequency measurements. The diode response is also flat down to 30 cycles.

The WV-75A is calibrated in rms voltages up to 100 volts in 4 ranges. An adaptor is supplied for low-frequency measurements up to 1000 volts.

The WV-75A also measures d-c voltages up to 1000 volts in six ranges and resistances to 1000 megohms in six ranges.

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Spot Radio News

★ *Presenting latest information on the Radio Industry.*

By FRED HAMLIN
Washington Editor, RADIO NEWS

LOOK FOR ONE OF THE MOST significant meetings in the history of world radio in Washington early next year if preparations now under way at State Department go through. It will be called the World Telecommunications Conference and its chief problem will be the urgent one of revising world frequency allocations and setting up a central frequency registration board to replace the present Berne Bureau, which wartime radio progress and the radio rules of war have conspired to make obsolete. Seventy nations have been invited to the gathering and as soon as twenty accept, a definite date will be announced. Meantime, State Department and the radio industry are already busy preparing for the meetings, which promise to set the pattern for frequency allocations throughout the world for years to come.

TWO MAJOR PROBLEMS will face the conferees. First to be attacked will be the continued use of frequencies by the military forces of all nations, now overcrowding the air lanes. According to Dr. J. H. Dellinger, chief of the radio division of the U.S. Bureau of Standards, frequencies for air navigation aids are also in demand. Many high frequency stations operating outside their allotted band are complicating the problem. Another tough one confronting the conferees will be what restrictions, if any, to put on the use of radio by former enemy nations.

SERIOUSNESS OF THE WORLD allocation problem and its enforcement was recently underlined domestically with the announcement of a master plan for policing the radio spectrum. FCC pointed out that wartime technological developments increased the usable spectrum space from a former limit of 300,000 kilocycles to the present 30,000,000 kilocycles —or more. "Despite the vast new spectrum space available," FCC added, "the demand for radio channels still far exceeds the supply." Efficient policing therefore is of paramount importance. To meet the need, FCC has merged its Radio Intelligence Division (the wartime counter-espionage RID) with its field division. The new division is called the Field Engineering and Monitoring Division, with powers to conduct FCC activities for all radio services. It will police the air for interference, illegal stations, and measure frequencies. It will inspect all classes of licensed stations, examine and license radio operators, and see that both groups obey the rules. Nine field offices and monitoring stations operating around the clock will implement the work.

FCC HAS ALSO recently streamlined its method of handling broadcast applications in an attempt to catch up with the increased load in this field. Underlining that the procedure is temporary, the Commission has ruled that parties who have applied for a station may waive a hearing if they desire. FCC reserves the right to hold a hearing despite waivers if the Commission deems it wise. It was also emphasized that the new waiver proceedings in no way change the Commission's practice on protests, nor does it withhold from applicants the right to appeal to the courts if a final FCC decision is adverse to the complainant's interests.

GOING BACK to the international front, a more immediate solution of difficulties in the international field seems indicated as this goes to press. Reason; a near-completion survey of ham activities in all nations under the direction of the Berne Bureau. Major goal of the survey is to find out what nations are going to permit their hams to communicate with other nationals and whether experimental private stations will be granted like privileges. Wartime restrictions, which took most hams off the air, have been lifted by many nations, including the U.S., but others have shown signs of keeping them in force. Others are known to be contemplating more restrictive licenses for postwar use. But U.S. policy of reinstating hams as quickly as possible after the shooting stopped is said to be the major influence on decisions of other nations and a comparatively free use of the air by hams everywhere is anticipated. State Department is expected to publish a summary of the Berne survey when it is finished, probably before the end of the summer.

ON THE HOME FRONT, hams were heartened recently by FCC's announcement that amateur stations are now authorized to operate in two additional frequency bands—7150 to 7300

kilocycles and 14,100 to 14,300 kilocycles. Only A1 emission is permitted on the 7150-7300 band. Use of A1 is also permitted on the band 14,100 to 14,300 kilocycles. On frequencies 14,200 to 14,300 kilocycles A3 emission is okayed, but only by an amateur station which is licensed to an amateur operator holding Class A privileges and then only when operated and controlled by an amateur holding Class A privileges. FCC has also made certain additional amendments to amateur regulations. Type A0 emission has been added to those authorized on the 144-148 megacycle band, the 235-240 megacycle band, and the 420-430 megacycle band. A3 emission is expanded on one band, limited on another, being good from 3900-4000 kilocycles to 3850-4000 kilocycles; but the band on which A3 may be used has been contracted from 28.1-29.7 megacycles to 28.5-29.7 megacycles.

SPEAKING OF AMATEURS, among the most enthusiastic radio users in the current news are taxi drivers with mobile two-way units. Use of the units in taxiing began about a year ago when FCC allocated six channels with a width of 50 kilocycles in the 104-108 megacycle band. Since then FCC has been swamped by applications from taxi companies operating in cities all over the country. Most of the outfits which have gained FCC approval have not gotten beyond the experimental stage in use of the two-way units, but those that have report high enthusiasm among the drivers. Notable is the *Yellow Cab Company,* Washington, D. C., perhaps the world's greatest town for taxis. *Yellow* assigned radio-equipped cabs to outlying neighborhoods and called for volunteers to attend classes three nights a week in order to pass examinations and qualify for operating the radio unit. More than a hundred drivers quickly qualified. . . . Yellow has 27 cabs equipped with two-way radio. Others will be added as the program continues to expand.

SCORES OF other urban users of mobile units have also applied to FCC for permits, including bus companies, telephone companies, and the *National Electronics Laboratories,* which is working on a system to be used by doctors, nurses, and ambulance drivers. Even a department store—*Rich's* in Atlanta, Ga.—has applied. They want to install units in trucks to speed up delivery. An indication of how widely two-way mobile units are expected to be used in the near future was the recent prediction of the *American Telephone and Telegraph Company* that at least 10,000 doctors' cars, ambulances, buses, taxis and commercial vehicles will soon be equipped with units in New York City alone. . . .

PRODUCTION OF RADIOS took a turn for the better by mid-summer, but manufacturers are still dogged by the problem of balancing their supply of component parts. Early-summer shortages were experienced in gang condensers, and tubes continued on the scarce list. Console models lagged behind, owing to the lumber shortage, but production of table models boomed, bringing the grand total of new sets for May to 1,075,000, eight per-cent higher than April and approximately at the 1940-41 level. It was expected to continue steadily upward for the last half of the year. By units, table models are accounting for more than 80 per-cent of the production total, with console and auto radios still in the less-than-10-per-cent bracket.

OPA CEILINGS at first were honored by the industry pending definite word from the Hill on what the score was going to be. R. C. Cosgrove, president of the *Radio Manufacturers Association,* sounded the keynote for the industry when he said that he "believed it advisable for all members of the radio industry to continue very reasonable prices, as near present prices as possible, on radio sets and parts." There was nevertheless a noticeable slowing of deliveries from manufacturer to dealer before the OPA battle quieted. How much of a price rise may be anticipated in sets for the Christmas season is problematical, but the concensus seems to be that it will not be dramatic. Even OPA experts were willing to predict that, totally freed of ceilings and regulations, radio prices would not jump more than 10-15 per-cent—exactly what manufacturers have been claiming all along they needed to meet increased costs. . . . Meantime, industry was encouraged by a report from M. F. Balcom, chairman of the *RMA* tube division, predicting that tube manufacturers will "satisfactorily take care of reasonable export plus domestic replacements" during the coming year.

WHAT MAY eventually result in sales rivalling those of radios for automobiles is heralded by aviation this month with coast-to-coast installation of very-high frequency equipment for the first time in history. *United Air Lines* got the static-free units into its transcontinental planes ahead of other operators, but all are following suit. As CAA completes ground installations, nation-wide v.h.f. use on the airways is planned. In the wake of the airline installations will come smaller units for private fliers who, though far from being as numerous as automobile drivers, nevertheless have much more need for radio. A steadily-increasing market may be expected within the next few years.

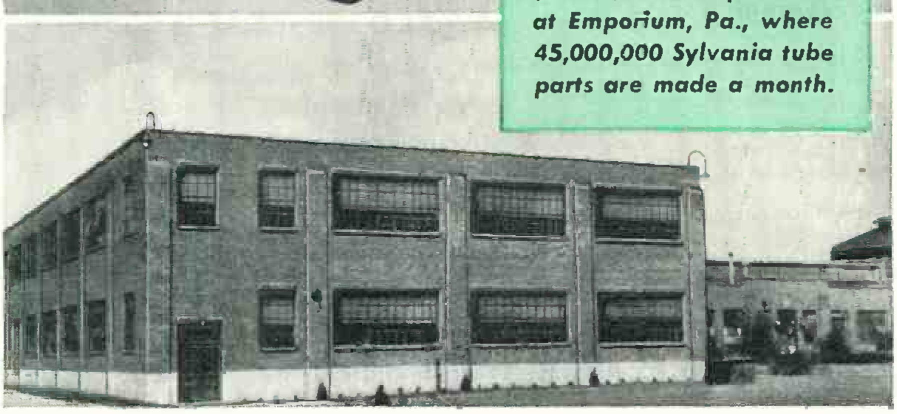
RADAR WILL continue to contribute to air safety, especially on long transoceanic hops, and is also showing up for Buck Rogers duty on the surface of the sea. A number of units have been installed in ocean liners, especially those on the North Atlantic (ice-

(*Continued on page* 144)

SYLVANIA NEWS
RADIO SERVICE EDITION

SEPT. *Prepared by* SYLVANIA ELECTRIC PRODUCTS INC., Emporium, Pa. 1946

SYLVANIA MAKES OWN TUBE PARTS AS AN EXTRA GUARANTEE OF QUALITY



(Above) ***These are some of the parts for Sylvania's Lock-In tube.***

(Below) ***Parts Department at Emporium, Pa., where 45,000,000 Sylvania tube parts are made a month.***

SYLVANIA SERVICEMAN SERVICE

by FRANK FAX

"Do it right" has always been a guiding principle of Sylvania tube production.

For instance, at Sylvania's Emporium, Pa. Tube Plant, there is a Parts Department that makes over 45,000,000 precision tube parts a month.

Sylvania even has its own Tungsten Plant, where fine wire filament for Sylvania tubes is made—to safeguard the quality of this vital tube element.

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SYLVANIA ELECTRIC

Emporium, Pa.

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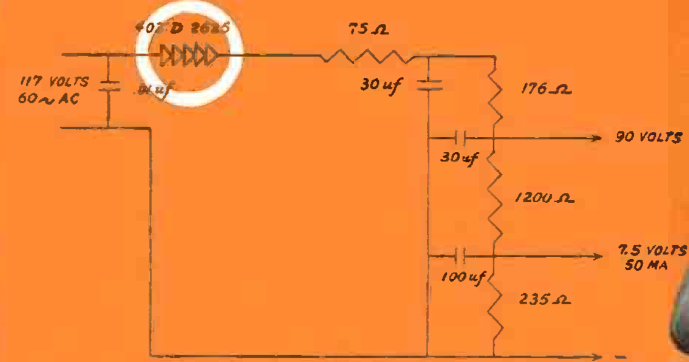
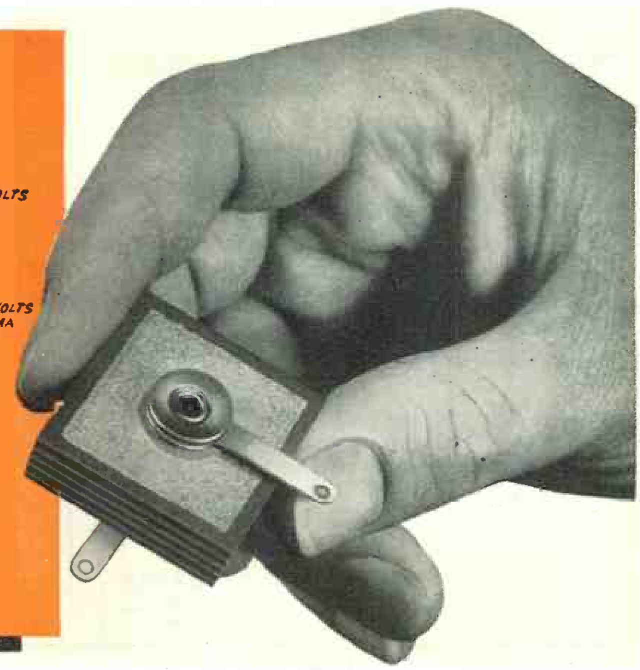
SHORT CIRCUIT THE RECTIFIER TUBE SHORTAGE

...with Federal's PROFIT-BOOSTING Miniature Rectifier Stack



Circuit diagram of power supply for AC-DC-Battery portable radio receiver, using a 5-plate Federal Rectifier unit in place of the conventional tube circuit.



29 DIFFERENT RECTIFIER TUBE TYPES NOW REPLACEABLE IN CONSOLE RADIOS, AC-DC PORTABLES, VIBRATOR POWER SUPPLIES!

YOU don't have to turn away repair jobs because there are no rectifier tubes on your shelf. Here's a replacement that is actually an *improvement* . . . and permits you to *earn more money!*

Install this remarkable, new rectifier stack which *costs less than a tube*, and the repaired set starts instantly without warmup, and runs cooler. Only 1¼ x 1¼ x 11/16 inches, it fits anywhere in the chassis. What's more, you can tell your customer it's in for good! For this Federal stack is built to last the life of the set. It withstands overloads, even when charging deformed electrolytic condensers. All metal construction prevents breakage.

Every one of Federal's famous "Center Contact" Selenium rectifiers is designed to give the full measure of dependable performance that has made them the standard of the industry. This miniature, 5-unit stack will help you to more business. A Federal engineer will send full information to assist you in their application. Write department F659.

REPLACEMENT FOR THESE TUBES

5T4	5Y3	6Y5	25Z6	50Y6
5U4	5Y4	6Z5	35W4	50Z7
5V4	5Z4	12Z5	35Z3	117Z3
5Z3	6X5	7Y4	35Z4	117Z6
5W4	0Z4	12Z3	35Z5	OY4
5X4	80	25Z5	35Z6	

ELECTRICAL CHARACTERISTICS

Maximum RMS voltage	130 volts
Maximum inverse voltage	380 volts
Maximum peak current	1200 ma.
Maximum RMS current	325 ma.
Maximum DC output	100 ma.
Approximate rectifier drop	5 volts

Two Federal Miniature Rectifiers in a voltage doubler circuit gives 250 volts and 80 milliampere output from 117 volt AC source.

Federal Telephone and Radio Corporation

In Canada:—Federal Electric Manufacturing Company, Ltd., Montreal
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Bass Reflex
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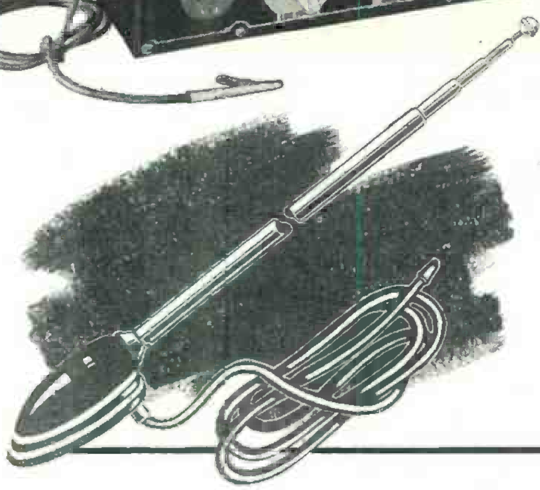

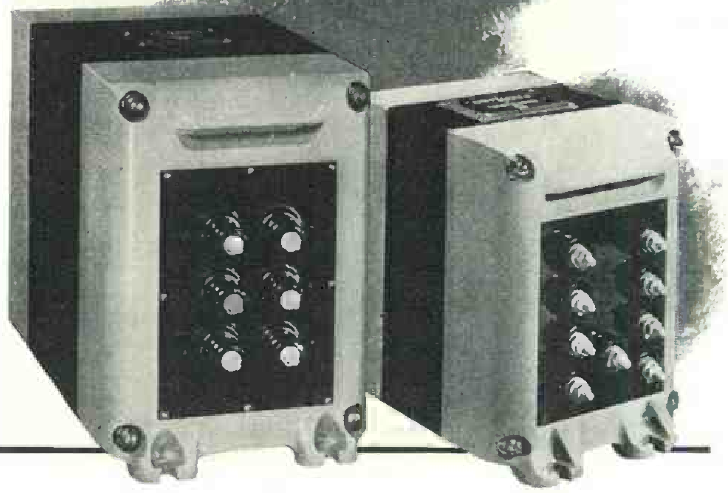

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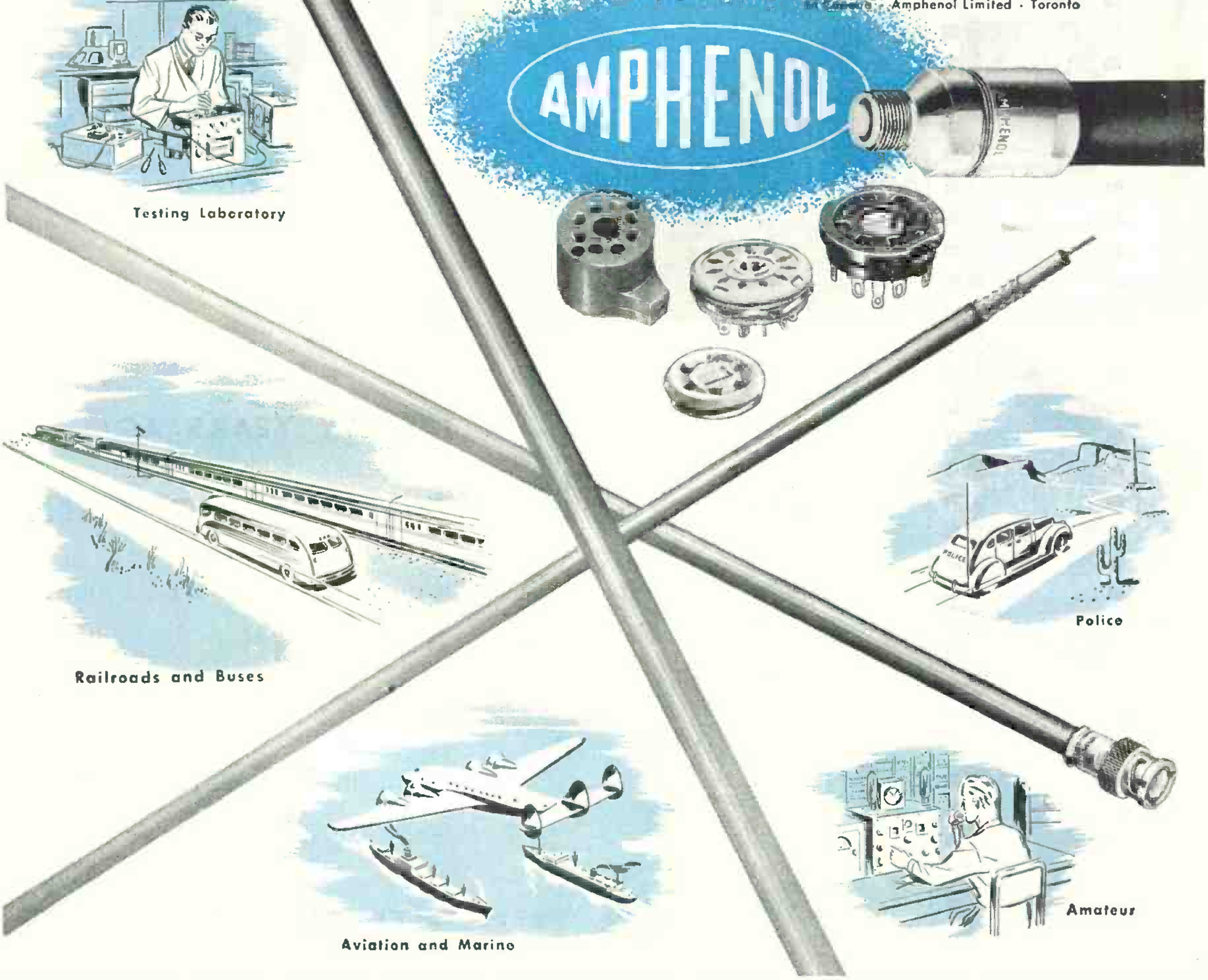

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TWENTY YEARS AGO

the movies learned to talk

THEN Broadway saw a dramatic presentation by Warner Brothers, using a synchronized system for high-quality sound developed by Bell Telephone Laboratories and produced by Western Electric.

Epochal for the motion picture industry, the occasion was only one of many landmarks set up by the Bell System along the stream of communication development.

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TWO-WAY RADIO

for everyone

By COMDR. S. FREEDMAN, USNR*
Navy Electronics Laboratory, San Diego, Calif.

Two-way radio in the microwave region opens a potential market for 32,700,000 units, retailing at $1,700,000,000.

The American Telephone & Telegraph Company through its various subsidiaries is rapidly establishing mobile radio-telephone and microwave relay networks through the nation. Photo shows New York City terminus.

ON MAY 7th, 1946 the author addressed the Radio and Electronic Service Association in the studios of Station KMPC, Hollywood, California, where a capacity crowd of 350 radio dealers, servicemen, radio engineers, and telephone company personnel had gathered to survey the vast field of two-way radio which is beginning to develop with increasing momentum.

Some idea of the possible scope of the two-way radio field can be gathered from the estimated market for such units, along with their dollar value, shown in Table 1.

Such an estimate provoked several questions which we will attempt to answer here. First, how can sufficient channels be provided to enable approximately 30,000,000 two-way radio stations to operate on the air simultaneously?

The answer to this problem lies in the use of the microwave region between 300 and 30,000 mc. with initial emphasis being placed on the ultra-high frequency band. A limited amount of this service will also be conducted on the very-high frequency band which at present lies principally between 30 and 40 mc. and 156 and 162 mc. In the permanent picture very-high frequencies will become of minor importance due to inadequate spectrum, and the greater size, power consumption, weight and cost of equipment for local communication ranges. It is also less desirable because much of the u.h.f. band is subject to serious long range interference with other stations on the same frequency located many horizons of range away. This has manifested itself in an increasing degree as the efficiency of receivers increased, antenna improvements developed, and FM replaced AM.

The Federal Communications Commission on May 25, 1945 released its findings and allocations for what is now virtually unrestricted two-way radio communication to legitimate groups or individuals interested in such facilities. Where heretofore operations were only permitted for emergency purposes, they may now be utilized by anyone for reasons of necessity, convenience or even novelty. However, a word of caution. An operator's license is still required for communications below the 25 mc. band.

Prior to World War I, radio which was then called "wireless" could not function satisfactorily with equipment and techniques at hand on wavelengths shorter than about 200 meters. This corresponded to a maximum frequency spectrum of 1500 kilocycles. If, as in the case of broadcasting, we consider a communication channel as equivalent to about 8 to 10 kilocycles in the case of AM and considerably more than that in the case of FM, it only permitted about 1500 channels per communication zone. In a nation the size of the United States there could not be more than about half a dozen zones where these channels could be reassigned. Even then the likelihood of serious interference during night hours, particularly in the winter months, always existed.

In order to utilize this limited number of channels extensively, it was common practice for all stations of the same service to operate on the same band of frequencies regardless of the great interference and incon-

Table 1. Potential market for two-way radio equipment represents an estimated total of 32,700,000 units with a cash value in excess of $1,700,000,000.

200,000	railroad units @ $500 each	$100,000,000
500,000	intercity trucks and buses @ $300 each	$150,000,000
2,000,000	local trucks and delivery vehicles @ $100 each	$200,000,000
15,000,000	automobiles, boats, planes, etc. @ $50 each	$750,000,000
5,000,000	rural and special users @ $50 each	$250,000,000
10,000,000	personalized sets @ $25 each	$250,000,000

* Comdr. Freedman is the author of the book "Two-Way Radio" published by the Ziff-Davis Publishing Company. He is also author of the book "Microwaves" which will be published by the same company early in 1947.

Photograph of transmitting and receiving facilities designed to meet the needs of two-way radio mobile communications. Many manufacturers are producing such equipment.

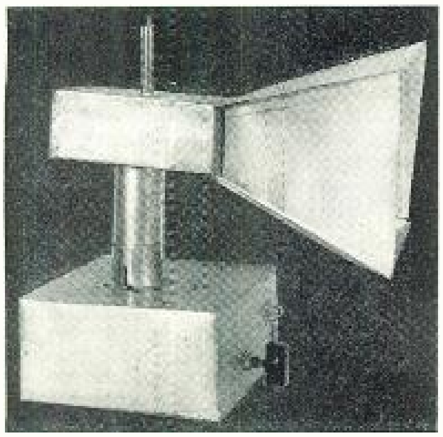
Government	14,288,000 kc.
Non-government fixed and mobile	11,060,000 kc.
Amateurs	2,130,000 kc.
Miscellaneous services	870,000 kc.

Table 2. FCC allocations in microwave region (between 300 and 30,000 megacycles).

venience this caused. Equipment being much less efficient than today and employing telegraphy rather than telephony, it was possible to accommodate the few thousand radio stations then in existence. Some idea as to the number of radio stations can be realized from the fact that there were less than five thousand commercial radio operators' licenses current for the entire United States with some stations employing more than one operator.

As the vacuum tube replaced the spark and arc transmitters, and doomed the simple crystal receiver, radio telephony and broadcasting became possible. Such services require about 20 times more channel space than radio-telegraph services. Furthermore, particularly with AM, the

Simple laboratory model of 1-tube microwave receiver complete with electromagnetic horn. The horn is equivalent to a flared out wave guide with directional antenna characteristics. Energy is directly received through the horn without the need of separate antenna facilities. This unit operates on approximately 3700 mc.



channels must be single occupancy or intelligibility may be impossible. While the vacuum tube resulted in services which required more spectrum than was feasible to utilize before, it also made possible equipment capable of operating on much shorter wavelengths and correspondingly higher frequencies. Between World War I and the beginning of World War II, the usable spectrum had been increased from about 1500 kilocycles to about 120,000 kilocycles. Much of the development took place in the region between 30 and 40 megacycles. This band was used primarily for two-way radio, particularly for police, fire, forestry, sheriff and other emergency services. As the operating frequency increased, the number of communication zones where the same frequency could be re-assigned began to drop. On short waves stations might have world-wide ranges so that even two stations in any part of the world might interfere with each other for important parts of a 24 hour period. As the frequency further increased to beyond 30,000 kilocycles, ionospheric reflections became less of a problem and, for the most part, it became possible to utilize the same frequencies over and over again every other horizon of distance. Now on microwaves, although natural waveguide paths and atmospheric stratification may produce phenomenal ranges under certain conditions and at certain times, it is considered safe to utilize the same frequency over and over, each horizon-and-a-half of range. For the elevation likely to be employed, a nation the size of the United States, discounting some of the unpopulated areas, can utilize the same frequency over and over about 10,000 times over its 3,000 000 square miles of area. If we consider a horizon to be the area represented by the average city or township, there can readily be at least twice that number of communication zones. For example, the city of South Portland, Maine, comprises 12 square miles. Hyannis, Massachusetts, Cape Cod's largest and most important community, comprises 74 square miles including its undeveloped outskirts. New York City, including all its five boroughs, represents 300 square miles of land area. 10,000 communication zones in the United States would, therefore, mean that each zone could represent an area occupied by the nation's largest city. Cities like Chicago and Los Angeles which occupy relatively great land areas have favorable conditions for two-way radio because of flat terrain or strategic elevated points convenient to the flat terrain.

Since the beginning of World War II, the radio spectrum has been extended down to wavelengths as short as 1 centimeter or to frequencies as high as 30,000,000 kilocycles. Allowing an average of 10 kilocycles per station, including both clear channel and common channel services, this represents about 3,000,000 possible stations per communication zone as compared to about 150 possible 25 years ago and the approximately 12,000 in operation immediately before World War II.

In addition to opening more communication zones with a greater frequency range available in each of the zones, a third factor which can increase the number of stations to be accommodated while improving the efficiency of each of the stations is now in use. This factor consists of utilizing reflecting surfaces, many times larger than the operating wavelength, to concentrate and beam the energy. For example, in the case of microwaves, the antenna dipoles may need to be only an inch or two in length. Such small antenna dimensions when focused with respect to a parabolic reflector, a corner reflector or in a flared-out wave guide (electromagnetic horn) may provide energy concentration and power gain in the desired direction of 1000 times, more or less, depending on dimensions and wavelength employed. Shorter wavelengths and larger reflectors (exceeding five feet in diameter) may provide energy concentration that may approach 1,000,000 times. This gain may be squared by providing it at both the transmitting and receiving points. Concentrating energy in the desired direction means that less energy will be radiated in the undesired directions. The result then becomes such that other stations may simultaneously operate in the same communication zone on the same frequency in other sectors. 100 sectors are readily achievable provided the stations are separated about a quarter mile or more in the same zone. At the same time such beaming systems make it possible to get the same or better results with a low powered transmitter and modest receiver than would otherwise be obtained with a very high powered transmitter and superior receiver facilities.

Integrating all of these advantages and possibilities we have 3,000,000 station channels x 10,000 communication zones x 100 separate sectors per communication zone. This means there is room enough in the United States for three trillion two-way radio stations at one time or 100,000 times more than necessary for the 30,000,000 stations which it has been estimated will be employing two-way radio during the next five years. This hundred-thousand fold margin is ample to take care of spectrum for other services such as television, navigational aids, military applications and microwave relay networks. It also means that stations can utilize much more than 10 kilocycles per channel, thereby eliminating the necessity for extremely critical and costly equipment. It further means that FM can be utilized with optimum deviation ratios, as the necessary extra kilocycles are readily available.

The second question that may be asked is: What is the policy of the Federal Communications Commission with respect to the necessary channel allocations, station and operator licenses for such a vast utilization of two-way radio?

On May 25th 1945, the FCC allocated the bands for all forms of two-way radio communication as well as other services. The microwave region (between 300 and 30,000 megacycles) has been allocated as shown in Table 2.

Most of this spectrum, excepting government allocations for the most part, may be utilized for fixed, portable, or mobile two-way radio communication. Part of this region will be used exclusively for that purpose while part will be in common with other types of non-interfering services, properly planned on a geographical basis.

All services seeking station licenses on common channel bands, such as the citizens' radio communication band, need do little more than merely request authorization and call letters. These formalities may be waived as the service becomes more widely used. Services requiring clear, sole-occupancy channels in any zone will have to comply with the requirements of the past but these will be administered less stringently because of the greater channel availability made possible by the development of microwaves.

With respect to operator licenses, the Federal Communications Commission has either abolished or waived radio operator licenses or permits for most of the two-way radio services in this region. The FCC still requires that professional maintenance or repair personnel hold at least the equivalent of a radiotelephone second class license. While requiring a knowledge of basic radio laws and basic theory, it is the simplest form of professional radio operator license to obtain. No knowledge of telegraphy is required. Typical services requiring no operator licenses already include all the railroads, truck, bus, mobile radiotelephone and other services of this nature. This recent liberalization serves both as a convenience and an aid to the expansion of two-way radio as well as relieving the FCC of the tremendous administrative and clerical burden the former licensing policies would have entailed. For example, the Association of American Railroads alone planned to use 463,000 of their employees as operators of the two-way radio equipment which railroads expect to install. The highway services would include an even greater number. The Commission saw no alternative but to waive licenses for persons who merely operate equipment.

Willett truck driver contacts his dispatcher over two-way radio installed in vehicle.

Type of Equipment

The author recently demonstrated and displayed basic working models of simple microwave equipment such as may be expected to appear during the future. Much of the equipment to be used in the two-way radio installations has been made possible by the two-billion dollar microwave research, development and production for radar and other applications conducted during World War II. The *Sperry Gyroscope Company* with its Klystron and many accessories, the *General Electric* with its disc-seal tube having short transit time, *RCA* with many special versions of conventional tubes, and other groups, such as *Fonda-Freedman,* with tubes where the transit time is synchronized with any required number of periods of oscillation in ordinary conventional tubes, are but a few of the many techniques and approaches to microwave two-way radio development.

For example, in the case of the *Fonda-Freedman* developments, the equipment may embody a combination of the following:

1. The use of ordinary mass-produced low cost tubes such as the 6N7, 6F6, 6V6, 6L6 or any transmitting, miniature or sub-miniature tube types

Two-way radio is destined to revolutionize railroad communications. The Association of American Railroads estimates that 463.000 of the 1,250.000 railroad employees will operate two-way radio equipment throughout U. S.

Woman taxi driver for the Yellow Cab Co. is shown using telephone handset in cab for test being conducted by the company in Philadelphia. Mobile two-way radio equipment installed in the test cab and a two-way "land station" on the roof of the 10-story Aldine Trust Building, permits conversations, reports, and instructions between the company's dispatchers and the test cab, whether parked or in operation. The antenna used for mobile operation is shown on roof.

comparable with these for either power or portability.

2. Operations on frequencies between 200 and 30,000 megacycles and perhaps further. Some observations have been made on frequencies as high as 50,000 megacycles.

3. Basic two-tube receiver which functions on either AM or FM without any circuit changes on the microwave frequencies. It provides the equivalent of two stages of r.f. amplication, detection/discrimination and an initial stage of audio amplification.

4. Signal generators for measuring the frequency and calibrating the receivers by the use of a single tube for that purpose.

5. Tuned reflectors which are not only correct for beam width but also may be adapted to act in lieu of a special relay station where the local horizon is badly obstructed. It is of such design and shape as to minimize boundary discontinuities and cancellation effects normally present because the reflector dimensions and operating wavelength are finite rather than infinite dimensions.

6. AM/FM noise elimination circuits which eliminate (not merely limit) AM distortion during FM reception or, by throwing one control toggle switch, do exactly the opposite. This is to improve the signal-to-noise ratio in any existing receiver.

7. Microwave FM modulator to provide any desired degree of FM deviation ratio merely by adjusting one small potentiometer. It is electromechanical and requires no special additional tubes for this purpose.

Transmitter Power Required

In microwaves, transmitter power is merely one necessary consideration. It may even be a minor one as long as enough initial power exists to develop a signal which can be beamed or focused to a receiving point. In practice this may be as little as 100 microwatts (100 millionths of a watt). The amount of power needed depends on the frequency employed and the beaming provisions employed. Little power will be lost between the equipment and the antenna if wave guides are used or if little separation between them exists, as will usually be the case. The equipment should be at or close to the antenna. If necessary to control or operate it remotely, it should be by remote control rather than direct control of the basic equipment.

As the frequency is increased, assuming the receiver efficiency holds for the higher frequency as it does for the lower frequencies, the power may be reduced in the transmitter. If the frequency is increased ten times, the power may be reduced about 100 times (inverse square) because the effective area of the reflector is directly proportional to the square of the frequency. The gains may be further extended to the receiving location by beamed antennas, good signal-to-noise ratios in the receiver, and ample inherent amplification to take advantage of this condition. It makes no difference whether we achieve our performance by more transmitter power, more energy concentration at the antenna, higher sensitivity at the receiver or better signal-to-noise ratios. If we can have all these advantages at the same time, extremely satisfactory performance is possible even with the most modest power.

Type of Modulation

While any type of modulation may be utilized, AM is likely to be the least preferred during the future. Direct FM or pulsed forms of modulation will be principally utilized on the basis of present developments. Direct FM is where the frequency varies in proportion to the frequency of the sounds fed into the microphone. AM applies where the amplitude or power of the signal varies in accordance with the sounds fed into the microphone. Pulsed forms of modulation are primarily of two types, namely:

1. PRM (Pulse Rate Modulation) where the energy is transmitted in pulses rather than continuously. Each pulse is many times stronger than the average value of continuous signal energy as heretofore employed. Modulation is obtained by varying the number of pulses per second in accordance with the sounds fed into the microphone.

2. PTM (Pulse Time Modulation) where the number of pulses is constant but the interval between each pulse varies in accordance with the sounds fed into the microphone. These intervals are sufficiently great to permit more than one channel of communication on the same carrier, transmission line, and antenna system. It is popular in commercial microwave relay networks to provide many communication channels on a single frequency.

Equipment Cost

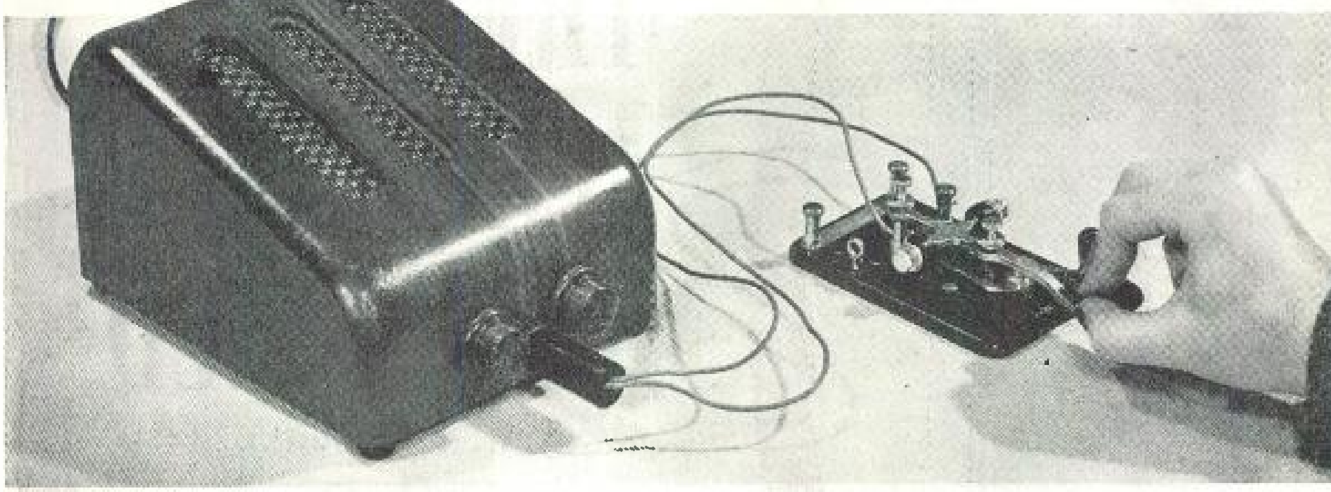
On the basis of material costs and manufacturing labor this equipment will cost much less than equipment on lower frequencies. Where this has not been the case, the high cost may be attributed to the absence of mass production and the large amount of research and development expense necessary to date. Assuming costs will be distributed over a broad base, the equipment will compare in cost with a medium priced standard broadcast receiver. Certainly the size, weight, number of parts and over-all complexity are less for the microwave two-way radio set than for the better grades of standard broadcast receivers. Material costs of preproduction

(*Continued on page* 78)

The Governor of Maine inspecting the first successful two-way mobile radio installation of the Maine State Police Radio System at the Thomaston barracks.

CODE PRACTICE OSCILLATOR

By NORMAN L. CHALFIN
The Daven Company



This code practice oscillator was built by the author and is described fully herein.

The first step toward obtaining a ham license is learning the Morse Code.

A CODE practice oscillator is a necessity in the learning of the Morse Code whether this learning process is accomplished by "hand" or through the agency of one of the many automatic tape keying devices.

The very simplest code practice oscillator is a buzzer that can be purchased at the dime store. A circuit arrangement utilizing such a buzzer is shown in Fig. 1A. Another very popular type of code practice oscillator is that employing a battery type triode such as the 30, 1H4, etc., in conjunction with a low voltage battery. As can be seen in the circuit diagram of Fig. 1B, an ordinary audio transformer is all that is needed besides the essentials of key, phones, tube and batteries. Should the circuit not oscillate, reverse either the primary or secondary leads of the audio transformer. Tone is controlled by the filament dropping rheostat. A 4.5 v. "C" battery will supply all necessary power for the oscillator shown in Fig. 1B.

Where higher voltages are available in "B" batteries, the circuits of Fig. 2 may be used. This is a Hartley type audio oscillator. Frequency (tone) may be varied by changing either fixed condenser C_1 or C_2. It is well to remember that the *higher the capacity,* the lower the frequency. Another method of tone control is to vary the grid leak resistor. A typical method for varying this resistor is the use of a volume control of about 100,000 ohms. The higher the resistance selected the lower will be the frequency.

Battery operated oscillators have one major disadvantage. The batteries require frequent replacement. An inexpensive oscillator which does not require batteries and operates from the power lines, is most desirable. A circuit diagram for such an oscillator is shown in Fig. 3. A photograph of this unit as constructed by the author is shown above, while the under chassis view is shown on page 84.

This a.c.-d.c. code practice oscillator employs a 117N7GT tube which comprises a beam power amplifier and half-wave rectifier in a single envelope. The circuit is similar to that of Fig. 2 A push-pull output transformer doubles as both oscillation and output transformer. The primary comprises the inductance of a Hartley oscillator tuned by capacitance C_2. Volume is controlled by the 50 ohm wire-wound control R_1 across the secondary (voice-coil) winding. A two-inch permanent magnet dynamic speaker is

(*Continued on page* 82)

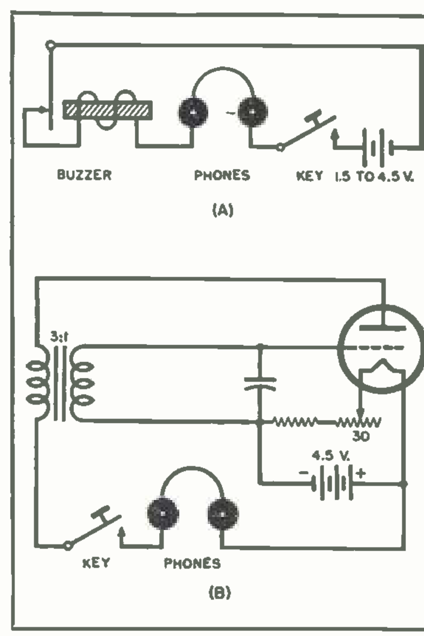
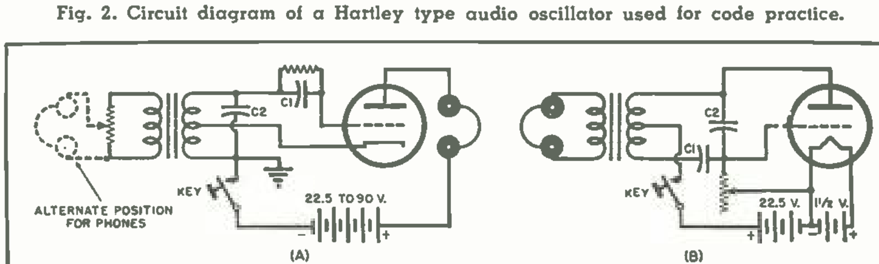
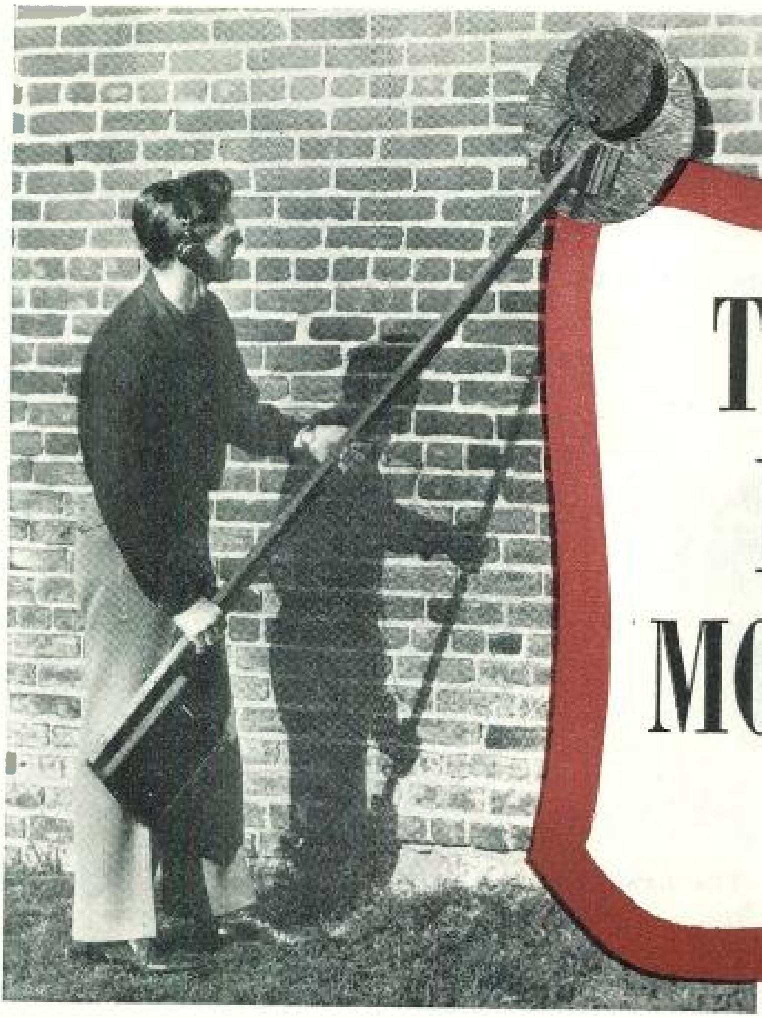


Fig. 1. Simple code practice oscillator.

Fig. 2. Circuit diagram of a Hartley type audio oscillator used for code practice.





A model of this type is convenient for exploring masonry walls for embedded metals.

TREASURE FINDING MODERNIZED

By W. E. OSBORNE

Gilfillan Bros., Inc.

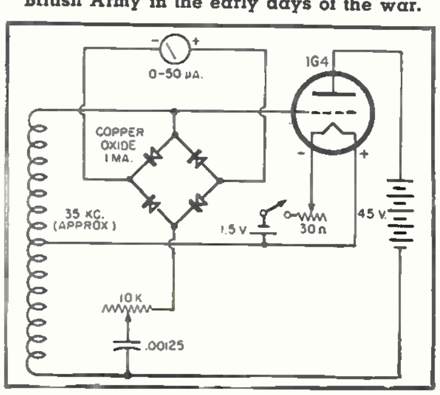
A general discussion on the design of electronic metal locators. Wartime research on mine detectors has been a boon to those interested in locating hidden treasures.

ELECTRONIC metal locators, or "treasure finders" as they are often romantically called, are due to return rapidly to favor—in a much more sensitive and modernized form—as a result of wartime research on mine detectors. Ever since the early 1920's metal locators have been more or less popular with experimenters, and have periodically made their appearance in radio magazines.

Single tube oscillators or near-oscillators have vied with cumbersome superhets, and many fantastic claims have been made as to the sensitivity of the various types and methods described. Getting down to cold, hard facts, however, no locator of a really portable type has ever reached a sensitivity—using a copper penny as a standard—of more than a few inches.

Of the various methods and circuit arrangements employed, the straight oscillator or transmitter always was, and still is, better than the heavier, bigger, and high current combinations of transmitter/receiver. In these latter types of metal locators, perfect shielding between transmitting and receiving antennas could obviously never be accomplished, and thus much of the otherwise high sensitivity was lost by direct pickup, plus the added disadvantages of weight, size, and high battery drain. A total of eight or even ten tubes was common in these models, and the poor operator staggering over sandy desert or rocky mountain under a boiling sun, with transmitter and receiver mounted fore and aft, ear-phones upon his head, and heavy duty batteries upon his back, was soon sagging at the knees, and apt to eventually swap all his gold prospects for an ice-cold bottle of beer!

Fig. 1. Single-tube oscillator used by the British Army in the early days of the war.



The straight oscillator can, on the other hand, be made at least equally sensitive, plus the other obvious advantages of light weight, small size and low drain. Ear-phones can be eliminated in practically any type, either by rectifying the signal and reading the output on a d.c. meter, or by amplifying the signal and using an a.c. meter in the output, which basically amounts to the same thing. A single-tube oscillator developed by the writer in 1928 and used by the British Army in the early days of the war is shown in Fig. 1.

The beat-frequency-oscillator is an improvement on both these types, and is, if properly designed and constructed, much more sensitive. It was in very general use during the war as a mine detector, and although even here the range was limited to a couple of feet or so, the safety factor was strengthened by mounting the loop antenna on a long pole. At least three tubes (usually four or five) are necessary with the b.f.o., and the idea is, of course, to use two oscillators (one fixed and one variable) separately shielded, feed them into a mixer tube and then read the difference frequency either by meter or head-phone. The loop antenna belongs to the variable oscillator. It should be mentioned here that the writer prefers, as a result of long and bitter experience, to watch a meter rather than listen to the monotonous beat note in headphones, as used in most Army locators. The meter is also more sensitive. Fig. 2 shows the general arrangement of a beat-frequency locator.

Frequencies used depend very largely on the type of metal (or other deposits, such as oil, etc.) sought, and the nature of the ground. Generally speaking, however, a frequency in the supersonic range is mostly desirable —say between 30 and 100 kc. The writer always prefers 80 to 90 kc., except in special cases. Higher frequencies, besides being more unstable, are affected by water and moisture, and in desert country a reading can be obtained from grass or green leaves. On the other hand, the higher the frequency the narrower the beam, and thus more accurate focusing is obtainable. The very low frequencies, almost in the audio range, can be used to advantage in the definition of non-magnetic versus magnetic metals—in other words, the separation of gold or copper from iron.

As the war advanced, new techniques came into being, and the Germans rapidly developed the "non-metallic" mine as a counter to our metal-locating mine-detectors. This caused a heavy toll at first among Allied troops, and was especially hard on the sappers, who operated the detectors. The urgency of the situation resulted in immediate action which, basically, followed two lines of thought.

1. The development of the "capacity wave" or "ground wave" type of detector, which generally speaking, recorded any dielectric change in the earth's surface (to a depth of about ten inches only). This was essentially an ultra high frequency type.

2. The fact that no mine would be really 100% non-metallic, i.e. some fractional amount of conducting material would be present, usually in the detonator. This meant the development of a super-sensitive version of one of the known types of detectors.

Both types were quickly and successfully produced and used against the enemy. Fig. 3 shows a detector of No. 2 type which was developed by the writer at the request of the Army Inventions Directorate (Melbourne) and later used by Australian troops in New Guinea. The loop is very large (6 ft. × 4 ft.) and is mechanically adjustable by a rod mounted in front of an army truck, and operated from the driving seat. Power for the oscillator and amplifier is supplied by a conventional vibrator unit.

The application of radar or pulsed transmissions to metal-locating equipment originated in the early days of 1940, and development along these lines continued in parallel to other methods. Vehicle-mounted equipment is usually required, and owing to the extremely high power output, enormous sensitivity is obtainable. Even with portable radar types, readings at 100 feet have been obtained from a small mine buried 2½ feet in the

(*Continued on page 90*)

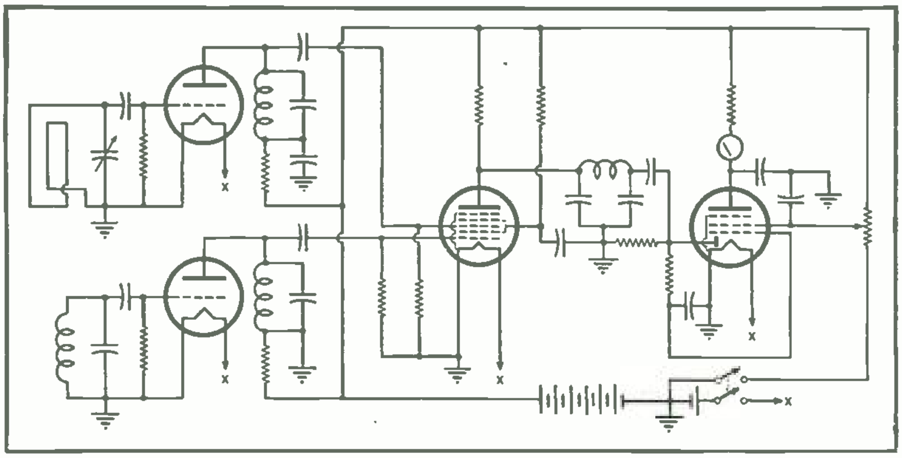


Fig. 2. General arrangement of a beat-frequency type metal locator.

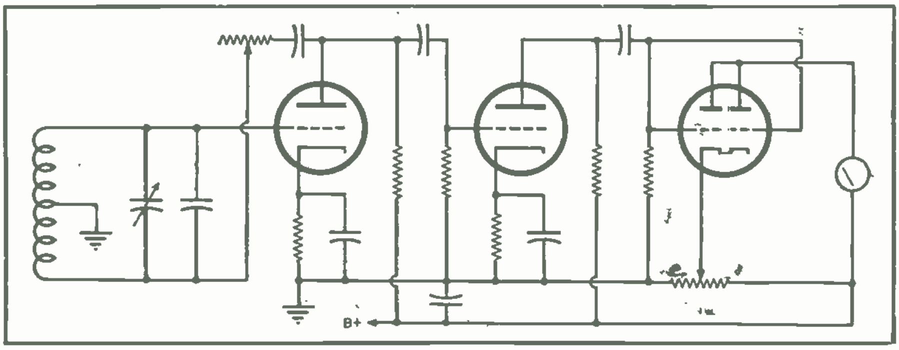


Fig. 3. Basic diagram of a super-sensitive type locator used by the Australian troops in locating the so-called "non-metallic" mines.

Although these American made metal locators were used to detect mines overseas, they would make excellent treasure locators.

OPERATION CROSSROADS

By OLIVER READ
Editor, RADIO NEWS

H. R. Diehl, ARM 1/C (right) explains operation of Geiger Counter to Editor O. Read, on board U.S.S. Shangri-La.

A "behind-the-scenes" resumé of history's greatest radio-electronic show featuring 20,000 instruments.

TRAVELING 17,146 miles to and from Operation Crossroads to gather information is, fortunately, a "once in a lifetime" assignment but, I hasten to add, the junket was worth every bit of the discomfort we were subjected to. As expected, radio communications and electronic devices were largely responsible for the success of the Operation.

Close-up view of one of the Geiger Counters used to test samples of seawater from Bikini lagoon after the detonation of the A-Bomb. Water samples were poured through the funnel at left, and passed into the instrument. The amount of radioactivity is then recorded on the dial as shown at the upper left.

We left Fairfield, California via Air Transport Command on a C-54, and arrived at Hickam Field, Hawaii early the next afternoon; a non-stop flight of 2448 miles. Before leaving we had had our first "briefing" consisting of instructions for "ditching" should it become necessary and the proper wearing of our almost constant companion, the Mae West.

My 16 lb. Brown-Crane wire recorder was planted firmly under my G.I. shoes to keep it from jumping around.

After a twenty-four hour layover on the island of Oahu, where we were royally entertained by the Chamber of Commerce, we proceeded on the last leg of our journey. We stopped at Johnston Island (a hunk of coral) for an hour and had our first initiation as to the kind of chow that was to follow. It wasn't too good!

As we crossed the International Date Line at 11:46 p.m., Kwajalein Time, the Flight Clerk hollered, "We are now passing over—be sure to set your watches ahead twenty-four hours." A couple of the travel-weary lads actually started to do just that.

Our arrival at Kwajalein was a terrific letdown. What mental pictures we had formed from reading travel folders were literally blown apart as we emerged from our C-54 in a very heavy tropic rain. We were speeded away via island bus to the Navy Officers' Mess only to find, a half hour later, that we had been misdirected. It seems as though we were supposed to go over to Commander Wyatt's for cocktails and breakfast. This at 3:00 a.m. The party broke up about six and we were assigned to our quarters in typical Navy barracks. Our flight of 4552 miles had removed whatever spark might have been in us. We had anticipated at least a cat nap. This was only a temporary delusion however, as we were soon rushed to our first briefing on something that they say we can do nothing about—weather. It seems however, that these weather boys had done something about the weather.

WX (weather) stations are located at Wake, Eniwetok, Majaro, Tarawa and at Kwajalein. Radio teletype connects these islands and reports are gathered and plotted at intervals of approximately one hour. A total of seven special weather craft—three B-29's and four PB4Y's—are used by the weathermen to gather wind, climatic, altitude and other information from remote areas in the North Pacific and their findings are radioed back to the islands for plotting on charts.

Radar tracking of balloons is now standard procedure in order to determine wind velocities at high altitudes.

I was told that the weather had been forecast accurately in five out of six previous practice bomb drops. That was very good considering the fact that the Army's only accurate records were for 1945 and also considering that the Japs and Germans had compiled very little altitude data.

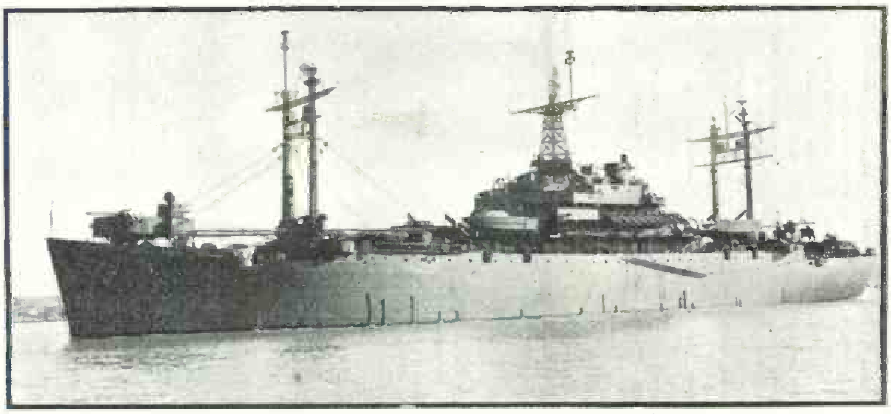
The following morning I visited WXLG, the island's transmitter. The station operates on 1440 kc., using a *Hallicrafters* BC-610 transmitter and serves Guam, Kusaie, Mili, Wake, Eniwetok, Midway and Johnston islands. The studio is built into a Quonset hut and is acoustically treated throughout.

Later in the day I visited Major Martin H. Luichinger on the U. S. S. Spindle Eye, with W. W. Chaplin of NBC and George Moorad of CBS. We are going to give you a special article on the elaborate radio installations aboard this broadcast ship and, if we are fortunate in clearing Intelligence, we will show you special photographs of the maze of intricate equipment installed thereon.

Another briefing, this time by Admiral Parsons, from the Manhattan Project, was next on the agenda. He outlined various methods to be used in the test for determining stress, strain, buckling and distortion on ships by means of simple "scratch gages." He described, too, the many electrical gadgets that would record damage to ships and send these findings by radio back to headquarters.

It should be borne in mind that all of these target ships were, in themselves, instruments and in all cases it was necessary to simulate actual battle conditions on these vessels if a thorough and accurate conclusion were to be drawn.

The following day was the briefing for "Queen Day" which, as you know, was the dress rehearsal for "Able Day." I also had my first visit to the



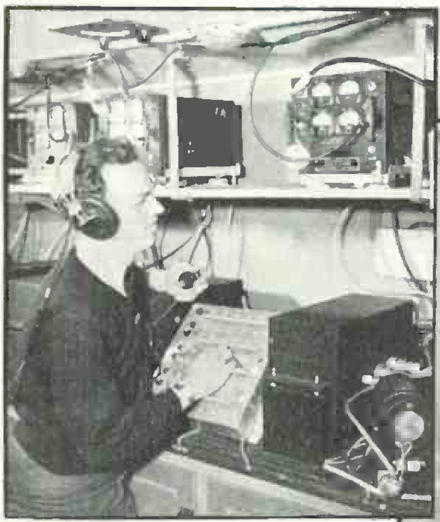
The U.S.S. Appalachian, floating press headquarters for all but a handful of the newspapermen, photographers, radio commentators, and magazine writers covering Operation Crossroads. During the second test, broadcast ship "Spindle-Eye" was wisely moved to Hawaii to improve radio transmission to the United States by acting as relay between the Appalachian and Mt. McKinley and the mainland.

Communications Center of Task Group 1.5 and got acquainted with Capt. Phillip E. Smith. Original plans were made for tapping into radio circuits so that I could make a complete wire recording of the important "Queen Day" communications. Special extensions and outlets were, in turn, provided.

One of the most exciting days came on Saturday, June 22nd. Went by boat to Ebeye Island to board a PBM-5 seaplane of Patrol Bomb Squadron 32. I sat in the nose gun turret on our entire flight to Bikini. I had my first bird's-eye view of the target fleet spread out on a huge green water carpet below. The battleship Nevada, painted a bright red, was clearly visible from a distance of about twenty miles. After a rather bumpy landing, we sped via LCP to the U.S.S. Orca where we had coffee and, of all things, another briefing. We then went by launch to the Officers' Club on Bikini to imbibe some beer and partake of some very nice chow. The sun was blazing on the white coral sand and the heat was terrific. There I visited "Radio Bikini, NIC01." This is one of the receiving stations for the Mt. McKinley.

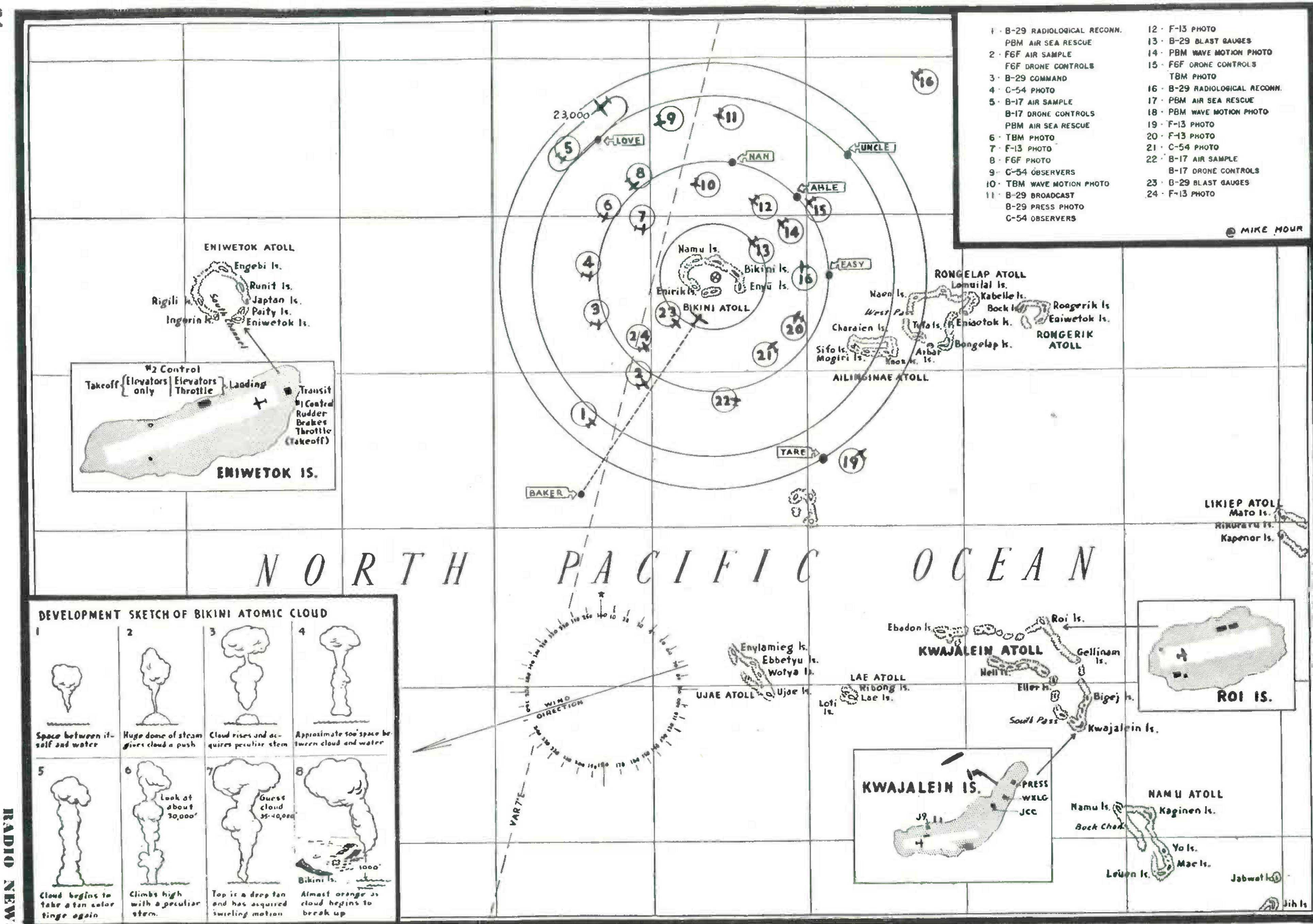
We then boarded the Mt. McKinley for a conference with Admiral Blandy. He predicted good "Queen Day" weather (which proved later to be a bad guess). He told us about the Nevada's turrets being repainted in red and white stripes, then followed a Q and A session that lasted for about an hour. He told us that submarines would be surfaced for the first test but submerged for the second and that the atom bomb would be the only weapon tested. Then returned to Ebeye via PBM-5 and LCM. The pilot gave me a bit of a hedge-hopping tour of the nearby islands enroute to Kwajalein.

Queen Day was next on the agenda. Getting up at 4:15 a.m., I rushed by jeep to the Communications Center adjacent to the air strip at the 58th Wing with my trusty wire recorder.



Picture shows technician checking electronic equipment for a F6F Hellcat in the Communications Maintenance Laboratory aboard the Navy aircraft carrier, the "Shangri-La."

Hallicrafter's S-27 and S-26 receivers aboard the Shangri-La were used to feed programs, etc. to 20 ship's speakers, or record communications on 12 transcribers.


1 · B-29 RADIOLOGICAL RECONN.
PBM AIR SEA RESCUE
2 · F6F AIR SAMPLE
F6F DRONE CONTROLS
3 · B-29 COMMAND
4 · C-54 PHOTO
5 · B-17 AIR SAMPLE
B-17 DRONE CONTROLS
PBM AIR SEA RESCUE
6 · TBM PHOTO
7 · F-13 PHOTO
8 · F6F PHOTO
9 · C-54 OBSERVERS
10 · TBM WAVE MOTION PHOTO
11 · B-29 BROADCAST
B-29 PRESS PHOTO
C-54 OBSERVERS
12 · F-13 PHOTO
13 · B-29 BLAST GAUGES
14 · PBM WAVE MOTION PHOTO
15 · F6F DRONE CONTROLS
TBM PHOTO
16 · B-29 RADIOLOGICAL RECONN.
17 · PBM AIR SEA RESCUE
18 · PBM WAVE MOTION PHOTO
19 · F-13 PHOTO
20 · F-13 PHOTO
21 · C-54 PHOTO
22 · B-17 AIR SAMPLE
B-17 DRONE CONTROLS
23 · B-29 BLAST GAUGES
24 · F-13 PHOTO
© MIKE MOUR
23,000
LOVE
NAN
UNCLE
AHLE
EASY
TARE
BAKER
Namu Is.
Bikini Is.
Enyu Is.
Enirik Is.
BIKINI ATOLL
ENIWETOK ATOLL
Engebi Is.
Runit Is.
Japtan Is.
Parry Is.
Eniwetok Is.
Rigili Is.
Ingurin Is.
South Channel
#2 Control
Takeoff
Elevators only
Elevators Throttle
Landing
Transit
#1 Control
Rudder
Brakes
Throttle
(Takeoff)
ENIWETOK IS.
RONGELAP ATOLL
Lomuilal Is.
Kabelle Is.
Bock Is.
Naen Is.
West Pass
Tufa Is.
Eniaetok Is.
Bongelap Is.
Charaien Is.
Sifo Is.
Mogiri Is.
Arbar Is.
Rongerik Is.
Eniwetok Is.
RONGERIK ATOLL
AILINGINAE ATOLL
LIKIEP ATOLL
Mato Is.
Kapenor Is.
NORTH PACIFIC OCEAN
WIND DIRECTION
VAR. 7°E
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Ebbetyu Is.
Wotya Is.
Ujae Is.
UJAE ATOLL
LAE ATOLL
Ribong Is.
Lae Is.
Loti Is.
Ebadon Is.
KWAJALEIN ATOLL
Roi Is.
Gellinam Is.
Ellep Is.
Bigej Is.
South Pass
Kwajalein Is.
ROI IS.
KWAJALEIN IS.
PRESS
WXLG
JCC
J9
NAMU ATOLL
Namu Is.
Kaginen Is.
Bock Chan.
Yo Is.
Mae Is.
Leuen Is.
Jabwat Is.
Jih Is.
DEVELOPMENT SKETCH OF BIKINI ATOMIC CLOUD
1
Space between itself and water
2
Huge dome of steam gives cloud a push
3
Cloud rises and acquires peculiar stem
4
Approximate 500' space between cloud and water
5
Cloud begins to take a tan color tinge again
6
Look at about 30,000'
Climbs high with a peculiar stem.
7
Guess cloud 35-40,000'
Top is a deep tan and has acquired swirling motion
8
1000'
Bikini Is.
Almost orange as cloud begins to break up

This F6F Navy drone has just been launched from the carrier catapult.

I was soon in action and was interviewing the bomber crew that was to lay the egg on the target fleet.

A few moments later I was witnessing the only major accident that we were to encounter. That was when an Ordnance captain backed into one of the propellers on "Dave's Dream." Major Swancutt and Colonel Blanchard carried the casualty to an ambulance and coolly boarded their plane for the takeoff.

I recorded the entire "Queen Day" operation from various vantage points and later interviewed Colonel G. C. Coleman, W8LQA/J9 at the island's "ham" station. The setup included a BC-610 transmitter and an SX-28 receiver and the shack was in the process of being house cleaned. Never have I heard such QRN in the form of key clicks and other interference. It wasn't surprising though as I learned that there were over 300 r.f. channels in and around Kwajalein.

I shall long remember Tuesday, June 25th. I flew to Eniwetok via C-54 Green Hornet to witness a special demonstration of the Army's radio controlled planes. The operation and background story of both Army and Navy drones is so intriguing that we will devote an entire article to the subject next month.

I was scheduled to return with five Army officers late in the afternoon for Kwajalein.

On the takeoff our Number 3 motor konked out and we returned PDQ to the strip. A B-17 control ship (mother) was summoned to fly the officers back to their base. I found myself boarding a B-17 drone for the 360 mile trip. After becoming acclimated to my new surroundings, and getting over the initial scare, I examined all of the control equipment on the plane which I will describe in my article next month. The thrilling ride ended with a perfect landing on our strip at Kwajalein just as the last rays of the sun sank below the horizon.

Several side trips were made during the next few days to some of the smaller islands of the atolls. I also visited the Joint Communications Center of the Navy. Their job is to plot electronic timing of drones and to engage in Navy communications with San Francisco; Roswell, New Mexico, etc. The subject of my interview was Commander C. T. McClellan, Officer in Charge, JTC-1. The Navy setup on Kwajalein is rather extensive and I spent a great deal of time with my photographer taking pictures of the equipment, personnel and other operations. At this writing these pictures and others have not as yet arrived through censorship channels.

Saturday, June 29th was the day we boarded the Shangri-La off the island of Roi. We sailed about 4:30 p.m. and had our first look at the Navy drones under the wing of Commander Davidson. We were asigned to our quarters, each one of us having a separate room, laundry service and help from our stewards. The mess on board the Shangri-La was excellent, in fact we had our first substantial meal that evening.

We were heading for our rendezvous at Point Tare and were accompanied by two destroyer escorts, one on our port and the other on our starboard.

The next morning which was A-Day minus one, we dined with the skipper of the Shangri-La, Captain Cruise, and had a general briefing as to the operations of the Shangri-La for the following day. I interviewed several members of the crews of the radio control mothers and they all eagerly awaited the big show. I also met Rear Admiral C. F. Sprague who is commander of the Air Group of JTF-1. Commander R. J. Rugen, Public Information Officer, was almost my steady companion during the remainder of the cruise. He took me on a sight-seeing cruise of the Shangri-La for a look at the maze of communications and radar equipment that was to play such a large part in Operation Crossroads. The ship's photog shot some film for me. It's now in Washington for clearance.

After having a typical Navy nightcap, we hit the sack at about 1:30 a.m., only to be roused suddenly from our slumber at 5:00 o'clock on Able Day, it now being Monday, July 1st in that area.

I had coffee with the pilots who were to send their drones into the atomic cloud following the blast. One of these pilots, upon returning from his mission later stated that, "My red drone went safely through the cloud but when picked up was all white in col-

(Continued on page 133)

Souvenirs from Operation Crossroads include special A-Day envelope and cancellation.

← Disposition of aircraft around target area at "Mike hour" on "A-Day."

A Precision RESISTANCE BRIDGE

By GUY DEXTER

Technical description of an accurate resistance bridge which may be built by the technician with limited capital and ordinary tools.

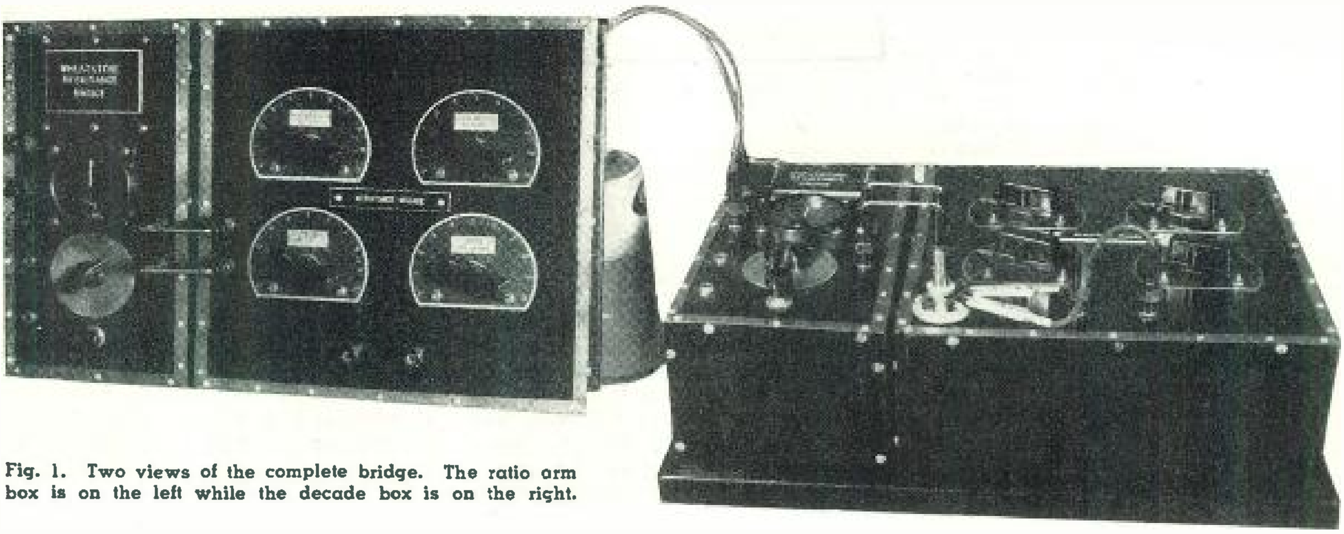


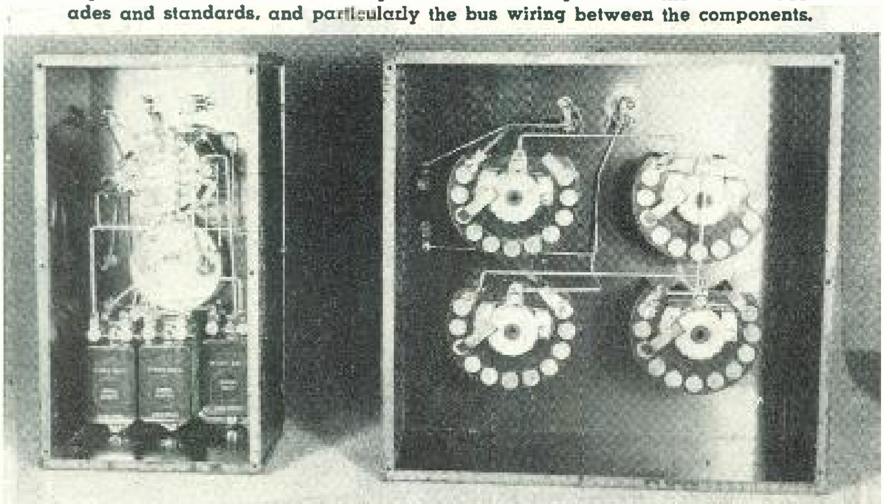
Fig. 1. Two views of the complete bridge. The ratio arm box is on the left while the decade box is on the right.

THE ever increasing number of small bridges manufactured with a slant toward the radio serviceman and small laboratory usually have an accuracy of 5 to 10 per-cent, or worse. At one or two dial points in each range, the accuracy may be as good as 1 or 2 per-cent, but this attractive figure does not obtain over the remaining greater portion. Indications on some resistance ranges of certain bridges establish order of magnitude a lot more reliably than they show finite values. That these important facts seldom, if ever, appear in the bridge advertisements and instruction books is a sin of omission. However, well-informed servicemen long have stacked the accuracy of their common ohmmeters against that of some of the low-priced bridges.

A *good* resistance bridge is not a cheap one. But any serviceman or laboratory technician can build a precision resistance bridge for a lot less money than he can buy the manufactured equivalent, and only ordinary tools will be required for the job. A great deal more uses are found for a precision resistance bridge around any shop or laboratory than usually are apparent to the non-owner. This is a basic instrument, and if small capital dictates that a home-built electronic laboratory grow up "instrument by instrument," the precision resistance bridge is the logical standard instrument to make the cornerstone.

The instrument described in this article has a range of 0.001 ohm to 11,110,000 ohms. Its accuracy is between 0.1 and 0.25% at ordinary room temperatures. The bridge is built into two small boxes which are mounted on a common base (See Fig. 1). The larger box contains the four decades and may be demounted easily for use in other laboratory setups as a precision resistance variable from 1 to 11,110 ohms in 1-ohm steps, or as the variable arm of impedance bridge circuits set up on the laboratory table. The smaller box contains the ratio arms, galvanometer, and meter pushbutton. The only external accessory required is a battery. The circuit schematic for the complete bridge is given in Fig. 3. Using *General Radio* resistor components throughout, the total cost of the instrument was sixty-one dollars.

Fig. 2. Internal view of the bridge. Note the arrangement of the various decades and standards, and particularly the bus wiring between the components.



Technical Description

External views of the bridge are shown in Fig. 1. The interiors of the two boxes comprising the instrument are shown in Fig. 2.

The decade resistance box (right-hand position in the photographs) contains one each units, tens, hundreds, and thousands decades, series-connected as shown in Fig. 3. Each of these decade units (*General Radio* 510 series) is supplied by its manufacturer completely assembled, with precision card-type resistors, heavy-contact low-resistance selector switch, name plate, and pointer knob. The adjustment accuracy of the resistors in the tens, hundreds, and thousands decades is 0.1 per-cent; that of the resistors in the units decade 0.25 per-cent. The decade units are mounted on the bakelite panel of the decade box. This panel is 9½" x 9½" in size and may be cut from ¼" or 3/16" stock. The decade box is 4⅛" deep and may be made of wood, plastic, or metal. Heavy bus bar connections are run between decades, as may be seen in Fig. 2. The decade box may be detached quickly from the platform base upon which it rests and used externally in other measuring circuits. Two pairs of binding posts are provided, one connected in parallel with the other (see Figs. 2 and 3), for convenience when the box is connected into circuits requiring more than one pair of connections.

The ratio arm box (left-hand position in the photographs) contains the multiplier switch, standard resistors, galvanometer (null indicator), meter pushbutton, and connection terminals for the unknown resistor (X-X) and battery (B-B). The bakelite panel of this box is 9½" x 5" in size, and the box, like that holding the decades, is 4⅛" deep. The multiplier switch, S_1-S_2, is a 2-pole, 7-position heavy-contact rotary selector switch which connects the five standard resistors into the circuit in various relationships to give bridge multiplier factors of 0.001, 0.01, 0.1, 1, 10, 100, and 1000. The standard resistors are *General Radio* 500 series. The adjustment accuracy of these resistors is 0.1 percent. The pushbutton switch, S_3, is a normally-open, spring release type of component. The galvanometer shown on the panel of the ratio box in Fig. 1 is a government surplus radium-dial center-zero microammeter (150-0-150 d.c. microamperes). This was the only such instrument available at the time the bridge was built. But greater accuracy of setting would be afforded by a more sensitive instrument, and the author plans to replace this meter with one having a scale of 20-0-20 microamperes when such instruments again are available. All connections in the ratio arm box are made with heavy bus wire, as may be seen in Fig. 2.

The two boxes comprising the bridge are secured to a heavy wood platform 15⅝" long and 10" wide. Connections may be made readily between the decade and ratio arm boxes and to the test battery and unknown resistor. Connections must be as short as practicable and of heavy conductor. Those made between the two boxes may be copper or brass strips held by the binding posts or may (as shown in Fig. 1) be plug-in jumpers made of bus wire and banana plugs. For best accuracy, especially when measuring low resistances, the heavy strips are to be preferred to the plug-in jumpers.

The test voltage source may be a single dry cell, as shown in Fig. 1, or a larger battery. Generally, it will be desirable to employ the single cell when first starting the balance operation and to increase the voltage by adding more cells in series as the null point is reached. In this way, the galvanometer is protected from excessive voltage due to wide discrepancies at the point of total unbalance, and the sensitivity of the bridge is increased as complete balance is more closely approached.

R_1, R_5—10,000 ohm precision res. (General Radio 500-J)
R_2—10 ohm precision res. (General Radio 500-B)
R_3—100 ohm precision resistor (General Radio 500-D)
R_4—1000 ohm precision res. (General Radio 500-H)
R_6 to R_{15}—Units decade—res. 1 ohm each. (General Radio 510-B
R_{16} to R_{25}—Tens decade—res. 10 ohms each. (General Radio 510-C)
R_{26} to R_{35}—Hundreds decade—res. 100 ohms each. (General Radio 510-D)
R_{36} to R_{45}—Thousands decade—res. 1000 ohms each. (General Radio 510-E)
S_1-S_2—2-pole, 7 pos. non-shorting, heavy-contact rotary selector sw. (Mallory 1321-L)
S_3—Pushbutton sw., spring release. Normally open. (Bud 743)
S_4, S_5, S_6, S_7—Low resistance rotary sw. supplied as part of the decades with which they are shown.
M—Zero center microammeter. 150-0-150 or less. (See text).

NOTE: Although the original supplier of the parts used is given, any other source supplying equipment having equivalent electrical and mechanical characteristics may be substituted.

Parts list for wiring diagram. Fig. 3.

Operation

This bridge is entirely standard in arrangement and accordingly may be operated in the conventional manner. No special procedure is required. The technique of balancing a Wheatstone bridge has been treated so completely in the textbooks and previous issues of magazines that there is hardly justification for a review here.

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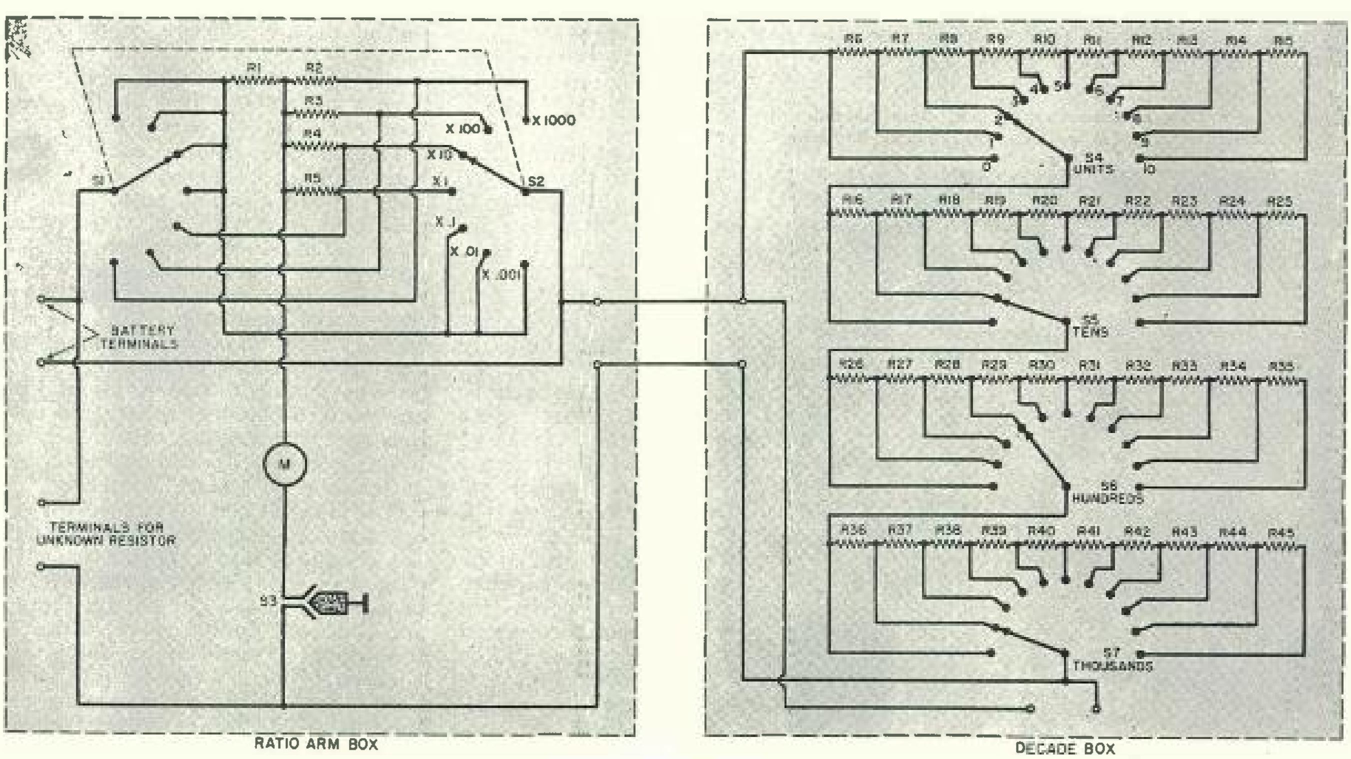
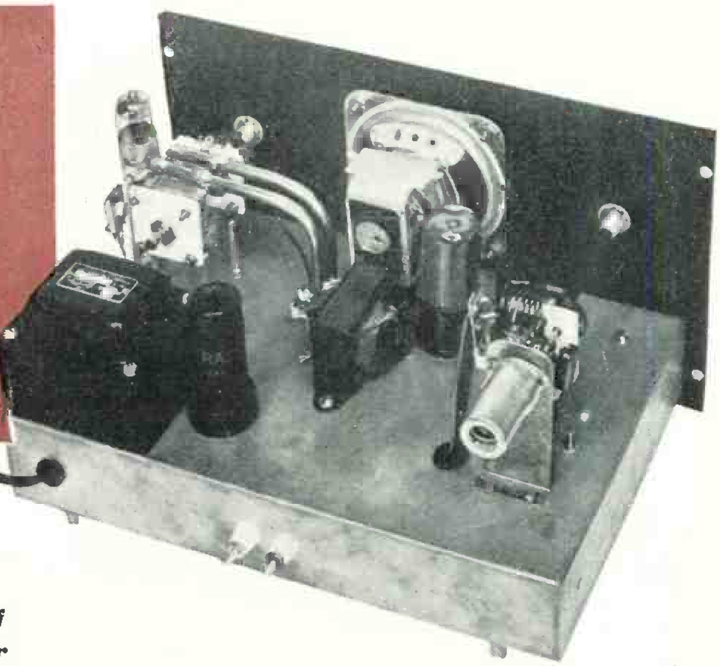
Fig. 3. Complete wiring diagram for the precision resistance bridge.



TRANSMITTER-RECEIVER for Ham Beginners

By CORINNE M. SULLIVAN
Editorial Staff, Radio News

Part II. Completing construction of 144-148 mc. transmitter-receiver that can easily be built by the novice.

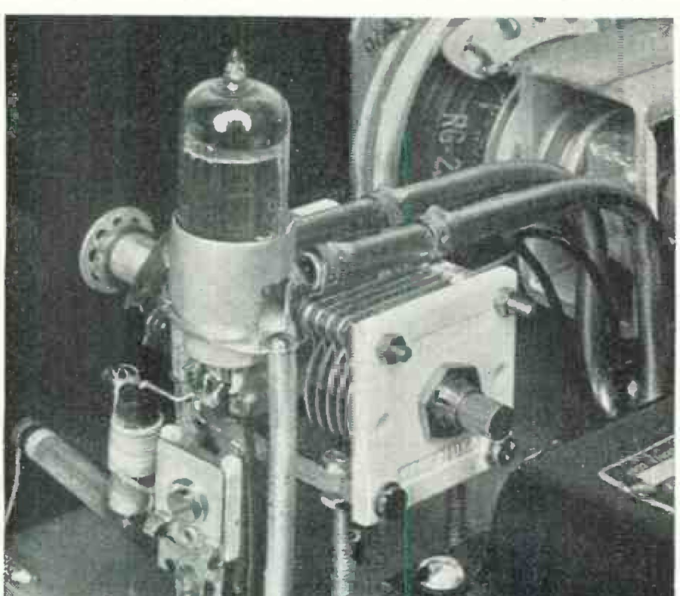


Rear view shows transmitter section (upper left) and receiver (lower right).

IN LAST month's article we discussed the general construction of the unit and the adjustment and operation of the receiver portion. Wiring was the big job in that section but the transmitter requires more actual construction work. Now, if the receiver is operating properly, the transmitter portion may be installed.

The circuit used is the Colpitts type in which the inductance is connected between the grid and plate of the tube with the cathode of the tube at ground potential. By examination of Fig. 1, it may be seen that the tank circuit, consisting of L_1 and C_2 is connected between the grid and plate of the tube with the condenser C_2 acting as a voltage dividing network so that at any given instant the voltages at the ends of the circuit are opposite in polarity with respect to the cathode and therefore in the proper phase for sustained oscillation. The frequency of oscillation is determined by the values L_1 and C_2.

Expanded view of transmitter section. Note that all wiring is kept extremely short to reduce stray capacity and inductance.



In order to obtain maximum stability in a self-excited oscillator, it is essential that the circuit be of high C and use components having low r.f. resistance. In general, the more capacity and the less inductance used in an oscillator circuit, the better the stability. Some compromise must be made however, for if the capacity is increased beyond a reasonable value, the tank circuit losses become excessive and the over-all efficiency of the oscillator drops.

One of the reasons for the use of high capacity in an oscillator tank circuit is to make the interelectrode capacity of the tube only a small portion of the total circuit capacity. In this way variations in the tube capacity caused by heating or vibration have a negligible effect on the oscillator stability.

The frequency control condenser, C_2 is a split stator type of 50$\mu\mu$fd. per section. In order to line up the shaft of this condenser with the dial hole in the panel, it is necessary to use 2" 4-36 machine screws, screwed directly into the mounting bars along the lower edge of the condenser. Nuts are run on the screws to allow adjustment and locking when the proper height has been determined. In lieu of machine screws, it is possible to use threaded rods and spacers for this mounting. In any event, this portion of the transmitter must be rigidly mounted.

The inductance L_1 is a piece of ¼" o.d. soft copper tubing 10" long which has been bent into a hairpin type "U" with the spacing between the two legs about ¼". In order to fit this inductance into the limited space available, it was bent at right angles so that the horizontal portion is about 3" long. Care should be taken in bending this tube to avoid kinking. Probably the best procedure is to bend it carefully over the fingers, being careful not to bend too sharply, working the curve in gradually. The inductance is fastened to the condenser by means of spade lugs with the open ends of the lugs fastened directly to the stator plates of the condenser, the lugs then bend around to fit snugly on the copper tubing. This forms a low resistance path for the heavy circulating r.f. current.

The antenna coupling loop, L_2, is a hairpin loop of No. 12 wire approximately 1¾" long after bending. Small feedthroughs are used while the ends of the loop run straight through the chassis and are connected directly to the antenna switch, S_{2a}, S_{2b}, as shown in the complete schematic, August, 1946 issue, page 34, by means of a short length of 300 ohm line. This antenna coupling loop should be bent to conform in general shape to the curvature of the vertical portion of L_1.

The r.f. choke, RFC_2 is mounted at the lower end of the "U" on L_1 and is fed through the chassis by means of a feedthrough to the "send" position of S_{2c}.

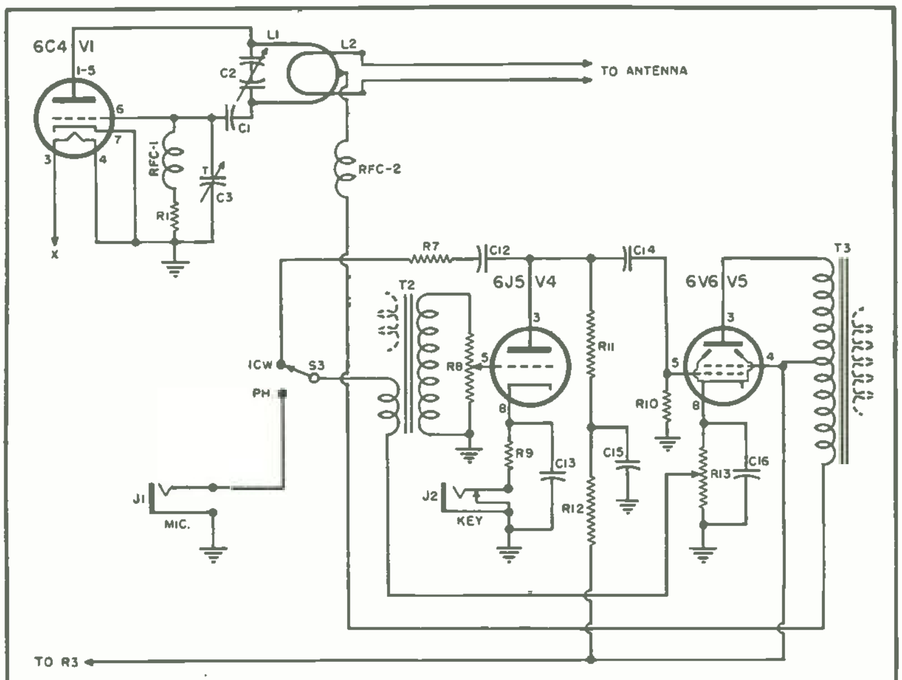
The socket for V_1 is mounted on threaded rods and spacers close to the condenser, C_2 and at approximately the same height to afford short leads. The over-all height of this socket should be carefully measured to insure that the top of the 6C4 tube does not project above the cabinet.

The grid condenser C_1 is a 50 μμfd. ceramic unit, although a regular midget mica may be used instead. Care should be taken that all leads to the socket be as short and rigid as possible. Of course short leads make for skinned knuckles and soldering acrobatics, but they do have a purpose. They are essential in any high frequency circuit to keep the inductance outside the tank circuit at a minimum.

In this particular type of transmitter circuit the rotor of the tuning condenser is not at ground potential so an insulated coupling is necessary to couple the condenser shaft to the dial. If a locking nut for the particular condenser used is available, it should be placed over the front panel bearing of the condenser and set so that the condenser is hard to turn to prevent accidental mistuning. The FCC will chalk that up—accidental or not. Alternately, either a shaft lock or a dial lock may be used.

Condenser C_3 is of the 3-30 μμfd. compression type and is used to control the amount of feedback. Its use may or may not be necessary, depending on the location of parts and wiring.

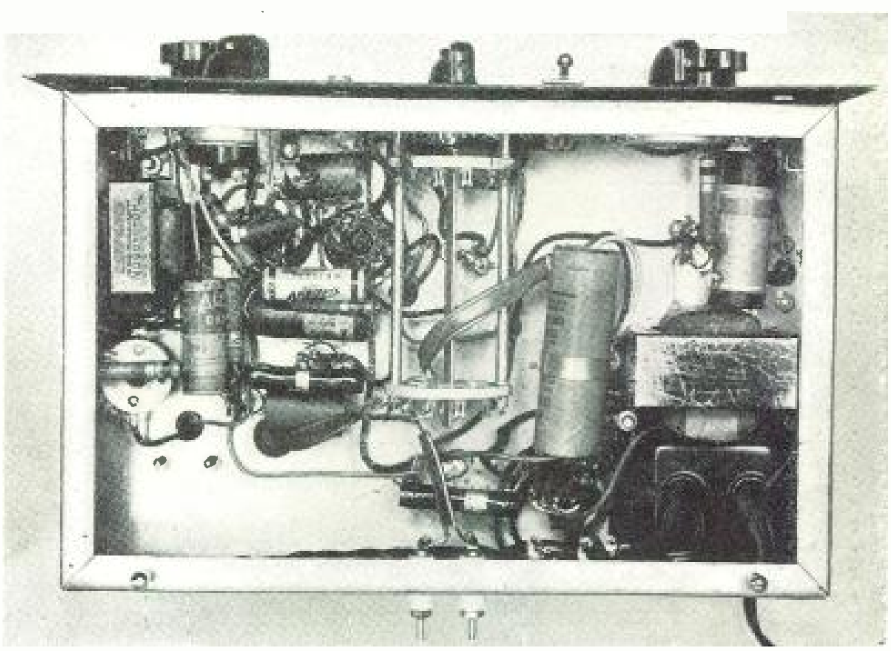
When construction of the transmitter portion has been completed, the unit should be turned on and the tubes allowed to warm up to the accompaniment of tightly crossed fingers and bated breath. If a 0-50 milliammeter is available, it should be connected to the "B" lead to the transmitter between S_{2c} and RFC_2. The maximum current rating of the 6C4 is 25 ma. and care should be taken not to exceed this value. With no antenna connected, the plate current of the transmitter should be in the vicinity of 15 ma. if the unit is operating properly. In the event that the "idling" plate current of the oscillator is too high, the value of the grid leak, R_1 may be increased. This will serve to increase the grid bias and in turn reduce the plate current. If the value of the grid leak is increased greatly, it will probably be necessary to increase the capacity of C_3 to afford more feedback in order to sustain oscillation. In order to determine if the oscillator is operating, simply touch the finger or a screw driver to



R_1—10.000 ohm, 1 w. res.
R_7—5000 ohm, ½ w. res.
R_8—500,000 ohm pot.
R_9—2000 ohm, ½ w. res.
R_{10}—500.000 ohm, ½ w. res.
R_{11}—100.000 ohm, ½ w. res.
R_{12}—25.000 ohm, ½ w. res.
R_{13}—500 ohm, 10 w. adjustable w.w.
C_1—50 μμfd., ceramic cond.
C_2—50-50 μμfd., split stator cond.
C_3—3-30 μμfd., ceramic padder
C_{12}—.1μfd., 400 v. paper cond.
C_{13}, C_{16}—10 μfd., 25 v. elec. cond.
C_{14}—.03 μfd., 400 v. paper cond.
C_{15}—10 μfd., 450 v. elec. cond.
L_1, L_2—See text
T_2—Transceiver transformer, mic. and single plate-to-grid.
T_3—Universal output p.p. plate-to-voice coil.
S_3—S.p.d.t. toggle sw.
J_1—Single circuit jack
J_2—Circuit closing jack
RFC_1, RFC_2—15T # 22 d.c.c. close wound on ¼" bakelite rod

Fig. 1. Schematic diagram of transmitter. For complete wiring diagram of transmitter-receiver refer to Fig. 3, page 34, of the August issue of Radio News.

Under chassis view of the completed instrument shows placement of components.



the grid terminal of the tube. This should result in a sharp increase in plate current. Care should be taken in this operation not to touch the tank circuit side of the grid condenser as this section is at a potential of 300 volts and may result in a serious shock. It would be preferable to use a plastic handled screw driver for this test. Alternately, a small neon bulb may be touched to either end of L_2 and should glow if the circuit is oscillating. Another method to determine oscillation is by means of a small pilot lamp connected to the ends of a loop, 1" in diameter, of hook up wire. Placing this loop near the inductance L_1 should result in a glow in the pilot light. It may also be connected to the antenna terminals at the rear of the unit.

An absorption type wavemeter should be used, if available, to check the frequency of the transmitter. If you're just starting out, you'll probably have to borrow the wavemeter and the owner along with it to help you with the checking. If resonance at the desired frequency occurs at less than ¾ of maximum capacity of C_2, the inductance of L_1 should be reduced by sliding the rods through the solder lugs and sawing off the free ends a small portion at a time. When the correct adjustment has been ascertained, the solder lugs should be soldered to the copper tubing.

In the event an absorption type wavemeter is not available, Lecher wires may be used to determine the transmitter frequency. These wires consist simply of two bare wires about 5' long, spaced about 2" apart and stretched tightly between insulators. One end of these wires is then connected to the antenna terminals of the unit. A shorting slider should be constructed of a small piece of metal about 2½" long with a sharp edge and mounted on a piece of insulating material. The slider should be placed on the wires at right angles to them and moved along the wires, beginning at the set end. The milliammeter should be carefully observed while moving the slider and several points will be noticed where the plate current increases slightly. These points should be carefully marked and the distance between any two adjacent points measured. The frequency may then be calculated by the formula: f(mc.) = 5906/(distance between points in inches). It will be possible to vary the frequency over a considerable range by tuning C_2.

(EDITOR'S NOTE: *Since this article would not have been complete without an explanation of the technical aspects of the circuit design, the staff of* RADIO NEWS *collaborated in making this explanation because the author, a beginning ham, was obviously not technically qualified to make this detailed exposition.)*

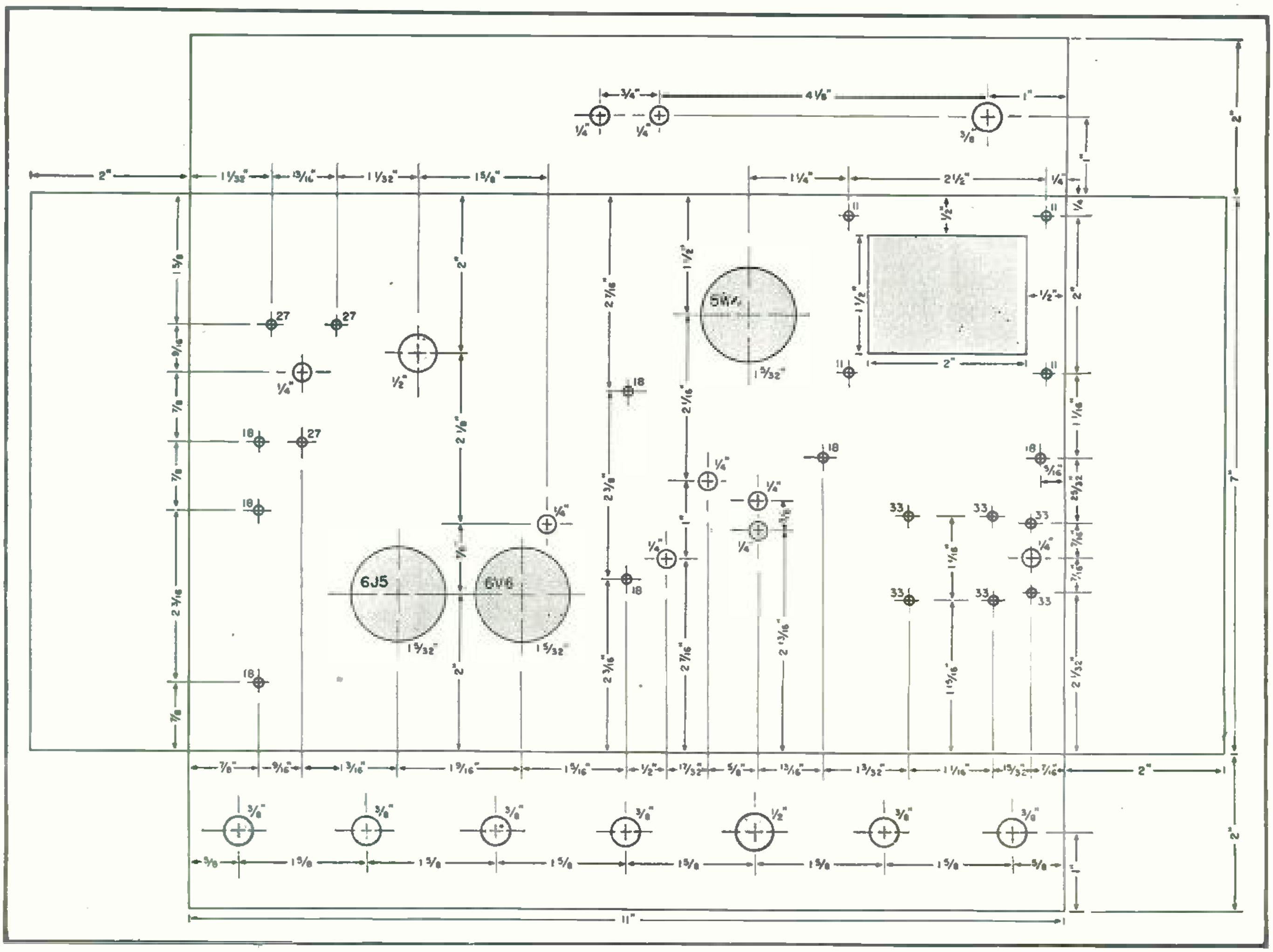
A 300 ohm resistor may be connected across the antenna terminals to simulate the antenna load. The coupling loop, L_2 should then be adjusted, by bending, to load the transmitter to a maximum of 25 ma., bending it closer to the copper tubing to increase loading, and away to reduce the load.

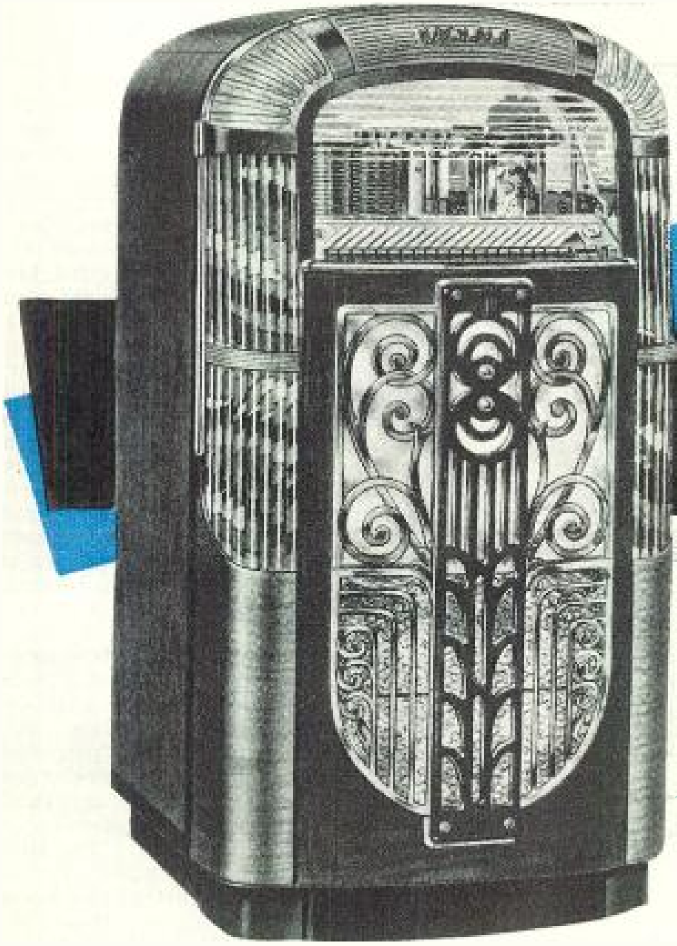
The optimum adjustment for C_3 is that which gives the maximum output consistent with stability under modulation. In the majority of cases this will be with the condenser set at minimum capacity or removed entirely from the circuit.

When adjustment of the transmitter portion has been completed, a 6.3 volt, 150 ma. pilot light should be connected in series with the 300 ohm resistor used as a dummy antenna and a single button carbon microphone plugged into the microphone jack. The switch, S_3 should be in the phone position with the gain control, R_5 well advanced. Speaking into the micro-

(*Continued on page* 120)

Fig. 2. Chassis layout shows proper placement and size of holes necessary for mounting chassis components.





Latest in juke box design. Rock-Ola Model 1422 which is being planned for early distribution.

"Juke Box" ANALYZER

By
RUFUS P. TURNER, W1AY
Consulting Engineer, RADIO NEWS

Construction details of a compact selective type analyzer for use in checking juke boxes and other types of audio equipment.

IN THE larger cities and towns, servicing juke boxes has become a full-time job for some servicemen and a profitable side line for others. Quick to grab up repair options on these instruments have been servicemen specializing in other types of audio-frequency equipment. This work is right down the amplifier man's alley.

After complicated superhets with all of their modern trappings, a skilled radio serviceman finds straight audio equipment a snap. So by comparison, shooting trouble in juke box amplifiers is a picnic. The "players" might look forbidding at first, but the serviceman's natural mechanical bent will help him to get on friendly terms quickly with the record-changing mechanisms.

Shooting trouble in juke boxes introduces the serviceman who is new at this endeavor to a distinct set of conditions. Most important of these is the *locale* of the instrument. The juke box almost always is installed in some public place, such as a restaurant, penny arcade, drug store, or jive joint, and must be serviced (or at least, tested) *there* while business goes on as usual. The serviceman is not expected to get in the way of the customers or to disturb them. He must do his job quickly and make as little muss and noise as possible. It wouldn't be proper for him to string wires across the floor for customers to trip on (things like that lead to law suits against stores), so there is an advantage in his carrying battery-operated equipment.

Test equipment requirements are the same in juke box servicing as in any other audio amplifier work. Essential equipment for trouble shooting includes an a.c.-d.c. voltmeter, d.c. milliammeter, and an audio oscillator. However, the juke box serviceman requires extreme portability, compactness, and completeness of his equipment. Any instrument for his use must afford a maximum of trouble shooting flexibility. His test unit must permit the serviceman to check all voltages and currents without removing the chassis from the cabinet. The only additional equipment required should be pliers and screwdriver.

The old set analyzers permitted voltage and current measurements to be made at the sockets without removing the chassis. Transferring the tube from the chassis socket to a socket on the analyzer panel kept the circuit in operation. These instruments lost their popularity among radio men because the large amount of lead capacitance in the test cable detunes r.f. and i.f. stages or sets them into oscillation. But in the audio stages, the analyzer was a hundred per cent useful. Since the electronic end of the juke box is all audio, a satisfactory instrument for checking it might consist, then, of a simplified and flexible version of the set analyzer *plus* an audio signal source for dynamic testing.

The juke box tester to be described in this article embraces the essentials just mentioned. It is an a.c.-d.c. volt-milliammeter arranged in an analyzer circuit. The employment of patch cords for "switching" the meter banishes instrument obsolescence and makes it possible to test in any new circuit and around any new tube that may be introduced. This instrument is used in the conventional manner of a set analyzer by removing the tube from the chassis socket at which tests are to be made and placing it in a socket on the analyzer panel. The analyzer plug is then inserted in the empty chassis socket, and all of the circuit voltages and currents are checked directly at the analyzer panel. The tube will draw its normal currents for the impressed voltages (plate, screen, grid, cathode, suppressor, etc.) and each of these currents may be measured. A battery-type audio oscillator might be employed as a single-frequency test signal source; but this requires a tube, as well as plate and filament batteries. So instead, a high-frequency buzzer has been included. The buzzer supplies an adequate test signal and will operate in normal service for a year or more on a single jumbo-size flashlight cell.

This tester enables the juke box serviceman to make all voltage, current, and operation tests necessary in

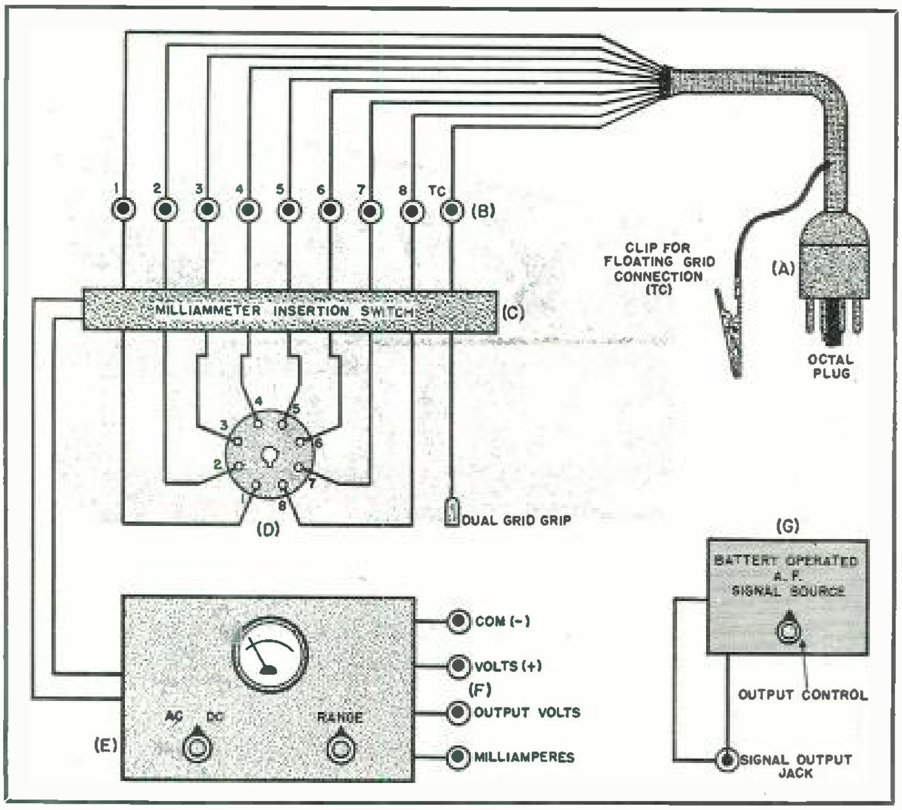


Fig. 1. Block diagram showing basic arrangement of the juke box analyzer.

trouble shooting right at the box, quickly and without performing strenuous work. The instrument is entirely independent of the power line and is small in size. The serviceman may take it into the cramped space behind a juke box without difficulty.

Basic Arrangement

The fundamental arrangement of the juke box tester is illustrated by the block diagram of Fig. 1.

Connections are made directly to a given socket on the juke box chassis by means of a male plug, *A*. The tube removed from this socket is transferred to socket *D* on the tester panel. *A* is an octal plug on the end of a 9-wire cable. (The 9th lead is connected to an alligator clip on the plug end of the cable for connection to floating grid leads; and on the instrument end of the cable to a dual grid grip for top-cap tube connections). A set of plug adaptors is provided to adapt the octal plug for insertion in 4-, 5-, 6-, and 7-pin and loktal sockets. Internal connections of the adaptors are given in Fig. 4. *D* is an octal socket, but a second set of adaptors is employed to accommodate 4-, 5-, 6-, and 7-pin, and loktal base tubes in this socket. The internal connections of this latter set of adaptors are also given in Fig. 4. Some experimenters might prefer to mount one of each type socket on the instrument panel, in the manner of a tube tester. This is entirely permissible. The author chose a single socket to conserve panel space.

All nine leads of the test cable make contact with individual insulated pin-type panel jacks shown in row *B*. These jacks are numbered to correspond to the standard number of the tube socket contacts to which they connect. A voltmeter may be connected by means of pin-plug-terminated test leads (patch cords) between any two of these jacks, and thus between any two corresponding contacts of the juke box socket. This system defies the kind of instrument obsolescence brought about by the introduction of new tubes and circuits. The measurement of plate-to-cathode voltage might be cited as an example. This voltage is measured, in a large number of octal tubes, between terminals 3 and 8. But it might just as easily be checked with this tester between terminals 4 and 6, 1 and 3, or 6 and 8, etc., etc. should any of these combinations become plate and cathode respectively in a later developed tube.

All nine leads of the test cable also pass through a special meter insertion switch, *C*. This switch, which is connected permanently to the d.c. milliammeter, permits the latter to be connected in series with any one of the nine leads to measure the current flowing therein. As soon as the switch is advanced to break a new lead, the lead previously opened automatically closes. When the switch is in its *"Off"* position, all nine leads are closed and voltages are impressed directly upon contacts of the panel socket. This switch is a further feature to banish obsolescence, since it permits measurement of current in *any* tube electrode circuit regardless of the future socket positions of that electrode.

E is a combined multi-range a.c.-d.c. voltmeter and multi-range d.c. milliammeter. The circuit is conventional. The milliammeter is connected directly, internally, to the meter insertion switch, and externally to the pin jacks labelled *"Milliamperes"* and *"Common."* The voltmeter circuit is connected to three of the insulated pin jacks on the tester panel. These jacks are shown in row *F*. The first one of these is the negative or *"Common"* terminal; the second is the positive terminal; and the third, being connected to the voltmeter through a large fixed capacitor, serves as the "high" terminal for audio output voltage measurements. Patch-cord-type leads, terminated on each end by insulated pin-type plugs, may be connected between the voltmeter jacks and any two of the nine jacks in row *B* for voltage measurement between any two terminals of the chassis socket. A single range switch in the meter circuit selects both milliammeter and voltmeter ranges. An a.c.-d.c. changeover switch also is provided in meter circuit *E*.

The audio signal source is shown at *F*. This is a small enclosed high-frequency buzzer operated by a self-contained flashlight cell. The circuit includes an output control potentiometer and a shielded signal output jack. An on-off switch for the dry cell is mounted on the output potentiometer and is actuated thereby. The signal source might be a compact, battery-operated oscillator instead of a buzzer. The schematic of an oscillator requiring only 4½ volts of "B" battery is given in Fig. 3A.

Complete Circuit

The complete circuit schematic of the juke box tester is given in Fig. 2.

The signal generator circuit consists of dry cell, "B," *"On-Off"* switch S_1 (which is mounted on and controlled by an output control potentiometer), the high-frequency miniature buzzer, coupling capacitor, C_1, coupling transformer, *T*, radio-frequency choke, *RFC*, and output jack, J_1. The dry cell, buzzer, transformer, and coupling capacitor all may be mounted on a metal bracket secured to the instrument panel directly behind the output control and output jack. For shielding, a metal box connected to the "low" side of the signal output jack may be fastened over the entire assembly.

The buzzer may be any one of the small watch-case-type high-frequency units generally found on telegraph code practice boards. A good buzzer will transmit very little direct sound through the air if it is enclosed in a wrapper of thick sponge rubber before mounting. This is particularly true if the buzzer is driven by a single dry cell. The vibrator screw should be set for a tone in the vicinity of 1000 cycles. Good buzzers for this application are manufactured by the *Bunnell*, *Signal*, and *Speed-X* companies. The radio-frequency choke, *RFC*, minimizes transmission of r.f. energy, developed as a damped wave by the buzzer contacts, to the output jack.

The meter circuit is made up of a 0-1 d.c. milliammeter; miniature meter rectifier; 4-pole, double-throw a.c.-d.c. changeover switch S_3; meter range switch S_4; voltmeter multiplier resistors R_2 to R_5; milliammeter shunt resistors R_6 to R_8; coupling capacitor C_2; meter safety pushbutton switch S_2-S_5; and input jacks J_2 to J_5.

The shunt resistor (R_6 to R_8) values given in the parts list for Fig. 2 apply to a milliammeter having an internal resistance of 100 ohms. If the meter employed by the reader has some other internal resistance value, the shunt values given in Fig. 2 must be multiplied by $R/100$, where R is the internal resistance of the reader's meter. For example: Some 0-1 d.c. milliammeters have 33 ohms internal resistance. The shunt values for such a meter would be determined by multiplying the values given in Fig. 2 by 33/100 or 0.333. The multiplier resistor (R_2 to R_5) values given in the parts list for Fig. 2 will be satisfactory for *any* 0-1 d.c. milliammeter. Switch S_4 handles both current and voltage ranges.

S_2 and S_5 are the two poles of a d.p. s.t. pushbutton switch. The purpose of this switch is to protect the meter during range switching. One section is connected in series with the milliammeter, the other in series with the meter rectifier. In this way, both meter and rectifier are protected. On any range or function, the meter will read only when S_2-S_5 is depressed. Before depressing the pushbutton, the operator will have ample opportunity to inspect the various switch positions for correctness.

Voltmeter jack *"VO"* is connected to the voltmeter circuit through a 1 μfd. fixed capacitor, C_2. By means of this arrangement, audio output may be checked with the a.c. voltmeter when the output voltage is applied to the *"VO"* and *"COM"* terminals. Straight a.c. voltage measurements are made through jacks *"COM"* and "+V," as are also all d.c. voltage measurements. The milliammeter is available externally through jacks *"+MA"* and *"COM."*

The test circuit consists of the pickup plug and its adaptors; the 9-wire cable; meter insertion switch, S_6; the nine voltage test pin-jacks, J_6 to J_{14}; and the panel socket and its adaptors. The two poles of switch S_6 move along the switch contacts connecting the meter circuit to any of the nine test lines. When the poles are switched into position on a particular line, the shorting pole that normally completes that line to the panel socket opens automatically to achieve insertion of the meter in series with the line. When S_6 is in the *"Off"* position, all of the shorting sections are closed and all nine test lines thus are uninterrupted. Voltage test jacks J_6 to J_{14} are connected directly to the test lines which they do not interrupt. Voltages accordingly may be checked between any two lines when S_6 is in the *"Off"* position.

By inserting the tube removed from the juke box socket into the panel socket of the tester, any electrode current may be checked by means of the multi-range milliammeter, and the voltage between any two of the tube electrodes may be checked under actual load conditions by means of the multi-range voltmeter.

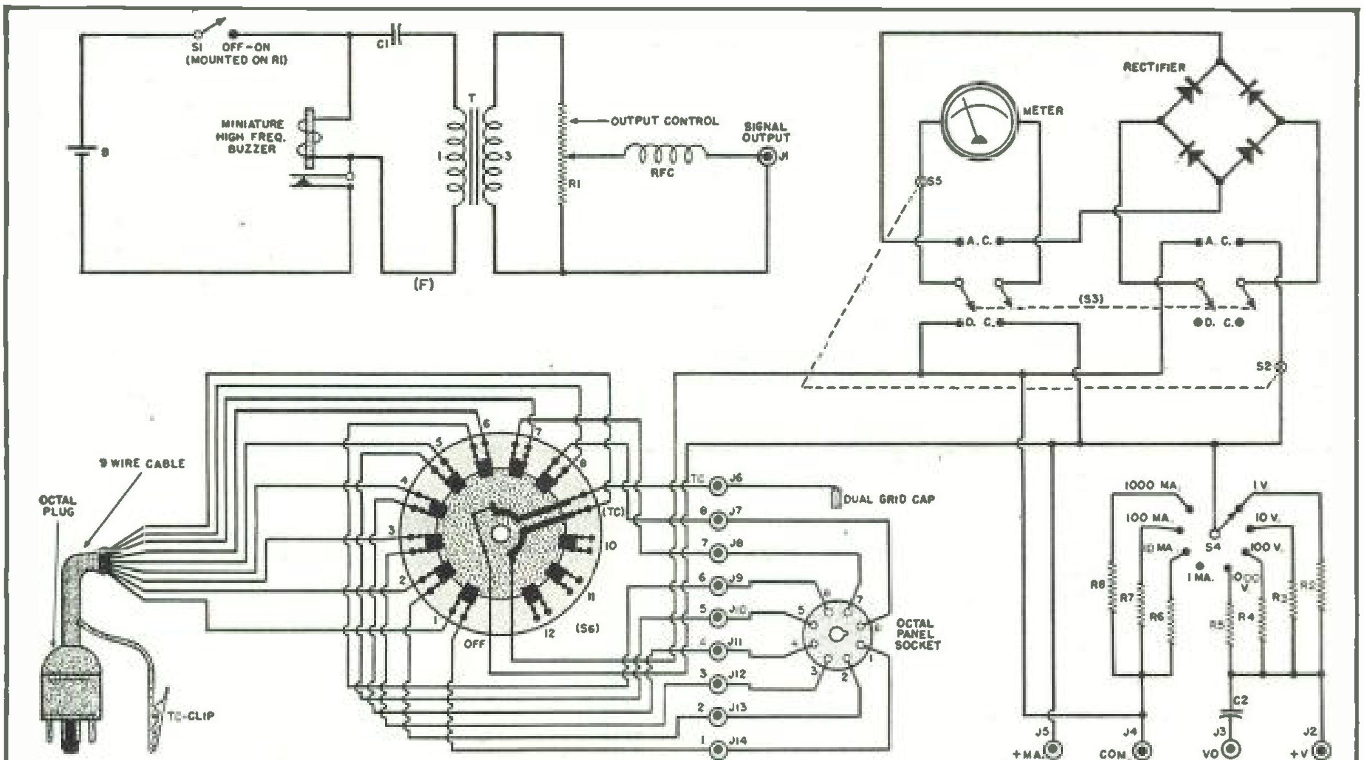
Mechanical and Electrical Construction

The instrument, as shown in Fig. 3B, is built on a 12" long by 9" high panel. Either metal, bakelite, or Masonite may be employed. The instrument may be mounted in a carrying case 6 inches deep, dimensioned to allow room in the lid to accommodate the adaptors. The mounting of parts is perfectly straightforward. No special rules need be followed nor extra precautions taken, except that the pin jacks must be insulated with shoulder-type fiber or bakelite washers if a metal panel is used.

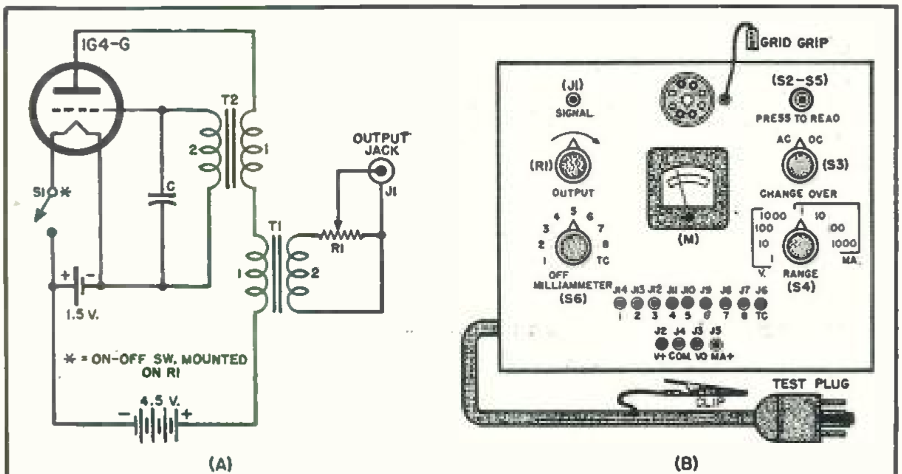
For neatness and simplicity, all leads should be cabled, and all connections should be made mechanically secure before soldering. All cables should be secured to uprights or to the instrument panel by means of standard cable clamps.

For best accuracy, careful attention must be paid to the meter circuit. For example, multiplier resistors R_2 to R_5 and shunt resistors R_6 to R_8 must be of exact ohmic value, and the milliammeter must be an accurate instrument

Fig. 2. Complete wiring diagram of test instrument. An inexpensive buzzer is used to produce an audio signal.



R_1—10,000 ohm, wire-wound vol. control type pot.
R_2—900 ohm res. (See text)
R_3—10,000 ohm res. (See text)
R_4—100,000 ohm res. (See text)
R_5—1 meg. res. (See text)
R_6—11.1 ohm res. (See text)
R_7—1.01 ohm res. (See text)
R_8—.100 ohm res. (See text)
C_1—.001 μfd. mica cond.
C_2—1 μfd., 600 v. tubular cond.
RECTIFIER—Miniature meter rectifier
RFC—85 mh. broadcast type r.f. choke
J_1—Shielded coaxial panel jack
J_2 to J_{14}—Insulated pin-type panel jacks
S_1—S.p.s.t. vol. control type sw. (Mounted on pot. R_1)
S_2, S_5—Poles of a d.p.s.t. non-locking push-button sw.
S_3—Miniature 4-pole, 2-pos. sw.
S_4—Single pole, 8-pos. rotary selector sw.
S_6—Special meter insertion sw. (Centralab Type 1442)
T—Midget 3:1 interstage audio trans.
B—1½ volt jumbo-size flashlight cell



R_1—10,000 ohm, wire-wound vol. control type pot.
C—.005 µfd. mica cond. (See text)
J_1—Shielded coaxial panel jack
S_1—S.p.s.t. vol. control-type sw. (Mounted on pot. R_1)
T_1, T_2—Midget 2:1 interstage audio trans.

Fig. 3. (A) An alternative vacuum tube type oscillator that may be used in lieu of buzzer. (B) Front panel layout of completed test instrument.

of good quality. It is best to employ precision non-inductive wire-wound instrument resistors for both shunts and multipliers. However, carefully selected and measured 1-watt metallized radio resistors may be used for R_2, R_3, R_4, and R_5 and the shunts (R_6 to R_8) may be wound non-inductively from short lengths of nichrome or manganin wire with the aid of a resistance bridge or *good* ohmmeter. Range switch S_4 must be a good quality selector-type component having low contact resistance. If the parts referred to are chosen with care, no special calibration of the d.c. scales of the meter will be required. The regular milliammeter scale will indicate automaticaly 0-1-10-100-1000 milliamperes and volts. A special a.c. voltage calibration and voltage scales are required, however, because of the non-linear characteristic of the meter rectifier.

The adaptors in each group may be constructed from *Amphenol* 50-Series adaptor bases and 44-Series adaptor socket tops.

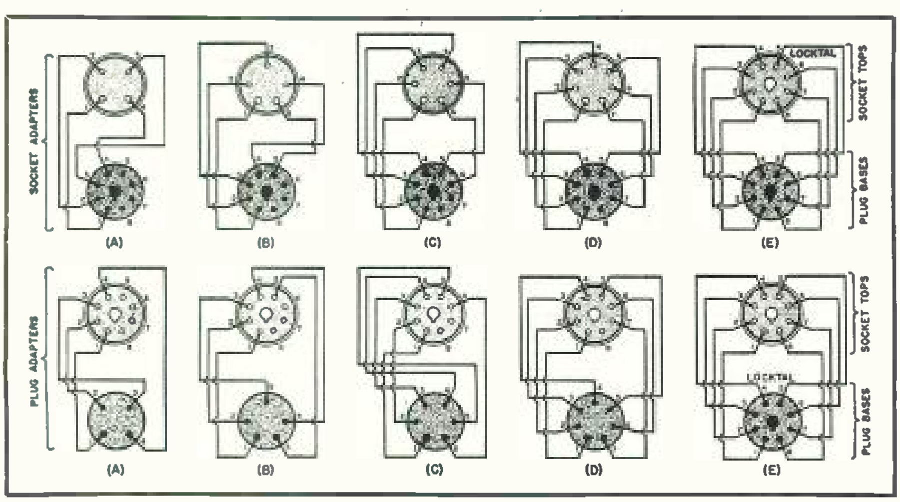
Patch cords for connection between meter jacks J_2 to J_4 and line jacks J_6 to J_{14} may be made by fastening insulated pin-type plugs to each end of 7-inch leads made from heavy, stranded hookup wire.

The line jacks (J_6 to J_{14}) are numbered on the instrument panel 1 to 8 and *TC* ("top-cap"), as shown by the circled figures in the complete schematic, Fig. 2. This corresponds to the standard tube socket numbering and enables the operator to locate easily any pair of tube electrodes between which a voltage test is to be made.

In the signal generating circuit, transformer *T* is a miniature 3:1 interstage unit. This transformer is connected, as shown in Fig. 2, with its high-turns winding on the output side of the circuit. This component need not be of especially high quality, but should be as small in size as can be obtained, in order not to take up too much space inside the instrument. Leads in the signal circuit should be as short and direct as possible, to prevent radiation and to minimize stray capacitive coupling. The 85 mh. broadcast-type radio-frequency choke, *RFC*, blocks out damped wave r.f. oscillations transmitted from the buzzer contacts through the system by capacitive coupling.

For builders who prefer to employ a vacuum-tube audio oscillator in lieu of the buzzer circuit, a low-voltage, single-frequency, battery-type oscillator is shown in Fig. 3A. This is the type of circuit used extensively in amateur code practice oscillators. While this arrangement is by no means a low-distortion, high-stability oscillator, it will be found adequate for trouble-shooting operations in which signal tracing and similar tests are required. Its a.f. output voltage will be found adequate for juke box testing. The tone frequency is determined by the capacitance of capacitor, *C*, and the inductance of the grid winding of transformer T_2. If this tone is not of a satisfactory pitch, it may be altered by changing the value of *C*—a higher capacitance giving a lower frequency and vice versa. T_1 and T_2 each are 2:1 ratio interstage audio transformers with their windings connected as shown in Fig. 3A. If oscillation is not obtained immediately when the oscillator first is placed into operation, the terminals of *one* winding of transformer T_2 should be interchanged. Other dry-cell triodes than the type shown may be employed with equal advantage in this circuit.

Fig. 4. Diagram shows wiring arrangement of plug and socket adaptors.



Adjustment and Calibration

D.C. Voltmeter. No d.c. voltmeter calibration is required if the milliammeter and multiplier resistors are accurate and if the circuit is wired correctly. The 0-1 scale of the milliammeter will indicate automatically 0-1-10-100-1000 volts. Should it be necessary to check the voltmeter, however, this procedure should be followed: (1) Set S_3 to *"DC"* and S_6 to *"Off"*; (2) Select known d.c. voltage (preferably supplied by a battery) whose value will fall in the upper quarter of the meter scale; (3) Connect voltage source to jacks J_2 and J_4; (4) Set S_4 to corresponding voltage range; (5) Depress pushbutton S_2-S_5, and observe meter deflection, which should be identical with accurately-known applied d.c. value. It should not be necessary to check more than one voltage point on each meter range and this point should be in the upper quarter of the scale.

A.C. Voltmeter. A special calibration must be made for the 0-1 and 0-10 ranges of the a.c. voltmeter, and corresponding scales must be drawn on the meter card. 0-100 and 0-1000 a.c. volts may be read on the same scales used for d.c. volts, so no special calibration is required for those two ranges.

An a.c. test voltage setup is shown in Fig. 5A. If a 10-volt filament-type transformer is not available for use in this circuit, two 5-v. windings or two 6.3-v. windings may be connected in series, properly poled. An accurate 0-1-10 standard a.c. voltmeter is used, and the potentiometer is a 10,000-ohm

(*Continued on page* 145)

By CARL COLEMAN

OLD timer Frederick Burgess arrived recently in New York aboard the cargo craft Platano in which he has been cruising around the Pacific for the past few years—this is FB's first call along in an east coast port for some time and he will be homeward bound for an extended vacation. Charles Cowan arrived in port aboard his "Cape" craft which tied up for repairs. George Falb sailed recently on a new assignment aboard one of the "Coastal" type cargo vessels. R. Drinkwater was recently assigned to a new cargo "reefer" job out of New York on the trans-Atlantic run.

AMERICAN South African Lines new "African Planet"—second of six new combination passenger and cargo vessels constructed for the runs to South and East African ports left recently on her maiden voyage. The new ships are of 17,000 tons and have accommodations for the usual twelve passengers. These ships should make a good berth for a marine radio officer.

AGWI Lines recently announced resumption of service weekly to Puerto Rico and on a twice-a-week basis to the Dominican Republic which is getting in shape to look like a postwar run—Things are slowly getting in condition for normal operations apparently—AGWI has chartered five ships for the Puerto Rico run and two for the Dominican schedule.

Shipping generally is rapidly coming closer to normal peacetime operation with announcements almost daily by the various shipping firms of restored service to various points . . . this means a more stable run for radiomen rather than the wartime condition when from one trip to the next it was never known where one was headed . . . Coupled with the announcements of new ships being placed in service for the replacement of prewar vessels either lost or over age and no longer serviceable for the postwar runs, the present news is of interest to marine radiomen inasmuch as it means steady, reliable runs and better accommodations aboard a better class ship.

Clyde-Mallory has started to resume its services to Gulf ports and the American President Lines have resumed their intercoastal service during the past week. That shipping generally is on the upgrade was shown in the recent report of the Maritime Commission which stated that the demand for the purchase or charter of war-built American vessels increased to a total of 1246 ships during the second preference period under the Ship Sales Act of 1946 which ended in midyear on June 30th . . . This represents an increase of 222 ships over the total applied for during the first period which ended May 31st. The Commission's report showed foreign applications for purchase had grown to a total of 664 from 24 countries . . . The largest number came from China (162), France (85), Norway (84), and Panama 67 . . . Applications for 92 ships were received from foreign countries during the past month. Prospective American purchasers have applied for 355 ships and for an additional 91 on charter.

The former coastwise steamer George Washington has been chartered by Alcoa for a New York to Bermuda run and will go into that service immediately on a weekly basis.

DONALD PAGE has been assigned to the Coastal Monitor out of New York . . . The many friends of W. C. Simon, Marine Supt. of TRT in the big town will be glad to know that he is around and in fine shape once again after his recent illness. H. Carroll seeking connections with radar firm down around the Baltimore-Washington area . . . Ed Sittler, former marine radio inspector running his own motor repair shop ashore in Brooklyn these days and doing well we hear. . . . William Stern assigned to a "Coastal" recently. A. L. Van Sickle in for a few days a short while back—his previous ship having been sold to foreign interests he has taken an assignment aboard a "Knot." Alfred Gordon also out aboard a "Knot" vessel.

Earl V. Eichenlaub recently joined the Pan Crescent down in the Gulf and has completed his first trip aboard his new ship. E. L. Hayden recently relieved Leroy Meador aboard his Victory while Roy enjoyed a well earned vacation down in Texas. O. Eltun is on vacation from his new cargo craft and is planning a trip back to the old country for a rest and to see the folks. R. W. Cameron has been assigned to the SS. Aztec. Leo Elbert is still aboard a Liberty on the run to northern France—and hoping she will stay in operation and not tie up like so many of the Libertys have been doing lately. C. E. Fraser was relieved from his berth on his "Cape" recently for a much needed rest and physical check up. J. R. Webb has taken out a "Coastal" assignment down in the Gulf.

CIVIL Aeronautics Board and the various shipping interests are still dickering over CAB's refusal to grant certificates to steamship lines in order to permit them to operate associated airlines in conjunction with their surface travel . . . Something should be done about this mess and quickly if the merchant marine is to have a chance in competition with foreign lines, both air and sea, handling the commerce of the world . . . Congress should enact legislation to permit sea-air transport by American operators or establish a new enabling act permitting such operation . . . This administration of law by the CAB will hamper and possibly destroy the United States merchant marine by its refusal to give it a chance to compete with cheaply operated foreign steamship and air- (*Cont. on page* 143)

"You mean radios need 'em too?"

Practical RADIO COURSE

By ALFRED A. GHIRARDI

A five-tube a.c. table model receiver, Model 551D, manufactured by Packard-Bell Co. Tubes are replaceable from bottom without removing chassis.

Part 48. Analysis of electron-coupled mixer and frequency converter tubes for superheterodyne receivers. The author also covers the disadvantages of the pentagrid converters at frequencies above 10 mc.

FOR the sake of completeness in this discussion of electron-coupled mixers and converters, the suppressor-grid type of autodyne,[1] which is a double-electrode input type of converter, will be considered first. Although it never attained great popularity and it has been abandoned in all present day designs, it still is encountered in some existing superheterodynes, especially in many midget receivers manufactured in the early thirties.

Suppressor-Grid Autodyne Frequency Converter

The *suppressor-grid* type of autodyne converter differs from the control-grid type previously described[1] (which was a single-electrode input type and did not employ electron-coupling) in that the oscillator voltage is injected into the suppressor grid of an r.f. pentode tube (such as the type 6C6, 6D6, etc.) in which the three grids are brought out to independent base terminals.

When the early single-band superheterodyne midget receivers became popular, the suppressor-grid type of autodyne frequency converter was used in some models in order to save the cost of a separate oscillator tube. Several circuit arrangements were employed for this type of autodyne, but that illustrated in Fig. 1 is typical of the improved arrangement which employs two bias resistors R_1 and R_2 in the cathode circuit so the control grid and the suppressor grid (which serves here as the oscillator grid) may each be suitably biased for proper operation of the mixer and oscillator sections. The control grid (signal grid) is usually biased 3 or 4 volts negatively by means of resistor R_2 and the suppressor grid is biased from 30 to 34 volts negative by $R_1 + R_2$ in order to secure a compromise of both good mixer and good oscillator performance. The rotor plates of signal-tuning capacitor C_1 are returned to ground so that a gang tuning capacitor C_1-C_2 with common grounded rotor may be employed to tune both the signal and oscillator tank circuits simultaneously for single-control tuning. It will be observed that this type of autodyne converter can be considered as utilizing electron-coupled mixing employing outer-grid oscillator injection[2] since the signal voltage is applied to the inner grid and the oscillator voltage is applied to the outer (suppressor grid) located in the same electron stream.

The developed oscillator voltage of such a converter varies throughout the frequency band of the receiver, and since this in turn varies the plate current (which, of course, must flow through the bias resistors in the cathode circuit) the signal-grid bias will likewise vary throughout the band. If the signal-grid bias is allowed to fall below a minimum value of about 2 volts negative at any frequency in the band, a strong local signal may drive the signal grid positive and cause greatly reduced sensitivity and selectivity, and poor tone quality. Consequently, the bias voltages applied to the signal and oscillator grids must be chosen carefully to effect the best compromise between uniform oscillator performance, most sensitive frequency conversion action and the ability of the mixer to handle strong local-station signals. Also the negative bias that must be used on the suppressor grid of the r.f. pentode greatly lowers the r.f. plate impedance, which is harmful to selectivity. These are important objections to the use of the suppressor-grid type of autodyne converter. Since it also has all of the other limitations previously cited for the control-grid autodyne type of converter,[1] there are good reasons why it never attained as much popularity as did the control-grid type. Because of their inherent limitations and objectionable features, both types of autodyne converters were quickly abandoned when the far superior electron-

[1] For a discussion of the Control-Grid type of autodyne frequency converter see Alfred A. Ghirardi, Practical Radio Course, Part 46, RADIO NEWS, July 1946

[2] For a comprehensive explanation of the principles of electron-coupled mixing see Alfred A. Ghirardi, Practical Radio Course, Part 47, RADIO NEWS, August 1946.

coupled pentagrid converter tubes especially designed to serve the dual function of mixer and oscillator became available. In other words, autodyne frequency converters were a temporary expedient in the sequence of radio tube and receiver design progress, employed mostly in the early inexpensive midget receivers in order to save the cost of the extra oscillator tube. They were converters we got by with until something better was developed for the purpose.

Development of Electron-Coupled Tubes Designed Especially for Frequency Conversion

The radical change from old to new ideas in superheterodyne frequency converters occurred in the early thirties. Although gradually improved performance had been obtained with the autodyne type composite mixer and oscillator systems already described here, and at the same time the number of tubes required for the frequency-conversion process had been reduced from two to one, there was need for more intensive modulation and greater conversion gain (i.e. more signal amplification while the frequency is being converted), and also the ability to control this conversion gain through variation of the grid bias of the tube. Later when multiband receivers became popular, there developed the additional need for satisfactory operation on the shorter waves (higher frequencies). These requirements were met by the gradual development of several types of special electron-coupled mixer and converter tubes designed especially for frequency-conversion service. These will now be described.

The Pentagrid Converter

The simple form of *pentagrid converter* tube (exemplified by such commercial types as the 1A7 for 1.4-volt battery operation, types 1A6 and 1C6 for 2-volt battery operation, type 2A7 for 2.5 volt a.c. operation, 6A7 glass and 6A8 metal types for 6.3 volt a.c. or a.c./d.c. operation, etc.) is a multi-electrode tube designed to perform simultaneously the functions of oscillator, mixer and amplifier within one structure, and to permit independent biasing for optimum mixer and optimum oscillator performance.

The word "pentagrid" is a compound word made up of the Greek prefix "pente" (or "penta" in the English translation) meaning *five,* and grid—literally, 5-grid.

The pentagrid converter (called the *heptode* in Europe) is a direct outgrowth of the successive attempts that have been made to improve the performance of the superheterodyne and increase its operating efficiency by reducing the number of tubes required. It has been used extensively in converter stages and was a real contribution to the compact midget type superheterodyne.

The ordinary pentagrid converter of the 6A8 and similar type contains five grids, four are of normal construction

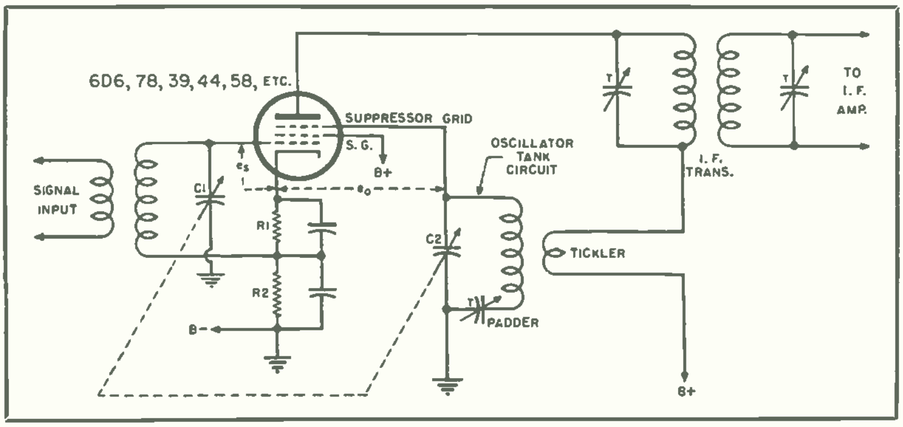


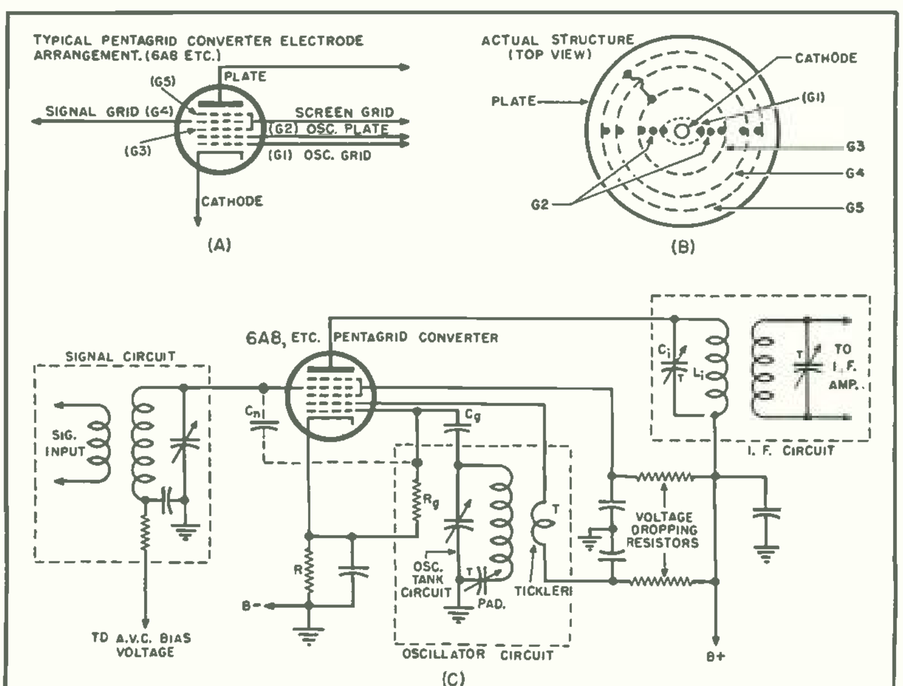
Fig. 1. Typical suppressor-grid type autodyne frequency converter employing electron coupling and used in early superheterodyne midget receivers as Majestic Model 370, etc.

and the fifth (so-called grid *G2* in the illustration at *B* of Fig. 2) consists merely of two side rods, similar to grid support rods, placed between grids *1* and *3*. These two rods constitute the plate of the oscillator, the control grid of which is *G1* nearest the cathode (thus, inner-grid oscillator injection is employed). Grids *G3* and *G5* are the positively-biased inner and outer screen grids, respectively, and are connected together inside the tube. They serve to accelerate the electron stream and shield the signal grid *G4* electrostatically from the other electrodes. They also increase the output impedance of the tube, thereby enhancing the *gain.* The one nearest the cathode serves also to reduce direct radiation (at oscillator frequency) from the inner electrodes comprising the oscillator. Grid *G4* is the signal input or control grid. It is shielded electrostatically from interaction with the oscillator section by screen grid *G3,* and from interaction with the main outer plate by screen grid *G5*. There are, of course, beside these various grids, a heater or filament, main outer plate, and, in indirectly-heated tubes, a cathode.

Although the oscillator plate *G2* consists merely of the two side rods, in circuit diagrams (see *A* and *C* of Fig. 2) it always is shown schematically as a grid for simplicity. The two rods forming this oscillator plate *G2* are only large enough to just maintain satisfactory oscillation. They are located physically in such a manner that they are set in line with the other grid supports. Since this puts them outside the main electron stream, they have little influence on it. Examination of Fig. 3 will make this clear. They depend somewhat on secondary emission from the inner screen-grid *G3* also. This is not shown in Fig. 3. It is essential that the oscillator plate should influence the main electron stream as little as possible, because

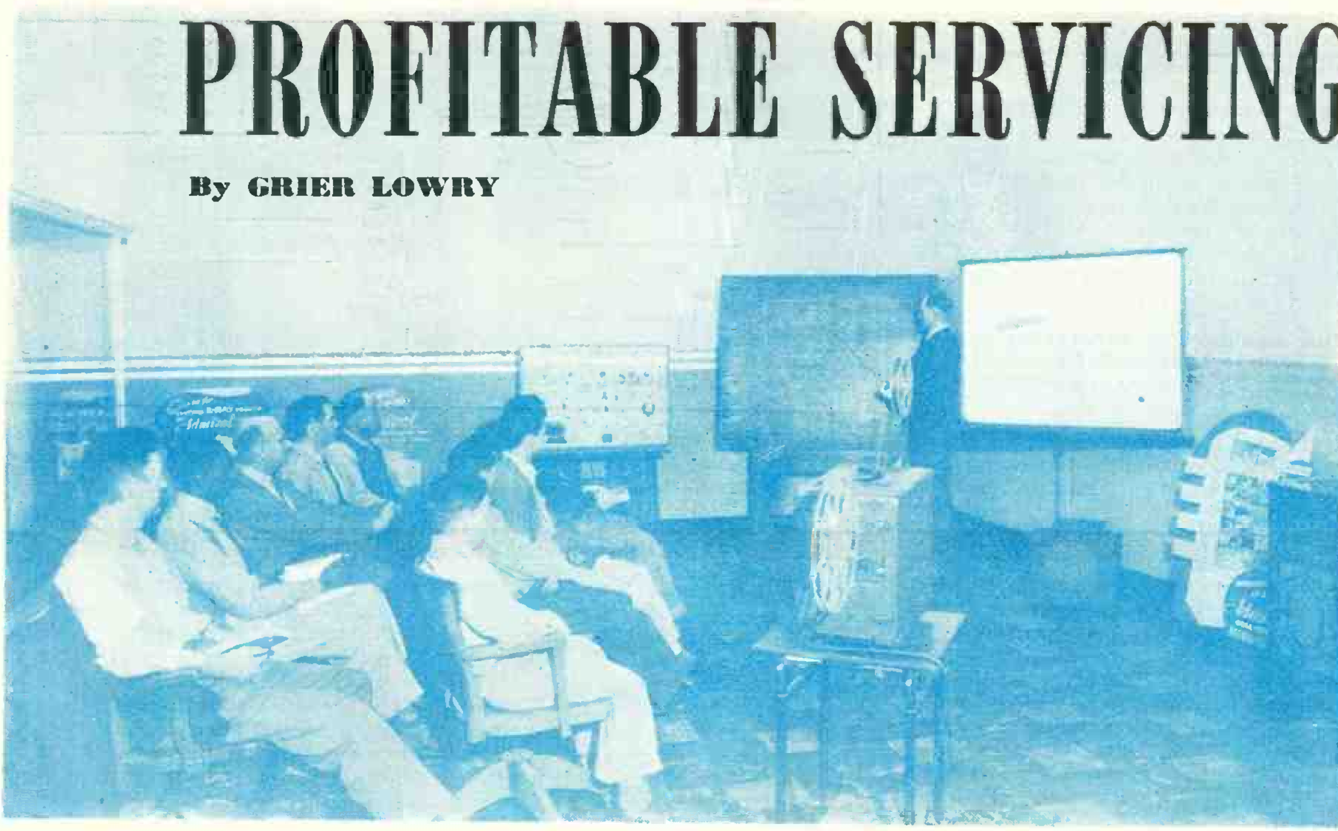
(*Continued on page* 148)

Fig. 2. Functions and arrangement of the various electrodes in a typical pentagrid converter of the 6A8, etc. design and typical circuit arrangement employed with these tubes.



PROFITABLE SERVICING

By GRIER LOWRY



Every Tuesday during the war the staff met to review some of the aspects of radio and electronic servicing. The course of study at the plant now has the added purpose of permitting war veterans who have rejoined the organization to brush up on servicing.

In order that technicians keep pace with the rapid developments in radio, some form of training program must be inaugurated.

AMONG the interesting revelations to emerge during the aftermath of the war are the methods employed by radio service institutions in overcoming various war-created perplexities.

A case in point pertains to a Kansas City radio serviceman who obtained salubrious dividends from the initiation of a well-balanced training schedule for his staff—from electronic experts to file clerks.

While other repair operators were bewailing the discouraging dearth of experienced personnel, C. W. Donaldson, president, *Donaldson Radio & Electric Company,* serenely introduced measures that would enable his firm to maintain quality of craftsmanship which had been a characteristic of the company's development.

The year 1922 marked the inception of this company. Periodic changes of address ultimately housed the equipment and staff in the present efficient, roomy structure near a heavy-trafficked thoroughfare, strategically located, but on a street exempt from the inconveniences of steady traffic.

Motor car radio repair absorbs sixty per-cent of the service work performed by the company, and car radio repair accommodations are allocated 5000 of the 10,000 square feet occupied. Of the fifteen members of the Donaldson crew, four technicians eliminate "bugs" from motor car sets, seven are employed in the laboratories designed for household set servicing, and the remaining members of the staff are engaged in clerical detail.

Soundproof rooms, two technicians to a room, versatile tools, constantly lodged in service bench drawers when not in use, a circular booth fronting the offices and labs, in which is ensconced a young woman who directs the radio service traffic, tags the sets, answers questions, and presses the button that lifts the door, permitting incoming motor cars to enter the driveway that eventually leads into the expansive chamber wherein minor repair work is executed and sets are routed for more intricate repair problems, comprises a succinct description of the plant layout.

Motor car radio repair traffic, in the opinion of C. W. Donaldson, is the cream of the radio service patronage. Owners of car sets are the topnotchers of business, solid citizens, and from

This building houses the servicing facilities of Donaldson Radio & Electric Co. of Kansas City. The building includes a lobby, adequate office space, a garage chamber where cars may be driven in, soundproof rooms in which both auto and domestic sets are serviced, and a kitchen used by employees for preparing lunch.

relations with such clientele can come assignments for other service work—movie projection repair, sound servicing and a miscellany of lucrative repair jobs.

Electronic servicing is an essential nucleus in the repair activity of the company. To Donaldson came an avalanche of wartime electronic repair work because his technicians had distinguished themselves for dependable servicing of this equipment.

It was with genuine distress that the man at the helm of this organization noted the trend of the personnel during the war. Loss of his prewar skilled technicians necessitated employment of replacements from among the fledglings turned out by radio schools, most of whom were willing, but who lacked experience necessary to turn out acceptable work, or replacements came in the form of service veterans, ripe in experience, deplorably short on fundamental training.

The problem posed by the inferior talents of the war staff was offset in an amazingly brief period by an educational system. Working with the Kansas City educational system which footed some of the school bills, the training program shaped by Donaldson achieved benefits in the form of a war staff that presently gave no ground to the prewar unit in the quality of workmanship.

Training sessions were patterned much like the courses offered by modern colleges. Conducted on a once-every-Tuesday basis, the school opened at 7:00 p.m. with an hour and a half lecture by the foreman of the Donaldson shop, interspersed occasionally with special lectures by key employees of other companies. Lectures were succeeded by an hour of practice activity, quizzes, and a review of the lecturer's presentation. Thirty minutes of the schedule was devoted to watching moving picture demonstrations of the technical aspects of electronics. These films were either borrowed from the Board of Education or manufacturers, or rented from photographic supply houses. Visual education, as a medium for enlightening technicians on the intricate problems of electronics, is commended by Mr. Donaldson. Animated diagrams frequently clarified points when other media failed. Sessions usually wound up with a showing of travel film, scientific shorts, or war documentary films.

Attendance was entirely voluntary. There was no pressure from the boss on employees to attend school, but it is interesting to note that attendance was virtually one hundred per-cent.

"The tragedy of the modern working man is that frequently he earnestly wishes to improve his position, but because of the necessity of supporting a family, attendance at a regular school is impossible. The earn-while-learning method is his only salvation. It is up to the employer to see that he is given this opportunity," pointed out C. W. Donaldson recently.

Subjects covered in the course offered during the war concerned such matters as fundamentals of electricity, vacuum tubes, electron theory, a.c. and d.c. currents. Each Tuesday students were assigned chapters for review before the next meeting.

Inestimable was the value of the *RCA* Dynamic Demonstrator No. 3 used at the school. This panel with every radio part and circuit graphically exhibited in a wide-open spacing type of construction permitted the students to examine and determine the operation of each radio part when not compactly bound together in a radio set. The students were able to disconnect the various units and observe the results. The face of the generator has, plainly visible, all the values and functions of the various parts. Variegated colors for the various circuits—green, the audio; yellow, the oscillator, etc.—created a clear picture of the operation of a radio.

Donaldson envisions linking radio engineers in Kansas City with the Electrical Maintenance Engineers, who have formulated an educational project of their own, with guest lecturers from leading electrical firms and universities, scheduled for appearances. He wishes the radio engineers to join hands with other members of the electrical industry for a unified educational program.

This will not supplant his own privately sponsored training sessions. Last winter a course in mathematics was started with an instructor furnished by the Board of Education. Other courses will be introduced, some with the motive of giving returned war veterans a brisk briefing on radio and electronics servicing.

The war, with its chaos of repair activity, coupled with the loss of the alert technicians to the service, sharply exhibited the glaring weaknesses in the craft. Education can remedy these defects.

"Radio technicians are underpaid," said C. W. Donaldson. "Undercompensation is another evil of training deficiency. It is a condition that adequate training, properly instilled, will rectify." —30—

This Kansas City radio repair operator, C. W. Donaldson, has serviced sets in the city since 1922. Car radio repair work constitutes sixty per-cent of the activity of the plant.

These servicemen were trained under the educational program instituted at the Donaldson Radio & Electric Co. From an inexperienced war staff the company has developed, by means of regular training sessions, an alert technical group.

FREQUENCY MEASUREMENTS at U.H.F.

By ROBERT ENDALL

Resumé of the more conventional types of wavemeters that are used to measure ultra-high frequencies.

IN ALMOST every type of radio activity, whether it be amateur communication, home and industrial experimentation, radio servicing, or high-power broadcasting, a reasonably accurate knowledge of operating frequency is essential. In the operation of transmitters it is necessary to know the output carrier frequency, in reception it is necessary to know the frequency of the received input signal and of the local oscillator, and in numerous other applications it is desirable to know accurately the oscillator fundamental and harmonic frequencies.

With the resumption of amateur communication, and the intense interest at the present time in ultra-high-frequency transmission and reception, the experimenter will find that some reliable means of measuring frequencies at u.h.f. is an absolute necessity in his work. This article will attempt to describe a number of u.h.f. wavemeters and other frequency measuring instruments which are suitable for amateur construction, and will discuss the technique of measuring frequency at u.h.f. At the same time, there will also be included some mention of commercial instruments, for the benefit of those who have facilities sufficiently elaborate for them to take advantage of some of the features of commercial equipment in the construction of equipment for their own use.

When great accuracy is required, as in commercial broadcasting, measurements must be performed by primary or secondary frequency standards. These are extremely stable oscillators, usually provided with harmonic and sub-harmonic generators to give a number of frequencies accurately related to the oscillator frequency. However, in general practice such great accuracy is not necessary, and frequency measurements at u.h.f. are generally performed by the following methods:

1. Wavemeters.
2. Lecher wires.
3. Heterodyne frequency meters.

The absorption-type wavemeter is the simplest type of frequency measuring device, and is extremely valuable in general experimental work and for making preliminary adjustments on transmitters and oscillators. It consists essentially of an ordinary resonant circuit formed by a coil and condenser in parallel, tunable over the desired frequency range and provided with a calibration that gives the resonant frequency in terms of the condenser setting.

As the name indicates, the absorption wavemeter operates on the principle of extracting energy from the circuit being measured. The basic principle of operation is illustrated in Fig. 4. To measure an unknown frequency, the inductance of the wavemeter is coupled into the circuit being measured, and the condenser setting varied until it is brought into resonance with the unknown frequency. When large amounts of power are present, as in transmitters, resonance can be indicated by a small flashlight lamp coupled into the wavemeter circuit, or by means of a meter. When the amount of u.h.f. energy is small, as in receivers, resonance may be determined by the reaction upon the circuit being measured. When this method is used, the reaction upon the circuit under test, due to the absorption of energy as the wavemeter is tuned

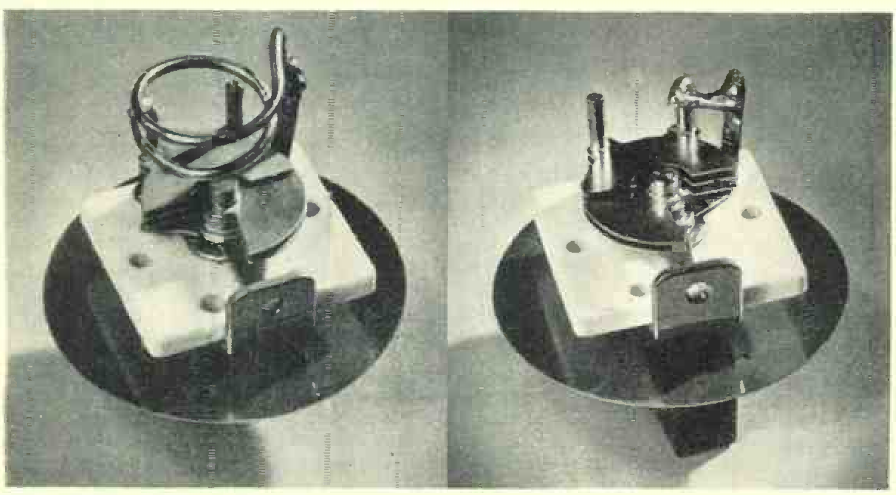
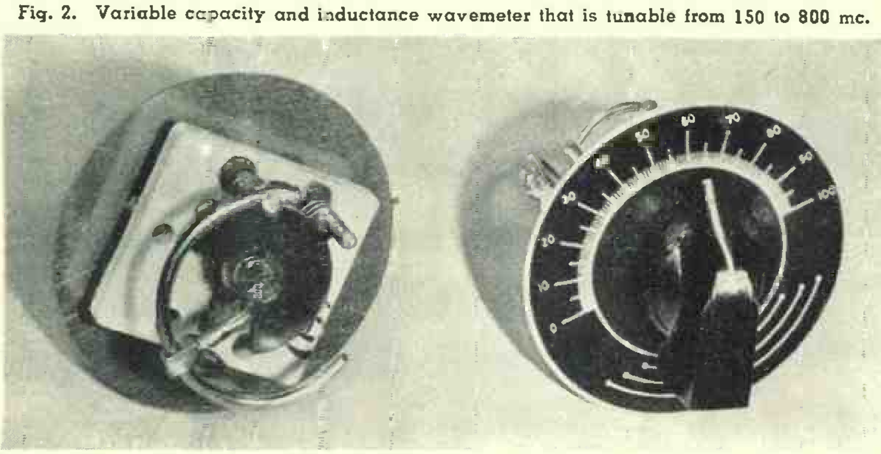


Fig. 1. Tuned-circuit absorption wavemeters covering frequency range 100 to 800 mc.

Fig. 2. Variable capacity and inductance wavemeter that is tunable from 150 to 800 mc.



through resonance, will be quite marked. The effect upon a low-power oscillator may be observed by watching for the change in plate current when the wavemeter is tuned through the oscillator frequency. In a receiver there will be a decrease in the audio-frequency output when the wavemeter is coupled into either the antenna or the local oscillator circuit. For best accuracy in measurements, the meter should be coupled into the circuit under test as loosely as is consistent with accurately observable indications.

In the construction of absorption wavemeters for u.h.f. it is important to bear in mind that the major respect in which high-frequency circuits differ from those in use at low frequencies is that the capacities and inductances must be extremely small. The residual inductance and capacity determine the highest frequency which can be reached, and must, therefore, be kept to an absolute minimum.

The construction of tuned circuits for wavemeters is simpler than for oscillators and receivers, since there are no vacuum tube capacities in parallel with the tank condenser. Therefore, much higher frequencies can be reached by tuned-circuit wavemeters than by oscillators and receiver tuning circuits with lumped circuit constants. In addition, since there is no d.c. in the wavemeter circuit, simple sliding contacts may be used, for even if good contact is not made there will be sufficient capacity to act as an effective short-circuit for high frequencies. Reasonably high frequencies can be attained by the use of standard low-capacity variable air condensers and low-inductance, single-turn coils. Frequencies of the order of 700 to 800 mc. can readily be measured by wavemeters having lumped capacity and inductance, if they are carefully constructed.

A set of two home-made absorption wavemeters covering the frequency range of 100 mc. to 800 mc. is shown in Fig. 1. Since the tuning range of a single wavemeter with fixed inductance is not great enough to cover this wide band, it is necessary to use two with overlapping tuning ranges to cover the desired band. Their construction is extremely simple: The tuning condensers are *Hammarlund* 3-20 $\mu\mu$fd. variable air condensers which have been designed for high-frequency work. The higher frequency unit has the soldering lugs of the condenser rotor and stator soldered directly together, so that the lugs and the blob of solder constitute the entire inductance of the circuit. The inductances for lower frequencies may then easily be determined, since the lowest frequency of one wavemeter must be the highest frequency of the other one, if the tuning ranges are to overlap. The inductances may be measured at low frequencies by tuning them with a larger capacity to a lower frequency which is already known.

In the 110-290 mc. unit, the coil consists of about one-and-three-quarters turns of No. 12 bare tinned copper bus wire, and has an inductance of .100 microhenries. It is set to this value by adjusting it to tune a capacity of 320 $\mu\mu$fd. to 27.5 mc. on a Q-meter.

Wider tuning ranges can be covered in a single tuned circuit if the inductance is varied simultaneously with the capacity. Thus, it is possible to have a relatively large inductance when the capacity is greatest, and by means of a sliding contact which moves with the rotor as the capacity is decreased, to have an exceedingly small inductance at minimum capacity. In this manner a wavemeter can be constructed which covers almost the entire tuning range of the two shown in Fig. 1 in a single instrument. A photograph of an extremely simple wavemeter constructed by the author, having variable capacity and inductance and tunable from 150 mc. to 800 mc. by a 180 degree rotation of the condenser, is shown in Fig. 2. The same type of variable condenser is used as for the wavemeters in Fig. 1, but in this instrument the inductance also is made variable by having a one-turn coil with a sliding contact arrangement that can clearly be seen in

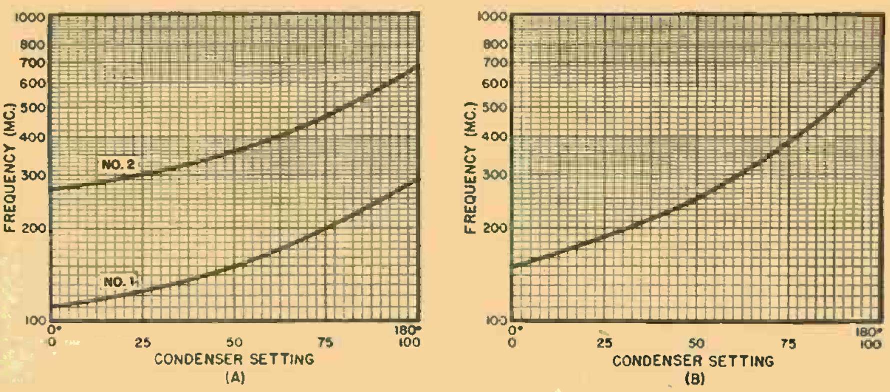


Fig. 3. (A) Tuning calibration curves of the two wavemeters shown in Fig. 1. (B) Tuning calibration curve of the wavemeter that is illustrated in Fig. 2.

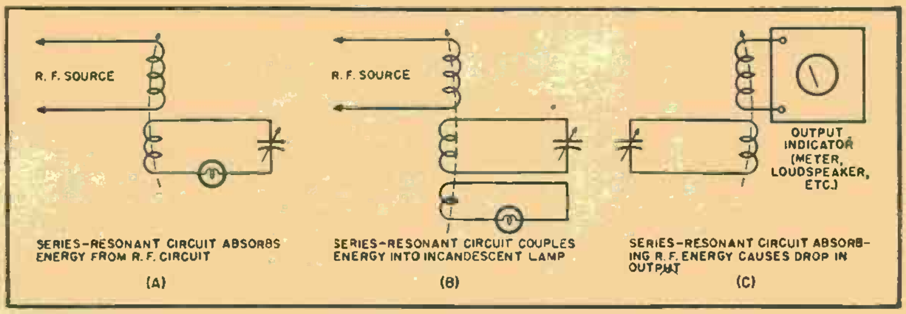
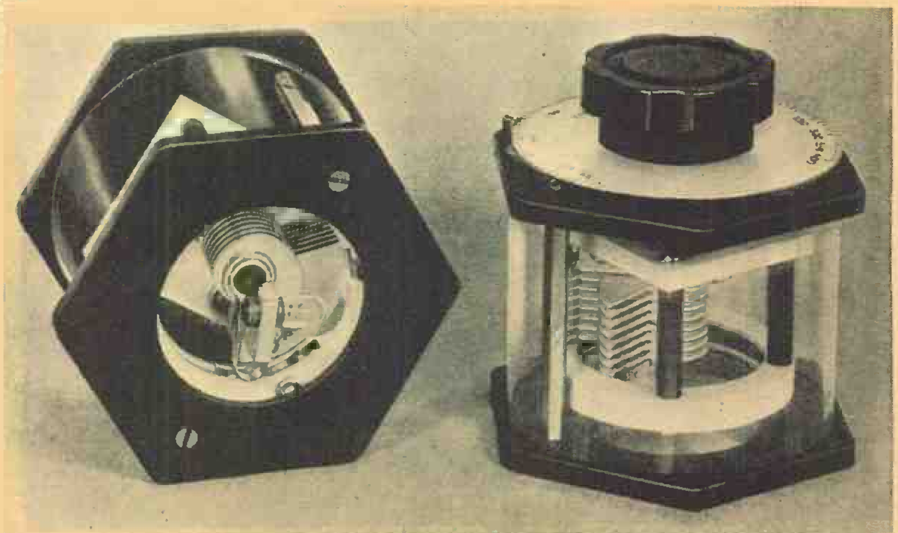


Fig. 4. Methods of using the absorption of energy, by a simple calibrated tuned circuit at resonance, as the basis of a wavemeter for measuring frequency.

Fig. 5. Commercial variable capacity and inductance wavemeter that is tunable within the range of 55 to 400 mc., General Radio Co. type 758-A/411203, No. 1200.



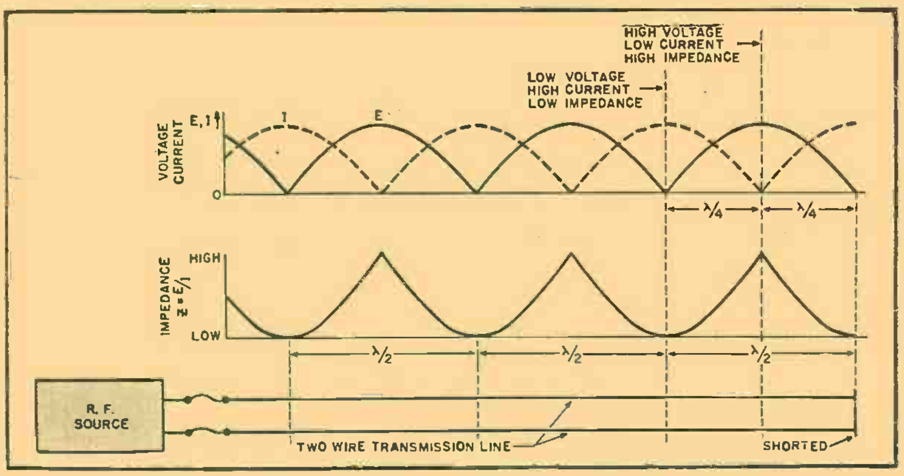


Fig. 6. Diagram illustrates standing waves and impedance that are set up along a two-wire transmission line that is coupled into an r.f. source.

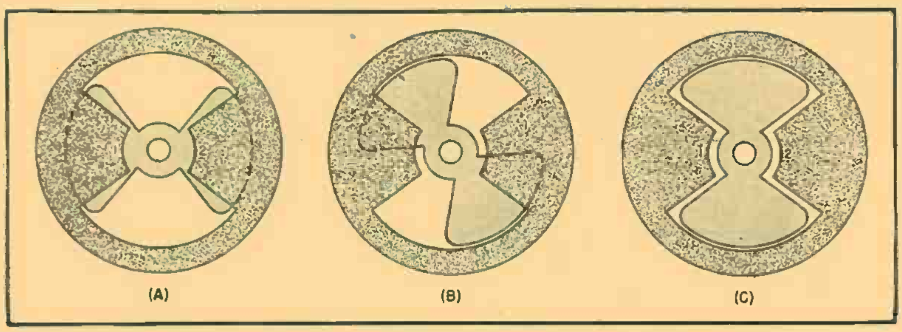
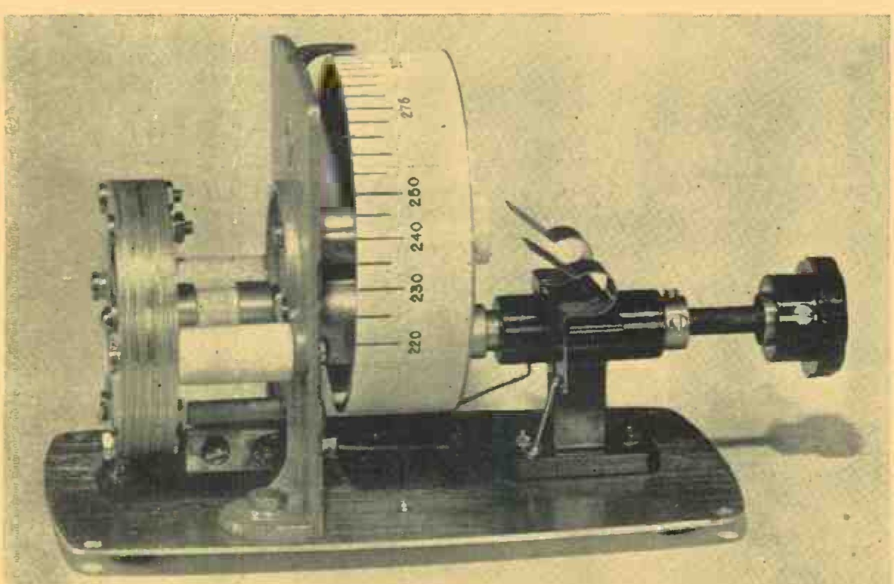


Fig. 7. Butterfly condenser. Refer to text for principle of operation.

Fig. 8. Commercial wavemeter using a butterfly tuned circuit. Tuning range is from 240 to 1200 megacycles. General Radio Co. type 1140-440522, No. 1543.



the illustration. As the capacity varies from 3 to 20 μμfd., the inductance changes over about a 1 to 3 range. This particular wavemeter has given excellent service in general home experimentation. Tuning calibrations of the wavemeters of Fig. 1 and 2 are given by the curves of Fig. 3A and 3B. The convenience of covering the tuning range in a single instrument rather than in two can readily be appreciated by the reader.

In the variable-inductance wavemeter, the outer inductance ring, along which the slider moves, consists of about two-and-one-half inches of No. 12 bus wire bent into a 225° arc of a circle one-and-one-quarter inch in diameter. It is soldered to one of the stator terminals as shown in the photograph, ¼ inch above the top stator plate, with its center above the center of the rotor. The slider arm is just another piece of No. 12 wire, of the proper length (about ¾ inch) to mount the brass eyelet slider correctly, and is soldered into a groove filed in the shaft of the rotor to give the solder connection a certain amount of mechanical strength. The total inductance of the circuit varies from about .02 to .06 microhenries.

The principle of simultaneous variation of both inductance and capacity has been the basis of a number of commercial u.h.f. wavemeters. Photograph of a commercial wavemeter of this type, tunable from 55 to 400 mc., is shown in Fig. 5.

A recently developed type of tuned circuit that has been found quite useful in the design of wide-band lumped-constant tuned circuits for wavemeters and tank circuits at u.h.f. is the "butterfly circuit." The details of the butterfly circuit are illustrated in Fig. 7. The diagram shows the plates in different positions to illustrate the manner in which tuning takes place. In position *A* the capacitance between points 1 and 2 on the two stator plates is at maximum, and the inductance is likewise at maximum. Both the capacitance and inductance decrease through position *B* to their minimum values at position *C*. The change in inductance is brought about as the rotor gradually fills up the opening of the inductance loop, so that in position *C* the lines of magnetic flux are restricted to the small clearance between rotor and stator. By this method, extremely wide tuning ranges are attainable at u.h.f. without the use of sliding contacts, and tuned circuits of the butterfly type have found considerable application in commercial instruments. A photograph of a commercial wavemeter using a butterfly tuned circuit, having a tuning range of 240 to 1200 mc. is shown in Fig. 8. Unfortunately, the mechanical construction of the butterfly circuit is somewhat difficult, requiring accurate control of critical clearance dimensions for widest tuning range, therefore does not easily lend itself to construction by the average amateur, who usually does not have elaborate machine shop facilities at his disposal.

For wide-band frequency measurement above the range of tuned-circuit wavemeters of the type shown in Figs. 1 and 2, it is usually easier to construct a two-wire transmission-line wavemeter than one of the butterfly type. By observing the standing waves on such a transmission line (known as a Lecher-wire system), frequency may be determined directly by measuring the length of the unknown waves.

A Lecher-wire wavemeter consists simply of a pair of parallel bare wires which may be coupled to the source of r.f. to form a transmission line along which standing waves may appear. The principle of the operation of the two-wire transmission line in measuring wavelength may easily be

(*Continued on page* 94)

Television ALIGNMENT

Compact television receiver to retail at approximately $150. It incorporates a 7 inch picture tube and has two tuning bands which cover the entire spectrum of assigned television channels. According to the manufacturer, Belmont Radio Corp. of Chicago, delivery is expected to start immediately.

By
EDWARD M. NOLL
Television Tech Enterprises

Part 15. Covering test equipment and procedures involved in the alignment of television receivers.

CAREFUL alignment of the television receiver is a tedious task. Fortunately, the attentive consideration given to r.f. and i.f. circuit stability by manufacturers make only occasional alignment necessary. In fact, with the more stable receivers, the original factory alignment suffices for a number of years. The best policy for servicemen to adopt is not to attempt alignment unless they have the specialized test equipment necessary to do the job. If equipment is available, first test to see if alignment is necessary before touching an aligning adjustment.

Specialized Test Equipment

The special test equipment required for television alignment are; cathode-ray oscilloscope, i.f. wide-band sweep generator, and r.f. wide-band sweep generator. Both sweep signal generators should have associated marker systems for identifying band limits and various frequencies within the band.

1. Cathode-ray Oscilloscope: The oscilloscope should have an associated vertical amplifier with sufficient gain to amply the relatively weak output of a video detector to a level sufficient for application to the vertical deflection plates. An incorporated horizontal amplifier and sweep generator is required. A sync system and phasing adjustment is helpful in producing a stationary, clean pattern on the oscilloscope screen.

2. I.F. Signal Generator: The i.f. signal generator should have a range between 7.5 and 15 mc., and should be capable of sweeping back and forth across this range at an audio rate. The conventional sweep generator uses an audio sine-wave to frequency modulate its output. The same generator must also generate a low amplitude, short duration signal each audio cycle for synchronizing the horizontal oscillator of the test oscilloscope.

3. R.F. Signal Generator: The r.f. signal generator should also be a sweep generator and capable of sweeping over a six megacycle band. The signal generator should have an r.f. band switch to permit choice of operation on either of the five lowest channels.

Alignment Objectives

The four major objectives of alignment are to (1) obtain utmost in gain without sacrificing bandwidth; (2) position r.f. and i.f. response characteristic on correct frequencies; (3) prevent entrance of spurious signals; and (4) set the relative amplitudes of the picture carrier and sidebands. The most accurate and direct method of alignment employs the test oscilloscope and sweep generator, connected as shown in Fig. 2. Notice the following points:

1. Frequency-modulated output of sweep oscillator is capacitively-coupled to the grid of the i.f. amplifier stage. Thus, a signal which is constant in amplitude but varying in frequency is applied to the i.f. amplifier. The frequency is made to vary between 7.5 and 15 mc. for receivers which have an 8.25 mc. sound carrier and a 12.75 mc. picture carrier frequency.

2. Output is taken directly off the diode detector load resistor and applied to the vertical deflection circuit of the oscilloscope. This output represents the instantaneous diode currents for the band of frequencies swept by the signal generator. Thus, the instantaneous output at any one instant is proportional to the amplification of the i.f. amplifier at the particular frequency the sweep is crossing—being maximum, of course, over the flat part of the bandpass and tapering off at the ends of the i.f. amplifier band-pass.

3. Audio sweep voltage output from the sweep oscillator is applied to the horizontal input of the oscilloscope. This sweep voltage is identical in character to the sweep voltage which fre-

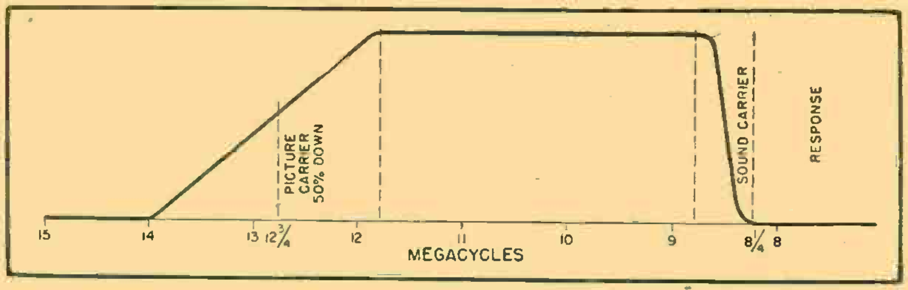


Fig. 1. Idealized band-pass characteristic of television i.f. amplifier.

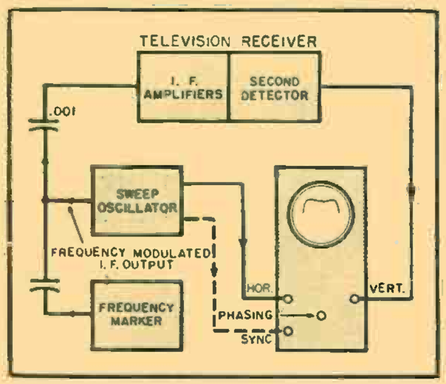


Fig. 2. Block diagram illustrates set-up for alignment of i.f. amplifiers.

quency modulates the i.f. output of the sweep oscillator. It is amplified by the horizontal amplifier of the oscilloscope and causes horizontal deflection of the oscilloscope beam.

Thus, the sweep signal (generally a sine-wave) applied to the horizontal input of the oscilloscope, causes horizontal deflection of the beam; signal applied to the vertical input from the receiver detector, vertical deflection of the beam. The pattern traced on the oscilloscope screen, therefore, is the actual band-pass characteristic of the i.f. amplifier. The horizontal axis of the trace (base line of the characteristic) can be calibrated in terms of frequency, for each point represents one particular frequency because the same sweep voltage which is sweeping the beam horizontally also frequency modulates the i.f. output, changing its frequency correspondingly. Now the vertical deflection of the beam is a relative measure of the gain of the i.f. amplifier at each particular frequency over which the i.f. signal is swept. If the gain of the i.f. amplifier were uniform over the 7.5 to 15 mc. range, only a straight horizontal line would appear on the screen. Inasmuch as the gain is not uniform, the characteristic appears straight and maximum over the flat portion of the i.f. characteristic and tapers off at the ends of the band-pass where the i.f. gain falls off and the rectified component of receiver diode current decreases.

A clearer picture of the pattern is afforded by Fig. 1, which shows how the trace would appear (heavy dark line) on the oscilloscope screen for a picture i.f. amplifier with an idealized perfect band-pass characteristic. Let us take a few typical points along the line:

When the frequency-modulated output of the sweep oscillator is on the 15 mc. point, the oscilloscope beam is at the extreme left of the screen. Inasmuch as 15 mc. is off the band-pass characteristic of the i.f. amplifier, there is no rectified component of diode detection current and, consequently, no vertical deflection of the oscilloscope beam. Now at the instant the frequency modulated output of the sweep oscillator is on 14 mcs., the beam has been moved horizontally to the right a short distance, Fig. 1. At this frequency point there is some small trace of amplification in the i.f. system and the beam is deflected vertically a bit. By the time the sweep output reaches the picture carrier frequency, the beam has moved horizontally almost to the center of the screen. At this frequency there is considerable i.f. amplification (50% point), causing appreciable vertical deflection. Just beyond 12 megacycles, the i.f. amplification reaches maximum, producing peak diode current and maximum vertical deflection of the scope. This level is held until the frequency-modulated output of the sweep oscillator has swept below 9 megacycles. Beyond 9 megacycles, the gain of the i.f. amplifier falls off rapidly and there is a sharp drop in vertical deflection. In fact at 8¼ megacycles, the i.f. gain must drop to practically zero to prevent the 8¼ megacycle sound signal from interfering with the picture signal.

It is apparent that the test equipment becomes very useful both in adjusting and checking the performance of the picture i.f. system. We have a means of checking bandwidth, relative amplitudes, proper positioning of picture carrier, response at sound carrier and response at adjacent sound carrier points.

4. To use the oscilloscope pattern successfully it must be calibrated in frequency. A frequency marker system is, therefore, installed with the sweep oscillator and is generally incorporated in the same case. Frequency markers are of two types. One type is a simple calibrated resonant circuit which is mutually coupled to the i.f. output of the sweep oscillator. On the frequency to which a resonant circuit is tuned, it will absorb some of the sweep oscillator output and reduce slightly the input to the receiver, causing a small dip to appear in the oscilloscope pattern at that frequency. With this type of marker, the pattern is first properly positioned on the screen using oscilloscope controls and, then, the marker is used to locate specific frequencies on the pattern which can be noted with crayon marks on the scope glass surface. After the marks have been set-up (such as shown in Fig. 4), do not touch the horizontal controls of the oscilloscope because they will have to be recalibrated and marked if the pattern is shifted horizontally. In the better sweep oscillators, a series of built-in marker circuits are used which can be switched in and out at will. This system permits the markers to appear on the pattern at all times, permitting ease in adjustment and not requiring recalibration, when changing test positions or oscilloscope controls.

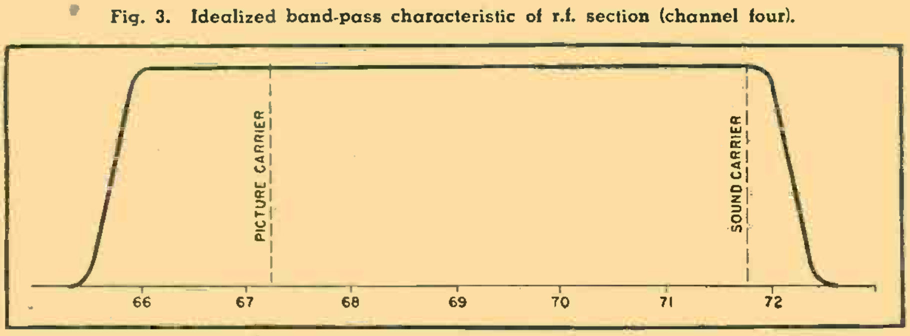
A second marker system uses a small calibrated signal generator, the output of which is also fed into the receiver along with the output of the sweep oscillator. This output also places a mark on the oscilloscope response pattern at the frequency to which it is tuned.

In using external marker systems, always loose couple to prevent distortion of the sweep pattern. In fact, the smallest discernible marker signal serves as the most accurate calibration.

5. A phasing knob on the oscilloscope is adjusted until pattern is stationary and dual response patterns, if they exist on the oscilloscope screen, coincide. Instability or dual patterns are caused by incorrect phase relation between detected signal, applied to the vertical deflection circuit, and direct signal, applied to the horizontal deflection circuit from the sweep oscillator. This relation is corrected with the oscilloscope phasing control.

6. An alternative method, used when

Fig. 3. Idealized band-pass characteristic of r.f. section (channel four).



the sweep oscillator has no direct sweep output for the oscilloscope horizontal circuit, is indicated by the dashed line of Fig. 2. In this type of sweep oscillator there is a pulsed output in synchronism with the frequency-modulated sweep cycle which can be used to synchronize the internal horizontal sweep of the oscilloscope. With this method consequently, the oscilloscope internal sweep must be turned on.

7. The latest sweep oscillator and oscilloscope combination for television receiver alignment requires no external connections between sweep oscillator and oscilloscope—entire alignment system is synchronized by the 60 cycle primary line voltage. The sweep oscillator output is frequency modulated at a 60 cycle rate and the horizontal sweep oscillator of the oscilloscope is locked-in on 60 cycles. Thus, the only external connections necessary are those between sweep oscillator output and receiver in, and between receiver out and vertical input of oscilloscope.

R.F. Alignment

The block diagram for alignment of the r.f. section of the receiver, Fig. 5, differs only slightly from that of the i.f. alignment. Alignment of the r.f. section differs in the following respects:

1. Frequency-modulated high-frequency output of the sweep oscillator is coupled directly to the antenna terminals. Output for the vertical input of the oscilloscope is generally taken off the plate or screen circuit decoupling network of the converter. Inasmuch as the d.c. component of current in the converter circuit is proportional to the strength of the r.f. signal, this stage affords a convenient point to check response of the r.f. section.

2. The response characteristic, Fig. 3, of the r.f. section, since it passes picture and sound, must be flat over a six megacycle band and fall off rapidly at the ends to reduce pick-up from adjacent channels or images.

Is Alignment Necessary?

The radio serviceman can save time and effort by first setting up his test gear to see if alignment is necessary. It has been customary in the better repair shops to align a broadcast set whether it appears necessary or not, to be certain the radio is giving the utmost in performance. However, we can be reasonably certain, in the case of the television receiver, that if the response pattern is correct the receiver is aligned properly.

With the r.f. pattern on the oscilloscope screen, check the following:

1. Six megacycle r.f. bandwidth.
2. Band-pass properly centered on each channel.
3. Response falls off rapidly at outer extremities of channel.

With the i.f. pattern on the oscilloscope screen, check the following:

1. Band-pass properly positioned on i.f. characteristic.
2. Proper four megacycle bandwidth. Small five inch receivers will not usually be flat over this great a range.
3. Response at picture carrier frequency will be down 50%.
4. Response at sound carrier frequency should be practically zero.
5. Response at adjacent sound carrier image frequency (14¼ mc.) should be practically zero.

Alignment of G.E. Model 90 Receiver

I.F. Alignment:

1. Connect vertical input cable of oscilloscope across diode load resistor R_7, Fig. 8.

2. Connect output of sweep oscillator to control grid of 2nd picture i.f. amplifier (oscillator to be sweeping between 7.5 and 15 mcs.). Adjust oscilloscope controls to give suitable horizontal deflection. Pattern on oscilloscope screen should appear as shown in curve C (less markers) of

(*Continued on page* 112)

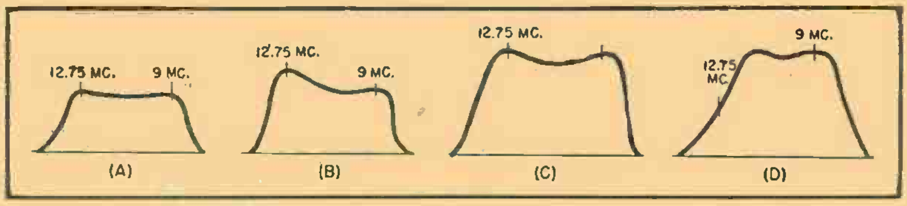


Fig. 4. Curves illustrate i.f. alignment.

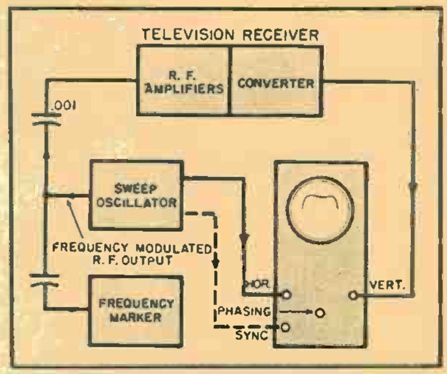


Fig. 5. Alignment diagram for r.f.

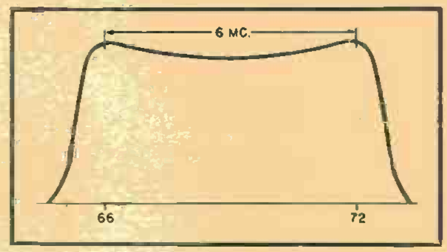


Fig. 6. Alignment r.f. curve (channel four).

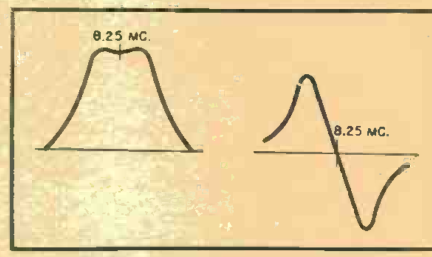
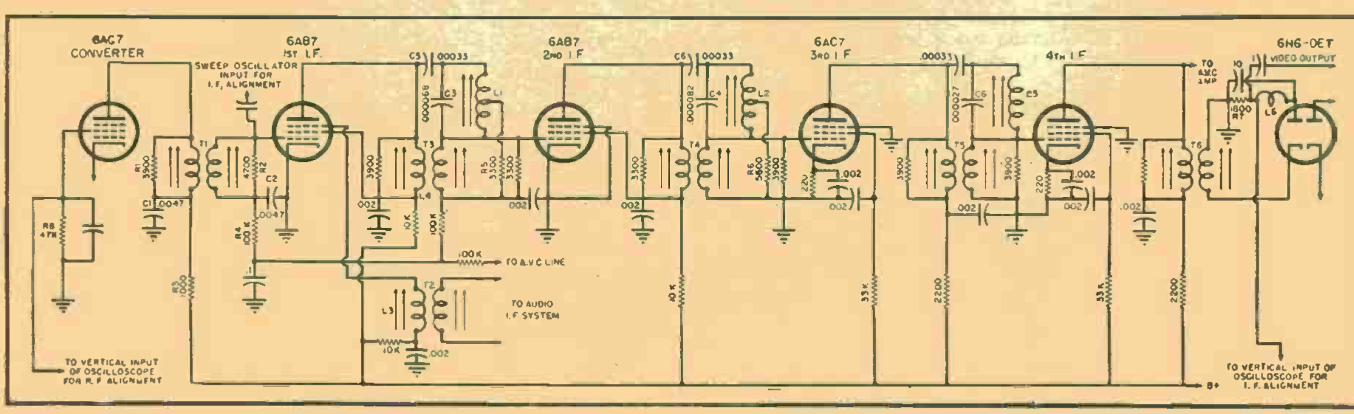


Fig. 7. Sound channel alignment curves.

★

Fig. 8. Diagram showing i.f. system of General Electric Model 90 television receiver. The output of the converter tube contains two signals; the video signal and the sound signal which is four and one-half megacycles lower than the video frequency. Output of sweep oscillator is connected to antenna terminals for r.f. alignment.



ELECTRONICS AFLOAT

By IRA KAMEN
Chief Electronics Engr., Design & Engineering Div., Conlan Elec. Corp.

As the United States leads the world as a maritime power, electronics plays a great role in helping to maintain her pre-eminent position on the seas.

NOT tomorrow, but today is the era of Marine Electronics. Much of the research work which was stimulated by the war has resulted in tremendous improvements in old electronic equipment and the development of new, important electronic tubes and systems. Many of these tubes and systems can be profitably applied to marine installations.

The electron has already started its work in the marine field. A remarkable variety of electron power-houses (electronic tubes) is available to perform necessary tasks better than they have been done before. Electronics in shipyards finds application in smoke detectors to reduce fuel consumption by maintaining proper combustion in power plant boilers. Electronic equipment (at surprisingly low cost) stops the flow of combustibles if the flame under gas or oil fired boilers is extinguished. Welding current may be electronically controlled more efficiently and accurately than by hand. Electronic call systems keep shipyard executives in constant touch with offices or operations, or these same systems can be used to broadcast morale building entertainment. The list of possibilities grows constantly. A few of these electronic applications are listed in greater detail for the reader's consideration.

1. *Electronic Rectifiers (conversion of a.c. to d.c. voltages).*

The greater economies of first cost and general operating cost, plus easier portability are the basic reasons why electronic rectifiers are superseding motor generators. An impressive war service record has overcome the reluctance of power engineers to adopt electronic rectifiers in the place of motor generators. They are employed efficiently and satisfactorily in many forms of service. A partial list of such services which may be performed include:

a. Battery charging.
b. Cable and insulation testing.
c. Electrolytic processing.
d. Supply to radio, radar and ventilation equipment.
e. Converting a.c. supplies to operate d.c. motors.

2. *Electronic Motor and Generator Control.*

Industry depends on its electric motors. It has spent millions on manual and mechanical methods of speed and voltage control. These methods have necessitated relatively wide tolerances until electronic controls made their appearance. Some application of electronic control has been achieved in the d.c. field. In this field the following advantages are already obtainable.

a. Electronically controlled d.c. motors have the following operational characteristics:

1. Control of a broad speed range from a few r.p.m. to the maximum limit of the motor.
2. Maintaining of pre-set motor speed (automatic speed control).
3. Complete remote control, including starting of the motor by means of a pushbutton and rheostat.
4. Electronic voltage regulation for generators is smooth in operation and requires little maintenance, since moving parts such as bearings and dashpots are not employed. A lower percentage of voltage regulation can be realized by the use of electronic circuits as against the best operating electro-mechanical device.

3. *Electronic Welding Controls*

Maintaining proper and constant welding heats depends on precise control of welding currents. Manual controls at their very best do not compensate properly for the current peaks and valleys occurring in the average power supply. Experience demonstrates conclusively that properly installed "ignitrons" (the name given to the electronic tubes which control welding currents) effectively compensate for those slight current rises and dips which occur normally in present power supplies but which cause important welding difficulties. The old method of controlling welding current by the adjustment of transformer taps requires bulky switches and other cumbersome equipment. In many installations special electricians are assigned to the welding power supplies. This procedure is helpful but even the watchfulness of these men cannot guarantee a steady welding current level such as is obtainable by properly installed and adjusted electronic circuits. These circuits, embodying tubes which are capable of delivering up to 2000 kw., accurately control the quantity and duration of the welding current, besides offering the advantages of long life, quiet operation and low cost maintenance.

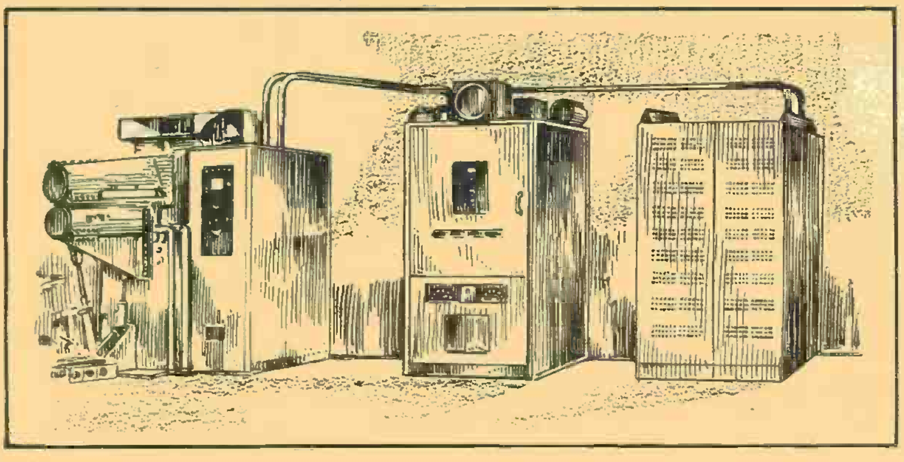
4. *Electronic Sound*

Electronic intercommunication, loud-hailing, and entertainment systems are here to stay. During the war, people became accustomed to these sound systems and they will be regarded as necessary on board new and converted vessels.

Installation of shipyard public address systems has been used to keep the workers happy with appropriate musical programs, for paging purposes and as an integral part of the fire alarm system.

Wireless intercommunication systems where the power line carries the

Artist's sketch shows the massive size of some of the electronic welding equipment that is finding its place in the shipbuilding industry.



voice currents are already in demand. Using this type of intercommunication system, it is only necessary to plug the intercommunicating units into the power line and select the station of operation.

5. *Electronic Inspectors*

Electronic inspection has come into prominence since the war as there was a need for speedy robot inspection devices. Electronic inspectors in the form of phototubes have been used to check the uniformity of metal stock prior to feeding it to a machine, the defects within metal welds, and many other applications where reflected, refracted or directed light beams could detect flaws in material.

Electronic inspectors in the form of a microphone and electronic amplifier have been employed in inspecting the soundness of forgings and castings. The forging or casting is struck with a metal hammer and the resulting vibration is picked up by the microphone and "inspected" by the amplifier for its integrity of sound. A defective piece has different tone characteristics which the amplifier easily recognizes but which will completely escape the human ear.

6. *Induction Heating*

Induction heating is the process by which a part is heated by the action of a magnetic or electric field. Magnetic materials such as iron can be heated by the action of high frequency magnetic fields. By using these fields for heating, it is possible to surface harden gear teeth, tools and crankshafts, etc., anneal material to relieve stresses and accomplish almost all other types of heat treatment without bulky, inefficient equipment.

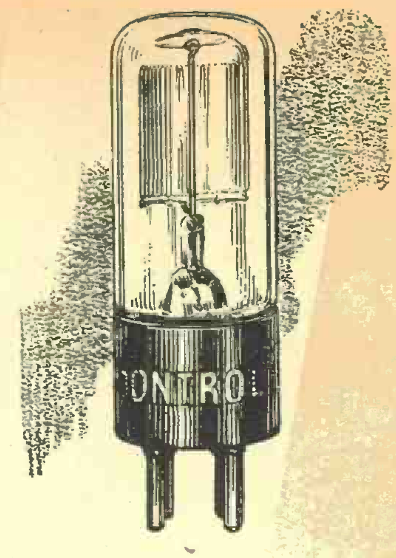
Insulating material such as plastics and wood can be bonded or dried by electric fields. These materials are heated in the same manner as human arms or legs by a diathermy treatment. Induction heating can be accomplished with small size equipment as it applies heat only in the necessary area. High frequency treatment has been used to speed chemical reactions, solidify melts of tin and aluminum and to sterilize foods.

7. *Electronic Water Depth Detector*

An electronic sea water depth detector has been developed which indicates the depth of sea water seeping into closed compartments. A cadmium electrode is located near the bottom of the closed compartment and a series of silver contacts are spotted at different heights. The currents between the two dissimilar metals pass through the water and unbalance an electronic circuit which then actuates a recording instrument.

8. *Electronic Phototube Controllers*

Electronic phototube controllers represent the latest contribution of the electric eye to plant operation. These controllers may be used as safety equipment for furnaces, burglar-protection, smoke or fire indicators, on shearing machines and punch presses and for elevator doors. They can be used industrially for automatic weighing, liquid-level controls and



Artist's conception of some of the electronic tubes used in industry as viewed through the eyes of the layman. Their sizes and shapes are varied as are their usages. They include such types as phototubes, thyratrons, grid glow, stroboglow, x-ray, to mention a few.

limit switches. The cost of the basic equipment is less than $100.

9. *Supervisory Protector Tube*

Supervisory protector tubes may be installed in lieu of costly and cumbersome relay systems as electrical circuit protectors. The inexpensive supervisory protector tube is constructed with three graphite electrodes enclosed in a gaseous atmosphere. Two of the electrodes are connected to the circuit under protection and the third is grounded. Sudden damaging voltage increases cause the grounded electrode to become conductive and it drains off the excess current to ground.

The initial cost of installing a supervisory protector tube circuit is much less than that of an intricate relay control system which requires continual maintenance.

10. *Other Electronic Tubes*

a. The current regulator tube is another controller which may be inserted in a power line as a regulator to compensate for power load fluctuations.

b. Thyratron tubes which are highly sensitive and efficient, can fill the bill for precision temperature control, automatic motor control and as a time delay switch.

c. Grid-glow tubes may be used for thermostatic safety control. This tube acts as an automatic controller for oil burners where it is operated by the conductivity of the furnace flame.

d. Stroboglow tubes which "stop visually" rotating equipment so that it may be examined for vibration, sparking and electrical contact.

e. X-ray tubes which allow structural examination of welds, rubber, soil, fibers and a multitude of other metallurgical, textile and electrical components, are now fully developed for practical use.

(*Continued on page* 166)

Front view of the basic amplifier unit.

The MULTIAMP

By
CLARK E. JACKSON

An amplifier of postwar design which provides new flexibility in matching and in a choice of output powers.

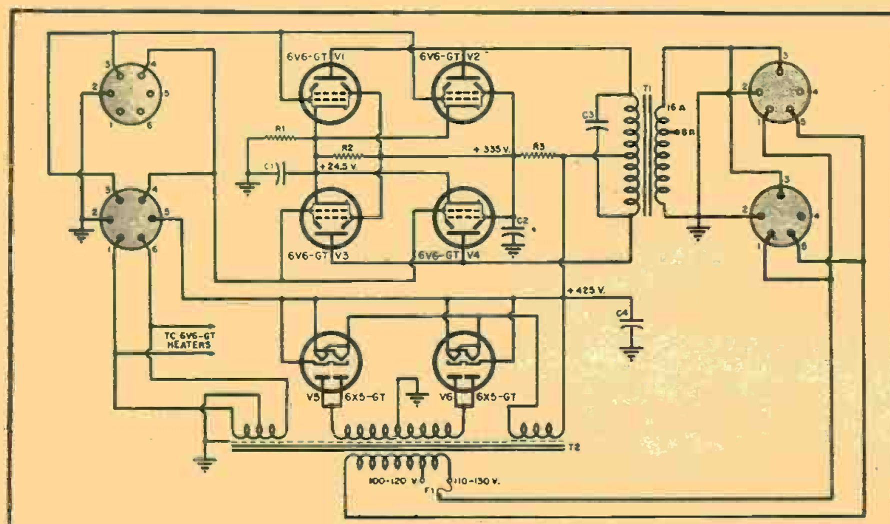
SOMETHING new *has* been added—in the design of the amplifier to be described in this article. The "additions" are in the form of add-a-unit booster units which permit a flexibility of output power as conditions demand.

These "additions" however, are not the only features to be found. During the war a Chicago engineer developed a new techinque for using the 6V6 at higher ratings than appeared in any of the tube manuals. He found means of obtaining greater output at comparatively low voltages by increasing the power gain by applying higher screen and plate voltages to the tube and controlling the plate current of the tube by the addition of a simple network.

So successful were the results that parts costs tumbled and performance took on new significance. High power at low distortion became a reality.

The heart of the new amplifier is the basic mixer and preamplifier to which may be added one, two or three booster amplifiers in order to increase the power output—up to 90 watts for large installations. Without these boosters the amplifier is, in itself, a complete 30 watt high fidelity unit capable of performance over the entire usable audio range.

Circuit diagram and parts list of 30-watt booster amplifier.



R_1—171 ohm, 5 w. res.
R_2—50,000 ohm, 2 w. res.
R_3—7500 ohm, 10 w. res.
C_1—20 μfd., 50 v. elec. cond.
C_2—10 μfd., 450 v. elec. cond.
C_3—.002 μfd., 1500 v. cond.
C_4—40 μfd., 450 v. elec. cond.
T_1—Push-pull output trans.
T_2—Power trans.
V_1, V_2, V_3, V_4—6V6GT tube
V_5, V_6—6X5GT tube

The output of the amplifier is 30 watts normal (60 watts peak). The total harmonic distortion is less than 2% while the hum and noise level on the mike channels is 60 db. below 30 w.

One of the newer features to be found in the unit is an output autoformer provided with six taps which makes possible the selection of fifteen impedance values. These have been selected so that proper matching to almost any combination of voice coils or lines is had at will.

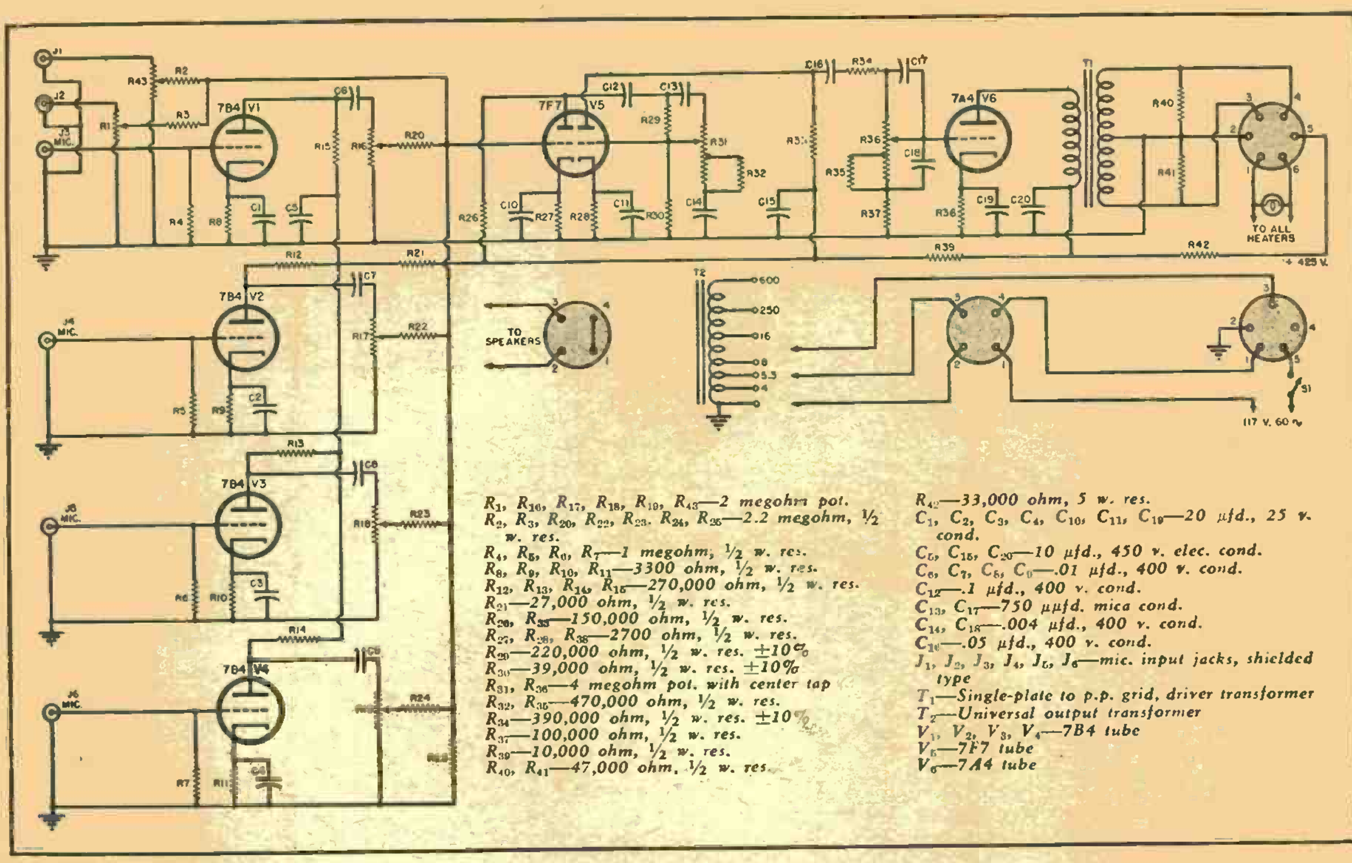
Input channels include two high gain microphone and two phono or program channels. The gain for the former is approximately 125 db. at 1000 cycles with 100,000 ohm input and with the tone controls set at normal. The phono channels provide an over-all gain of approximately 85 db. under the same conditions. Full equalization is afforded by means of bass and treble equalizers.

Reference to Fig. 1 shows how additional mike inputs may be connected in order to handle complicated setups such as large orchestras, etc.

The use of pentodes with their inherent noise has been avoided in the design of the mike channels. Instead, 7B4 triodes are employed. These provide sufficient gain and, best of all, introduce little, if any, distortion.

A 7F7 duo-triode serves as an amplifier and as one part of the equalizer. Smooth, properly tapered control in this and the following 7A4 stage has been made possible by the use of high grade noiseless potentiometers in conjunction with properly designed resistive-capacitive networks.

The output transformer of the preamplifier section connects to a six prong female connector which is mounted on the back of the chassis, where it lines up exactly with the



R_1, R_{16}, R_{17}, R_{18}, R_{19}, R_{43}—2 megohm pot.
R_2, R_3, R_{20}, R_{22}, R_{23}, R_{24}, R_{25}—2.2 megohm, ½ w. res.
R_4, R_5, R_6, R_7—1 megohm, ½ w. res.
R_8, R_9, R_{10}, R_{11}—3300 ohm, ½ w. res.
R_{12}, R_{13}, R_{14}, R_{15}—270,000 ohm, ½ w. res.
R_{21}—27,000 ohm, ½ w. res.
R_{26}, R_{33}—150,000 ohm, ½ w. res.
R_{27}, R_{28}, R_{38}—2700 ohm, ½ w. res.
R_{29}—220,000 ohm, ½ w. res. ±10%
R_{30}—39,000 ohm, ½ w. res. ±10%
R_{31}, R_{36}—4 megohm pot. with center tap
R_{32}, R_{35}—470,000 ohm, ½ w. res.
R_{34}—390,000 ohm, ½ w. res. ±10%
R_{37}—100,000 ohm, ½ w. res.
R_{39}—10,000 ohm, ½ w. res.
R_{40}, R_{41}—47,000 ohm, ½ w. res.
R_{42}—33,000 ohm, 5 w. res.
C_1, C_2, C_3, C_4, C_{10}, C_{11}, C_{19}—20 μfd., 25 v. cond.
C_5, C_{15}, C_{20}—10 μfd., 450 v. elec. cond.
C_6, C_7, C_8, C_9—.01 μfd., 400 v. cond.
C_{12}—.1 μfd., 400 v. cond.
C_{13}, C_{17}—750 μμfd. mica cond.
C_{14}, C_{18}—.004 μfd., 400 v. cond.
C_{16}—.05 μfd., 400 v. cond.
J_1, J_2, J_3, J_4, J_5, J_6—mic. input jacks, shielded type
T_1—Single-plate to p.p. grid, driver transformer
T_2—Universal output transformer
V_1, V_2, V_3, V_4—7B4 tube
V_5—7F7 tube
V_6—7A4 tube

Fig. 1. Schematic diagram of basic pre-amp unit with six inputs, tone control circuit, and driver stage.

corresponding input plug of a booster stage which slides quickly and easily from the rear, without the use of special tools, whenever more power is needed. If additional channels are needed to further raise the power, they may be quickly added.

A five prong connector, also on the back of the chassis but at the opposite end, connects to the autoformer and returns the audio power from the booster stage. Additional pins on the connector are used to provide a safety link for the 60-cycle line supply.

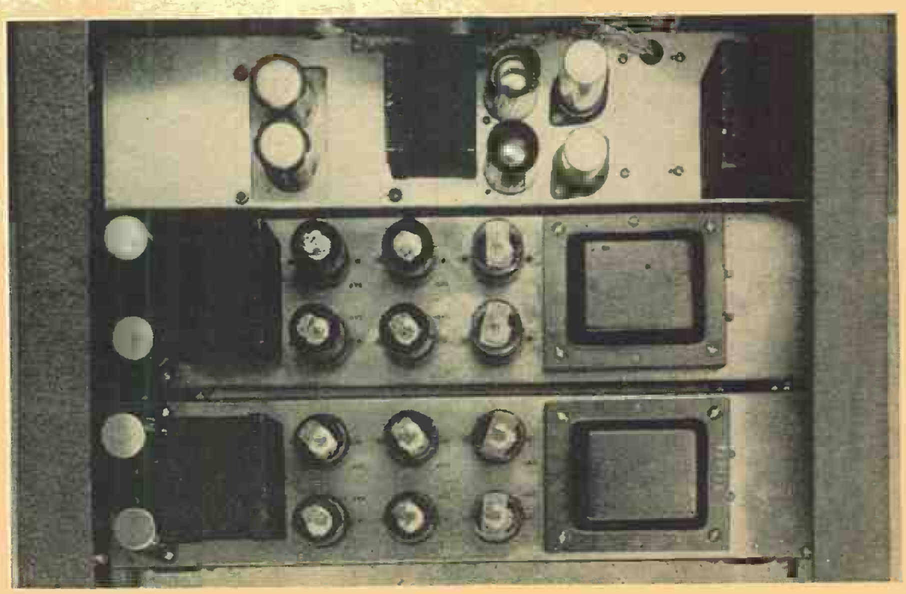
In all cases lines or speakers terminate in a four-plug connector located at the rear of the basic pre-amplifier. The amplifier may not be turned on unless the plug for this connector is inserted.

The 30 watt booster amplifier illustrated employs four 6V6 tubes in push-pull parallel. Plate power is provided by two 6X5s in parallel. This affords compact assembly while furnishing adequate power without producing distortion. Note that the output transformer has a low impedance secondary. If, accordingly, two of these boosters were used, the 16 ohm output could connect back to the 8 ohm tap of the autoformer T_2 for proper matching.

The writer has found another very worthwhile application when employing two of the 30 watt booster units. The output of one channel, instead of feeding to the autoformer, goes directly to a monitor speaker during

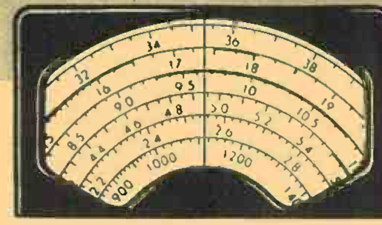
(*Continued on page* 155)

(Left) Neon volume indicator. (Right) 30 watt booster unit for amplifier.



Top view of pre-amp with two 30 watt channels in place. →

International SHORT-WAVE



***Compiled by* KENNETH R. BOORD**

IT IS with pleasure, that we dedicate this issue of ISW to our neighbor in the North Atlantic, Iceland, for the citizens of few nations of the world are more dependent on a broadcast service than the Icelanders. The country is large and the settlements are scattered around the coast and are cut off from one another by mountains, which often are impassable. Since there are no railroads in Iceland, winter communications are rare and difficult. With the introduction of broadcasting in 1930, every remote valley has thus been brought into the high tide of civilization.

A large proportion of the Icelandic nation depends upon the sea for a livlihood through merchant shipping and fishing. Radio has been instrumental in keeping them in closer touch with land than would otherwise be possible, both through the regular programs and through the broadcasting of general and personal messages to seafaring people. In peacetime, the broadcasting of weather reports in three languages, and notices of missing ships and boats, have proved to be most effective in safeguarding the lives of fishermen and merchant seamen of many nationalities on the sea around the coast of Iceland. Hence, the broadcast service is of the utmost importance to the Icelandic nation, to its industries, educational and cultural life. It is the quickest and most efficient means of communication, which has bridged great distances, has increased the knowledge and education of the most isolated inhabitants, and has promoted cultural progress.

"The broadcast corporations are probably nowhere as linked to the State as here in Iceland," says *Rikisutvarpid* (Iceland State Broadcast Service), "and for that reason our Broadcast Corporation has certain features unsimilar to the corporations of our neighboring countries. These features are (a) sales-monopoly on radio receivers; (b) repair department; (c) independent news service; and (d) advertisement department."

The Iceland State Broadcast Service was established in 1930. Offices and studios are in Reykjavik, the capital city. It is conducted entirely by the State as an independent establishment, under the control of the Ministry of Education. It is directed by a General Director (Jonas Thorbergsson), and programs are supervised by a Program Council, consisting of five members chosen by the *Althing* (The Icelandic Legislative Assembly), promptly after each general election. The Minister of Education appoints one member as the Chairman.

A long-wave transmitter of 100 kw. aerial power is operated at 9 kilometers' distance from Reykjavik. The aerial is supported by two 500-ft. insulated steel masts. A special cable connects it to the studios in Reykjavik. The assigned frequency is 208 kcs. (1442 m.), but during the war other frequencies were used also.

A medium-wave relay transmitter is located at Eidar, in the eastern part of Iceland. Its aerial power is 1 kw. A high-quality receiver, with a unidirectional aerial, picks up the programs from the long-wave transmitter at Reykjavik and directs them through to the relay transmitter 600 meters away.

Special programs are broadcast through TFJ, the 7 kw. short-wave transmitter at Reykjavik, which belongs to the State Post and Telegraph Administration. This station has directional aerials towards New York, London, and Copenhagen. The present frequency is 12.235 (24.52 m.), and the schedule now is *only* on Sundays between 9-9:30 a.m. EST.* There is a signal tune, newscasts in Icelandic, and the National Anthem. But Thorst. Egilson, Secretary of the Iceland State Broadcast Service informs me that "it is contemplated to take up newscasts in a Scandinavian language and *possibly in English also.*"

This short-wave station in the faraway North Atlantic sends out an attractive, illustrated verie card, signed by the Director General, *Rikisutvarpid,* "against a correct report and an International Reply Coupon," and it has an interesting booklet and a late supplement thereto (*all in English*), called *"Broadcast in Iceland."*

The story of radio in Iceland is intriguing. When the Broadcast Service was established in 1930, there were practically no radio receivers in the country, but on July 1, 1943, there were about 24,400 registered radio-owners, or roughly 1 set to every 5 of

This is the SW listening post of Lt. Col. Ned T. Norris, 3513 S. Stafford Street, Arlington, Virginia. Col. Norris has been experimenting with inside antennas, using a switching arrangement for changing doublet to a center fed flat top. An accurate reporter for ISW, Col. Norris is bringing in real DX on his modified Howard 435A receiver shown in the picture.

*Unless otherwise indicated, all time herein is in *Eastern Standard Time,* 5 hours *behind* GMT.

the population. While in 1930, there were only 450 radio-owners in Iceland, now they number about 28,000, or 22 per-cent of the population. Foreign-made receiving sets have not been available during the past few years, but when importation of these receivers again is made possible, it is estimated that the number of radio-owners will quickly reach 30,000.

The annual license fee for each radio set was 30 kronur until January 1, 1943, when it was raised to 50 kronur, due to the general increase in costs. Considerable revenues are also derived from broadcasting of spot-ads and announcements. In fact, broadcast advertisements enjoy ever-increasing popularity and now take a considerable part of the broadcast time. The charge is kr. 1.00 per word and the revenues of the Advertisement Department were in 1944 about one-third of the total revenues of the Broadcast Corporation.

The laws pertaining to the Iceland State Broadcast Service prescribe that all its revenues, including revenues from other activities under its supervision—such as the Radio Sales Monopoly, Radio Building and Repair Department, and so on—shall only be used to promote the broadcast activity for the common good of the nation. Considerable amounts are spent annually on radio repair and educational ours through the country, and on ducational courses, which are aranged for those who wish to study radio techniques for the purpose of repairing radio sets and for advising the public in their proper use. Funds have also been allotted annually to promote the erection of small electrical units for the purpose of charging radio batteries, mainly in the farming and rural areas. Windpower-stations are now very common in these districts, and by applying vibrators, the radio-owners no longer have need for dry batteries.

The Broadcast Service has always been hampered by insufficient housing conditions and the various activities have been scattered about the city of Reykjavik. It has now been decided to build a new Broadcast House, and building operations are scheduled for this year. All costs will be borne by the Corporation and the radio-owners. Some funds are available, but the remainder will be secured by raising the annual license fee from the present kr. 60.00 to kr. 100.00.

Time on the air averages about 2400 broadcast hours annually. Programs are of a similar arrangement and character to the radio programs of the other Scandinavian countries. Special emphasis is put on an efficient and reliable news service. Four languages are being taught: Icelandic, Danish, *English*, and German. Esperanto was also taught for several years, but has been discontinued.

Rikisutvarpid reports there are more Icelandic broadcasts of a political nature—such as discussions from *Althing* and election disputes—than in

(*Continued on page* 122)

INSTANT ACTION

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The Model 80 Phonomotor has been the outstanding favorite of manufacturers and jobbers who want a power source that's smooth, quiet, and time-tested. This is the No. 1 motor for driving turntables and record changers!

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Modern design calls for "tailored power"

Alliance motors are rated as low as 1/400th h.p. on up to 1/20th h.p. They are small, compact and some weigh less than one pound. They furnish economical driving energy to meet the special demands of small loads. Some are uni-directional—others are reversible—some are for continuous duty—others for intermittent operation.

Alliance Powr-Pakt motors are mass produced, precision made and low in cost. They can help you get *instant action*—when you want it—and where you want it! Write today.

WHEN YOU DESIGN—KEEP alliance MOTORS IN MIND

ALLIANCE MANUFACTURING COMPANY • ALLIANCE, OHIO

FOUR ELEMENT 144 mc. ROTARY BEAM ANTENNAS

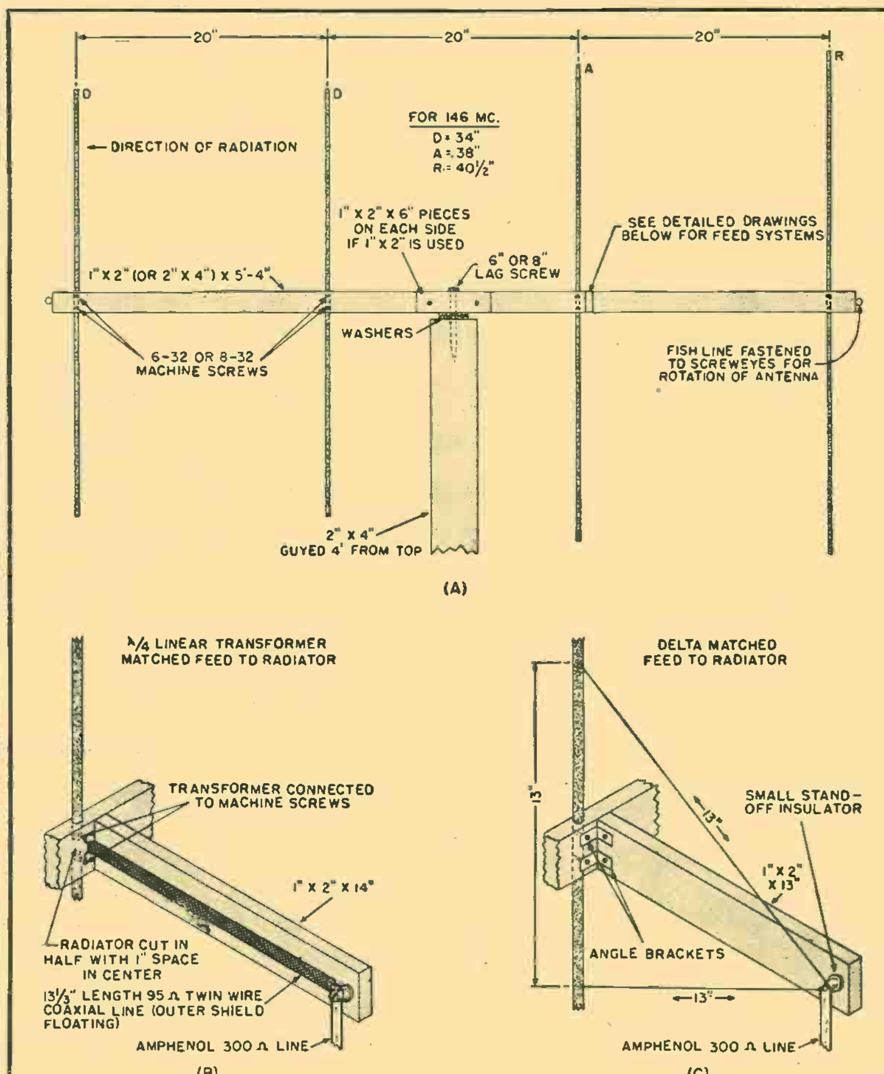
By H. S. BRIER, W9EGQ

Directive antennas of this type will give an effective transmitter power gain of 4 times.

WITH all the beam antennas that have been described, at first glance it hardly seems worth the effort to describe another. However the ones used by W9MVZ and W9EGQ show how simple they can be and still be effective radiators. No world's records have been established with them, but they do put out an S8-S9 signal up to 20 miles, and we often work over 40 miles. This with no more than 15 watts input, and heights of 25 and 35 feet, respectively.

Essentially, the antennas are four element, one-quarter wave spaced affairs, W9MVZ's being fed through a linear transformer, and W9EGQ's by a delta matching transformer. Theoretically, more gain could be obtained by using closer spacing between the elements, but results indicate that is all the improvement would be, theoretical. The great advantage of using the wide spacing is that the elements can be cut to calculated length, and the array will work well without laborious adjustments. Also the arrays are broad enough to more than

Fig. 1. Mechanical details for construction of 144-148 mc. rotary beam antennas.



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VOLT-OHM MILLIAMMETER plus CAPACITY REACTANCE INDUCTANCE and DECIBEL MEASUREMENTS

Added Feature:

The Model 670 includes a special GOOD-BAD scale for checking the quality of electrolytic condensers at a test potential of 150 Volts.

Specifications:

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5 Amperes

RESISTANCE: 0 to 500/100,000 ohms 0 to 10 Megohms
CAPACITY: .001 to .2 Mfd. .1 to 4 Mfd. (Quality test for electrolytics)
REACTANCE: 700 to 27,000 Ohms 13,000 Ohms to 3 Megohms
INDUCTANCE: 1.75 to 70 Henries 35 to 8,000 Henries
DECIBELS: —10 to +18 +10 to +38 +30 to +58

The Model 670 comes housed in a rugged, crackle-finished steel cabinet complete with test leads and operating instructions. Size 5½" x 7½" x 3".

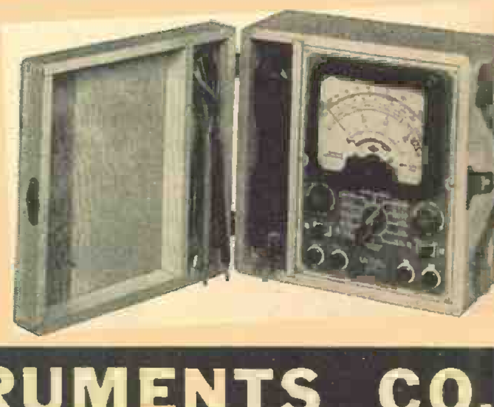
$28.40 NET

Model 670P

The Model 670P is identical to the Model 670 described in detail except housed in a hand-rubbed, portable oak cabinet complete with cover.

The Model 670P comes complete with test leads and all operating instructions.

$35.75 NET



Please place your order with your regular radio parts jobber. If your local jobber cannot supply you, kindly write for a list of jobbers in your State who do distribute our instruments or send your order directly to us.

SUPERIOR INSTRUMENTS CO.

Dept. RN 227 FULTON ST., NEW YORK 7, N.Y.

Reflector: 492/f
Antenna: 464/f
Director: 423/f
Spacing: 246/f
Length of matching transformer (Fig. 1B): $\frac{246\sqrt{D}}{f}$

Impedance of matching transformer: $\sqrt{Z_a \cdot Z_l}$

f is frequency in megacycles

D is dieletric constant of insulating material in twisted pair or coaxial cable. For polyethylene D is 2.29

Z_a is impedance of antenna

Z_l is impedance of feed line

Dimensions of delta matching transformer are found by experiment.

Formulas that can be used to calculate antenna dimensions for any given frequency.

cover the entire frequency band.

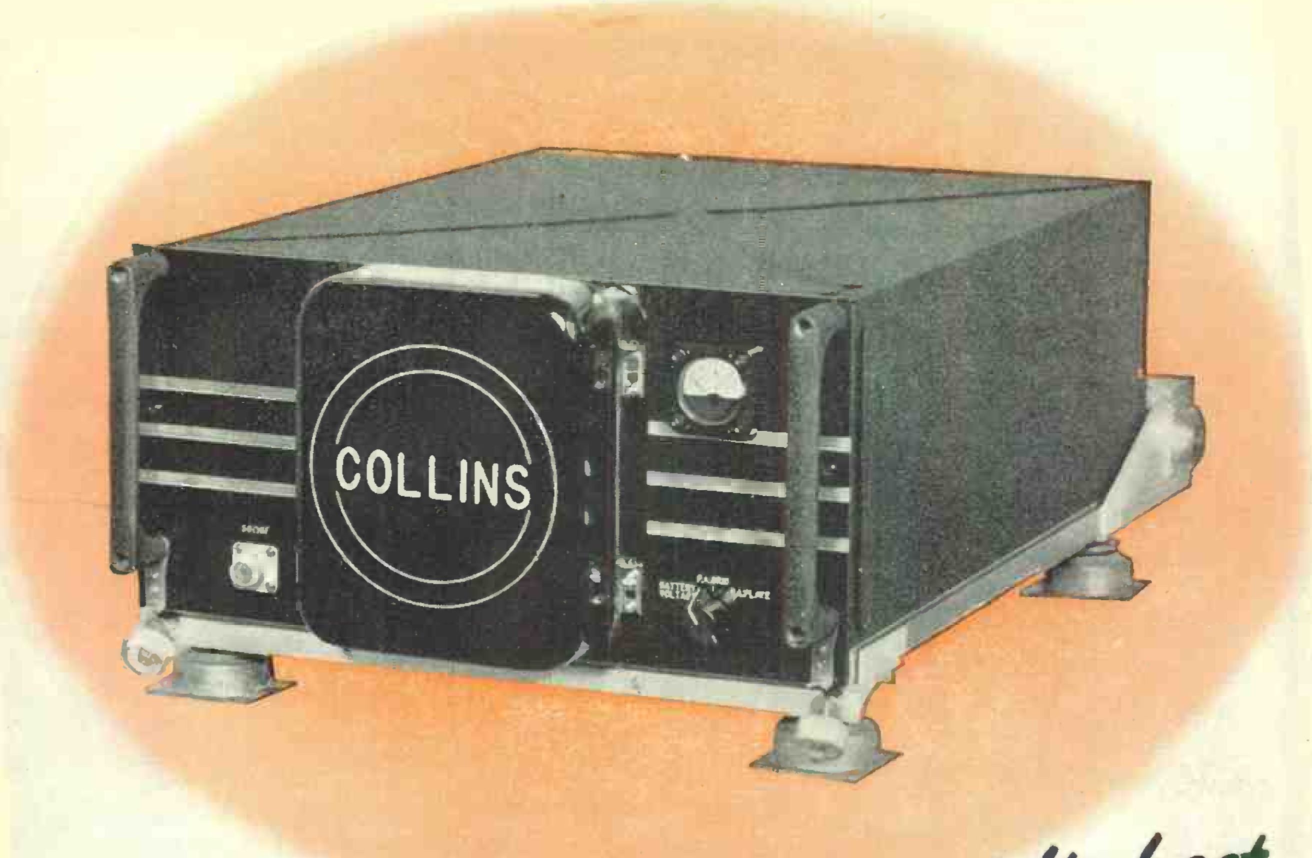
Gain is at least one "S" point (6 db.) over a half-wave dipole. Front-to-side and front-to-back ratio is more than five "S" points. Often signals that take out all the hiss in a super-regen receiver with the beam on them are unreadable when the beam is swung 90 degrees.

The dimensions shown in Fig. 1 are for 146 mc., and are satisfactory for operation throughout the entire 144-148 mc. band. The center impedance of the radiator was estimated to be approximately 30 ohms. The presence of some standing waves on the feed-line for the feed system shown in Fig. 1B indicate that this guess is not exactly right, but is fairly close. Not enough improvement was anticipated to warrant attempting to eliminate the standing waves completely.

While the feed-line should be as short as consistent with the height of the antenna, varying the length from 50 to 75 feet on W9EGQ's antenna made no difference in results. Because the lines are not absolutely "flat," changing their length does affect the receiver and transmitter loading. A slight adjustment of coupling compensates for this effect. As seems to be characteristic of most antennas fed with 300 ohm line, moisture reduces the efficiency of the antennas slightly.

Constructional details are so clearly shown in the sketches that detailed instructions are unnecessary. The elements go directly through the supporting 1" x 2" or 2" x 4", which is mounted on edge, and are prevented from slipping and flopping around by two machine screws through the support and element. Naturally, the beam built of three-eighths inch tubing and 1" x 2" is much lighter than the other, but the conduit is often easier to obtain in a hurry.

The center of all elements are points of zero r.f. voltage; so no losses are introduced by them not being insulated from the wood. There may be some loss at the center of the split radiator shown in Fig. 1B, but practical operation does not show it. —30—



Aircraft communication at its best

THE COLLINS 18S-1 transmitter-receiver is engineered for highest performance in aviation communications. It is specifically designed for commercial airlines and executive aircraft. Reflecting years of experience and proved dependability in the field of aircraft radio, the 18S-1 is new in every respect, and has performed superbly under flight tests.

Ten channels, with twenty crystal controlled frequencies are available for transmission between 2.5—10.0 mc. Power output from the transmitter is more than 100 watts. The receiver is controlled by a separate group of 20 crystals, and does not necessarily operate on the transmitting frequency. Quick, automatic frequency selection is provided, with all circuits tuned and ready to operate. Remote control encourages locating the unit with respect to proper weight distribution within the plane. The 18S-1 works into a 50 ohm transmission line.

A single 1½ ATR unit cabinet contains transmitter, receiver, and dynamotor power supply for the transmitter. The receiver operates directly from the 26.5 volt d-c source. The entire weight, including shock mount, is 60 lbs.

The first group of these equipments is scheduled for delivery to airlines in September of this year. Write today for further information.

THE 180K-1 antenna loading unit efficiently transfers the power output from the 18S-1 to any standard commercial fixed antenna. Remote controlled, pretuned operation for ten channels is provided. The nominal input impedance is 50 ohms. Weight, 10 lbs. Size, 7½" h, 10½" d, 12" l.

Collins Radio Company, Cedar Rapids, Iowa

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ARIZONA

Phoenix—Radio Parts of Arizona

CALIFORNIA

Bakersfield—Bakersfield Radio Supply
Fresno—Jack C. Arbuckle
Billings Wholesale Radio
Hollywood—Hollywood Radio Supply, Inc.
Long Beach—Radio & Tel. Equip. Co.
Los Angeles—Figart Radio Supply Co.
Kierulff & Co.
Nelson Brothers Co.
Radio Equip. Distributors
United Radio Supply Co.
Universal Radio Supply Co.
Modesto—Jack Warren
Oakland—W. D. Brill Company
E. C. Wenger Co.
Pasadena—Dow Radio Supply Co.
Sacramento—C. C. Brown Co.
Henderson Bros.
Sacramento Elec. Supply Co.
San Diego—Coast Electric Co.
Electronic Equip. Distr.
Shanks & Wright
San Francisco—Associated Radio Distrs.
C. C. Brown Co.
San Jose—Frank Quement
Santa Ana—Radio & Tel. Equip. Co.

COLORADO

Denver—Inter-State Radio & Supply Co.

CONNECTICUT

Bridgeport—Hatry & Young, Inc.
Hartford—Hatry & Young, Inc.
New Britain—United Radio Supply
Universal Radio Co.
New Haven—Thomas H. Brown Co.
Hatry & Young, Inc.
New London—Hatry & Young of New London, Inc.
Stamford—Hatry & Young, Inc.
Waterbury—Hatry & Young, Inc.

DELAWARE

Wilmington—Radio Elec. Serv. Co.

DISTRICT OF COLUMBIA

Washington—Kenyon Radio Supply Co.
Rucker Radio Wholesalers

FLORIDA

Jacksonville—Kinkade Radio Supply
Major Appliances
Miami—Electronic Supply Co.
Major Appliances
Orlando—Radio Accessories Co.
St. Petersburg—Welch Radio Supply
Sarasota—Morley Radio Co.
Tampa—Kinkade Radio Supply
Major Appliances

GEORGIA

Atlanta—Concord Radio Corp.
Southeastern Radio Parts Co.
Specialty Dstg. Co., Inc.
Macon—Specialty Dstg. Co., Inc.
Savannah—Southeastern Radio Parts Co.
Specialty Dstg. Co., Inc.

ILLINOIS

Bloomington—J. W. Arbuckle
Chicago—Allied Radio Corp.
Concord Radio Corp.
Grant Radio Co., Inc.
Nation Wide Radio
Radio Parts Company
Kankakee—Radio Doctors Supply House

INDIANA

Angola—Lakeland Radio Supply
Richmond—Fox Sound Equipment Co.

IOWA

Cedar Rapids—Gifford-Brown, Inc.
Council Bluffs—World Radio Labs., Inc.
Des Moines—Gifford-Brown, Inc.
Radio Trade Supply Corp.
Fort Dodge—Gifford-Brown, Inc.
Ken-Els Radio Supply
Mason City—Radio-Electric Supply Co.
Sioux City—Power City Radio Company
Sioux City Radio & Appl. Co.
Waterloo—Gifford-Brown, Inc.
World Radio Laboratories, Inc.

KANSAS

Pittsburg—Pittsburg Radio Supply
Topeka—Acme Radio Supply
Wichita—Radio Supply Co.

KENTUCKY

Lexington—Radio Equipment Co.
Louisville—Peerless Electronic Equip. Co.
Newport—Apex Distributing Co.

LOUISIANA

Lake Providence—F. H. Schneider & Sons, Inc.
New Orleans—Radio Parts, Inc.
Shreveport—Dunckelman-Pace
Koelemay Sales Co.

MAINE

Auburn—Radio Service & Supply Store
Portland—Frank M. Brown Co.

MARYLAND

Baltimore—Henry O. Berman Co., Inc.
Cumberland—Cumberland Radio Whol.
Salisbury—Dealers Radio Service

MASSACHUSETTS

Boston—De Mambro Dstrs., Inc.
Hatry & Young of Mass., Inc.
A. W. Mayer Co.
Radio Wire Television, Inc.
Sager Elec'l Supply Co.
Cambridge—The Eastern Co.
Holyoke—Springfield Radio Co.
Lawrence—Hatry & Young of Mass., Inc.
New Bedford—C. E. Beckman Co.
Pittsfield—Pittsfield Radio Co.
Roxbury—Gerber Radio Supply Co.
Springfield—T. F. Cushing Co.
Springfield Radio Co.
Worcester—De Mambro Dstrs., Inc.
The Eastern Co.
Radio Electronic Sales Co.
Radio Maintenance Supply Co.

MICHIGAN

Ann Arbor—Wedemeyer Elec. Supply Co.
Battle Creek—Wedemeyer Elec. Supply Co.
Detroit—Ferguson Radio Supplies
Radio Specialties Co.
Radio Supply & Eng. Co., Inc.
Flint—Radio Tube Mdsg. Co.
Grand Rapids—Wholesale Radio Co.
Jackson—Fulton Radio Supply
Kalamazoo—Ralph M. Ralston Co.
Muskegon—Industrial Elec. Supply Co.
Pontiac—Electronic Supply Co.
Saginaw—Radio Parts Company

MINNESOTA

Duluth—Northwest Radio
Minneapolis—Bauman Company
Sidney Rosenthal
St. Paul—Electronic Distributing Co.

MISSISSIPPI

Greenville—The Goyer Company
Meridian—Griffin Radio Supply

MISSOURI

Cape Girardeau—Suedekum Elec. Sup. Co.
Jefferson City—Central Mo. Dstg. Co.
Joplin—M. Brotherson
Mardick Dstg. Co.
Kansas City—Burstein-Applebee Co.
Manhattan Corp.
St. Joseph—St. Joseph Radio & Supply Co.
St. Louis—Walter Ashe Radio Co.
Interstate Supply Co.
Radonics
Springfield—Harry Reed Radio & Sup. Co.

MONTANA

Butte—George Steele & Co.
Kalispell—McIntosh Music House

NEBRASKA

Omaha—Omaha Appliance Co.
Radio Equipment Co.
Scottsbluff—Joachim Radio Supply

NEW HAMPSHIRE

Dover—American Radio Corp.

NEW JERSEY

Camden—Radio Elec. Serv. Co.
Newark—Continental Sales Co.
Krich-Radisco, Inc.
T. A. O'Loughlin & Co.
Radio Wire Tel., Inc.
Perth Amboy—Bennett's Radio Supply
Red Bank—J. H. Kelly Company
Trenton—United Tire Stores Co.

NEW YORK

Albany—Fort Orange Radio Dstg. Co.
Amsterdam—Adirondack Radio Supply
Auburn—Dare's Radio Service
Binghamton—Broome Dstg. Co., Inc.
Federal Radio Supply Co.
Brooklyn—Green Radio Distributors
Stan-Burn Radio & Elec. Co.
Buffalo—Bars Radio & Electronic Parts
Dymac, Inc.
Genesee Radio & Parts Co.
Radio Equipment Corp.
Standard Electronics Co.
Elmira—LeValley-McLeod-Kinkaid Co., Inc.
Fredonia—C. R. Barker
Glens Falls—Ray Distributing Co.
Hempstead, L. I.—Standard Parts Corp.
Ithaca—Stallman of Ithaca
Jamaica, L. I.—Norman Radio Distrs.
Middletown—L & S Radio Sales
New York City—Fischer Distributing Co.
Radionic Equipment Co.
Radio Wire Tel., Inc.
Niagara Falls—Niagara Radio & Parts Co.
Rochester—Beaucaire, Inc.
Masline Radio & Electronic Equip. Co.
Schenectady—Fort Orange Radio Dstg. Co.
M. Schwartz & Son
Syracuse—Broome Dstg. Co., Inc.
Syracuse Radio Supply
Troy—Trojan Radio Co.
Utica—Beacon Electronic Inc.
Watertown—Beacon Electronic Inc.

NORTH CAROLINA

Asheville—Freck Radio & Supply Co.
Charlotte—Dixie Radio Supply Co.
Southern Radio Corp.
Fayetteville—Eastern Radio Supply
Goldsboro—Signal Radio Supply
Greensboro—Dixie Radio Supply Co.
Raleigh—Carolina Radio Equip. Co.
Winston-Salem—C. R. Williams Radio Co.

NORTH DAKOTA

Fargo—Radio Equipment Co.

OHIO

Akron—Olson Radio Warehouse
Ashtabula—Morrison Radio Supply
Canton—Armstrong Radio Supply
Burroughs Radio
Cincinnati—Chambers Radio Supply Co.
Schuster Elec. Co.
United Radio, Inc.
Cleveland—Goldhamer, Inc.
Northern Ohio Laboratories
Winteradio, Inc.
Columbus—Hughes-Peters, Inc.
Whitehead Radio Co.
Dayton—Hughes-Peters, Inc.
Standard Radio & Electronic Prod. Co.
East Liverpool—Hausfeld Radio
Kent—Kladag Radio Labs.
Lima—The Northwestern Radio Co.
Mansfield—Burroughs Radio
Marion—Bell Radio Supply
Springfield—Standard Radio & Electronic Prod. Co.
Steubenville—D & R Radio Supply
Hausfeld Radio
Toledo—Toledo Radio Specialties
Warren—Radio Specialties
Youngstown—Appliance Wholesalers

OKLAHOMA

Enid—Standard Measuring & Equip. Co.
Oklahoma City—Radio Supply, Inc.
Southern Sales Co.
Tulsa—Radio, Inc.

OREGON

Portland—Bargelt Supply
Harper-Meggee, Inc.
Portland Radio Supply Co.

PENNSYLVANIA

Allentown—Radio Elec. Serv. Co.
Beaver Falls—Reliable Motor Parts Co.
Easton—Radio Elec. Serv. Co.
Erie—John V. Duncombe Co.
Harrisburg—Radio Distributing Co.
Lancaster—Eshelman Supply Co.
George D. Barbey Co.
Norristown—Kratz Bros. Co.
Philadelphia—Almo Radio Company
Consolidated Radio Corp.
Electric Warehouse
Emerson Radio of Pa.
Radio Elec. Serv. Co.
N. W. Cor. 7th & Arch Sts.
5133 Market St.
3145 N. Broad St.
Eugene G. Wile
Pittsburgh—Hamburg Bros.
The John Marshall Co.
Radio Parts Co.
Pottsville—Jones Radio Co.
Reading—George D. Barbey Co.
St. Marys—B & R Electric Co.
Scranton—Broome Dstg. Co., Inc.
Wilkes-Barre—General Radio & Elec. Co.
Radio Service Co.
Williamsport—Williamsport Radio Supply

RHODE ISLAND

Providence—William Dandreta & Co.
W. H. Edwards Co.

SOUTH CAROLINA

Columbia—Dixie Radio Supply Co.

SOUTH DAKOTA

Aberdeen—Danielson & Brost Co.
Sioux Falls—Power City Radio Co.
United Radio Supply

TENNESSEE

Knoxville—Bomar's
Chemcity Radio & Elec. Co.
C. M. McClung & Co.
Memphis—McTyier Radio Supply
Nashville—Currey's Radio Service
Radio & Appliance Corp.

TEXAS

Abilene—R & R Supply Co., Inc.
Amarillo—R & R Supply Co., Inc.
Austin—The Hargis Company
Beaumont—Montague Radio Co.
Corpus Christi—Wicks-DeVilbiss Co.
Electronic Equip. & Engin. Co.
Dallas—All-State Dstg. Co.
Crabtree's Wholesale Radio
Southwest Radio Supply
Wanslow & Co.
Fort Worth—Electronic Equipment Co.
Fort Worth Radio Supply Co.
Houston—A. R. Beyer Company
Lubbock—R & R Supply Co., Inc.
San Antonio—Olsen Radio Supply
Tyler—Lavender Radio Supply Co.
Waco—The Hargis Company
Wichita Falls—Wichita Falls Bat. & Elec.

VIRGINIA

Norfolk—Ashman Distr. Company
Roanoke—Leonard Elec. Sup. Co.
Richmond—Johnston Gasser Co.

WASHINGTON

Bellingham—Waitkus Supply Co.
Seattle—General Radio, Inc.
Harper-Meggee, Inc.
Sunset Electric Co.
Spokane—Harper-Meggee, Inc.
Tacoma—Wible Radio Supply

WEST VIRGINIA

Bluefield—Whitehead Radio Co.
Charleston—Chemcity Radio & Elec. Co.
Hicks Radio Supply
Clarksburg—Trenton Radio Co.
Huntington—Electronic Supply, Inc.
Morgantown—Trenton Radio Co.
Parkersburg—Randle & Hornbrook
Wheeling—Wheeling Radio Supply

WISCONSIN

Green Bay—Neslo Electronic Dstrs.
Madison—Radio Dstrs. of Madison, Wis.
Milwaukee—Radio Parts Co., Inc.

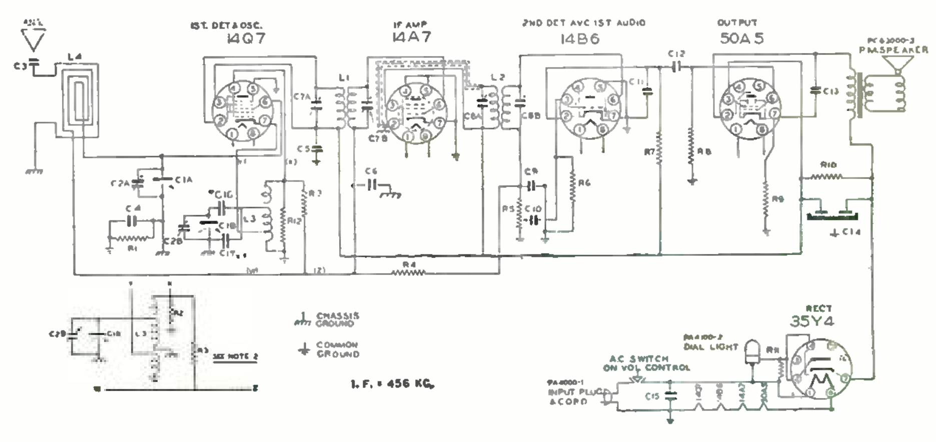
. . *KOOLOHM RESISTORS

*REG. U. S. PAT. OFF.

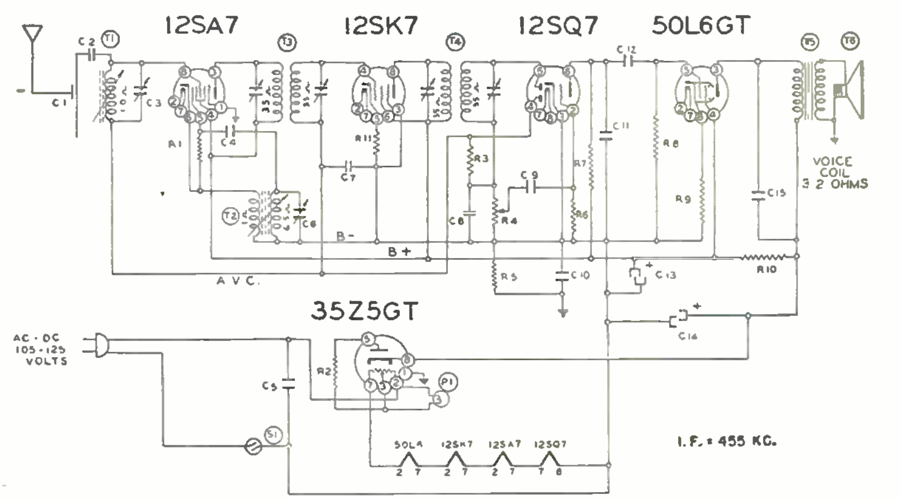
the RN CIRCUIT PAGE

(FOR PARTS LISTS SEE PAGE 76)

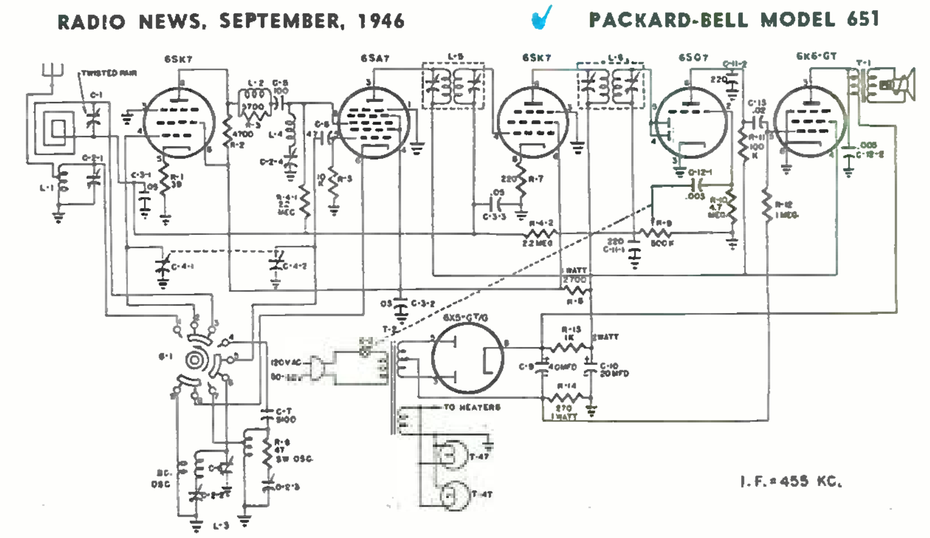
RADIO NEWS, SEPTEMBER, 1946 **SPARTON MODEL 5-06**



RADIO NEWS, SEPTEMBER, 1946 **TRUETONE MODEL D2610 or D2611**



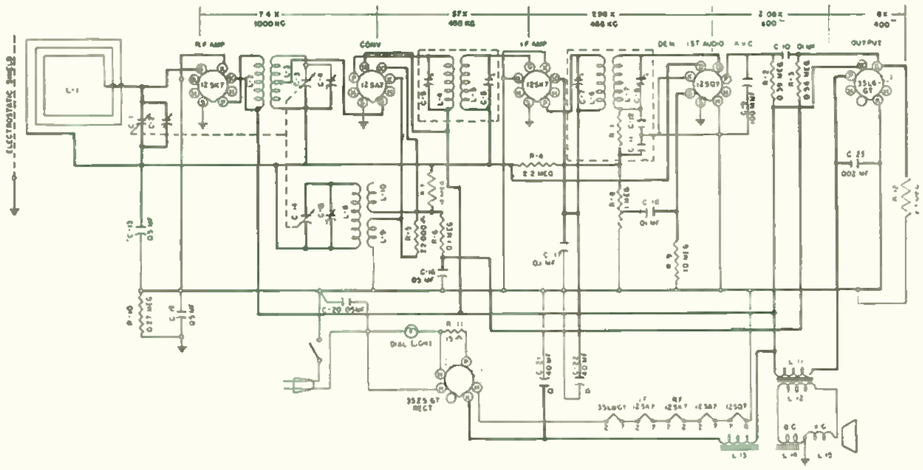
RADIO NEWS, SEPTEMBER, 1946 **PACKARD-BELL MODEL 651**



Here, and on following pages, are circuit diagrams and parts lists of many new postwar radio receivers. Radio News will bring to you other circuits as quickly as possible after we receive them from manufacturers.

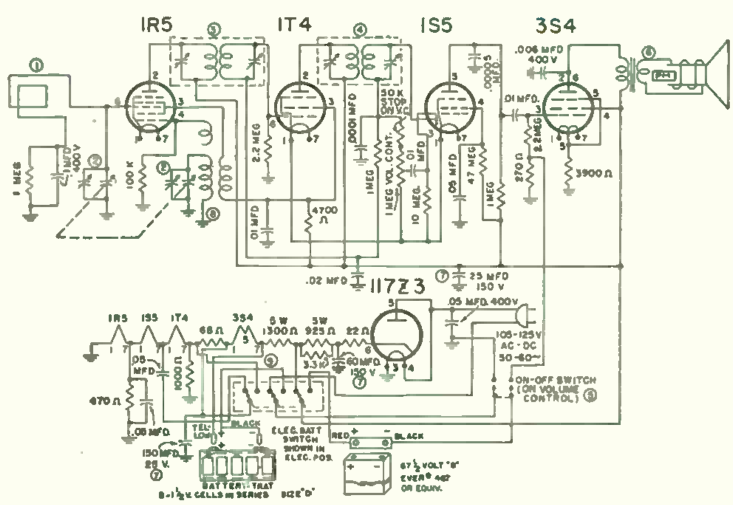
RADIO NEWS, SEPTEMBER, 1946

STROMBERG-CARLSON
MODEL 1101, SERIES 10-11



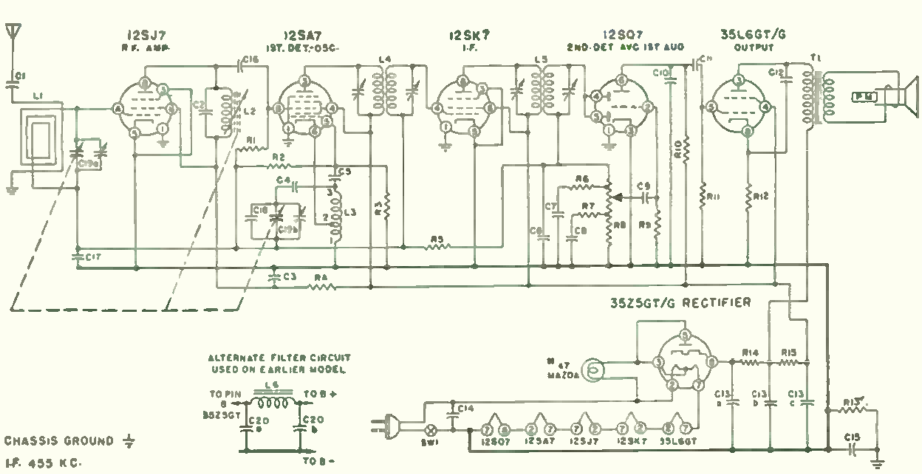
RADIO NEWS, SEPTEMBER, 1946

GAROD MODEL 5D



RADIO NEWS, SEPTEMBER, 1946

ADMIRAL MODEL 6A1



What's New in Radio

G. E. UNIMETER

A Type YMW-1 unimeter has been announced by the Specialty Division of *General Electric Company's* Electronic Department.

Rated at 20,000 ohms per volt, the

twelve-pound, multi-range measuring instrument will be useful for service and general laboratory work. Accurate measurement of volts, ohms, current and decibels, plus a single rotary selector switch which controls all functions and ranges, are features of this new instrument.

All operations of the YMW-1, with the exception of the 50 microampere current range reading and capacitor for output measurements, are available without changing the test leads to various jacks. A separate two-position switch handles a.c. or d.c. volts.

A specification sheet on the new multi-range unimeter is available upon request to *General Electric* Specialty Division, Wolf Street, Syracuse, New York.

MOTOROLA RECORD PLAYER

Galvin Mfg. Corporation has recently announced its new WR8 fiber-based wireless record player which plays through any radio.

In addition to the new pressed fiber which has been used as a base material for this record player, the unit includes the exclusive "Floating Action" which handles ten 10" or eight 12" records quietly and safely, the newly designed record release spindle

and the Tangent Tone Arm which was designed to reduce record scratch and wear.

Further information on the WR8 will be furnished by *Galvin Manufacturing Corporation,* 4545 Augusta Boulevard, Chicago 51, Illinois.

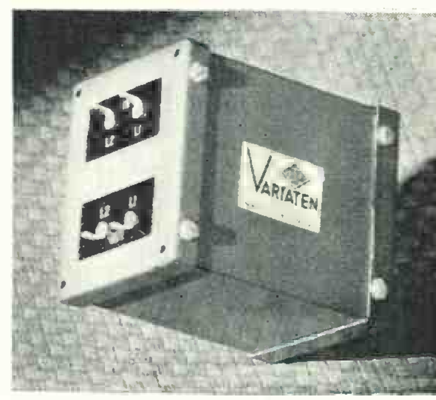
ORTHOCOUSTIC EQUALIZERS

Cinema Engineering Company of Burbank, California has announced the commercial manufacture of orthocoustic equalizers for use in broadcasting and recording studios.

Available for 500 and 600 ohm circuits, these new equalizers are especially built to deliver a fixed orthocoustic curve, equalizing for high frequency losses.

These devices meet all NAB standards. Resistors, capacitors and inductances are individually bridged and adjusted. Insertion loss is approximately 16 db. They are fitted with two input and two output terminals and shielded against pickup of extraneous inductances.

Known as the Type 4137, these



equalizers are 2¾ x 3¼ x 2½ inches over-all.

Additional information on these units may be secured by writing *Cinema Engineering Company,* 1510 W. Verdugo Avenue, Burbank, California.

"TABLE-TOP" RECEIVER

Electromatic Manufacturing Corporation of New York has introduced a new feature in the manufacture of table-top combination radio-phonographs. They are showing a new table model radio-phonograph which is equipped with separate legs.

Fastening with screws to the cabinet base, the four legs convert this table-top model into a modernistic chairside model. The legs raise the set 16¼" above the floor level. Made of hand-rubbed walnut, the removable legs match the cabinet of the receiver.

Dealers may merchandise this receiver with or without the legs and can attach legs before shipment, or the customer may attach or detach the legs, as needed, at home.

Further information on this unit and other models of the *Electromatic* line will be sent to those addressing their requests to Mr. Len Welling, Sales Manager, *Electromatic Manu-*

facturing Corporation, 88 University Place, New York 3, New York.

WIRED RECORD PLAYER

An automatic record player which may be used to convert any radio into a radio-phonograph combination, has been recently introduced by *National Acoustic Products* of Chicago.

This unit, known as the Model OR2

"Use-A-Tone," utilizes the radio audio system to provide full tone reproduction. The record player features a new gearless fast change, 3.8-second *Milwaukee Erwood* changer. The unit will handle ten 12" or twelve 10" records. The entire player is mounted on a leatherette covered base, 13⅛" x 13⅝" x 8¼".

Complete details and prices of this unit will be furnished upon request to *National Acoustic Products,* 120 N. Green Street, Chicago, Illinois.

ELECTRONIC COUNTER

The Model 101 Scaler, an electronic counter for greater accuracy and convenience in making nuclear measurements, has just been announced by *The Atomic Instrument Company,* Boston.

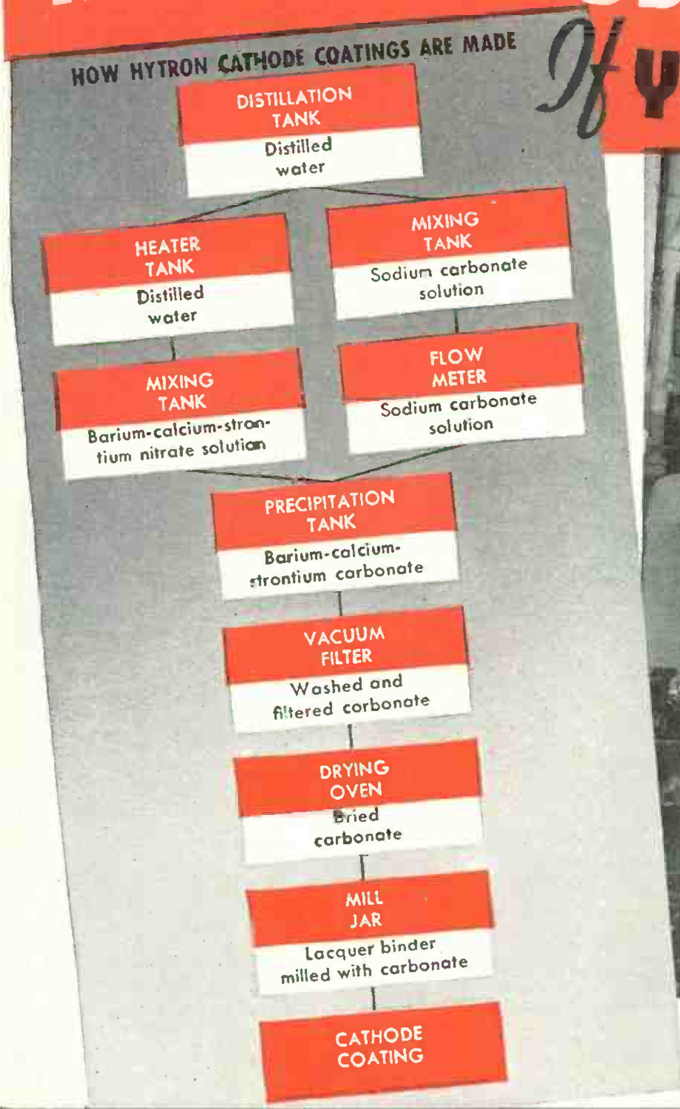
The unit features a precision pulse amplitude discriminator in the input circuit which allows only pulses greater than a predetermined amplitude to operate the scaler. By means of a direct reading dial, the discrimination level may be accurately set to within ±1% for pulses between −50 and +100 volts. The resolution of the scaler is such that pulses occurring as

close together as 5 microseconds will be individually recorded. A counting rate of 100,000 counts per minute at only 1½% loss is obtained with this unit. Scaling factors of either 8 or 64 are optional by means of a toggle switch.

An electronically regulated, high voltage power supply is incorporated in this unit for stability of calibration. The output circuit is adapted to the operation of various types of electromechanical impulse registers and

(*Continued on page* 84)

MAKING TUBES IS EASY... *If* YOU KNOW HOW!



First floor of Hytron chemical precipitation system. Note the flow meter, precipitation tanks, and ceramic vacuum filters. Spotless cleanliness is vital to avoid contamination of carbonates precipitated for cathode coatings.

AGAIN HYTRON KNOW-HOW WORKS FOR YOU . . .

THIS photograph and flow chart may look strange in an advertisement on radio tubes. Chemistry and metallurgy, however, are a vital part of Hytron engineering. The picture illustrates the first of three floors used by Hytron's chemical system which precipitates the carbonates for cathode coatings.

Prewar, Hytron purchased such carbonates—as did most other tube manufacturers. Wartime mass production demanded much better quality control than suppliers offered. By doing the job itself, Hytron gained extra know-how which serves you in peacetime.

For these carbonates, absolute control is required of formulation, crystal size and shape, density, purity, and viscosity. Most cathode coatings are prepared from carbonates compounded of barium, calcium, and strontium. The percentage of each of these elements affects the performance of different types of tubes. Crystal size and shape, density, freedom from impurities, all determine the degree of electronic emission. Variations in viscosity must be minimized to assure uniform application of coating on the cathode.

There is still much "black magic" in obtaining proper cathode emission. But Hytron makes easier the problems involved by accurate chemical and metallurgical controls. No research is too tough or too unrelated, if it leads to know-how which will give better performance of the Hytron tubes you buy.

OLDEST MANUFACTURER SPECIALIZING IN RADIO RECEIVING TUBES

HYTRON RADIO AND ELECTRONICS CORP.

MAIN OFFICE: SALEM, MASSACHUSETTS

Parts Lists

(FOR CIRCUIT DIAGRAMS APPEARING ON PAGES 70 AND 71)

STROMBERG-CARLSON—MODEL 1101, SERIES 10-11

Part No.	Code and Description
114302	R_1, L_6, L_7, C_7, C_8, C_{11}, C_{12}—Second i.f. trans.
26364	R_2—390,000 ohm res.
26366	R_3—560,000 ohm res.
26373	R_4—2.2 megohm res.
26349	R_5—22,000 ohm res.
26357	R_6—100,000 ohm res.
26381	R_7, R_8—10 megohm res.
145001	R_9—Vol control & sw.
26362	R_{10}—270,000 ohm res.
26311	R_{11}—15 ohm res.
28196	R_{12}—2.7 megohm res.
110001	C_1, C_2, C_3, C_4, C_{14}, C_{15}—Var. cond.
24559	C_9—100 μμfd. cond.
25485	C_{10}, C_{18}—.01 μfd. cond.
40632	C_{13}, C_{16}, C_{19}, C_{20}—.05 μfd. cond.
23483	C_{17}—.1 μfd. cond.
111001	C_{21}, C_{22}—Elec. cond.
27646	C_{23}—.002 μfd. cond.
139005	L_1—Loop assembly
114001	L_2, L_3—R. F. coil assembly
114002	L_4, L_5—Osc. coil assembly
114301	L_8, L_9, L_{10}, C_{14}, C_{15}—First i.f. trans.
155001	L_{11}, L_{12}, L_{13}, L_{14}, L_{15}—Speaker assembly

PACKARD-BELL—MODEL 651

Part No.	Code and Description
73008	R_1—39 ohm, ½ w. res.
73033	R_2—4700 ohm, ½ w. res.
29006	R_3, L_2—Peaking coil
73055	R_{4-1}, R_{4-2}—2.2 megohm, ½ w. res.
73037	R_5—10,000 ohm, ½ w. res.
73009	R_6—47 ohm, ½ w. res.
73041	R_7—22,000 ohm, ½ w. res.
73079	R_8—2700 ohm, 1 w. res.
25003A	R_9, S_2—500,000 ohm vol. control
73057	R_{10}—4.7 megohm, ½ w. res.
73047	R_{11}—100,000 ohm, ½ w. res.
73053	R_{12}—1 megohm, ½ w. res.
73126	R_{13}—1000 ohm, 2 w. res.
73074	R_{14}—270 ohm, 1 w. res.
23403A	C_{2-1}, C_{2-2}, C_{2-3}, C_{2-4}—3-50 μμfd. trimmer
23009	C_{3-1}, C_{3-2}, C_{3-3}—.05 μfd., 600 v. cond.
23504D	C_{4-1}, C_{4-2}—Two-gang var. cond.
23510	C_{4-1}, C_{4-2}—Two-gang var. cond. (alternate for 23504D)
23227	C_5—100 μμfd. mica cond.
23404A	C_6—300-850 μμfd. padder cond.
23230	C_7—5100 μμfd. mica cond.
23225	C_8—47 μμfd. mica cond.
24004B	C_9—40 μfd., 350 w. v., elec. cond.
24003	C_{10}—20 μfd., 350 w. v. elec. cond.
23206	C_{11-1}, C_{11-2}—220 μμfd., mica cond.
23004	C_{12-1}, C_{12-2}—.005 μfd., 600 v. cond.
23007	C_{13}—.02 μfd., 600 v. cond.
29402	L_1—Short-wave antenna coil
29204A	L_3—B. C. and S.W. osc. coil
29005	L_4—I.F. coil trap
29004D	L_5—First i.f. coil
29001D	L_6—Second i.f. coil
86002C	S_1—Band sw., wafer type
89401B	T_1—Output trans.
89001A	T_2—Power trans.

SPARTON—MODEL 5-06

Part No.	Code and Description
BR12N-154	R_1—150,000 ohm, ½ w. res.
BR12S-223	R_2—22,000 ohm, ½ w. res.
BR12S-156	R_3—15 megohm, ½ w. res.
BR12N-225	R_4—2.2 megohm, ½ w. res.
PA4400-2	R_5—.5 megohm vol. cont. & sw.
BR12S-565	R_6—5.6 megohm, ½ w. res.
BR12N-224	R_7—220,000 ohm, ½ w. res.
BR12N-474	R_8—470,000 ohm, ½ w. res.
BR12S-151	R_9—150 ohm, ½ w. res.
CR12S-122	R_{10}—1200 ohm, 1 w. res.
BR12S-820	R_{11}—82 ohm, ½ w. res.
BR12S-473	R_{12}—47,000 ohm, ½ w. res.
	C_{1a}, C_{1b}—Variable cond.
	C_{2a}, C_{2b}—Trimmers on variable
PC40GL-102	C_3—.001 μfd., 400 v. cond.
PC40GL-154	C_4—.15 μfd., 400 v. cond.
PC40GK-503	C_5, C_6—.05 μfd., 200 v. cond.
AB43500-1	C_{7a}, C_{7b}—First i.f. trimmers
AB43500-2	C_{8a}, C_{8b}—Second i.f. trimmers
MC60G-271	C_9—270 μμfd. mica cond.
PC40GL-103	C_{10}, C_{13}—.01 μfd., 400 v. cond.
MC60G-511	C_{11}—510 μμfd. mica cond.
PC40GL-202	C_{12}—.002 μfd., 400 v. cond.
PA4301	C_{14}—30/40 μfd. elec. cond.
PC40GL-503	C_{15}—.05 μfd., 400 v. cond.
PC40FK-503	C_{16}—.05 μfd., 200 v. cond.
PA4328-1	C_{17}—15 μμfd., cond.
AA6800-1	L_1—First i.f. coil assembly
AA6800-2	L_2—Second i.f. coil assembly
AB42200-1	L_3—B.C. osc. coil
	L_4—Loop assembly

ADMIRAL—CHASSIS 6A1

Part No.	Code and Description
	R_1—10,000 ohm, ½ w. res.
	R_2—10 megohm, ½ w. res.
	R_3—22,000 ohm, ½ w. res.
	R_4—100 ohm, ½ w. res.
	R_5—1 megohm, ½ w. res.
	R_6—47,000 ohm, ½ w. res.
	R_7—27,000 ohm, ½ w. res.
	R_8—500,000 ohm vol. control
	R_9—5 megohm, ½ w. res.
	R_{10}—270,000 ohm, ½ w. res.
	R_{11}—470,000 ohm, ½ w. res.
	R_{12}—150 ohm, ½ w. res.
	R_{13}—150,000 ohm, ½ w. res.
	R_{14}—150 ohm, ½ w. res.
	R_{15}—1000 ohm, 1 w. res.
	R_{16}—33 ohm, 1 w. res.
	C_1—.005 μfd., 600 v. cond.
	C_2—785 μμfd. mica cond.
	C_3—.05 μfd., 400 v. cond.
	C_4—.02 μfd., 400 v. cond.
	C_5—50 μμfd., mica cond.
	C_6—250 μμfd. mica cond.
	C_7, C_8, C_9, C_{11}—.01 μfd., 400 v. cond.
	C_{10}—500 μμfd. mica cond.
	C_{12}—.02 μfd., 400 v. cond.
	C_{13a}, C_{13b}, C_{13c}—30/30/20 μfd. elec. cond.
	C_{14}—.05 μfd., 400 v. cond.
	C_{15}—.2 μfd., 400 v. cond.
	C_{16}—250 μμfd. mica cond.
	C_{17}—.1 μfd., 200 v. cond.
	C_{18}—20 μμfd., mica cond.
	C_{19a}—420 μμfd., var. (max)
	C_{19b}—180 μμfd., var. (max)
	C_{20a}, C_{20b}—30/50 μfd., 150 v. elec. cond.
	L_1—Loop
	L_2—R.F. coil
	L_3—Osc. coil
	L_4—First i.f. trans.
	L_5—Second i.f. trans.
	L_6—325 ohm, filter choke

Note 1. In later production R_{14} and C_{13a} are disconnected from pin #8 of the 35Z5 and a 33 ohm, 1 w. res. (R_{16}) is connected from pin #8 to the junction of R_{14} and C_{13a}.

Note 2. The jumper between pins 4 and 5 on the 12SQ7 is removed and one pin is connected to the secondary of the second i.f. (L_5) and the other pin is connected directly to the junction point of R_5 and the secondary of the first i.f. (L_4).

GAROD—MODEL 5D

Part No.	Code and Description
1.405	1—Loop antenna
2.203	2—Two-gang var. cond.
1.412	3—First i.f. trans.
1.413	4—Second i.f. trans.
8.200-2	5—Vol. control & sw.
30.302	6—3½" PM speaker
5.400-3	7—60/25 μfd., 150 v. elec. cond.
1.414	8—Osc. coil
11.200	9—Elec-battery sw.

TRUETONE—MODELS D2610, D2611

Part No.	Code and Description
A-9B1-78	R_1—22,000 ohm, ½ w. res.
A-9B1-3	R_2—22 ohm, ½ w. res.
A-9B1-34	R_3—3.3 megohm, ½ w. res.
101230	R_4—500,000 ohm vol. control
A-9B1-88	R_5, R_7—150,000 ohm, ½ w. res.
A-9B1-35	R_6—4.7 megohm, ½ w. res.
A-9B1-28	R_8—330,000 ohm, ½ w. res.
A-9B1-52	R_9—150 ohm, ½ w. res.
A-9B2-64	R_{10}—1500 ohm, 1 w. res.
A-9B1-50	R_{11}—100 ohm, ½ w. res.
12912	C_2, C_8—.00025 μfd., mica cond.
124150	C_3, C_6—Ant. and osc. dual trimmer
12938	C_4—.00005 μfd., mica cond.
1001	C_5—.1 μfd., 400 v. cond.
1009	C_7—.05 μfd., 200 v. cond.
10025	C_9—.002 μfd., 600 v. cond.
10091	C_{10}—.15 μfd., 400 v. cond.
129160	C_{11}—.0004 μfd., mica cond.
10078	C_{12}—.01 μfd., 200 v. cond.
11992	C_{13}, C_{14}—20/40 μfd. 150 v. elec. cond. (25 cycles)
11993	C_{13}, C_{14}—60/60 μfd., 150 v. elec. con. (25 cycles)

10011	*C_{15}—.01 µfd., 400 v. cond.*
112827	*T_1, T_2—Tuning assembly*
108157J	*T_3—Input i.f. coil*
108157K	*T_4—Output i.f. coil*
105117	*T_5—Output trans. for speaker*
114213	*T_6—4" PM speaker (less output trans.)*

—30—

Two-Way Radio

(*Continued from page* 28)

models, based on the *Fonda-Freedman* developments, have been as low as $10 for a microwave transmitter or receiver. Where mass production is not possible, much of the difficulty in manufacture and cost is due to the problems of part dimension and placement in a unit, since small deviations in construction may represent dimensions equivalent to the actual wavelength. Generally speaking, microwave equipment will be cheaper and simpler than lower frequency equipment except where special high cost tubes are employed. Equipment which only needs to be precise and stable enough to operate within a band, such as the citizens' radiocommunication band rather than on a specific frequency, will be less costly due to the absence of special components that serve no other useful purpose except frequency control to a critical value. Most of the cost of microwave development has been met in World War II through governmental contracts and military production. Any additional costs henceforth can be distributed over a potential market of many millions of sets rather than the few thousand heretofore.

The *Bell Telephone* mobile radiotelephone services currently being established in most principal cities of the United States are the greatest single factor for the stimulation of two-way radio for the general public. This service is of two principal types at present. The highway mobile service operates in the 30 to 44 megacycle region where police, fire and forestry services have already operated for many years. The urban mobile service operates in the 156 to 162 megacycle region for local communication. At least for the present while the service is still experimental, the telephone company provides both the equipment and the service to the customer. Current practice calls for a deposit of $25 for the equipment installed in the customer's automobile. In addition the customer guarantees a minimum revenue of $15 per month. Local calls between car and office or home or vice-versa are expected to cost fifteen cents for a zone comparable with the area one ordinarily could reach for five cents in a pay station.

Another form of two-way radio development may follow the pattern already successfully demonstrated in the ship-to-shore field. The author proposes a multi-channel equipment with band switching wherein:

Band 1 is a toll channel with the *Bell System.*

Band 2 is the citizens' radiocommunication band involving no tolls.

Band 3 is a new emergency band which will be monitored by all law enforcement and first aid activities. Such a channel will be kept clear at all times for the sole purpose of receiving calls for assistance or special emergency information from motorists.

Band 1 will compare with the marine coastal radiotelephone stations used today for fishing boats, yachts, etc.

Band 2 will compare with the ship-to-ship bands of 2638 and 2738 kilocycles.

Band 3 will be comparable with 2670 kilocycle NCU band which the United States Coast Guard monitors to receive calls for assistance from boats in distress.

The employment and commercial opportunities which two-way radio now unfolds taxes the imagination. It is possible that a shortage of personnel will exist in this field. Prewar on the 30 to 40 megacycle band there was one job for every 20 units of equipment in connection with its development, construction, installation, maintenance and, in some cases, its operation. The author's personal experiences with some fifty systems which he established in New England as well as innumerable others with which he is familiar involved an even higher employment rate. Specifically, in Maine and on Cape Cod it takes one man per 25 to 30 units of equipment for normal maintenance, reinstallation and repair alone. Assuming that microwave equipment for the mass market and liberal FCC requirements will make over-the-counter purchases of equipment possible, it is estimated that there will be at least one job per 100 units. This means about a quarter of a million jobs developing between now and 1952 in this single phase of the radio-electronic field alone. It is expected that some but not all of the positions will be filled by personnel previously engaged in other tasks as in the case of the railroads. In such an event new employees will be required to fill the positions vacated at installations where radio supplements, but does not replace, existing facilities. —30—

WRAQ. Barnstable County Police Radio System headquarters serving police, fire, forestry, sheriff vehicles and township affiliates throughout the Cape Cod territory.

Technical BOOKS

"RADIO TUBE VADE MECUM 1945." Published by *P. H. Brans,* 28 Prince Leopold Street, Borgerhout, Antwerp, Belgium. $2.50 (including mailing charges).

This is the fifth edition of this comprehensive tube manual and the publishers advise that a sixth edition (the 1946 revised edition) will make its appearance this fall.

This tube manual will be of particular value to the many persons who own foreign-built radio equipment and wish to substitute American tube types in such equipment. The manual is printed in chart form with a supplementary equivalent chart in the appendix.

Complete instructions for using the manual are given in English, French, German, etc., and the following information is given about each tube type; definition of the tube (diode, triode, etc.), function of the tube, base, tube characteristics, etc. Upon compilation of this data, suitable substitutions with American-made tubes become a matter of a few minutes work with an American tube manual.

The publishers have advised that the sixth edition will be available at 98 Belgium francs, a slight reduction in price over the 1945 edition (108 Belgium francs). In writing for this book, be sure to specify which edition is desired.

* * *

"UNDERSTANDING MICROWAVES" by Victor J. Young. Published by *John F. Rider Publisher, Inc.,* New York. 380 pages. Price $6.00.

In the preface of this book, the author, who is the Senior Project Engineer for *Sperry Gyroscope Co.,* has stated his purpose in writing this text as that of disseminating the knowledge of microwave radio and radar to those "with a small knowledge of the conventional uses of electricity plus a willingness to think in terms of physical ideas and experiments." It is the opinion of this reviewer that Mr. Young was stretching the point a bit when he set the limits at a "small knowledge" of electricity. This advancing of his sights in no way detracts from the excellence of the presentation but it definitely removes the text from the catagory of "beginning books." True, the author has accomplished a seemingly impossible task in presenting the subject of microwave techniques without resorting to the use of complicated mathematics.

The book covers the ultra high frequency concept, stationary charge and its field, magnetostatics, alternating current and lumped constants, transmission lines, Poynting's vector and Maxwell's equations (the only chapter devoted to mathematical treatment of the subject), wave guides, resonant cavities, antennas, microwave oscillators and radar and communication.

With the increased interest in microwave equipment which is being manifest almost daily, this book should prove to be of value to the engineer, student, amateur and technician whose vocation or avocation makes the subject of importance.

* * *

"RADAR WHAT IT IS" by John F. Rider and G. C. Baxter Rowe. Published by *John F. Rider Publisher, Inc.,* New York. 72 pages. Price $1.00.

Although this little book is written for the lay audience it is technically accurate and factually correct.

The authors have turned in a good job in the presentation of a complicated subject in simple terms by the use of a great many analogies within the experience of their readers.

The first chapter, dealing with the underlying principles of radar, is well illustrated with cartoon type drawings which clarify such subjects as measuring distance by sound, direction, moving target, determining height by sound, the echo as a basic principle of radar, etc.

While the remaining chapters deal with such subjects as the basic radar set, antennas and indicators, how ground troops used radar, how radar is used at sea, how the Air Forces used radar, radar IFF and countermeasures and the future of radar, the authors have never lost sight of their objective—that of presenting an easily understood explanation of radar.

The book is recommended for anyone interested in the subject; layman, student, technician or engineer.

* * *

"RADIO THE FIFTH ESTATE" by Judith C. Waller. Published by *Houghton Mifflin Company,* Boston. 444 pages and appendix. Price $4.00.

The material included in this book was originally developed as instructional material for the Radio Institute, a joint venture of Northwestern University and the National Broadcasting Company.

From its humble beginning as mimeographed classroom notes, this information has been developed and expanded until it includes a broad outline of the broadcasting industry, its operation, and its obligations.

Miss Waller, who functions as Director of Public Service for NBC's Central Division, has been associated with the broadcasting industry since April of 1922. Drawing on her varied experience Miss Waller has compiled a book which serves both the student and the intelligent layman. Certain chapters of the book, dealing with specific functions of broadcasting, such as program production, sales, audience measurement, press and publicity, and engineering, have been written by the persons in NBC whose departments are involved. The author has integrated this material in the text in such a way that the entire story of the "Fifth Estate" becomes an absorbing success story.

This book is a "must" for persons who contemplate entering the broadcasting field, whether in the capacity of engineer, receptionist, program director, actor, announcer, etc. The background material thus acquired will be a decided asset in whatever phase of the broadcasting game the reader choses to enter.

* * *

"SOUL OF LODESTONE" by Alfred Still. Published by *Murray Hill Books, Inc.*, New York, 223 pages. Price $2.50.

In this companion volume to "Soul of Amber," the author has again presented a subject which is both instructive and entertaining. This time Mr. Still has outlined the background of magnetical science.

Careful and thoughtful research has gone into the preparation of this book, covering as it does the earliest references to lodestone and dealing with the popular conceptions and superstitions through the ages.

While the publication of this book cannot be considered a world shaking event, the gentle humor and the tolerance which characterizes the civilized man have their way with the reader and cannot fail to contribute to the sum total of his scientific knowledge.

Those who read the author's "Soul of Amber" will probably welcome the opportunity of reading another book by the same author, while those who missed that happy event have a new experience awaiting them in the reading of this book.

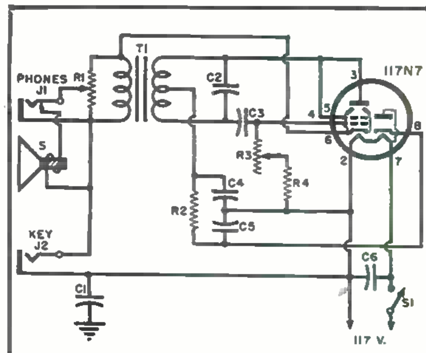
—30—

Code Oscillator

(*Continued from page 29*)

built into the unit. While the unit pictured does not provide for substitution of phones in place of the speaker, the diagram shows such a connection. Any type of phones will operate in the circuit, including crystal. For multiple operation, any number of keys may be connected in parallel for insertion in the key jack. The power output of the oscillator is about one watt, loud enough to drive any family out of the house.

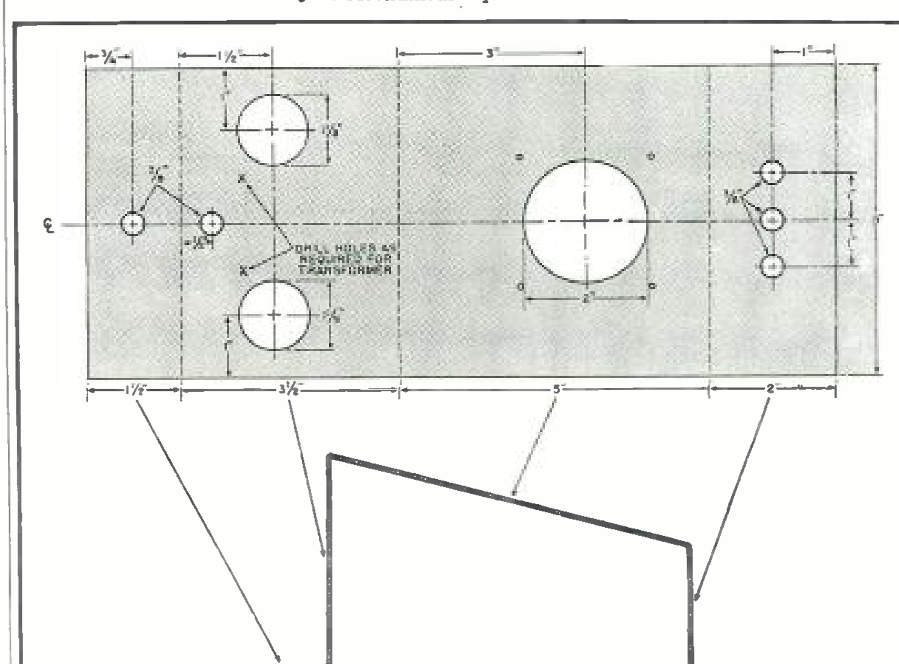
As illustrated in the photographs, the oscillator was housed in a walnut veneer wall cabinet of the type designed to accommodate a 5" speaker. By laying the case on its back and inserting rubber feet at the corners the consolette construction is obtained. In this cabinet the code practice oscillator is nice enough looking to be left around on the living room table with-



R_1—50 ohm wire-wound pot.
R_2—1500 ohm, 1 w. res.
R_3—500,000 ohm pot. with sw. S_1
R_4—20,000 ohm, 1/2 w. res.
C_1—.1 µfd., 400 v. cond.
C_2—.005 µfd., 200 v. cond.
C_3—.01 µfd., 200 v. cond.
C_4—30 µfd., 150 v. elec. cond.
C_5—50 µfd., 150 v. elec. cond.
C_6—.05 µfd., 400 v. cond.
S_1—S.p.s.t. sw. on R_3
T_1—Midget push-pull output trans.
S—2" PM speaker
J_1—Closed circuit phone jack
J_2—Open circuit phone jack
1—117N7GT tube

Fig. 3. Circuit diagram of the code practice oscillator constructed by the author and illustrated on page 29.

Fig. 4. Mechanical layout of chassis.



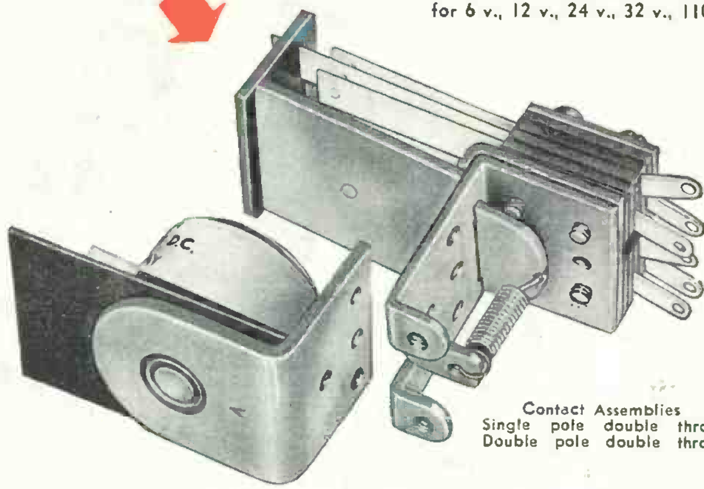
New! Series 200

A RELAY BY GUARDIAN with *Interchangeable Coils*

BUILT IN TWO PARTS

A.C. Coil Assemblies available for 6 v., 12 v., 24 v., 115 v.
D.C. Coil Assemblies available for 6 v., 12 v., 24 v., 32 v., 110 v.

★ Two basic parts—a coil assembly and a contact assembly—comprise this simple, yet versatile relay. The coil assembly consists of the coil and field piece. The contact assembly consists of switch blades, armature, return spring, and mounting bracket. The coil and contact assembly are easily aligned by two locator pins on the back end of the contact assembly which fit into two holes on the coil assembly. They are then rigidly held together with the two screws and lock washers. Assembly takes only a few seconds and requires no adjustment on factory built units.



Contact Assemblies
Single pole double throw
Double pole double throw

SERIES 200 RELAY

On Sale at Your Nearest Jobber NOW!

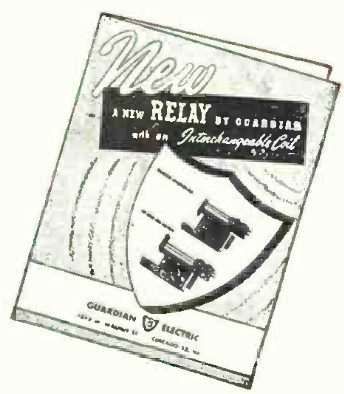
See it today! . . . this amazing new relay with interchangeable coils. See how you can operate it on any of nine different a-c or d-c voltages —simply by changing the coil. Ideal for experimenters, inventors, engineers.

TWO CONTACT ASSEMBLIES

The Series 200 is available with a single pole double throw, or a double pole double throw contact assembly. In addition, a set of Series 200 Contact Switch Parts, which you can buy separately, enables you to build dozens of other combinations. Instructions in each box.

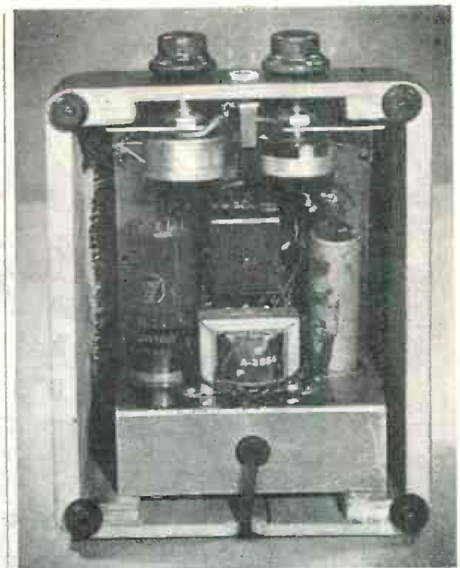
NINE COIL ASSEMBLIES

Four a-c coils and five d-c coils are available. Interchangeability of coils enables you to operate the Series 200 relay on one voltage or current and change it over to operate on another type simply by changing coils.



Your jobber has this sensational new relay on sale now. Ask him about it.
Or write for descriptive bulletin.

GUARDIAN ELECTRIC
1630-L W. WALNUT STREET CHICAGO 12, ILLINOIS
A COMPLETE LINE OF RELAYS SERVING AMERICAN INDUSTRY



Under-chassis view of code oscillator shown schematically in Fig. 3.

out incurring the wrath of the ladies of the house.

The chassis was bent from a single strip of aluminum as shown in Fig. 4. This provides a unit type construction requiring a minimum of assembly.

In wiring, it must be remembered that the negative return side of the power supply is one leg of the power line. For this reason a capacity C_1 has been inserted between the circuit "ground" and chassis.

An important feature of the circuit, which functions as a hum reducer, is the insertion of the voice coil secondary in the cathode of the oscillator tube circuit. This is similar to negative feedback.

—30—

What's New in Radio

(*Continued from page 74*)

there is a separate discriminator output circuit for connecting a counting rate meter.

For complete details on the Model 101 Scaler, write direct to *The Atomic Instrument Company*, 178 Charles Street, Boston, Massachusetts.

SELENIUM RECTIFIER

A heavy-duty selenium rectifier stack suitable for application in arc welding, aviation equipment, cathodic protection, electroplating, anodizing, large battery chargers, etc. is being offered by *Federal Telephone and Radio Corporation.*

This unit has double stud, center contact construction and 26 volt plates. Employing rectangular, square-cornered plates instead of the round type, the new stack is designed to mount either in a vertical or horizontal position. The double mount feature eliminates the vibration problem usually found in rectifiers, according to the manufacturer. The mounting of a.c. and d.c. bus connections has also been simplified.

More information about this new

heavy-duty selenium rectifier stack will be furnished upon request to *Federal Telephone and Radio Corporation,* Newark, New Jersey.

ELECTRONIC VOLTMETER

Instrument Electronics has announced a new electronic voltmeter, the Model 45, a stable amplifier type with a logarithmic indicator.

The instrument covers a range of from .0005 to 500 volts at frequencies

from 7 c.p.s. to 1.6 mc. which makes the unit suitable for voltage measurements in the vibration, audio, supersonic and broadcast frequency bands.

The complete range is covered by six switch positions with all controls located on the front panel. The db. scale of this instrument is linear. Line voltage variations from 105 to 125 will vary the readings at all frequencies within the specified range by less than ±1%.

A booklet covering this instrument will be sent upon request to *Instrument Electronics,* 253-21 Northern Boulevard, Little Neck, Long Island, New York.

PRECISION CRYSTALS

Petersen Radio Company of Council Bluffs, Iowa, has recently announced a new line of precision crystals for the 10, 20, 40 and 80 meter bands.

The PR Type Z-5 for the 10-meter band has a temperature coefficient less than 2 cycles per mc. per degree Centigrade. The 20-meter crystal, Type Z-3, has the same temperature coefficient as the crystal for the 10-meter band.

Type Z-2, for the 40 and 80 meter bands, is characterized by low drift and high keying activity, according to the manufacturer.

Prices and additional information will be furnished upon request to *Petersen Radio Company,* 2800 West Broadway, Council Bluffs, Iowa.

ELECTRON TRACER

A complete service laboratory, the "Electron Tracer," has been introduced by *Electronic Instrument Co., Inc.,* of Brooklyn, New York.

According to the company, this unit will completely check and isolate trouble in any broadcast, short-wave, FM or television receiver. The actual signal is traced audibly, stage by stage, through the entire receiver, by means of the speaker, built into the instrument. This signal tracing is done without removing tubes or disconnecting any part of the receiver. The unit

has a self-contained electronic a.c.-d.c. voltmeter and ohmmeter for additional testing if desired.

This unit covers a frequency range of from 20 cycles to over 100 megacycles. It utilizes the transmitted signal as a test signal. This eliminates the necessity of using a signal generator in a majority of servicing cases.

Additional details will be forwarded upon request to *Electronic Instrument Co., Inc.*, 926 Clarkson Avenue, Brooklyn 12, New York.

LEAD-IN WIRE

A complete line of weather resisting, low loss, polyethylene insulated twin conductor for FM and television lead-in transmission lines has been announced by *Federal Telephone and Radio Corporation.*

These lines which are manufactured with 100, 200 or 300 ohm characteristic impedance, are especially suited to the amateur radio field where, due to their high degree of flexibility, they can be constructed into a matched folded dipole antenna.

The 100 ohm line may also be used for home receiver installations, while the 200 ohm line which was developed for special type transmitting and receiving equipment may be used in laboratory applications.

Federal Telephone and Radio Corporation, Newark, New Jersey, will forward additional information upon request.

FREQUENCY STANDARD

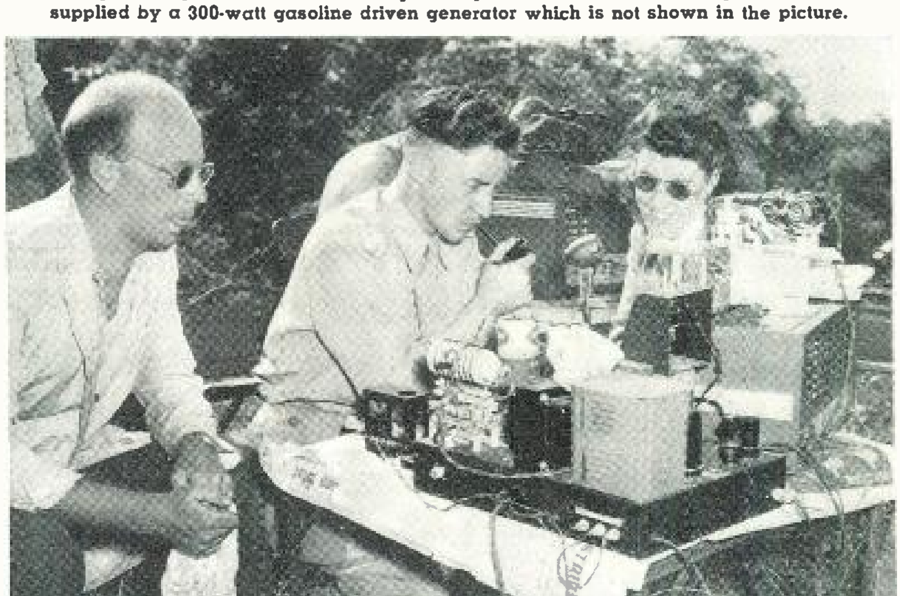
Monitor Products of South Pasadena, California, has announced the production of a precision secondary standard for measuring frequencies from 10 kc. to 100 mc.

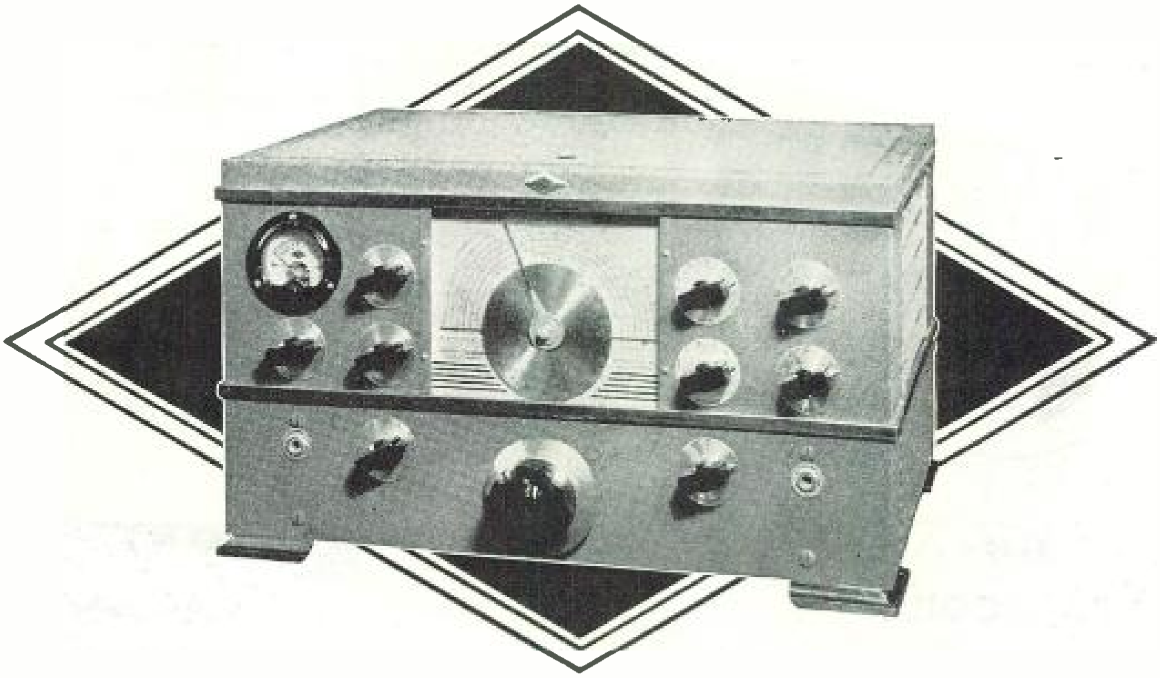
This unit employs a 100 kc., shockproof, gold-silver plated crystal coupled through a switching arrangement to either a 100 kc., 50 kc. or 10 kc. multivibrator, followed by a mixer stage which includes a Pierce oscillator circuit for the external reference spotting crystal.

The frequency standard is simple to operate and requires a minimum of adjustment. Frequency shift is less

than .002% for each degree Centigrade of temperature change. Provision is made for an external crystal for spotting specific reference points.

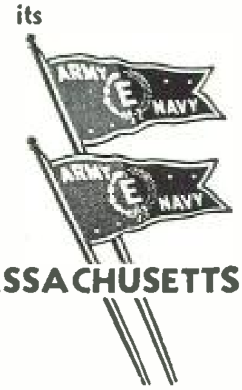
Field Day at the Washington Radio Club found Dick Houston, W4QPW, Major Eric Ilott, G2JK, of the British Army and Barbara Houston, club secretary, operating high in the Blue Ridge Mountains of Shenandoah National Park. They are operating 25-watt phone rig on 10 meters with Sky Champion receiver. Power for operation was supplied by a 300-watt gasoline driven generator which is not shown in the picture.





THE NC-2-40C RECEIVER

Back of the superb NC-2-40C receiver stand National's twenty-five years of experience in building to the highest quality. In the NC-2-40C as in other products, National has excellence for sale. Stability and sensitivity are outstanding. Controls are convenient to the hand and smooth in operation. All important auxiliary circuits — wide range crystal filter, noise limiter, S-meter, beat oscillator, AVC — are present in advanced design. You will find the operation of the NC-2-40C a gratifying pleasure and its ownership a source of pride. See it at your dealer's.

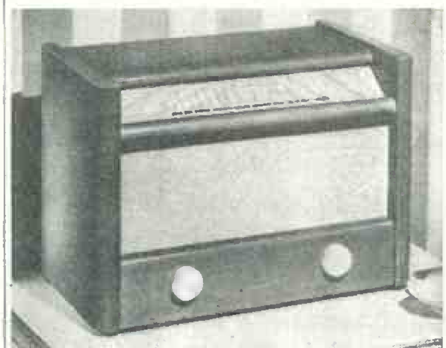


NATIONAL COMPANY, INC. **MALDEN, MASSACHUSETTS**

Additional information on this unit will be furnished by *Monitor Products,* 815 Fremont Avenue, South Pasadena, California.

TABLE RECEIVER

Stewart-Warner Corporation has recently added three new AM receivers to their line of radios, two table models and a console radio-phonograph combination.



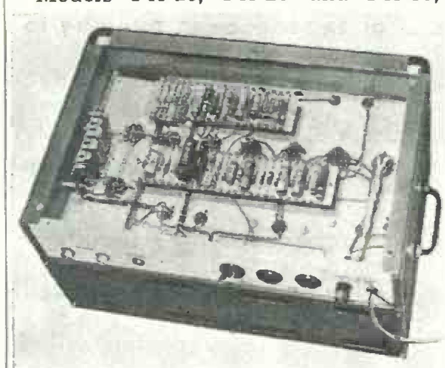
The set illustrated is the Model 51T56 housed in an Early American maple cabinet. This receiver has 4 tubes plus a rectifier and covers the broadcast band from 540 to 1600 kc. Operation is either a.c. or d.c. Two other cabinet finishes for this same model are also available, walnut and blonde "Desert Tan."

These receivers are being manufactured at the Chicago plant of *Stewart-Warner Corporation.*

P.A. AMPLIFIER

Clark Radio Equipment Corporation is currently offering a new line of public address amplifiers which feature terminal strip mounting of component parts, a construction detail usually found only in high priced equipment.

Models PA-10, PA-20 and PA-30, rated at 10, 20, and 30 watts respectively, are in production at the present time. These amplifiers have a virtually flat response from 30 to 15,000 cycles.



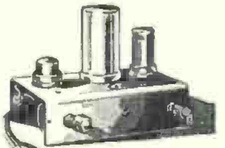
Prices and performance data on these amplifiers will be supplied by *Clark Radio Equipment Corporation,* 4313 Lincoln Avenue, Chicago 18, Illinois, upon request.

BUILT-IN RADIO

American Communications Corporation is introducing an ultra-modern, built-in, wall-type receiver which is available in harmonizing colors to match interior walls or kitchen tile.

CALRAD "hard-to-get" RADIO VALUES!

SPECIAL



Make any record player wireless with brand new

TWO-TUBE PHONO OSCILLATORS

Operates as far as 100 feet from a radio and can be used with Automatic Record Changers, Players or Microphone.
Uses 1-12SH7 and 1-12H6 Tubes.
Complete with tubes, $8.75 net.
Supplied in kit form with "easy-to-follow" instructions for assembly.
Complete with all parts, instructions and tubes .... $4.95 Net

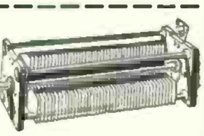
4 Prong Electronic Universal Vibrator

Fits 80% of all replacements. Individually boxed .... $1.25 ea.

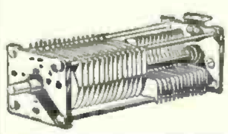
TURNER CRYSTAL MIKE

With 100 ft. Shielded Mike Cable .... $7.95 ea.

VARIABLE CONDENSERS



Single Gang 440 Mfd. Variable Condensers ....95c ea.



Dual Spaced 110. 110 Mfd Variable Condensers ....95c ea.
Dual Spaced 170. 170 Mfd Variable Condensers ....95c ea.

5 Tube Super AC-DC PARTS KIT

Kits include: Stamped Chassis—Dynamic Speakers—Output Transformer—Volume Control and Switch—2 Shielded I.F. Coils—Antenna and Osc. Coils—Two-gang Super Variable—50 Octal Sockets—20x20 Mfd. 150 Volt Filter—5 Tubular Condensers—3 Mica Condensers—6 Resistors—6 ft. AC Cord and Plug—Circuit Diagram.

WHILE THEY LAST $8.95 ea. LOTS OF 6 $50.00

Brand New WESTON VOLT Ohmmeter MODEL 663

Limited Quantity

Complete with carrying case and leads. List $71.50. Special... $39.50

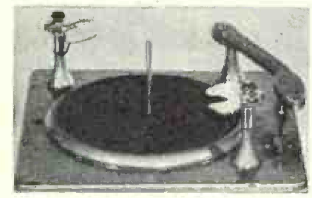
AUTO ANTENNAS

- 3 Section
- 66" Long
- Brass Tubing
- Triple Chromium Plated
- 2 Insulator Type Cowl Mounting with Lead Individually Boxed

24 to Master Carton $30.00 Lots of 48 $55.00

Immediate Delivery, but Quantity is Limited.

V.M. TWO POST AUTOMATIC RECORD CHANGER



This Record Changer is a well made mechanism, will play either 10 in. or 12 in. records. The pickup uses a crystal cartridge. Size 14 in. x 14 in. Packed 2 to a factory sealed carton, factory guaranteed.

CARTON OF 2 $35.00 Special $18.95 ea.

T-17B MICROPHONE

Made of durable plastic. Complete with 5 ft. rubber coated cord and plug PL-68. Press-to-talk button. Can be used with most radio sets as home broadcaster mike for entertainment.

$1.95 each

SUPPLY IS LIMITED! ACT QUICKLY.

BUY NOW! LOWEST PRICES! STOCKS LIMITED!

Fully Shielded Power Transformers

50 Mill—6.3 Vo. @ 2 amp. C.T.—5 Vo. @ 2 amp. C.T.—650 Vo. C.T. $2.25 ea. Lots of 10—$2.00 ea.
90 Mill—6.3 Vo. C.T.@3½ Amp.—5 Vo.@3 Amp. C.T.—750 Vo. C.T. ....$2.95 ea.
200 Mill—800 Vo. C.T.—6.3 Vo. C.T.@5 Amp.—5 Vo. C.T.@3 Amp. ....$4.95 ea.

Push Pull 6L6 Shielded Output Transformer

30 Watt Peak. to 2-4-6-8-16-250 and 500 ohm line. $3.45 ea. Lots of 12, $3.25 ea.

Push Pull Input Transformer. 10.000 ohm plate to push pull 6L6—$1.10 ea. Lots of 12—$1.00 ea.

Midget Universal Output Transformer—push pull plate to 2-4-6-8-10-16 ohm voice coil—95c ea. Lots of 10—85c ea.

10 Watt Large Universal Output—$1.35 ea. Lots of 10—$1.20 ea.

Single Pentode Midget Output—for 50L6, 6V6, 6F6, etc.—55c ea.

50 Mill Filter Choke 300 ohm—65c ea. Lots of 10—60c ea.

75 Mill Filter Choke 250 ohm—95c ea. Lots of 10—85c. ea.

100 Mill Filter Choke 250 Ohm...........$1.10 each
Lots of 25..............................$1.00 each

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4-In. 450-Ohm Dynamic...................$1.75 ea.
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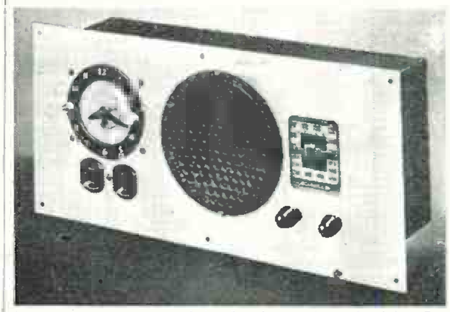
The unit features a duplex receptacle conveniently located for plugging in toaster, coffee percolator or other appliances. A "Telechron" alarm clock, with automatic switch which



turns the radio on or off is another feature of this unit.

The receiver is designed to mount between the studs with ample clearance from the front to the back partition. Louvres are provided for the dissipation of interior heat.

The radio is a 6-tube superheterodyne. Mounting dimensions of interior box are 14" x 6" x 4". The front panel measures 7½" x 16". This unit has been priced at $57.85 including Federal Excise Tax.

Additional details will be furnished by *American Communications Corporation,* 306 Broadway, New York, New York.

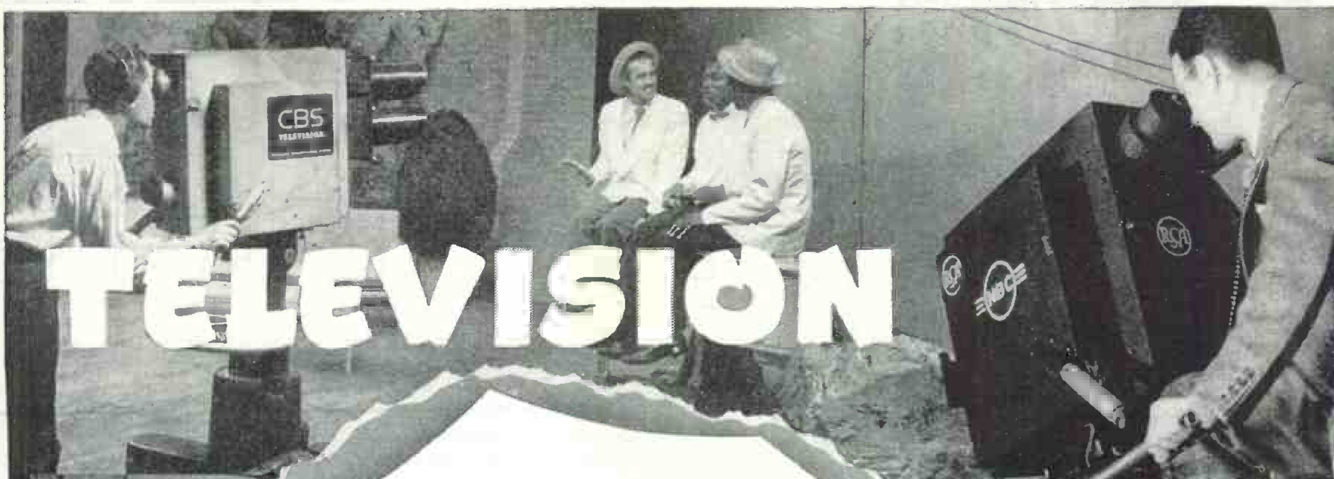
—30—

Treasure Finding
(*Continued from page* 31)

ground. The term "portable" however, in connection with radar mine detectors is very flexible, and even though the chassis and antenna may weigh only seven or eight pounds, the batteries can easily be 40 pounds or more. A minimum potential of 1000 volts is required for satisfactory operation, although the current drain is low enough to permit the use of very light-duty batteries. Either self-pulsed or externally-pulsed oscillators can be used, and representative circuits are shown in Figs. 4A and 4B.

"A" batteries, too, can be very heavy, even though the usual filament potential required is only 1½ or 3 volts, and in portable equipment this often forces a compromise between comfortable weight and power output. In the medium class the 3A5 miniature twin triode, used with the two halves in parallel, handles quite an appreciable amount of power—at the expense of almost a quarter-amp of filament current from a 1½ volt battery. In the 50-milliamp class, no miniature triode with the required oscillator characteristics is yet available, and the old 1G4 is still easily the best of the standard types.

Since the cessation of hostilities much work has been done in converting and improving the military types of locators for civilian use, especially in regard to the development of high-power "capacity-wave" equipment (mentioned above) for oil-location,



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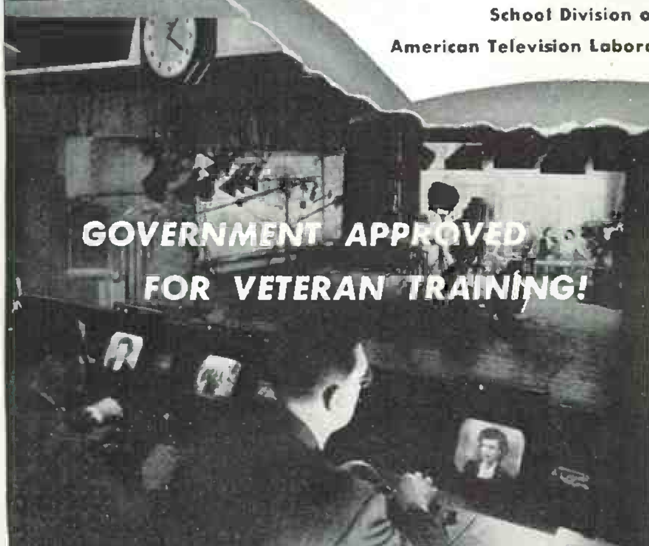

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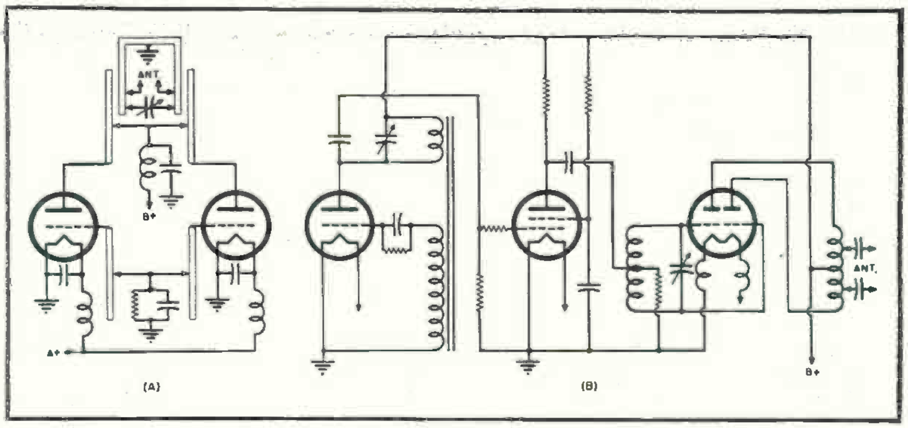

Fig. 4. Conventional diagram of two types of metal locators. (A) The self-pulsed radar type and (B) the triggered radar type.

and highly sensitive beat frequency and pulsed types for gold finding. The release of new tube types may therefore be expected shortly, in addition to Army types formerly on the secret list. Two lighthouse triodes in the latter class are the 2C40 and 2C43. Of these, the 2C40 makes an excellent oscillator for oil-detecting apparatus, although the voltage and current requirements take it out of the portable class into the lighter type of vehicle mounted job. This little tube can be operated under pulse conditions with up to 1200 plate volts, although the maximum potential for ordinary service is around 450.

Summarizing, we can place the modern treasure finder into three classes:

1. The midget portable of up to 10 pounds total weight, which is today at least four times as sensitive as its pre-war cousin. This class would include two and three-tube oscillators, and four-tube, low-drain b.f.o. types.

2. The semi-portable, to cover the larger b.f.o. types (with more powerful oscillator tubes) and light pulsed or radar types.

3. The vehicle-mounted locators, to include super-sensitive "straight" sets, radar types, and oil detecting equipment.

Of the three, I would recommend Type 1 for use by the average experimenter in searching for placer gold.

(Editor's Note: An article presenting complete details on construction

Since increased activity in the field of radio is expected due to the opening of new bands, the Federal Communications Commission has set up a large and efficient organization whose task it will be to patrol the air lanes for illegal transmissions. In a recent demonstration of these tracking techniques, held at Laurel, Maryland, L. E. DeLafleur, left, chief technical advisor, and F. M. Kratokvil, chief of the monitoring division, are shown in one of the FCC's hundred mobile direction finder units. They are tuning in on signals coming from another hidden car which is playing the part of an illegal station. The driver of the FCC car keeps in touch with the control center by radio-telephone on an FM band. The small hand wheel in the top of the car turns the antenna to the direction of the signal.

of a modern treasure locator is being planned. If present arrangements follow through, it will be published in RADIO NEWS *within the next few months.)*

—30—

Frequency Measurements
(Continued from page 52)

understood by reference to the diagram in Fig. 6, which shows a standing-wave distribution along a line coupled into a source of high-frequency current. The distance between successive current maxima (which is also equal to the distance between current minima) is one-half a wavelength. If a shorting bar is moved along the line, the relative position of the standing-wave distribution may be determined by the effect of the impedance which is reflected back into the driving circuit. When the shorting bar is at an odd multiple of a quarter-wave, the transmission-line at the input end represents a parallel-resonant circuit at the signal frequency, and looks like a high impedance reflected into the driving circuit. When the shorting bar is at an even multiple of a quarter-waves (i.e., at a half-wave point) the transmission-line represents a series-resonant circuit, and a very low impedance is reflected into the source of r.f. The amount of energy absorbed by the transmission-line when the shorting bar is at the half-wave point depends upon how tightly it is coupled into the driving circuit.

Because of their resonant-circuit characteristics, Lecher wires may be used to measure frequencies in either of two ways:

(a) as an absorption-type wavemeter, in which the transmission line takes the place of the lumped-constant tuned circuit which is used at the lower frequencies;

(b) as a standing-wave transmission line to measure the wavelength by determining the distance between successive current loops or nodes.

The details of construction of a Lecher-wire system for measuring frequency by method (a), as an absorption wavemeter in the manner illustrated in Fig. 4, are shown in Fig. 9. It consists of a sturdily constructed transmission-line shorted at one end, with a sliding shorting bar, and a calibration along the line indicating the half-wave position of the shorting bar from the closed end for different frequencies. At the frequency for which the distance between the closed end and the setting of the shorting bar is one half-wave, the line represents a series-resonant circuit coupled into the signal source. This is the same as the principle of operation of the lumped-constant, tuned-circuit wavemeter, thus this Lecher-wire system may be used in exactly the same manner as a calibrated absorption wavemeter, and may be used at frequencies well above the range of the lumped-constant tuned circuit.


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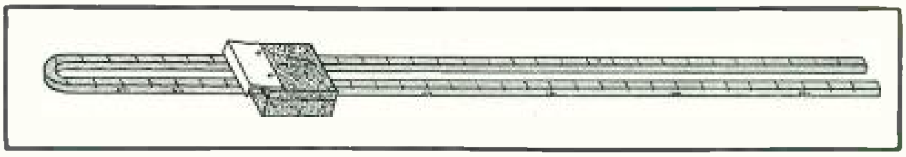


Fig. 9. Transmission-line absorption wavemeter.

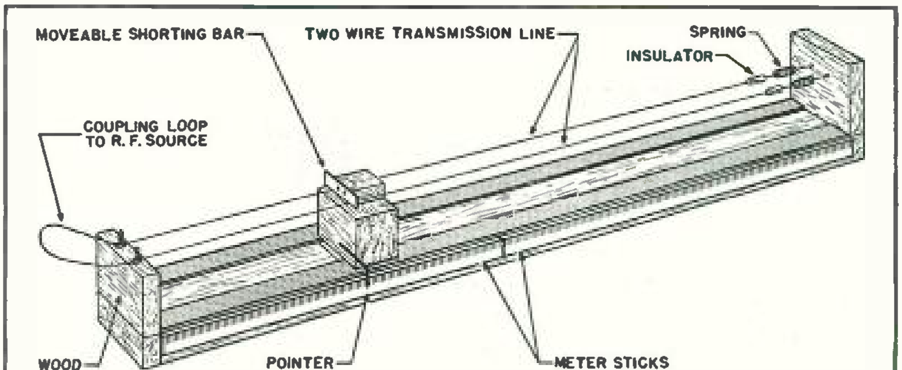
When using this wavemeter, the closed end is coupled into the circuit being tested, with the shorting bar in position at the closed end. The line is then tuned by moving the shorting bar slowly toward lower frequencies until an indication of resonance is obtained. The frequency is then read directly from the calibration of the line. It is necessary to use the instrument in this manner (i.e., tuning away from the closed end) in order to insure that the position of resonance represents one single half-wave rather than a multiple of the half-wave.

The construction of a Lecher-wire system for measuring wavelength by determining the distance between successive positions of current or voltage maximum is shown in Fig. 10. If a sensitive current-reading instrument is inserted in the shorting bar, series-resonance will be indicated by maximum current, and parallel-resonance by minimum current. When the amount of power supplied by the measured circuit is small, series-resonance (i.e., the shorting bar at half-wave positions) is indicated by maximum reaction upon the circuit, and parallel resonance (i.e., the shorting bar at odd quarter-wave positions) by minimum reaction upon the circuit. To measure frequency, the line is coupled into the circuit and the shorting bar moved to a position of resonance, with fairly loose coupling. The shorting bar is then moved to the next position of similar resonance, and the distance between the two is equal to one half-wavelength, from which frequency is known.

Under good conditions, frequency measurements may be made by the Lecher-wire method to an accuracy of the order of .1%. At the higher frequencies the accuracy decreases due to the difficulty of measuring small distances to such a high degree of accuracy. In addition to their greater accuracy, Lecher-wire wavemeters have the further advantages over tuned-circuit wavemeters that they can be used to measure extremely high frequencies, and that they give the wavelength in absolute terms without requiring previous frequency calibration. For this reason, and because of the simplicity of their construction for high-frequency use, they are extremely useful in amateur work. A disadvantage of Lecher wires is that an ambiguity in their readings is possible, since resonance indications are obtained at all multiples of the half-wavelength; thus, if the first resonance indication is missed and the second observed, the frequency reading will be incorrect since a full-wavelength will have been mistaken for a half-wave. The tuned-circuit wavemeter is resonant at only one frequency within its tuning range, therefore no such misinterpretation of its reading is possible. However, when care is taken in making measurements, Lecher wires can be relied upon to give accurate readings at the correct frequency.

When it is necessary to measure frequency to a greater degree of accuracy than is possible with wavemeters and Lecher wires, as in checking carrier frequencies of transmitters, such measurements may be performed by means of a heterodyne frequency meter. The heterodyne meter is an extremely useful instrument for measuring ultra-high frequencies, since it requires only a comparatively low-frequency oscillator of stable construction with a precision dial, for the measurement of very-high frequencies, and because of its high sensitivity requires very little energy from the source of signal. It consists essentially of an oscillator which is very precisely calibrated for frequency as a function of tuning capacity, and so designed and constructed that it will retain its frequency calibration over long periods of time. A receiver, or a simple detector and audio amplifier, indicates the presence of beat notes between the oscillations of known frequency and the signal of unknown fre-

Fig. 10. Construction of a Lecher-wire system for measuring wavelength.



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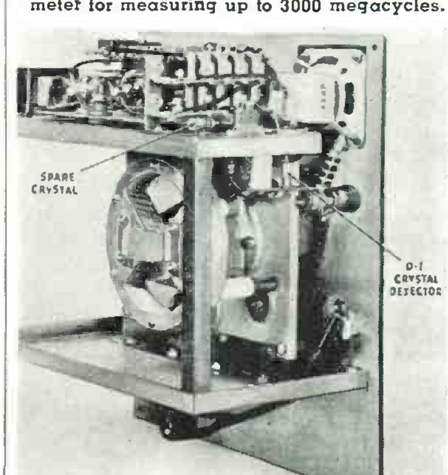
A photograph of the internal construction of a commercial instrument embodying these features is shown in Fig. 11. The ruggedness and stability of construction of the oscillator section should be noted. The complete circuit diagram is shown in detail of Fig. 12. Beat notes between the oscillator signal and the unknown are produced in the crystal detector, and amplified by the three-stage audio amplifier whose output may be indicated by an audible note (from speaker or headphones) or by a reading of the meter. The audio amplifier has an effective bandwidth of 50 kc., so that the output may be read on the meter even when it cannot be detected audibly. This feature is useful when the frequency under measurement is not sufficiently stable to produce a steady audible beat.

The procedure in measuring an unknown frequency within the fundamental-frequency range of the oscillator is to tune to zero beat with the unknown and read the frequency directly from the calibration of the meter. When the unknown is higher than the highest frequency of the calibrated oscillator, a harmonic of the known generated frequency must be used. By using harmonics of the oscillator, frequencies up to 3000 mc. can be measured by a heterodyne frequency meter having a fundamental-frequency range of 100 to 200 mc.

When a harmonic of the heterodyne oscillator is used to measure frequency it is necessary to know the order of harmonic of the beat observed, as well as the fundamental frequency of the oscillator. This can be determined by tuning the oscillator from the high end, and measuring the fundamental frequencies for two successive beats. If the frequency at which the first beat occurs is divided by the frequency difference between it and the next lower beat, the result is an integer and is the harmonic number of the lower of the two beats. As an example: Suppose that successive strong beats are indicated for settings of 200 and 175 mc. of the beat oscillator. Subtract-

Fig. 11. Commercial heterodyne frequency meter for measuring up to 3000 megacycles.



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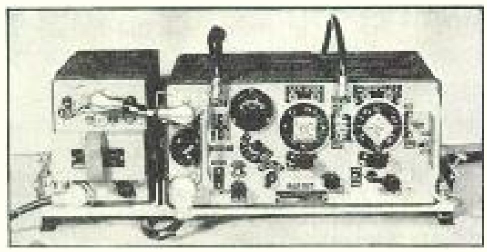

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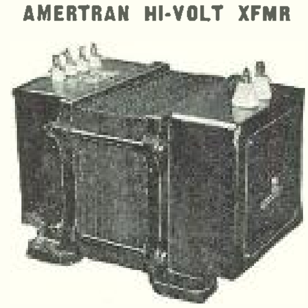

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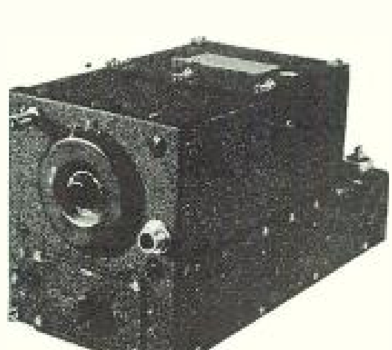

NEW ARC-5 SUPERHET RECEIVERS. Tubes (included) 3—12SK7; 1—12K8; 1—12SR7; 1—12AG7. Range (specify freq. desired): 190-550 Kc; 1.5-3 mc; 3-6 mc; 6-9.1 mc. Power: 24-28 VDC. Unit and Dynamotor **$37.50**

NEW ARC-5 TRANSMITTERS: 25 watts CW; 15 watts phone. Tubes (included): 2—1625; 1—1629; 1—1626; 1—6200 Kc crystal RANGE: (specify freq. desired): .5-.8 mc; 8-1.3 mc; 1.3-2.1 mc; 3-4 mc; 4-5.3 mc; 5.3-7 mc; 7-9.1 mc. POWER: 24-28 VDC. MODULATOR with: 1-1625; 1-VR-150; 1-12J5 less Dynamotor **$59.50**
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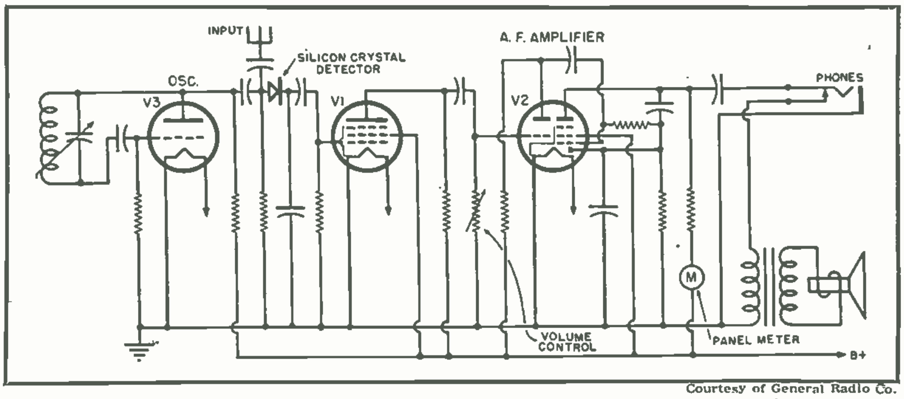


Courtesy of General Radio Co.

Fig. 12. Schematic diagram of the heterodyne frequency meter shown in Fig. 11.

ing gives 200 − 175 = 25 mc., which, divided into the higher reading gives 200/25 = 8 as the harmonic number of the second beat. Hence, the unknown frequency is 8 × 175 = 1200 mc. (In many cases additional weaker beats may be heard. These are beats produced between harmonics of the unknown and harmonics of the heterodyne oscillator, and are usually much weaker than the fundamental beats.)

Generally, if the unknown frequency has previously been determined approximately (for instance, by wavemeter or Lecher-wire measurements), only a single reading of the heterodyne meter is sufficient to determine the frequency accurately.

When greatest accuracy is required in a heterodyne frequency meter, a stable crystal oscillator may be included as part of the meter for self-calibration. The over-all accuracy of a well-constructed heterodyne meter, having a precision dial, and self-calibrated or checked against standard-frequency broadcasts, may be of the order of .01 to .05%.

An important consideration in the use of frequency-measuring instruments is their calibration. The absorption wavemeter and the heterodyne meter require a source of signal, operating at known frequencies, for their calibration. Lecher wires may be calibrated without any signal, since instead of frequency they measure wavelength, for which only an accurate meter-stick is necessary. Since Lecher wires are more accurate than the tuned-circuit wavemeter, the wavemeter may be calibrated by constructing a simple uncalibrated variable oscillator, and calibrating the condenser settings of the tuned circuit at different frequencies according to the readings obtained from the Lecher-wire measurements. In this manner it is possible for the amateur experimenter to construct and calibrate both a tuned-circuit wavemeter and a variable oscillator, to the limit of accuracy of the Lecher wires, without the need of a standard source of signal.

To make use of the greater accuracy of the heterodyne frequency meter, it should be calibrated against an accurately known frequency standard. This standard frequency may be a harmonic of a stable crystal oscillator operating at a lower frequency than the heterodyne oscillator, or it may be an experimental u.h.f. commercial broadcast or television transmitter. (For instance, in New York there is the *CBS* experimental color television transmitter W2XCS operating at a carrier frequency of 485 mc.) Many such transmitters may be expected to go on the air throughout the country in the near future.

The instruments that have been described in this article are simple of construction, and make it possible for the interested amateur to measure frequencies in the u.h.f. and microwave region up to 3000 mc. and higher, without great difficulty, by means of equipment and techniques within the reach of his constructional facilities.

—30—

CHICAGO BOYS CLUB

Newly organized activity provides sound and practical experience for teen-age Chicagoans.

THE Chicago Boys Club, largest boys' club in the country, has recently instituted a radio training program for its 11,000 members. These boys range from six to eighteen years of age with an average of twelve years.

Eight club houses are provided for the boys and an intensive program of instruction in radio theory, operating, and studio productions is rapidly being put into effect.

The Lawndale Branch of the club has equipped a complete broadcast studio where courses in radio announcing, studio control, station maintenance, and actual program production will be given.

The students do all the actual work of constructing the equipment, and the installation, when completed, will rival that of many of the smaller broadcast stations. Provision for any type of input has been made and several monitoring channels are provided. In addition, the entire building has been wired to permit both pick-up and reproduction at any point so that programs may be originated in any room and heard in any part of the building.

The club activities include classes in music and dramatics and, by use of radio, it will be possible to train not only the technicians but those who wish to prepare themselves for careers in broadcasting or allied professions. By referring to recordings of their programs, participants in the program can vastly improve their technique so that after several rehearsals the performance becomes a finished product.

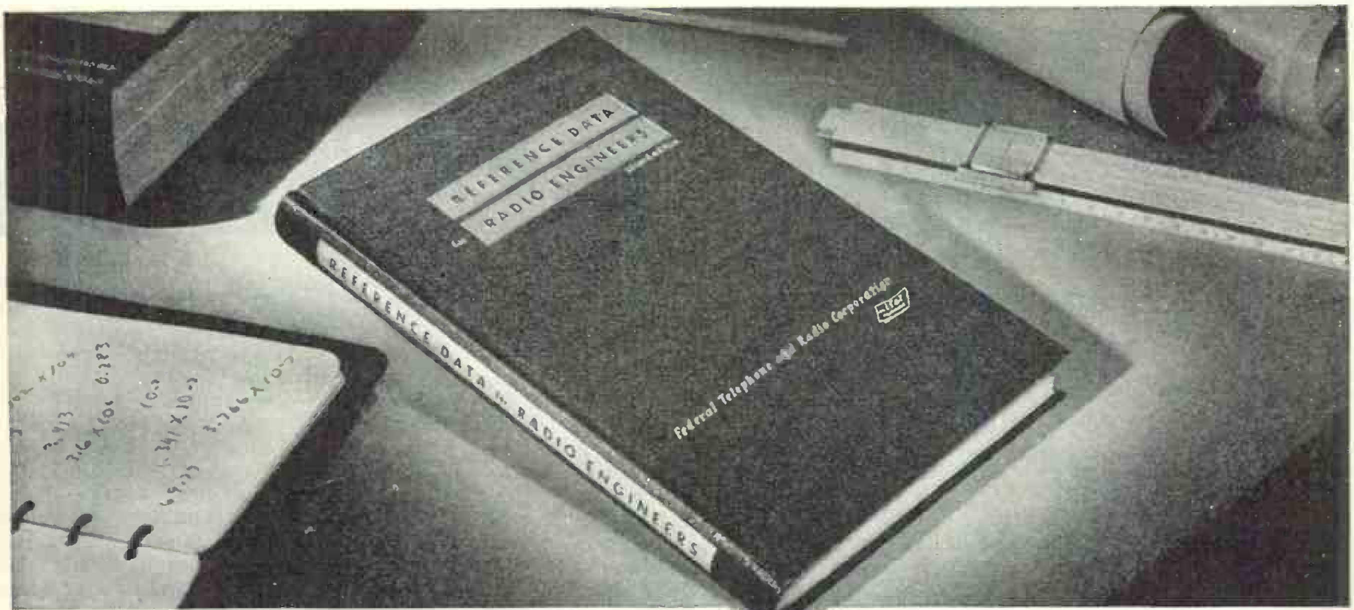
The control room is constructed on the stage of the auditorium and is built of sound absorbing tile with a double plate glass window. The con-

Laddie Veir connects console wires.

trol room is also equipped with a ventilation system to insure the comfort of the engineer and control man. Transcription tables are provided for either recording studio programs or for furnishing programs to various points in the building.

For those interested in the technical aspects of amateur radio operating, war surplus transmitters and receivers have been provided. These will be converted by the students for use on the various amateur bands. In this manner much practical experience will be gained as well as satisfactory equipment put into operation at low cost. Most of the students have had no experience in radio and plan to use this means for learning under experienced instructors, rather than the usual hit or miss methods. -30-

"On the Air" with Victor Pokorny at the mike. Robert Rada, left, and Paul Baldrige, right, keep things under control.



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Compiled jointly by the physicists and electronic specialists of the Federal Telecommunication Laboratories and the International Telephone and Telegraph Corporation, the material in this new book has behind it the technical authority of an organization with international leadership in radio, communications and television.

Enlarged from 200 to 336 pages with over 400 charts and diagrams, it makes available quickly the answers to problems that normally arise in practical radio work. This ready reference feature is one reason why *Reference Data for Radio Engineers*, in its earlier edition, received such an enthusiastic welcome by electronic specialists. Orders totaled more than 50,000 copies. With the wealth of new material now included, the second edition can be of even greater aid to the practicing radio engineer.

Commenting on the first edition, Walter J. Seeley, Chairman, Department of Electrical Engineering, Duke University, wrote enthusiastically:

> *"It is so chock full of useful data that I am urging all students to purchase their own personal copies . . . fills a long-felt need for a convenient compilation of both mathematical and engineering data, and the combination will be appreciated by all who have to work with radio circuits and their concomitant mathematics. That applies especially to teachers and students and I should not be surprised if it becomes a must in many college courses."*

The new, second edition of *Reference Data for Radio Engineers*, in green cloth binding, revised and enlarged to include much new data, is ready now. To order, merely fill in the convenient coupon.

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Within the INDUSTRY

RENALD P. EVANS has recently been elevated to the position of president of the *Turner Company,* Cedar Rapids, Iowa, manufacturers of microphone and electronic devices. Mr. Evans has been *Turner's* general manager for the past three years.

An addition to the company's main plant is now nearing completion which, when finished, will double the size of the present plant. A number of new items in the company's line of electronic equipment are expected to be announced in the near future when production facilities are enlarged.

* * *

THE INDIANA STEEL PRODUCTS COMPANY, pioneer producers of permanent magnets, has acquired the plant and facilities of the *Cinaudagraph Corporation* of Stamford, Conn., and has begun operation of that company under the name of the *Indiana Steel Products Co., Cinaudagraph Division.*

Philip Smith, manager of the *Indiana Steel* New York office will be general manager of the new plant and Robert Fulton, until recently with the *General Electric Company* at Schenectady, New York, will be in charge of production.

* * *

FRANK A. RUDOLPH, formerly general manager of the Greenwich, Conn., laboratory of *Aireon Mfg. Corp.,* has been elected vice-president in charge of sales of the *Ripley Co., Inc.,* of Torrington, Conn., manufacturers of electronics equipment for laboratory and industrial uses.

Mr. Rudolph has been associated with *Aireon* since 1941 and prior to that time was with *General Electric Co.* as district representative in the appliance and merchandising divisions. Later he had charge of subcontracting for the radio and television department of that company.

* * *

THE BENDIX RADIO DIVISION has taken a license to produce color television receivers under patents of the *Columbia Broadcasting System.* Immediate plans call for the establishment of an experimental color television transmitter at the research and engineering laboratories of the main *Bendix Radio* plant in Baltimore.

According to Charles Marcus, *Bendix Aviation Corporation's* vice-president in charge of engineering, the corporation has already expanded its engineering and research facilities to provide for the manufacture of a complete television line, including the manufacture of television receivers for the home.

* * *

WESTON ELECTRICAL INSTRUMENT CORPORATION is constructing a large engineering and administration building on the plant grounds at Newark, N. J., in order to release needed manufacturing space which was formerly occupied by the offices and laboratories.

The three-story structure is to be T-shaped, of brick-faced reinforced concrete and will have 78,620 square feet of floor area.

* * *

EDWARD R. JAHNS has been named Chief Electrical Engineer of *Templetone Radio Mfg. Corp.,* New London, Conn.

Mr. Jahns has held a similar position for the past eight years with the *Pilot Radio Corporation* from which he resigned as Chief Engineer in charge of all home radio receivers.

His position with *Templetone* will enable him to devote much time to research and development in connection with the company's projects covering FM and television.

* * *

PAUL GALVIN, president of *Galvin Manufacturing Corp.,* recently made the following statement about an industry rumor regarding the company to RADIO NEWS.

"My attention has been called to a trade rumor that I, personally, am selling out my interest in the *Galvin Manufacturing Corp.* and giving up my active management of the concern. I have no intention of selling my interests and I am not even discussing the matter of sale with anyone. Nor do I have any idea of giving up my active management of the affairs of the *Galvin Corporation.*"

The company manufactures the *Motorola* line of home and automobile radio receivers.

* * *

ELECTRONIC CORPORATION OF AMERICA has formally opened its new radio manufacturing plant in Brooklyn, N. Y. The plant is completely built for straight line radio set manufacture.

The production area, located on the

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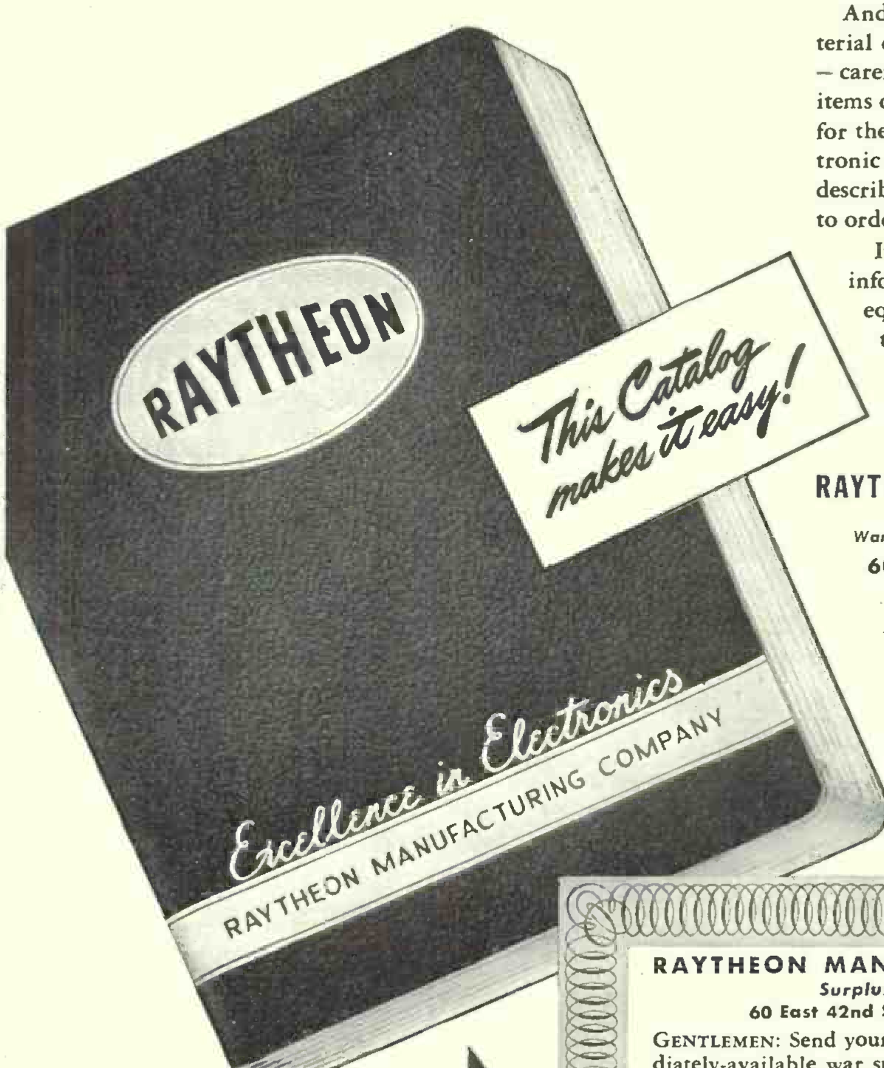
ELECTRONIC EQUIPMENT and COMPONENT PARTS



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street floor of the building but completely open to the skylight 50 feet above, covers approximately a city square block. Production equipment is of the mobile type for maximum convenience in shifting assembly lines to manufacture a variety of models. Suspended duct wiring is installed over the entire ceiling area of the factory so that any layout is possible without altering the wiring arrangement.

* * *

GEORGE L. BEST, who has been assistant vice-president of the *American Telephone and Telegraph Company*, was recently elected vice-president of the *Western Electric Company*.

Mr. Best served as an assistant engineer in the *New York Telephone Company's* Commercial Department and later entered the *A. T. & T.* Commercial Engineering Division where, in 1940, he advanced to commercial engineer and two years later was appointed assistant vice-president.

In his new capacity, Mr. Best will have charge of securing necessary licenses under patents of others for use by the *Bell System*, and for licensing others to use *Bell System* inventions.

* * *

THE RADIO TECHNICAL PLANNING BOARD elected Haraden Pratt of *Mackay Radio and Telegraph Co.* as Chairman for a period of one year beginning October 1, 1946. Also elected to serve with Mr. Pratt were: J. L. Middlebrooks of the *National Association of Broadcasters, Inc.*, Vice-Chairman; George W. Bailey, President of the *ARRL* and Executive Secretary of the *Institute of Radio Engineers, Inc.*, Secretary, and Will Baltin of the *Television Broadcasters Association* as Treasurer.

* * *

AUGUSTUS J. EAVES has been appointed Director of Sales for *Finch Telecommunications, Inc.*, of Passaic, N. J.

Mr. Eaves has spent many years with the *Bell Telephone Laboratories* as a development engineer of communications systems and for the past twenty years has been General Communications Sales Manager of the *Graybar Electric Company* in New York.

* * *

CLIPPARD INSTRUMENT LABORATORY, INC., has greatly expanded its production facilities through the acquisition of a new plant in Cincinnati.

All types of r.f. coils and coil assemblies, small bobbin-wound magnetic coils, paper section coils and specialized laboratory and production test equipment for radio and electrical

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Under favorable operating conditions you can communicate up to twenty-five miles.

The send-receive switch is located on the hand set, operates a relay in the tranceiver. This relay assures fast and dependable changing from receive to transmit.

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Tranceiver fits on top of the battery. Overall size H-14", D-8¼", W-5½".

Telescopic aerial 14" to 9'.

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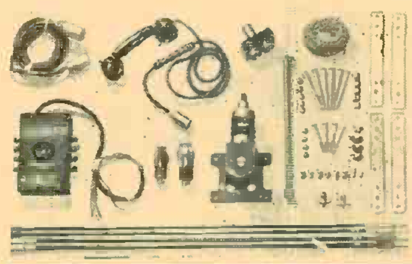

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CLAROSTAT • HALLICRAFTERS • HAMMARLUND • INSULINE • JENSEN • MEISSNER • R.C.A. • HYTRON • ASTATIC • R.C.P. • AMPHENOL manufacturers will continue to be manufactured. The company's present line of radio test equipment for radio jobbers, dealers and servicemen also will be expanded.

* * *

FRANK LESTER, W2AMJ, has been named head of the Amateur division of *Radio Wire Television, Inc.,* New York. A well-known u.h.f. amateur and designer, Mr. Lester is the originator of the double extended Zepp antenna for 5 meters and higher and the "Lestet" oscillator and harmonic generator circuit.

Mr. Lester was formerly associated with the company from 1928 to 1941 as the designer of transceivers, transmitters, and 5-10 meter converters for the firm's "Lafayette" line. He was Chief Engineer for the *Electronic Corporation of America* from 1941 to 1946.

* * *

ELECTROMATIC MANUFACTURING CORPORATION has recently completed the purchase of an additional plant in Yonkers, New York.

This new plant, which increases the active floor area of *Electromatic* over four fold, is already in operation and deliveries are being made of the new line of *Electromatic* radio-phonograph combinations.

* * *

WILLIAM H. MYERS, former product engineer in charge of automobile radios of *Farnsworth Television & Radio Corporation,* has recently been appointed chief engineer of the Receiver Division of that company.

During the war, Mr. Myers was project engineer in charge of *Farnsworth* aircraft and tank radio transmitters and was also in charge of an important electronic bombsight project for the Armed Forces.

A pioneer in automobile radio development, he was responsible for numerous improvements and new devices in that field, including trigger and automatic tuning devices, and speaker and antenna refinements.

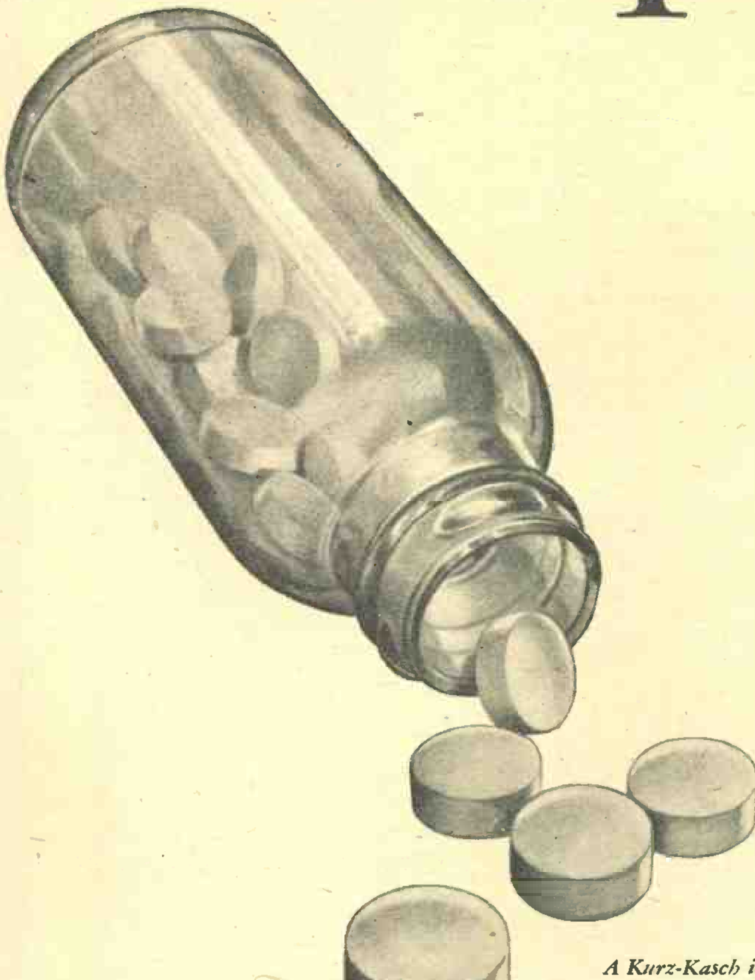
* * *

GEORGE C. HALE of the *Jefferson-Travis Corporation,* communications and recorder equipment manufacturers, has recently been appointed vice-president in charge of operations for that company.

During the war, he spent three years as world-wide Communication Equipment Officer on the staff of General Arnold, resigning in January 1945 with the rank of Colonel.

Immediately following his army service, Mr. Hale joined the *Emerson Radio and Phonograph Corporation* as the director of the special products

How Pills picked-up Plastics



A Kurz-Kasch idea for reducing loading time back in 1920, forming material into pre-forms or "pills," quickly came into universal use. Without it, early pre-heating and today's Heatronic techniques might never have proved practical.

SOMEONE always benefits *first* from every new idea in plastic molding—and plastics buyers in that happy position usually count their gains in dollars and cents.

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Branch Sales Offices: New York • Chicago • Detroit • Los Angeles • Dallas • St. Louis • Toronto, Canada.

division. He left *Emerson* last February to become associated with *Jefferson-Travis* where he has been serving in an operations executive post until his recent appointment.

* * *

M. F. CHAPIN is now transmitter representative in the Central District of *General Electric Company's* Electronics Department. In this capacity Mr. Chapin will be responsible for the sale of broadcast, marine and aviation electronic and radio communications equipment in the northwest portion of this district.

Educated at the University of Wisconsin in electrical engineering, Mr. Chapin has held various engineering positions.

* * *

RAYMOND W. ANDREWS, merchandising manager for the Radio Tube Division of *Sylvania Electric Products, Inc.*, has been appointed chairman of the parts sub-committee, radio amateur section, of the Radio Manufacturers Association.

The sub-committee has been formed to stimulate interest in the establishment of reference standards, accurate product comparisons and to encourage the cooperation of parts manufacturers in improved advertising and cataloging for the radio amateur.

* * *

HERLEC CORPORATION, a newly organized radio and electronic parts manufacturer, has recently announced that production on the company's line of switches, capacitors and other components has started at its Milwaukee plant.

The new company, headed by Thomas B. Hunter, G. Milton Ehlers and Harry W. Rubinstein, is also prepared to offer specially engineered parts. The three men are well known in the radio industry having been formerly employed in various capacities by *Centralab, Division of Globe-Union, Inc.*, of Milwaukee.

* * *

THEODORE LEY has been appointed director of export merchandising for the *R-L Electronic Corp.* of Chicago.

Mr. Ley, who is also acting in the capacity of export consultant to several manufacturers of electrical equipment, has just finished compiling an export catalogue of radio and electronic parts for *R-L Electronic Corp.* —30—

On June 21st the Federal Communications Commission announced a few of the details of its master plan for policing the postwar radio spectrum. Despite the vast new spectrum space made available by wartime developments, the demand for radio channels still exceeds the supply, making efficient policing of paramount importance. With many highly developed small radio transmitters readily available, criminals, bootleggers, and race track crooks can be expected to increase their efforts to use this weapon to outwit the law. In a recent demonstration of methods for detecting and locating illegal radio transmitters held at Laurel, Maryland, James W. Ramsey, left, chief mechanic and W. N. Fellow, radio engineer, demonstrate the method of locating an illegal station. Playing the part of illegal senders, the men have hidden their clandestine transmitter in the back of an auto, parked in a lonely spot. The signal from their transmitter will be picked up by FCC monitors and the hunt is on.

Television Alignment

(*Continued from page* 55)

Fig. 4. If pattern is flat, bright and with a heavy trace on the top, the sweep oscillator output may be overloading the i.f. amplifier. In this case, reduce output of sweep oscillator.

3. Superimpose accurately calibrated 12.75 and 9 mc. marker signals in parallel with the sweep signals. Signal will appear on sweep curve as a wiggle, the center of which is a thin black line. Calibrate these points on the screen of the oscilloscope with a pen or crayon. Hereafter the horizontal controls on the oscilloscope must not be touched. If sweep oscillator has marker points internally supplied this calibration need not be performed.

Connect sweep oscillator to control grid of fourth i.f. amplifier. Adjust iron cores of transformer T_6, Fig. 8, until pattern is similar to curve A of Fig. 4. A relatively flat-top, maximum amplitude, 12.75 mc. marker at one corner and 9 mc. marker at the other insure correct alignment.

5. Connect sweep oscillator to control grid of third i.f. amplifier. Adjust iron cores of transformer T_5 for maximum gain, flatness, and proper centering between markers as illustrated in curve B of Fig. 4. When transferring sweep oscillator from stage to stage, always readjust output to a level which does not overload i.f. amplifier.

6. Connect sweep oscillator to control grid of second i.f. amplifier. Adjust iron cores of transformer T_4 for curve B of Fig. 4.

7. Connect sweep oscillator to control grid of first i.f. amplifier. Adjust iron cores of transformer T_3 for curve C of Fig. 4.

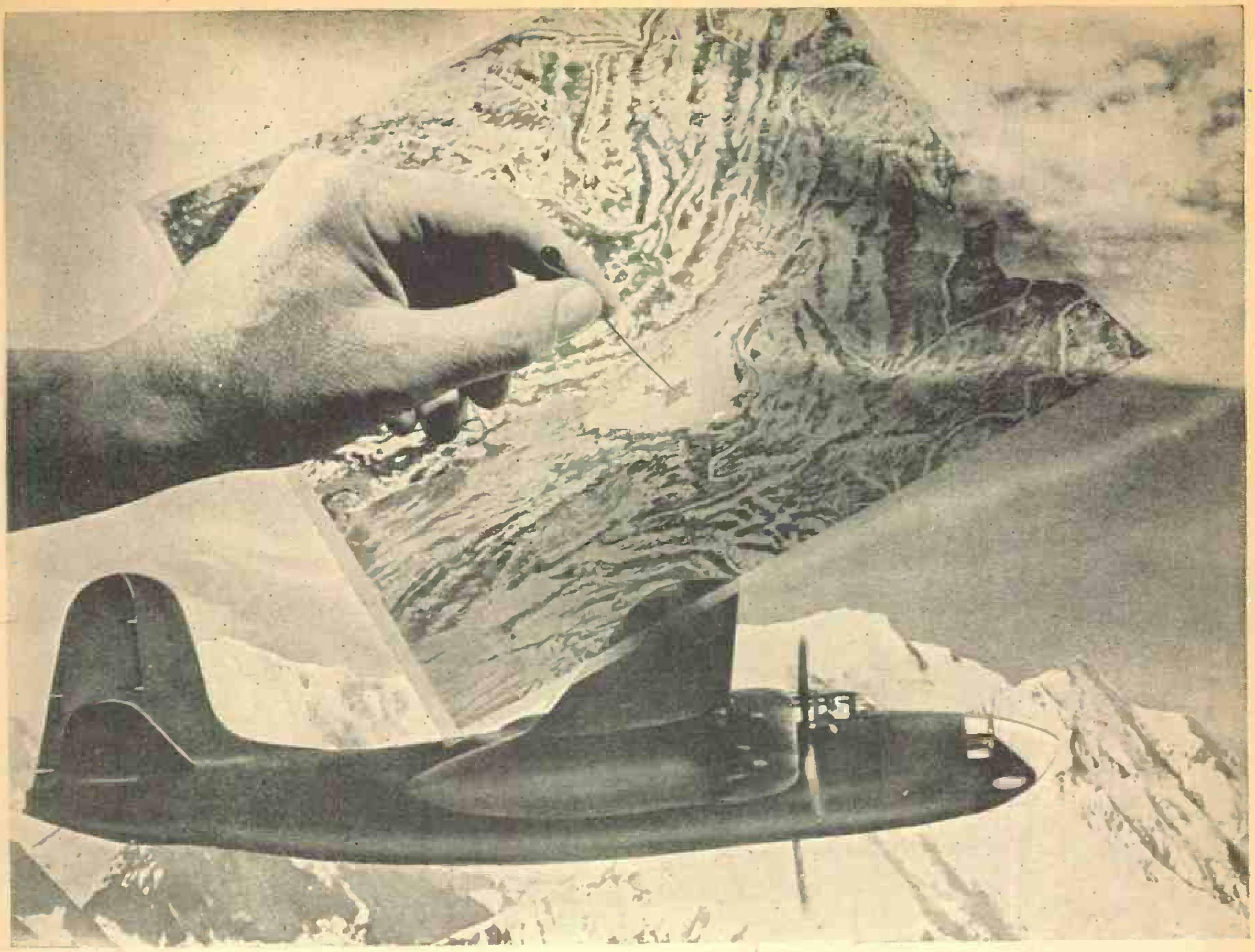
8. Connect sweep oscillator to grid of converter tube. Adjust iron cores of transformer T_1 for curve C of Fig. 4. Since transformer T_1 also passes the audio i.f. signal, check for audio in the sound channel.

CLEAN SOCKETS

TUBE sockets should be cleaned when overhauling the radio as there is usually an accumulation of dirt or grease and sometimes solder rubbed off of the tube prongs.

A stiff toothbrush may be used as shown.

The use of a solvent such as carbon tetrachloride will be of assistance for cutting the grease and dirt. . . . H.L.



Developed by RCA as an aid to blind bombing in wartime, Shoran is a new radar yardstick for world mapping

SHORAN – a surveying system with pin-point accuracy!

One small error in a map can be costly in the location of an oil well or mining property. But with Shoran, vast areas can now be charted by plane with an error of less than twelve inches in five miles—and in a matter of minutes or hours as opposed to weeks or months that would be required by laborious surveys made on the ground. Shoran is called one of the most important geographic inventions since the compass.

Shoran can also direct a plane flying in a blackout or heavy overcast with such accuracy that during the war it was possible to drop bombs only a few hundred feet ahead of completely invisible advancing troops below with unerring precision.

Just as Shoran is a revolutionary stride forward in map-making, so do all RCA products represent the farthest point of progress in their fields.

And when you buy anything made by RCA or RCA Victor, you are sure of getting one of the finest instruments of its kind science has achieved.

Radio Corporation of America, RCA Building, Radio City, New York 20. Listen to The RCA Victor Show, Sundays, 2:00 P. M., Eastern Daylight Time, over NBC Network.

Until recently a closely guarded military secret, Shoran was developed at RCA Laboratories—a world center of radio and electronic research. Here, in this vast community of scientists, the same imagination and skills that developed Shoran keep RCA and RCA Victor the outstanding names in radio, television and recorded entertainment.

RCA **RADIO CORPORATION of AMERICA**

9. With sweep oscillator still connected to converter grid, adjust series iron core trap coil L_5 of transformer T_5 until 12.75 mc. marker is down 50% in amplitude. See curve D Fig. 4. It should be noted at this point that it is the over-all response, curve D, of the i.f. amplifier that is similar to the idealized response of Fig. 1. and the response of groups of stages or a single stage may be altogether different.

10. With a 14.25 mc. signal applied to converter grid, adjust series iron core trap coil L_1 of transformer T_3 for minimum response at the adjacent sound carrier i.f. frequency of 14.25 mcs. This can be conveniently done by applying a 14.25 mc. signal to grid, reduce oscilloscope horizontal gain to minimum, and adjust iron core for minimum vertical line length.

11. With an 8.25 mc. signal applied to converter grid, adjust series iron core trap L_2 of transformer T_4 for minimum vertical line length.

R.F. Alignment:

1. Connect output of r.f. sweep oscillator to antenna input terminals. Connect oscilloscope vertical input cable across resistor R_8, Fig. 8.

2. Depress push-button for channel number one. Adjust antenna, r.f., and mixer trimmers for maximum amplitude, flatness, and proper centering between end of channel markers; see Fig. 6.

3. Follow the same procedure on all channels.

4. To align oscillator trimmers, apply a modulated signal on the sound carrier frequency to the antenna input terminals. Align respective trimmers for maximum sound output with main tuning control set to mid-rotation. Follow the same procedure on all channels.

Sound Alignment:

In aligning the sound channel follow the normal procedures for aligning on FM i.f. system. Typical curves with an 8.25 mc. marker are shown in Fig. 7.

(To be continued)

VIBRATOR HASH

LOOSE bolts or screws on the car radio transformer case may result in noise or vibrator hash.

This is often more pronounced after the set is in operation some time.

In testing, the radio should be operated for at least one half hour and then the bolts tightened as illustrated. H.L.

A Method of OSCILLATOR KEYING

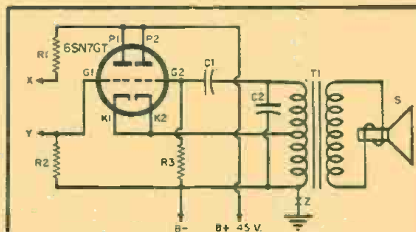
By H. T. MILLER

A novel circuit which will find wide application by the amateur operator.

EVERY alert amateur radio operator is interested in circuits that might have a possible application in his rig.

The circuit described in this article was originally designed as an indicating device on a highly specialized instrument in a research laboratory. The indicator was to be preferably an audio signal of some type so that the laboratory worker could have an indication in any part of the room. This audio signal had to be designed so that it could be keyed by an effective resistance of any value of from less than one ohm to possibly 500 megohms or more. In other words one ohm or 500 megohms had to cause the indicator to operate equally positively and effectively. Because of the nature of the contact material in the instrument only minute quantities of current could be tolerated.

The final circuit of such an indicator is shown in Fig. 1.



R_1, R_2—.5 megohm, ½ w. res.
R_3—68,000 ohm, ½ w. res.
C_1, C_2—.01 µfd., 600 v. cond.
T_1—Output trans. Stancor A-3856 or equivalent
S—P.M. speaker
1—6SN7GT tube

Fig. 1. Circuit diagram for control tube keyed audio oscillator.

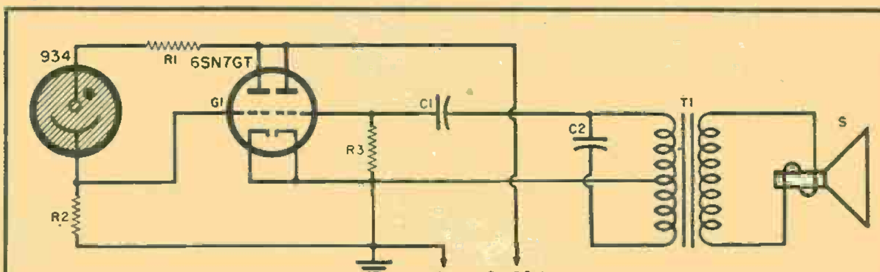
One half of the 6SN7GT is used as the control section while the other triode portion is used as a simple triode grounded-plate audio oscillator. The operation of the system shown is simple and straight forward. A negative charge is placed upon G_1 by resistor R_1. Since K_1 and K_2 are common, this charge effectively causes current to cease flowing in the oscillator section of the duo-triode. Hence oscillations in this portion of the circuit do not occur.

Now if across points X and Y a resistance equal to, or less than, the value of R_2 is placed, a positive charge is placed upon G_1 and since K_1 and K_2 are common, current is caused to flow in the grid return circuit of the oscillator and oscillations exist. Thus, triode section 1 effectively controls the oscillator section.

To make the control section more sensitive resistances R_1 and R_2 may be increased to extremely large values. How sensitive the control can be made depends for the most part upon three things: 1. The type of wiring used. 2. The type of components used. 3. The type of tube used. In the case of the 6SN7GT, by using careful judgment in wiring and ordinary components, it is possible to make the resistances R_1 and R_2 as much as 100 megohms.

In ordinary practice the oscillator could be keyed at many points in the d.c. portion of the circuit. But this would immediately limit the versatility of the circuit. Assuming that we choose to key at point Z, the keying contacts would have to carry an appreciable amount of current. The im-

Fig. 2. Diagram for photo-control tube keyed oscillator.



R_1, R_2—100,000 ohm, ½ w. res.
R_3—68,000 ohm, ½ w. res.
C_1, C_2—.01 µfd., 600 v. cond.
T_1—Output trans. Stancor A-3856 or equivalent
1—6SN7GT tube
1—934 phototube

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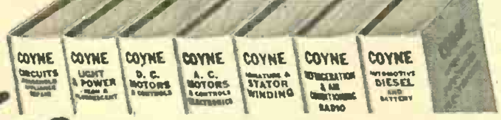

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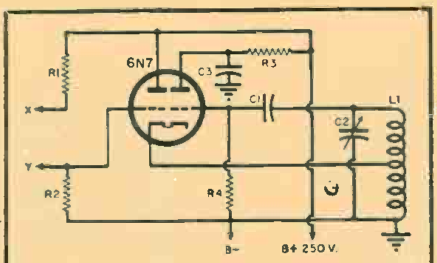


R_1, R_2—.1 megohm, ½ w. res.
R_3—25,000 ohm, 5 w. res.
R_4—50,000 ohm, 1 w. res.
C_1—100 μμfd. mica cond.
C_2, L_1—Variable cond. and inductance for frequency wanted
C_3—1 μfd.. 1000 v. cond.
1—6N7 tube

Fig. 3. Circuit diagram for control tube keyed radio frequency oscillator.

pedance of such a method of keying would be confined to extremely small values. In the case of the oscillator section of Fig. 1, a trial indicated that any value of resistance in excess of 2000 ohms definitely affected the performance of the oscillator.

Let us see what the ham can do with the basic control-oscillator circuit shown in Fig. 1.

Without any changes whatever the circuit in Fig. 1 can be used as a code practice oscillator. The key should be connected across points *X* and *Y*. With the values shown for R_1 and R_2 good clean-cut keying will result. However, for high speeds it will be necessary to reduce the values of R_1 and R_2 to about 68.000 ohms depending on the maximum speed the operator wishes to use. Observe also that since all wires running closely in parallel such as "zip-cord" or "microphone wire" have appreciable impedance, the length of the leads from points *X* and *Y* to the key may have an effect on the keying of the oscillator.

This circuit lends itself well to machine keying. By making simple contactors of *X* and *Y* in the form of brass brushes it was found that ordinary telegraph tape recorded on an instrument such as a *Boehm* recorder could very effectively key the control circuit. Using nothing except the resistance of the ink, the oscillator could be keyed. Based on past experience with the code recorders that burn the tape while recording instead of inking, this method of "playing-back" would be extremely good.

The oscillator in this circuit can easily be made a radio frequency oscillator of high stability as shown in Fig. 3.

This circuit is keyed just as effectively as the one shown in Fig. 1 by a similar control circuit.

The r.f. oscillator and control section makes an excellent v.f.o. with the distinct advantage of superb keying. It is only necessary for the ham to use the usual necessary constructional precautions of sturdiness in every detail in order to eliminate as much as possible the mechanical variations of circuit elements.

The 6N7 tube is used in this circuit to provide adequate oscillator output without overloading the tube itself. Other tube types can be used just as well and there is no doubt that the pet oscillator tube of each individual ham will find its way into *his circuit*.

Just as for the audio oscillator, some adjustment of R_1 and R_2 may be required to achieve sharp keying at the highest speed used by each individual operator.

Phototube keying can be accomplished in this circuit by inserting a phototube between points *X* and *Y*. This circuit is shown in Fig. 2. The operation of this system is as follows: When light falls upon the cathode of the phototube electrons are caused to flow, in turn, changing the conductivity of the tube. As the conductivity of the tube increases, a more positive charge is placed upon G_1 causing triode section 2 to oscillate.

The amount of light flux required to control the oscillator is a function of R_1 and R_2. The less the resistance of R_1 and R_2 the more light flux is required to key the oscillator. Nominal values are shown in Fig 2. For high speed keying it is, or course, again necessary to keep the resistance values of R_1 and R_2 as low as possible.

The above method of phototube control has various other applications that will be apparent to the reader. For example, using the phototube controlled audio oscillator plus proper diffusing discs, this circuit can be used as a light meter in determining proper exposure in the making of enlargements.

There are many other uses for this circuit around the shack. For example, the circuit of Fig. 1 makes an excellent dynamic condenser checker. By placing either a paper or electrolytic condenser across *X* and *Y* and carefully listening to the audio output, one can easily and quickly ascertain the condition of the capacitor being tested.

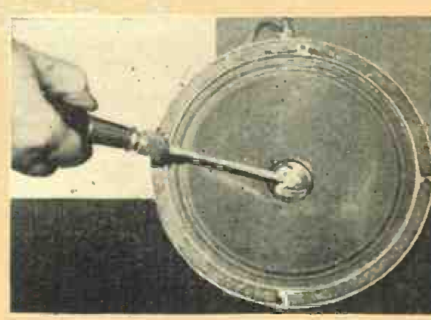
-30-

TESTING SPEAKERS

IN CHECKING a radio when no signal or a very faint one on a local station is received, it is worthwhile to make a quick test for an open field coil of the dynamic speaker.

This can be accomplished by using the metal blade of a screwdriver to touch the screw which holds the spider to the pole piece of the speaker as illustrated.

With the set turned on, a strong pull on the tip of the screwdriver should be felt if the coil is not open. . . . . H.L.



Transmitter-Receiver for Hams

(*Continued from page* 40)

phone should cause the brilliancy of the pilot light in the antenna circuit to increase. This is an indication of upward modulation, and should the brilliancy of the light decrease, the capacity of C_3 should be increased by screwing down the adjustment screw. The slider on R_{13} should be set at approximately the midpoint. Different types of microphones will require more or less voltage than this and the voltage may be lowered by sliding R_{13} toward the grounded end or raised by moving it toward the cathode end.

The transmitter is so arranged that by means of throwing S_3 to the i.c.w. position, a feedback circuit consisting of R_7 and C_{12} is put into the circuit resulting in audio oscillation of V_1. In the event that oscillation does not occur when this switch is thrown, it will be necessary to reverse the leads from S_3 to the transformer T_2. With the components used, the frequency of oscillation in this particular unit is about 1000 cycles. Other types of transformers will probably have a different value of inductance and it will be necessary to change either the value of R_7 or C_{12} to change the tone to that most pleasing to the operator.

For code work, a key should be plugged into the jack, J_2, and the microphone removed from its jack, J_1. Some control of the tone will be obtained by varying R_8. In general, R_8 should be used in its maximum position for i.c.w.

Almost any type of h.f. antenna may be used with the unit but it is preferable to use one fed with either 300 ohm line or coaxial cable. It is essential on high frequencies that the antenna be mounted as high as possible and in the clear as these frequencies in general follow "line of sight." Probably the simplest antenna for this work is the folded dipole. This type of antenna consists of two wires separated by 1" and with the ends connected together. The 300 ohm feeders are attached to the center of one of these wires by cutting the wire and connecting the feeders at this point. The over-all length of each wire in an antenna of this type may be calculated by the formula: Length in inches equals 5540 divided by frequency in megacycles. For example, if it were desired to operate on 146 megacycles, the length of each wire of the antenna would be about 37¾".

There is considerable controversy among amateurs whether horizontal or vertical polarization of the signal is preferable. It is probable, however, that the majority of stations use vertical polarization and improved results will be obtained when both antennas are of the same type.

If a 300 ohm feeder is used, it is essential that it be at right angles to the antenna for several feet to prevent unbalance of the line. —30—

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Kenyon engineering intends to maintain its place as a pioneer in the continued development of outstanding Transformer Equipment.

KENYON TRANSFORMER CO., Inc. 840 BARRY STREET NEW YORK, U. S. A.

International Short-Wave
(*Continued from page 62*)

any of the other Scandinavian countries. "The difficult communications and great distances have prompted our politicians to agree upon the desirability of such broadcasts."

One or two talks, or a reading, are daily features, and radio plays or dramas are broadcast once a week during the greater part of the year. Outstanding vocal and instrumental soloists are featured at least weekly, besides which there are quite frequent performances by vocal and instrumental groups. The Iceland State Broadcast Service maintains a small orchestra ensemble and a mixed choir. Frequent performances are given also by teachers and pupils of a local College of Music, and the male voice choirs are still another popular feature. Music from phonograph records is also broadcast daily.

During the war, the Iceland State Broadcast Service leased considerable broadcast time to the British and United States governments for the purpose of broadcasting news and entertainment to Allied Forces stationed in Iceland. *Rikisutvarpid* comments that "there was at all times perfect cooperation between the parties concerned."

From early times, it has been a national custom in Iceland that during the darkest winter days, the families on the farms and in the rural parts of the country would gather in their living quarters with their handiwork, while someone would read aloud to them from the *Sagas* or from some other literature of interest. This custom is abating somewhat, due to altered conditions, but the radio is now providing entertainment and education on broader lines with the aim of increasing the happiness and independence of each home and to strengthen the unity of all Icelanders into one national family, sounder and happier than ever before.

* * *

BBC to Verify!

Good news for both old timers and new DXers comes from Bryan Hayes, Local BBC Representative, 8 Althorpe Crescent, New Bradwell, Bletchley, Bucks, England, that the BBC will now verify. He writes:

"You may care to know that as I am the local BBC representative, I can verify for your readers all s.w. and b.c.b. reports of the BBC's reception. I am now doing this and my only charge is ten cents' worth of stamps (unused, of course); this is to cover cost of verifying and mailing verification back. QSL cards are in the printing, I understand, and I shall be able to issue a verification of all reports. I received some specimen copies from the BBC the other day and I enclose a specimen for you to see. So, if any of your readers wish to have reports verified, just tell them to send them along and I will verify with this card.

Please don't forget the ten cents' worth of unused stamps as these will help me with all costs. I am sure all your readers will want verification cards as *this is the first time they have ever been issued."*

* * *

Date from Chungking

By airmail from Chungking, Fung Chien, Director of XGOY, The Chinese International Broadcasting Station in that city, comes the following late information:

"Our 7 o'clock news has been suspended for some time owing to lack of adequate *English* announcers. We should like to add that we are now trying to resume that *English* program for the benefit of listeners in America. *(I believe he refers to an evening transmission to North America, probably with English news at 7 p.m. EST, and which would most likely be transmitted over 11.913, actually 11.920, in the 25-meter band.)*

"Presently, our station gives identification in *English only* when transmitting the *English* period, while for each kind of language broadcast other than *English*, identification is given in the very language concerned. *Complying with your suggestions, we are trying to arrange to give identification in English oftener for the benefit of English-speaking people.*

"We send verifications in letter form, International Reply Coupons may not be required." *(A verification of my report of November, 1945, covering reception of XGOY on 9.805, was enclosed, written on rice paper. Evidently, one should allow six months for verification.)* Simply address, XGOY, The Chinese International Broadcasting Station, Chungking, China.

* * *

Luxembourg Schedules Given

From the Chief Manager, *Radio Luxembourg*, Compagnie Luxembourgeoise de Radiodiffusion, Société Anoyme, Luxembourg Grand Duchy, comes this statement:

Radio Luxembourg's transmitter is located at Junglinster, Grand Duchy of Luxembourg, latitude 06 18 50 E.—49 39 40 N., with studios and offices at Luxembourg, Villa Louvigny. Frequency is 6.090 (49.26 m.) and schedule is:

Sunday—2:30-6 p.m., *English*. Monday, Tuesday, Wednesday, Thursday, and Friday—2:30-4:30 p.m., French; 4:30-5 p.m., *English*. Saturday—2:30-4:30 p.m., French; 4:30-6 p.m., *English*. No newscasts in English are listed, and to date no programs particularly designed for listeners in the United States and Canada have been produced.

"Receipt of reception reports we get from our listeners is acknowledged by means of a letter, whether accompanied by an International Reply Coupon or not."

* * *

Verification Data

Cleve Maher, Australia, writes that "I have always sent my reception reports on Australians to the P.M.G. Dept., Melbourne (they sent a letter). Now, I find that by writing to *'Radio Australia,'* Melbourne (that address will find them), cards are sent. The VLC card is blue with a yellow map of Australia and a radio mast on it. A pamphlet on *'Radio Australia'* is sent also. It thus appears that all our s.w. xmtrs send verification cards. That of VLQ is black on a white card; the same for VLR; VLH sends a red on white card. And either of two cards seems to be sent from VLW; one is black on white, the other orange with a map of Australia and a picture of a kangaroo. The card for VPD2 is black and white with a native scene on it, one of the nicest QSL's I've seen."

"I recently received a card from *Radio Saigon,* in red and blue on white, with a picture of a local dancing girl in the background; *it's in French and English."*

"A very plain card is sent from Singapore, it is black on a yellow card, sent by Department of Publicity and Printing, British Military Administration; address in Singapore is the Cathay Building."

Verifications are now being sent out from KOFA, the AFRS at Salzburg, Austria; *an IRC is not necessary.* Address, Andrew J. Staiano, Station Engineer, Armed Forces Radio Station KOFA, Salzburg, Austria, A.P.O. No. 541.

OAX2A, 5.620, *Radio Trujillo,* Peru, verifies reception by letter and *requests further reports;* address, Apartado 338, Trujillo, Peru. (Cushen)

* * *

Best Bets for Beginners

Listeners in the Deep South will be interested in this group of *Best Bets,* compiled from separate lists furnished by Don Miller and Pete Brennecke, both of New Orleans, Louisiana:

CKLX, 15.09, Montreal, Canada, heard 11 a.m.-5.05 p.m. in the European beam; usually has excellent signal, but sometimes is QRM'd. CKNC, 17.82, heard in parallel, excellent at 1 p.m.

ZFY, 6.000, Georgetown, British Guiana, heard 2:45-7:45 p.m.; BBC news relayed at 5:45 p.m.; excellent with some CWQRM.

Komsomolsk, 15.23, U.S.S.R., relaying *Radio Centre,* Moscow, good signal in North American beam, 6:20-7:30 p.m., *English* news at 6:30 p.m.

Radio Dakar, 11.715, French West Africa, heard in French news at 2:15 a.m., terrific signals.

VLA4, 11.77, Australia, heard with experimental broadcast to Britain at 2:40 a.m., loud.

FZI, 11.97, Brazzaville, French Equatorial Africa, good in *English* news at 3:45 p.m. and 6:30 p.m.; and is excellent strength in a French transmission, 12 midnight-2:25 a.m.

HCJB, 12.455, Quito, Ecuador, excellent around 5 p.m. when relays *English* news from the United Network, San Francisco.

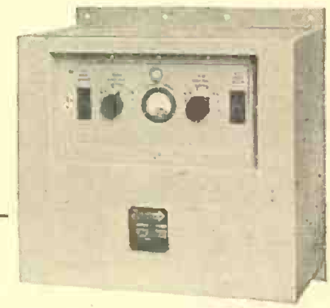
RNF, 9.550, Paris, heard 8:55-10:45 p.m. in North American beam; *English* news, 9 and 10:30 p.m.

Here's D C POWER for WAR SURPLUS ARMY-NAVY RADIO EQUIPMENT!

Get 6-12-24-28 Volts DC with a FEDERAL Power Supply

(FROM 115 AC 60 CYCLE — FOR USE WITHOUT BATTERIES)

. . . BUILT WITH SELENIUM RECTIFIERS FOR LONG LIFE, HIGH EFFICIENCY



FTR 3106-S — Low ripple DC power supply. Highly flexible unit provides DC at 5 to 80 volts—12 amperes. Sturdily constructed, requires no maintenance.

FTR 3093-S — 12 volt battery eliminator. Supplies 3 amperes, continuous operation. Compact unit; weighs only 15 pounds. Larger models supply 5 and 7.5 amperes.

Now you can take full advantage of the fine equipment becoming available as war surplus. Without the inconvenience of batteries, without any wiring changes, Federal's power supplies give you the required DC voltages from any 115 volt, 60 cycle, AC source . . . *assuring the utmost in performance from the equipment!* And they're available *now!*

Powered by Federal "Center Contact" Selenium Rectifiers, they have practically unlimited life, operate noiselessly. They provide the heavy current, low voltage outputs required by mobile and airborne transmitters and receivers, ground station units, rotary equipment.

It will pay you to plan your power supply *first* when considering war surplus radio gear, motors, relays, inverters. Consult the chart below for ratings, and let us send you full information.

RATINGS: 6-12-24-28 VOLT POWER SUPPLIES

Model Number	AC Volts Single Phase 60 Cycles	DC Volts	DC Amperes	Filter
FTR-3246-AS	115	6	10	NO
FTR-3008-BS	115	5/10	24/12	NO
FTR-3093-S	115	12	3	YES
FTR-3138-S	115	12	5	YES
FTR-3185-S	115	12	7.5	YES
FTR-3133-BS	115	6-24	2-18	NO
FTR-3341-AS	115	28	5	NO
FTR-3182-S	220/3 phase	14/28	200/100	YES
FTR-3128-S	115	22-30	10	Regulated & Filtered
FTR-3300-AS	115	2-32	45	NO
FTR-3106-S	115	5-80	12	Choke Only

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In Canada:—Federal Electric Manufacturing Company, Ltd., Montreal
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AN IT&T ASSOCIATE — FEDERAL TELEPHONE & RADIO — FTR

Newark 1, New Jersey

VLC5, 9.54 Melbourne, heard 8-8:45 a.m. in East Coast beam; *English* news, 7 and 8 a.m.

PZH5, 5.844, Parimaribo, Surinam, heard 6-8:32 p.m., sometimes is inaudible to 8 p.m., then has fair signal to sign-off.

KU5Q, 9.670, 7.645, 9.280, Guam, heard early mornings, good signals.

JLU-2, 9.525, Tokyo, heard 6:30-8 a.m. working KES-2 and KEL.

VLC8, 7.280, Melbourne, heard with program to Britain around 3 a.m.

GSD, 11.750, London, heard evenings in North American Service.

* * *

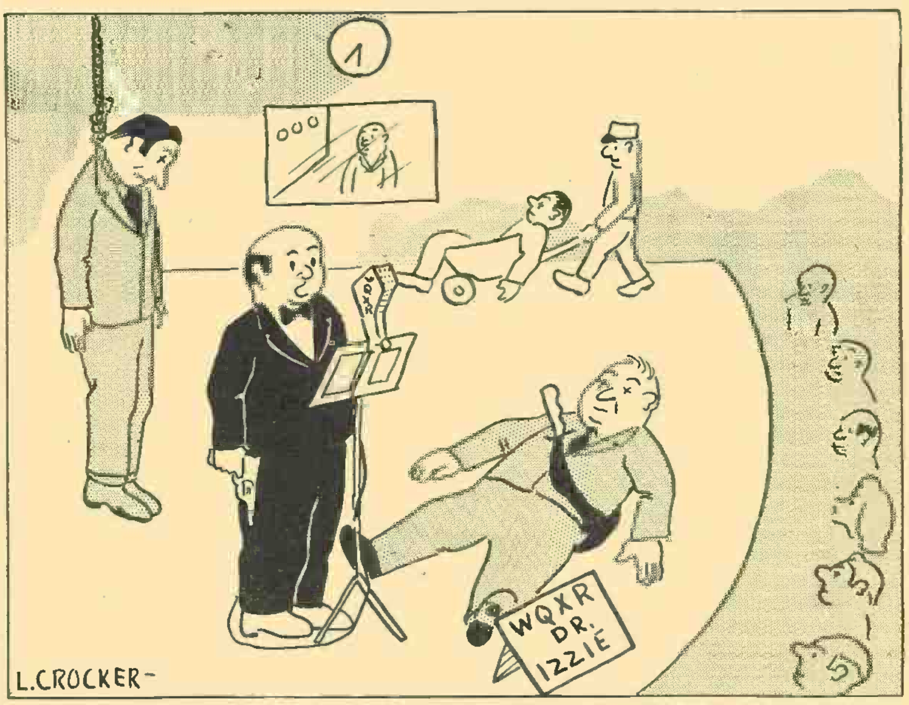
This Month's Schedules

Algeria—Europeans list current schedules of *"The Voice of America in North Africa,"* Algiers, as 6-10:30 a.m. on 11.880; 6 am.-2:15 p.m. on 11.765; 2:30-6:15 p.m. on 9.610; and 12:15-6:15 p.m. on T.540.

Anglo-Egyptian Sudan—From Sudan Government, Civil Secretary's Department, Public Relations, P.O. Box No. 282, Khartoum, Anglo-Egyptian Sudan, W. F. Cottrell, Broadcasting Officer, informs me that "call letters of STK are used *only* when this station is sending Morse telegraphy; no call letters are used for radiotelephone broadcasts. The transmitting station is at Omdurman. Address, Sudan Broadcasting Service, c/o Public Relations Office, Khartoum, Anglo-Egyptian Sudan. Frequencies of 13.320, 9.650, and 572.5 kcs. are used. Schedule is, Arabic programs, *all* days of the week *except* Thursday, 11:30 a.m.-1 p.m. and 2-2:30 p.m.; Thursday, 11:30 a.m.-12:30 p.m. and 2-2:30 p.m.; Friday, 3-4:30 a.m.; Sunday, 3-4 a.m. *English* programs are heard *Thursday only,* 12:30-1 p.m., including local news, music, talks. No programs are designed particularly for the Americas. Verification is sent; *International Reply Coupons are welcomed.* The Service developed in the war to serve listeners in the Sudan, and the low-powered Morse transmitters of the Post & Telegraphs Department were adapted provisionally. *Plans are under consideration for fuller-scale development.* The Service publishes a weekly magazine, wholly in Arabic, for its public. 'Omdurman Calling' is announced at irregular intervals during the *English* program, and 'Huna Omdurman' (Arabic for 'Here is Omdurman'), during the Arabic ones."

Australia—Rex Gillett, DX Editor, "Radio Call" (South Australia), has just sent over a printed schedule of the Australian Broadcasting Commission's "National Short-wave Programs," Melbourne, Victoria, Australia. All mail matter should be addressed to Short-wave Section, Box 1688 G.P.O., Melbourne. Stations scheduled in the series included VLR2, VLR, VLH4, VLH5, VLH3, VLG7. Power of the VLR series is listed at 2 kw.; VLH series, 10 kw.; VLG7, 10 kw.

This interesting letter regarding the old VK's in Australia has been received by Cleve Maher, Sydney, from V. M. Brooker, Manager of the Broadcasting Department of Amalgamated Wireless (Australasia), Ltd., 47 York street, Sydney: "VK2ME, VK3ME, and VK6ME are still employed in the services set up during the war and it is hoped that when this work is completed, they or other transmitters, will again be available for the broadcasting of Australian programs. VPD is a telegraph station and is still in operation, while a 10 kw., VPD2, was stripped down for use as a high-speed telegraph transmitter and was made available to the Navy during the war. *It will be rebuilt and most likely will be put into use again as the 'Voice of the Pacific' station."*



"Thus ends another of Dr. Izzie's quiz programs. 'Tell the Truth or You'll Wish You Had'!"

An Australian correspondent writes that in reply to a reception report of a station heard relaying *Radio Australia* on 6.100, the P.M.G. Department, Melbourne, advised that this frequency was used in testing the new 100 kw. transmitter located at Shepparton (near Melbourne), soon to be put into service under the callsign of VLB. *(VLB might use 9.540 also.)*

The evening transmission from VLC9, 17.84, Melbourne, to the Eastern United States and Canada, is now heard 7:30-8:45 p.m. with *English* news at 8 p.m.; good signals. VLC6, 9.615, Melbourne, is heard with good signals now mornings here in the East, but the best signal from "down under" continues on VLC5, 9.54, Melbourne, 7-8:15 a.m. with news at beginning and repeated at 8 a.m. VLG10, 11.76, Melbourne, is heard some mornings with fair to good signals, paralleling VLC6. Swedish observers report hearing VLA6, 15.200, Melbourne, around 4:15-5 p.m. with *English* news at 4:45 p.m. *Radio Australia's* VLA4, 11.770, has been heard with good signals at 1:45 a.m. testing to Switzerland.

Austria—From the Public Administrator of the Austrian Broadcasting System, Dr. Siegmund Guggenberger, Wien IV, Argentinierstrasse 30A, Vienna, Austria, comes this information on *Radio Wien (Radio Vienna)*: Wien I, medium-wave, 10 kw., 591.9 kcs., and short-wave, 0.4 kw., 6.250; 0.4 kw., 7.317; 0.35 kw., 10.000, and 0.2 kw., 12.000, all listed 10:45 p.m. to 7:30 p.m. next day. Wien II, medium-wave, 10 kw., 1.316 kcs., is scheduled 12 noon-3:15 p.m. *All* broadcasts are in German *only*. The Director points out that "owing to the vast devastations caused by the last few weeks of the European war, our transmitters have, at present, only a very limited power *which we hope to increase as soon as possible, that is to say as soon as our station Bisamberg near Vienna will be rebuilt with its former capacity of 100 kw. Its construction will depend to a large extent on our future chances of obtaining the necessary technical outfit.*" An Ohio DXer reports hearing the 7.317 outlet at 12:10 a.m., in German, recently.

Official schedule of KOFA, 7.220, AFRS station at Salzburg, is 2 a.m.-7:30 p.m.

Bechuanaland—According to the South African Broadcasting Corporation, station ZNB at Mafeking is still broadcasting. But as it is the control station for the network of radio communications, its broadcasting operaations are limited to gaps in the communication schedule, namely 5-6 a.m. and 12 noon-2:30 p.m. The frequency is 5.900 and the transmitter power is 200 watts. Audio input equipment, recordings, and the staff to operate are supplied by the SABC. Programs are entirely recorded music. No chance to hear this one in the U.S. unless on an accidental harmonic! (Ecksteen)

Belgian Congo—The Belgian National Radio's Spanish news for Spain is now heard at 4:15 p.m. instead of 4:30 p.m. on 9.740 (varying); last frequency listing of this station was again 9.738.

Official schedules of *Radio Congo Belge* are 12 midnight-2 a.m. on 9.380 and 6.295; 5:30-7:30 a.m. on 11.720 and 6.295; and 10:45 a.m.-4 p.m. on 9.380 and 6.295. All programs are in French or Flemish except for a Portuguese news period at 10:45 a.m.

Bolivia—CP38 recently verified reception for an Eastern DXer and gave schedule as 7-9 a.m., 10 a.m.-1 p.m., and 3-11 p.m.; they listed frequency of 9.505, but actually are lower.

Borneo—Additional information about *Radio Balikpapan* received by **Rex Gillett**, DX Editor, "Radio Call" (South Australia), is that "the station began operations March 1 with equipment of relatively low standard. Many good-quality recordings obtained from the former Australian Amenities Station 9AG assisted in getting the station started. Broadcasts daily on 9.125, 7-9:30 a.m. Atmospherics permitting, the PCJ (Hilversum, Holland) broadcast is picked up at 8 a.m. on a *Wells-Gardner* RAO-5 communications receiver for relaying." West Coast monitors report they have not picked up *Radio Balikpapan* lately, but add that a station on 10.050 might possibly be that station; if not, it is probably another Javanese; sign-off on 10.05 is at 9:30 a.m., last half-hour is in Dutch.

Brazil—ZYC8, 9.610, Rio de Janeiro, is heard in Portuguese, 6:30-6:45 p.m. with good signals; complete schedule not known.

Bulgaria—Sofia is reported from Sweden on 7.670, but schedule is not definitely known. On 9.350, the Home Service is now scheduled, 11 p.m.-1 a.m., 5:30-7 a.m., 11 a.m.-1:30 p.m.; the European Service, 2-3:40 p.m., with the *English* period, 3:30-3:40 p.m.; 352.9 m. is in dual, at least a part of the time. Address, *Radio Sofia*, Information Service, Sofia, Bulgaria. *This station wants reports.*

Burma—*Radio Rangoon*, 6.040, closes at 8:15 a.m. following a native-type program. The 11.845 transmitter is scheduled, 8:30-10:15 a.m. with *English* news at 8:45 a.m. On Sundays, the *English* news is usually heard at 9 a.m. just prior to closing down with "God Save the King."

Canada—It is interesting to note that Andrec Thomasson recently picked up VE9AI, 9.540, Edmonton, Alberta, in Sweden in the early morning.

CKNC, 17.82, Montreal, is reported heard Friday morning, 8-8:10 a.m. sign-off beamed to Norway. And CKNC and CKLX (15.090), also Montreal, has been heard Thursday night from 7:15 p.m. with a transmission beamed to South America. *Expansion of the CBC's International Service transmissions is anticipated.*

Celebes—*Radio Macassar*, 9.370, has a news broadcast in Dutch at 7:45 a.m.; identification is announced each quarter of an hour as "Here is *Radio Macassar*." Latest schedule reported is 5:30-9:30 a.m. with *English* between 8-8:45 a.m. on Monday, Wednesday, Friday. A Swedish reporter says news in *English* is heard some days at 6 a.m.

Ceylon—Paul Dilg, Monrovia, California, has received this letter from the Station Director, Radio Unit SEAC, 191 Turret Road, Colombo, Ceylon: "Very many thanks for your reception report of our station in the 49-meter band, the first report that we have received from the United States. Our 88.3 m. transmission is only intended for listeners in Ceylon and South India, with its small aerial power of 1 kw., and it is extremely doubtful whether you would be able to receive it. The station on 4.900 is *Radio Colombo,* catering to Ceylon only. Our transmission schedule, operative from June 1, is 15.12, 7:30 p.m.-6:45 a.m.; 6.075, 7:15 a.m.-12 noon Further reception reports and any program comments will be welcomed."

Cleve Maher, Australia, reports schedule of the 3.395 (88.3 m.) frequency as 6 a.m.-12:30 p.m. Australians report that the 6.075 outlet is sometimes heard earlier than the scheduled opening of 7:15 a.m.; at 7 a.m. some morning, an AFRS program has been presented. The *English* news is at 7:30 a.m.

Australians report the station on 4.900 announcing as "The Ceylon Broadcasting Station" signs off at 12:30 p.m. with the playing of "God Save the King."

It is reported from England that *Radio SEAC,* 15.120, has been picked up there, 1-1:30 p.m. with a special test transmission beamed to the British Isles. The 15.210 frequency also is reported heard well at 6 a.m. in the U.S. relaying the BBC news from London; at 6:43 a.m., the program outline for the day is given and the transmitter power is announced as 100 kw.

China—Current schedules of The Chinese International Broadcasting Station, XGOY, Chunking, have just arrived by airmail: To Australia, Asia, New Zealand, and East Russia, 11.913, news in *English,* 4 a.m.; in Cantonese, 4:15 a.m.; in Kuoyu, 4:30 a.m.; in Russian, 4:45 a.m. (Sundays, Western Music); Western Music, 4:55 a.m.

To Japan, 11.913, Japanese music, 5 a.m.; news in Japanese, 5:05 a.m.; Western Music, 5:15 a.m.; talks in Japanese, 5:20 a.m.; pause, 5:30 a.m. *(I have been picking up this transmission and notice that sign-off is usually at 5:25 a.m. EST, and is quite abrupt.)*

To North America, 9.635 and 7.153, news and commentary in Kuoyu, 7:40 a.m.; news in *English,* 8 a.m.; in Cantonese, 8:15 a.m. (Sunday, music); news in *English,* 8:30 a.m. (Sunday, music); news in *English* at dictation speed, 9 a.m. (Sunday, code and music); pause, 9:40 a.m.

To Europe, 9:635, news in Russian, 9:45 a.m. (Friday, music); news in *English,* 10 a.m. (Sunday, music); in Kuoyu, 10:15 a.m.; National Anthem, 10:25 a.m.; stop, 10:30 a.m. On Tuesday and Thursday, the beam to Europe is radiated with news in Russian, 9:45 a.m.; Chinese music, 9:35 a.m.; news in *English*, 10:15 a.m.; in Kuoyu, 10:20 a.m.; stop, 10:30 a.m.

With the above schedules came the following list of "Short-Wave Stations of the Central Broadcasting Administration of China:" XGOA, 5.918, 7.5 kw., Nanking; XGOY, 11.913, 35 kw., Chungking; XGOY, 9.635, 35 kw., Chungking; XGOY, 6.146, 35 kw., Chungking; XGOY, 7.153, 10 kw., Chungking; XRRA, 6.100, 10 kw., Peiping; XRRA, 10.260, 10 kw., Peiping; XUPA, 6.990, 10 kw., Kweiyang; XORA, 11.780, 4 kw., Shanghai *(they still insist that 11.780 is the frequency although XORA is actually heard on approximately 11.695/8)*; XGOL, 10.000, 200 watts, Fuchow; XTPA, 11.650, 500 watts, Canton; XOPB, 7.400, 600 watts, Hangchow; and XUPB, 8.388, 100 watts, Amoy.

Swedish sources give schedule of XORA, 11.780 (actually 11.695/8) as 7:30 p.m.-1 a.m. and 4-10:30 a.m.; carries the *English* news from XGOY, Chungking, at 8 a.m.

XGOL, Fuchow, has disappeared from 9.035 and is definitely back on about 9.997 (listed as 10.000), a former frequency, heard on West Coast, best after 7:30 a.m. to sign-off at 9:30 a.m.; relays the 8 a.m. *English* news from Chungking's XGOY. This station is heard in Texas from 6-8 a.m. fade-out, and also with another transmission at 6:30-7:45 p.m. sign-off.

Colombia—HJCAB, 9.690, Bogota, is heard with good signals evenings; HJCD, 6.160, Bogota, has news in Spanish at 10 p.m., sign-off is 10:15 p.m. HJCT, 6.200, Bogota, is heard with good signals to 11 p.m. sign-off, while HJFK, 6.100, Pereira, is heard with fair strength around 9:30-10 p.m.

Cuba—COBQ, 9.238, Havana, is heard identifying in Spanish and *English* at 10:30 a.m., paralleling CMCQ on BCB. COCO, 8.696, Havana; COBL, 9.833, Havana; and COCW, 6.325, Havana, are all good evenings.

Czechoslovakia — *Czechoslovak Radio*, 15.230, Prague, is coming through with a good signal, starting with identification signal at 6:45 p.m., ending transmission at 7:30 p.m. At 7 p.m. opens the transmission with the Czech National Anthem, "Kde Domov Mug," or "Where Is My Home," followed by comments and musical program, ending with a repeat of "Kde Domov Mug." While listeners in the East report this program is entirely in Czech, I recently heard a woman announcer at 7:15 p.m. giving *English* news and announcing, "This is the Czech radio." It is assumed that this frequency, OLR5A, has replaced OLR4A, 11.840, in the evening North American beam, although OLR4A was reported to me as late as early July as heard in the East with *English* news, at 7:15 p.m. OLR4A is now heard afternoons in European languages to 4:20 p.m. sign-off, replacing the 6.010 frequency.

Tests that were heard some weeks ago from OLR5C, 15.160, 11-11:20 p.m. and 12-12:20 a.m., alternating with OLR5A, 15.230, seem to have been discontinued.

Denmark—A monitor in Wisconsin has received this letter from the Danish *Statsradiofonien* in Copenhagen: "The Danish *Statsradiofonien* (State's Radio Broadcasting System) is at the present time operating the following short-wave transmitters, in conjunction with the regular BCB transmitters, and carries the same programs as the BCB transmitters: OZF, 9.520, 6 kw., 1:35-6 p.m.; OZH, 15.320, 5 kw., 9 a.m.-2 p.m. OZH, however, is operated *only* on Sunday, and is used with a directional beam-antenna, beamed to the East. For this reason and the fact that we are at the present time using only 5- and 6-kw. transmitters, we do not think that reception in the States will be very good. *As to our new transmitter, this is going to take a little time to put on the air. We are being delayed by lack of materials and unless we receive these before we expect them, we will not be on with the new job until the early part of 1947. The new transmitter will have an output of 50 kw. and will be beamed to the States on certain transmissions.*"

Dominican Republic—HI1Z, 6.312, Ciudad Trujillo, is heard with excellent signals in the East with an all-Spanish program to 10:45 p.m. sign-off.

Egypt—SUV, 10.055, Cairo, is heard irregularly around 7:15-7:30 p.m. relaying correspondence to the American networks; strong signals.

England — Greenwich Observatory time signals are transmitted 4:55-5 a.m. on GIC, 8.640; GKU3, 12.455; GBR, 16.000; and GYB8, 19.080; and at 12:55-1 p.m. on GKU3, GBR, and GKU2 (17.685). The station opens one minute and six seconds prior to the above, repeating its call letters four times in Morse followed by a tuning note, then 306 dots, the final on the exact hour.

Finland—OIX2, 9.503, Lahti, is being heard in Sweden, 7:15-7:45 p.m.

France—A Paris transmitter on 15.24 is heard in Australia, 7-9 a.m., in French. Paris sends good signals to North America evenings, 9-10:45 p.m., with *English* news at 9 and 10:30 p.m.; frequencies, 9.550 and 11.847 (sometimes, 11.886).

According to the French Press and Information Service in New York, letters about the *French Radio* should be addressed to Paul Girson, 14 East 53rd street, New York City.

FFE, 13.710, Paris, is good *daily* around 1-3 p.m. calling New York and relaying French programs.

French Equatorial Africa — FZI, 9.440, 9.984, 11.970, Brazzaville, now has *English* news at 7 p.m. instead of at 7:25 p.m. Although not scheduled at that time, *Radio Brazzaville* was heard recently on 15.595 between 10-10:30 p.m. with extremely strong signals.

French Indo-China—*Radio Saigon,*

11.778, has *English* news at 5 and 8:30 a.m., with 4.81 in dual.

French West Africa—*Radio Dakar,* 11.715, comes on at 2 a.m. with flute-like identification; the French news is heard, 2:15-2:25 a.m.; *no English* reported; good signals in the East. Reliable sources indicate that *Radio Dakar* now has three daily transmissions on *both* 11.715 and 6.917, 2:15-2:25 a.m., 7:15-7:45 a.m., and 1:45-4:25 p.m. The 11.715 frequency is heard well before the 4:25 p.m. sign-off.

Germany—Baden-Baden on 7.610 is reported heard in Sweden around 1 p.m. in French. It is also reported that from the French Zone of Occupation of "Tyskland," Baden-Baden radiates the same program as the medium-wave station at Freiburg, on a frequency which appears to be 6.300, 11:45 p.m.-1 a.m., 5:30-7 a.m., and 11:45 a.m.-3:45 p.m.

Leipzig (also reported as *Radio Berlin*) 9.688, is heard with fair signals in the East some nights as early as 10:45 p.m. and with news in *German* at 11:03 p.m.

Guam—KU5Q has been busy lately in connection with Operation Cross-

(*Continued on page* 156)

SAFETY BIAS SUPPLY

By
R. O. DECK, W9JV1

THE USE of grid-leak bias alone does not protect transmitting tubes should excitation fail. Cathode bias is not the answer, as it wastes precious plate voltage. Battery bias is simple, cheap, and efficient but has not enjoyed great use, possibly due to poor thermal and age characteristics

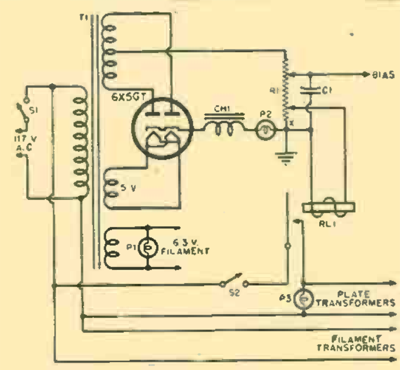
The bias supply described here may be used with modern beam or pentode tubes, or triodes requiring small grid currents. Best of all, it provides complete protection for the high-voltage rectifiers as well, delaying plate voltage until they have had time to reach operating temperature.

An ordinary receiver transformer is used, and a 6X5GT rectifier provides the time delay. Two could be used for greater currents than the 60 ma. provided here. The pilot lamp also serves as a fuse.

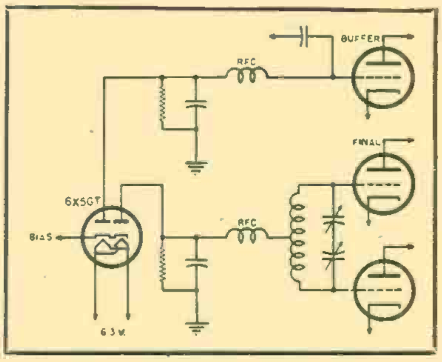
If a suitable relay is at hand, it may be connected in series with the bleeder resistor at the point marked "X". This would open the plate supply circuit if the bleeder opened up. However the more common 2500 or 5000 ohm coil, low priced relays may be operated from a tap on the bleeder.

Heavy duty contacts are not necessary on this relay, as it will normally close before the plate switch is closed, and will open only after the plate switch and the filament switch are opened.

Plate voltages should not be applied until after the filaments have heated and the bias voltage is present.



R_1—5000 ohm, 50 w. res.
C_1—8 µfd., 250 v. elec. cond.
RL_1—2500 ohm relay
T_1—Midget receiver trans.
CH_1—Filter choke
S_1, S_2—S.p.s.t. toggle sw.
P_1—6.3 v. lamp (green)
P_2—2 v., .06 a. lamp (amber)
P_3—110 v. pilot lamp (red)



If the grid current greatly exceeds the supply rating, and the grid leak draws a small current, bias isolating rectifiers may be used. The grid leak values will depend on the type of tube in use.

Very little filtering has been found necessary, and no other electrolytic condensers are needed. Decoupling filters are normally included at the transmitter stages.

The bleeder resistor should have a very liberal wattage rating, as it may carry a larger current than expected. Also the greater length permits better tapping.

It will be noted that the bias rectifier is supplied from a five volt winding. Because of the low current, the actual voltage is rather more, giving a delay of about fifteen seconds.

Should it be desired to incorporate bias isolating rectifiers, the use of 6X5GT tubes supplied by the 6.3 volts winding is advised. These are sometimes used to supplement grid-leak bias, when tubes requiring large grid currents are used. They are quite unnecessary when using a single small triode or screen-grid tube such as the 807, 813, 815, etc.

The smallest and cheapest of broadcast transformers will yield at least two hundred volts maximum at 40 ma. or more, depending on the rating given. Because of the use of choke input, less voltage than usual is obtained. A very cheap choke is quite satisfactory.

The red plate pilot lamp may be a 110 volt candelabra based type, or a plate transformer having a 6.3 volt winding may be used. An idle filament transformer or bell transformer can also be used to light this pilot. It is not advisable to use a neon lamp supplied from the high voltage unless very safe voltage dividers are used.

—30—

Operation Crossroads
(Continued from page 35)

or." But more about this next month.

Proceeding to the forward fire control tower, directly under the radar antennas, I set up my wire recorder in readiness for the big event. We were approximately 21 miles from the point of detonation and from our perch 85 feet above the water were able to get a bird's-eye view of the ghastly but beautiful spectacle that appeared off our starboard.

The destroyer escort's bow was in perfect alignment with the expanding cloud after we turned about and steamed downwind at thirty-three knots.

The recorder was kept in continuous operation for well over an hour and I was able to record, with the help of Commander Rugen, a step by step delineation of what we were witnessing.

Next I ran down to the Flag Plot room where I interviewed Captain Cruise shortly following the blast. He stressed the importance of radio communications in making such a test possible. Later I talked to Admiral Sprague and he too was most pleased with the communications setup. The broadcast that you tried to hear in the States was recorded almost in its entirety and in that area, of course, was crystal clear.

Hurrying back to another high perch, I was able to watch and record the return of the mother control ships to the flight deck of the Shangri-La. A total of sixteen planes made their landings with only twenty second intervals and no mishaps. Here's a summary of operations.

The word on ATOMIC Day came early the day before. There were lots of ships and personnel to get out of the lagoon, and movement of ships to assigned areas in the safe zones started 24 hours before the drop. Nearly all Task Groups left key "last minute" personnel and ships in the lagoon and on ships in the atoll islands. Here's how the bulk of the Task Force evacuated the lagoon and where they went:

1. THE TECHNICAL GROUP, including instrumentation, laboratory, and Drone Boat Units, cleared Bikini Atoll late in the afternoon before ATOMIC Day.

2. THE TARGET GROUP had a large number of ships not in the target array, and the responsibility for large numbers of personnel from the actual target ships in the array. Most of these crews were put on transport ships. The bulk of the non-target ships of the GROUP cleared the lagoon by 1700 or 5 p.m. the day before the blast. The non-target ships of the TARGET GROUP took stations at safe distances.

3. THE TRANSPORT GROUP which included the APPALACHIAN, BLUE RIDGE, and PANAMINT cleared the atoll during the late afternoon of ATOMIC Day minus one . . .

the afternoon before the burst. Before leaving the lagoon, certain ships in the transport group picked up the bulk of the crews of the target ships. The entire group proceeded in an easterly direction about 18 miles from the target.

4. THE NAVY AIR GROUP headed by the Shangri-La, myself on board, and plane guards approached the lagoon on "A minus one day." We cleared Bikini Atoll prior to the day before the drop and operated within a 15 mile radius of Point Tare, or about 30 miles southeast of Bikini. The Shangri-La launched her four drone planes from this area and then returned to Roi Island late in the afternoon.

5. THE SURFACE PATROL GROUP cleared all ships out of the lagoon prior to sunset the day before the first drop, with the exception of one destroyer and one tug which were stationed at the entrance to the lagoon as "check-off" ships and dispatch boats, where they remained until the MT. MC KINLEY steamed out on ATOMIC Day. THE SURFACE PATROL GROUP proceeded to sector HUDSON where it remained until units were despatched after the blast to take up duties as radiological patrol vessels.

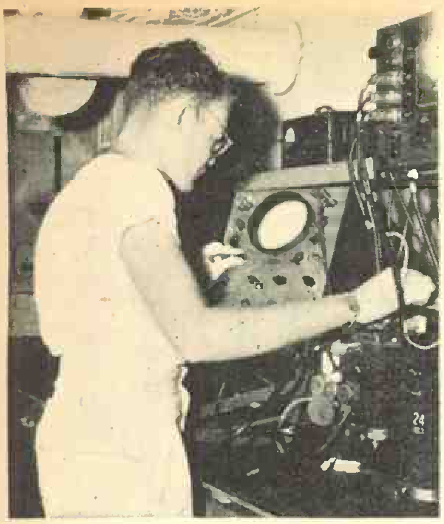
6. At the same time, the ARMY AIR GROUPS were located at KWAJALEIN and ENIWETOK, where they busily prepared for A-Day at the time ships in the Task Force were taking up their positions.

7. There were some additional units of the TASK FORCE which were not present at Bikini the day before the first test. There was a NAVY SEAPLANE UNIT located at EBEYE. THE SURVEY UNIT had two principal units out measuring waves, THE JOHN BLISS at RONGELAP ATOLL, and the JAMES GILES at WOTHO ATOLL. Both these ships were prepared to leave their locations on an hour's notice if movements of the radioactive cloud made that necessary.

Thus you have a rough idea of major ship movements of the TASK FORCE starting with the "Go" signal from Admiral Blandy, which came when the weatherman gave him the nod.

There was a considerable number of personnel still in the target area as the clock registered midnight. A total of 46 persons were on Amen, Bikini, Enyu, and Erik islands attending to the final preparations of instruments and cameras and other recording equipment. On the ships in the target array, 246 men made last minute adjustments and preparations. A lone man was still in a small boat at the starting buoys. . . . All worked against a vital, and final deadline.

It must be remembered that the blast could have come anywhere between about 0930 and 1200. However, the *planned* time for detonation, known as "H" or "HOW Hour" was 0930. The *actual* clocked time at which the bomb went off was known as



R. A. Bartlett, AETM 2/C, checks IFF of radar identification unit.

"M" or MIKE Hour." Mike hour was important because it formed the basis of all subsequent time references used in instrumentation. Now, what ships were still in the lagoon as ATOMIC Day arrived?

As I mentioned before most of the ships of the Task Force took their positions for ATOMIC DAY on the day before. There were a few important elements of the Force which had to remain in the lagoon until the early hours of A-Day. The most important of these exceptions were:

1. The FLAGSHIP OF THE TASK FORCE, THE MT. MC KINLEY.
2. The instrumentation ship KENNETH WHITING, supervising last minute settings of recording and measurement instruments, and picking up all personnel that remained on the atoll on A-Day, except the drone boat boys, the target ship group and some personnel on Amen and Erik islands.
3. The instrumentation ship CUMBERLAND SOUND.
4. A PGM, or small gunboat type vessel, at anchor off AMEN island and another off ERIK island picked up last minute personnel there.
5. THE FALL RIVER, flagship of the TARGET VESSEL GROUP.
6. Two APA's, transports, including the GEORGE CLYMER, Flag of the TRANSPORT group, remained to pick up the bulk of personnel left behind when the hands of the clock started moving through ATOMIC DAY.

I might say here that every man that had a job to do on the target ships had special instructions on what to do if he by some freak should be stranded on his ship in the lagoon. The senior member of the "Last-minute" crew was the last man to leave each ship according to plan. Before he left he hoisted the international alphabet flag, a red and yellow-striped flag called Yoke flag, at the yard arm. If a straggler turned up, he had instructions to haul down the Yoke flag and hoist all possible bunting. This signal would have halted the test until the man was removed.

The MT. MC KINLEY and all other ships not in target array reported clear of the lagoon two hours before HOW-hour. These included, instrumentation units, evacuation ships, drone boat units . . . all ships, which left Bikini Atoll deserted of human life. The drone boats were anchored in the lee of ENYO Island.

With the ships out of the lagoon on A-Day and in their assigned positions about Bikini, action switched to the Army-Navy Air Forces where things had been moving for several hours. There were eight primary air task units in this operation, for a total of 73 airplanes. Other airplanes in secondary roles of logistic support brought the total CROSSROADS airplanes to 140. Here is how this complicated air phase got underway.

Operations

Three hours and 45 minutes before H-Hour, the bombing B-29 took off from Kwajalein. At about the same time, the Shangri-La, with her drone aircraft aboard, passed point Tare.

The sector axis was in the direction from which the average wind (ave. for all altitudes up to 20,000 feet) was blowing and was rotated periodically as necessary to correct for wind shift. Test A had average wind direction from approximately 75 degrees true, roughly east, northeast. This brings us to one hour and forty-five minutes before the drop.

When the bombing plane was at altitude and ready to start the first practice bombing run the command plane, a B-29 aerial eye for Admiral Blandy, approached Bikini. The press-radio plane approached Orbit Point Easy at 7000 feet (orbit point is a rendezvous point). The Press photography airplane was also at Easy but at 3000 feet ready to circle the target array according to plan. Off at Orbit Point Love and at Uncle, air-sea rescue planes arrived.

Fifteen minutes later, the Army Air Photographic Unit flying at 26,000 feet arrived followed by a second Army Air Photo Unit flying at 1000 feet above the actual bombing altitude which was not announced. This unit proceeded to Orbit Point Peter while observer aircraft carrying members of the evaluation groups arrived at Easy, coming in at 7500 feet.

One hour before the blast the MT. MC KINLEY and other ships which left the lagoon in the morning of ABLE DAY reached their prescribed positions for test "A." The MT. MC-KINLEY took position on the inner circle of sector CHEVROLET, where she was the nearest ship (about 11 miles) bearing human beings to the center of the blast. The only possible exception was the destroyer USS BARTON, which was at Point WILLYS, eight miles from the target. Immediately after the detonation, the WILLYS joined the "downwind" radiological patrol. The CUMBERLAND SOUND reached sector GRAHAM.

The KENNETH WHITING was in sector GRAHAM, and the transports which picked up "last minute" personnel joined their group along with the APPALACHIAN, BLUE RIDGE, and PANAMINT in sector MARMON. The two PGM's which evacuated AMEN and ERIK islands reached sector PACKARD.

In the meantime, the destroyer O'BRIEN, a veteran of many Pacific battles, took up station at INITIAL POINT, a distance of 35 miles southwest of the target and the destroyer R. K. HUNTINGTON took up a position at ORBIT POINT BAKER, 50 miles southwest of the target. These two destroyers acted as reference ships or aiming sights for the bomb carrying B-29 which swept in over them on the way to the target. The only problem they faced was getting up plenty of steam and high-tailing it out of there, immediately after the blast, because they were "downwind" of the atomic cloud, and not so fast as a plane in getting away. That was one time they didn't want to have any engine trouble. Immediately after the detonation, these destroyers joined the "downwind" radiological patrol. All ships were in position awaiting the big moment. Meantime, however, air operations were humming with increasing intensity.

With all that air traffic, a highly specialized wartime development was brought into effective play, an air-sea rescue team. As the more active planes of the operation assumed their positions in this fabulous traffic pattern, the rescue planes assembled over Wotho.

In the next half hour, the entire air operations plan hit its traffic peak . . . 30 minutes to H-hour when all had to be ready.

At 30 minutes before the blast the CUMBERLAND SOUND announced over voice radio "Thirty Minutes Before Bomb Detonation (Repeats) Stand by—Mark."

C-54 Photo planes assumed their levels at 12,000 feet. Four Navy F6F's, single-seater fighter photo planes meanwhile completed their runs and cleared the area. The Navy's big PBM's, cameras bristling, moved to rendezvous points and the entire air armada by this time was flying tracks in accordance with General Kepner's air plan. Then came the drones of the Army Air Forces. Five B-17's were maneuvered to altitudes from 30,000 feet to 13,000 feet, and within five minutes four Navy F6F Drones and their control planes arrived at ORBIT POINT VICTOR at altitudes from 28,000 feet to 10,000 feet. Instrumentation aircraft, two B-29's, similar to the two accompanying strike aircraft at the Hiroshima and Nagasaki strikes, tracked 1000 feet above the atomic bomber. Radiological reconnaisance planes, two B-29's, and two TBM's spread-eagled the various elevations where the characteristic bomb cloud was expected. Then with 20 minutes to go, the press plane slipped away from the target area and headed for its observation point 20 miles from the blast. From that point on, the entire air fleet moved into the detailed air schedule and maintained position in the vast moving pattern of aircraft, standing by for the drop.

Fifteen minutes before the drop, the CUMBERLAND SOUND broadcast estimated time of the bomb detonation again. Then at ten minutes before drop, CUMBERLAND SOUND announced that fact.

The bomb plane, by procedure set by Joint Task Force One, made its *trial* run over the target. Radar aids were tested, the target closely inspected by the bombardier, and all possible margins of error were checked during this run to set the stage for the second or live run for the colossal job of placing the bomb on the focal point of the target after its free fall of more than six miles.

Once the bomb was dropped, then the air plan hit its peak. Army and Navy drones which had been circling at their proper altitudes, poised for the burst, now streaked for the cloud. The Navy system was to have control ships (mothers) on the opposite side of the cloud to pick the drones up on the way out . . . and guide them to their landing field at Roi Island. The Army Air Forces picked up their own drones by their same mother ship, and guided them back to Eniwetok. One Navy drone's automatic pilot failed before it reached the cloud and it crashed at sea. The other planes after they performed their detailed assigned missions returned to their bases, then turned to the technical job of tracking the radioactive cloud which became the top business of the (post-burst) air phase.

Re-Entry

The plan of re-entry was primarily dependent on these factors:

The probability of considerable hazard, which was expected, required that ships and personnel not required for safety inspections and urgent salvage work be kept clear of the atoll until such danger passed completely. However, approximately half an hour after the detonation PBM's (Navy flying boats) were sent into the target area at an altitude of 2000 feet. If they did not run into radioactivity after flying a zigzag pattern over the target they would have repeated the flight at 1000 feet and at 500 feet. If they had encountered dangerous radioactivity, they would have returned to a position northeast of the atoll to await further orders. About an hour after the initiation of the radiological reconnaissance, the PBM's and one or two helicopters approached the shores of Bikini from the windward. They took dirt samples from the atoll and advised on the contaminated areas at a lower level than the PBM's. Further radiological reconnaissance was carried out during the period immediately after the detonation by means of four radio-controlled LCVP's which broadcast Geiger counter reports of the degree of contamination in the target area as they were guided about through the ships by a "mother" plane from the BEGOR. In order to provide the mother plane with accurate information on the position of the drone boats, a helicopter hovered over the target fleet to give minute by minute reports of the position of the drones. At the same time destroyers of the Surface Patrol proceeded to monitor for the spread of radioactivity in air and water outside the atoll, both up and downwind. Surface and deep water samples were taken but the priority job was to determine the early limits of radiologically dangerous areas in air and water. Biological samples also were taken according to plan. At the same time air reconnaisance by two Geiger-counter equipped B-29's were set about the stern task of delimiting the radioactive cloud masses. There was no assurance that the area would be declared safe on A-Day, or the day following. However, re-entry was effected within 24 hours and here is how it was accomplished.

The order of re-entry, when the safety and radiological experts gave the word was as follows:

Wave 0—The MT. McKINLEY operated independently in accordance with orders from CJTF-1.

Wave 1—Six gunboats approached the lagoon through the southeastern entrance. These gunboats constituted the first re-entry wave and carried monitors of the radiological safety party.

Wave 2—The second section of the radiological safety party in 20 LCVP's (small landing craft), were on their ships, each containing three monitors and an assistant as well as a full crew. Their mission was to trace the extent of the contaminated area and to move in among the ships of the target array as soon as safety permitted. They reported, along with the monitors in the first section, to the Chief of the Radiological Safety Section, when no contamination was encountered.

Wave 3—The initial boarding and inspection party was moved in as soon as the lagoon was declared free of radiological hazards. This wave was comprised of six ARS's, small ships of sea going tug type, specially fitted for rescue and salvage, and four LCVP's, carrying the initial boarding teams, and two other ARS's, as primary and secondary control vessels. Each boarding team, in addition to a radiological safety officer, included a bomb and ammunition disposal officer and a technical representative of the Director of Ship Material and a photographer. Their function was to fight fires, to control flooding and to advise the commanding officer of the salvage unit in matters of safety and to record the extent and general nature of the damage. Radiological safety officers checked all parts of the ships for radio-activity prior to detailed survey of damage. This inspection began before the boarding party went aboard the ship. It continued as long as there was any indication of radioactivity present.

Wave 4—The remainder of the salvage unit.

Wave 5—The technical group.

Wave 6—The transport group, including the APPALACHIAN, BLUE RIDGE and PANAMINT.

Wave 7—The target vessel group with the hands that manned the target ships.

The remaining ships with reasons for re-entry followed the above waves into Bikini Lagoon.

We arrived back at Kwajalein at 4:30 that afternoon, having flown in from the Shangri-La on a TBM.

The following day was spent in trying to make arrangements for the long flight to the mainland. Luckily I was able to get passage on an ATC Cargo Carrier which was carrying precious film of the blast aboard. We flew to San Francisco with only one short stop at Honolulu. Through the timely help on the part of our Chicago Office, I got space on a TWA Stratoliner for Chicago. I arrived at ten o'clock on the morning of July 5th, exactly four weeks after having left the same airport.

I am firmly convinced from what I have seen that the next war, if it ever comes, will be one of radio guided missiles. Atomic bombs will become drones in themselves and they in turn might also serve as control media for the guiding of accompanying missiles. The science of radio control is not new. With new techniques and perfection of control, it is entirely conceivable that the next war would be one conducted at remote distances by "push button radio." We hope that day never comes.

—30—

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.

VACUUM CAPACITORS

A new brochure, ETX-3, describing the *General Electric* line of vacuum capacitors for use in aircraft, military and commercial radio electronic circuits, has recently been released for distribution by the company.

The bulletin is complete with schematic drawings, circuit diagrams, rating and installation photographs, in addition to major design and operation features of the capacitors.

This line of vacuum capacitors is especially suited for high frequency and high voltage circuits where stability of operations and small size are important factors, according to the company. They may be used in circuits where peak voltages range from 7500 to 16,000 volts.

A copy of brochure ETX-3, entitled "G-E Vacuum Capacitors" is available from the Tube Division, *General Electric Company,* Electronic Department, Schenectady, New York.

REINER INSTRUMENT

A four-page bulletin, describing the company's Model 333 laboratory volt-milli-ammeter is currently available from *Reiner Electronics Company, Inc.*

The bulletin covers the principles of operation and all applications of this new instrument.

A copy of bulletin No. 105 will be forwarded to those making their request to *Reiner Electronics Company, Inc.,* 152 West 25 Street, New York 1, New York.

SUPPLY EXHAUSTED

Electronic Corporation of America has asked us to advise our readers that the supply of the booklet "The Amazing Electron," recently announced in this column, has been exhausted and is no longer available.

Our readers are asked not to forward additional requests for this booklet as the company does not plan to print more copies at the present time.

SPEAKER CATALOGUE

University Loudspeakers, Inc. has just released a new 22-page catalogue covering their line of super power speakers, breakdown-proof driver units, reflex loudspeaker trumpets, radial reflex projectors, industrial paging speakers, radial communication speakers, submergence and explosion proof speakers, compact railroad and marine speakers, and radial cone speakers.

Several models of each type of unit are illustrated and size and frequency range data is provided.

A copy of this catalogue is free for the asking. Address your requests to *University Loudspeakers, Inc.,* 225 Varick Street, New York 14, New York.

WALL CHART

A heavy-paper chart, suitable for filing or wall use, has been issued by *Shallcross Manufacturing Company* and covers their line of Akra-Ohm Precision Fixed Wire-Wound Resistors.

This chart, which is free of charge, contains complete engineering details of the line. Fifty-four different resistor types are illustrated and described. Full details are included on adaptations for specific engineering purposes. Dimension data, mounting specifications, minimum and maximum resistance values, tolerance, temperature charts, temperature coefficient data and other factors are arranged in easy-to-find style. All resistors are illustrated in a close approximation of actual size.

A copy of the chart will be forwarded upon request to *Shallcross Manufacturing Company,* Collingdale, Pennsylvania. Ask for the *Shallcross* Akra-Ohm Resistor Engineering Data Chart.

TUBE CATALOGUE

Chatham Electronics of Newark, New Jersey, has recently released a new catalogue covering their line of electronic tubes.

Operational data on several types of thyratrons and rectifiers is included along with base connections, information and ratings.

This catalogue is intended to be the basis of a complete file, new data sheets being issued from time to time to supplement this original catalogue.

A copy of this bulletin will be forwarded to those requesting a copy from *Chatham Electronics,* 475 Washington Street, Newark 2, New Jersey.

DILECTO CATALOGUE

Continental-Diamond Fibre Company of Newark, Delaware, are currently offering a new catalogue covering Dilecto Sheet grades of their laminated phenolic plastic.

This 42-page catalogue features a complete electrical and mechanical property data sheet which should be of value to design engineers. Information covers 32 different grades of this material tabulated in easy-to-read form.

Individual grades are discussed in the catalogue as to various application characteristics.

A copy of catalogue DO-49 will be sent upon request to *Continental-Diamond Fibre Company*, Newark 49 Delaware.

TOBE CATALOGUE

The 1946 edition of the *Tobe* catalogue has recently been made available by *Tobe Deutschmann Corporation* of Canton, Massachusetts.

Included in this catalogue is an up-to-date compilation of structural data and performance characteristics of capacitors having widely diversified application in the production of electrical apparatus.

This 40-page edition includes a section devoted to "Filterettes," radio noise suppression units manufactured by the company. This section contains detailed data and specific recommendations for the selection of units to quell radio noise from common electrical devices.

The catalogue is available without cost to those engaged in the production of electrical and electronic apparatus. Requests should be addressed to the company, *Tobe Deutschmann Corporation*, Canton, Massachusetts.

MAINTENANCE HANDBOOK

A new handbook, "Maintenance of Industrial Electronic Equipment" has just been announced by *Westinghouse Electric Corporation*.

Six basic maintenance operations; cleaning, inspecting, feeling, tightening, adjusting and lubricating, are discussed and applied to vacuum and ignitron tubes, capacitors, resistors, fuses, bushings and insulators, relays, switches, transformers, filter chokes, terminal blocks, meters and other components. Safety precautions to be observed during preventive maintenance operations are also included.

A copy of the booklet, B-3658, may be secured from *Westinghouse Electric Corporation*, P.O. Box 868, Pittsburgh, 30, Pennsylvania. Be sure to specify the booklet number when making your request.

RESISTOR CATALOGUE

A two-color, 8-page catalogue, featuring their precision line of vitreous enameled resistors, has been released for distribution by *Model Engineering & Mfg., Inc.* of Huntington, Indiana.

All types of vitreous enameled resistors are shown in the catalogue, including some special non-inductive and ferrule types. Since this line, which was formerly manufactured by *Utah Radio Products Company* of Chicago, is now being manufactured by *Model Engineering & Mfg., Inc.* the old *Utah* numbers have been assigned to these new resistors in order to avoid confusion. The listing of these resistors has been simplified so that full electrical and physical characteristics can be determined rapidly. A complimentary line of resistor mounting hardware is also included in this catalogue.

The catalogue is available free to engineers and purchasing agents who make their request to *Model Engineering & Mfg., Inc.* Huntington, Indiana, on their firm letterhead.

CAPACITOR BULLETIN

The Radolek Company of Chicago, Illinois, is currently distributing a new catalogue covering the *Solar* line of condensers suitable for radio servicing.

Included in the listing are *Solar* "Minicap" dry electrolytics, Type DH "Universal" dry electrolytics, Type DY "Twist-Prong" dry electrolytics, Types D, DM and DI dry electrolytics with round screw-base metal cans, paper capacitors, suppressor types, Type XTIMS oil-filled tubular paper capacitors, Types MO and MW receiving mica capacitors and "Elim-O-Stat" suppressors.

A copy of this bulletin covering all types of capacitors for industrial, service, and amateur use will be sent upon request to *The Radolek Company*, 601 W. Randolph Street, Chicago 6, Illinois.

BULLETIN SERVICE

Centralab, Division of Globe-Union, Inc., has instituted a new policy of issuing temporary bulletins covering their line because of the rapidly changing conditions in the radio industry.

These bulletins include part numbers, standard values, tolerances, working voltages, power factor limits, leakage resistance, color code and dimensions of the parts. The first of these bulletins, Form 933, covers the company's BC (by-pass and coupling) capacitors. The material included in these temporary bulletins will later be incorporated in a permanent catalogue.

A copy of this form will be forwarded upon request to *Centralab, Division of Globe-Union, Inc.*, 900 East Keefe Avenue, Milwaukee 1, Wis.

INSTRUMENT COURSE

Westinghouse Electric Corporation has just completed the preparation of a new course designed to present fundamental knowledge of the construction, operation and selection of electrical measuring instruments.

The course includes sound slide films, a complete pocket-size textbook, and an instructor's manual.

Although this course was primarily designed for use within the *Westinghouse* organization, it has been made available to educational institutions, engineering societies and the engineering departments.

Subjects covered include the importance of electrical instruments, permanent magnet moving coil mechanism, the electro-dynamometer mechanism, stationary coil and moving iron mechanism, rotating vane mechanism, and the selection and use of electrical instruments.

Distribution of the course is being handled by the Industrial Relations Department, *Westinghouse Electric Corporation*, 306 Fourth Avenue, Pittsburgh, 30, Pennsylvania. Orders or inquiries regarding this course should be directed to this department.

ASA CATALOGUE

A revised list of standards approved to date has been published by the *American Standards Association* and is available free of charge.

The 845 standards listed in the catalogue include definitions of technical terms, specifications for metals and other materials, and test procedures.

Also included is a listing of the 154 American War Standards which were used by the Army, Navy and WPB and are, at the present, being reevaluated for possible peacetime adoption.

The listing should be of value to engineers and manufacturers and will be sent free of charge upon request to *American Standards Association*, 70 East 45th Street, New York 17, New York.

W-L RELAY BOOKLET

A four-page bulletin covering their line of midget metal base relays is being offered by *Ward Leonard Electric Co.*

This fully illustrated bulletin covers coil and contact data, contact arrangement diagrams, dimension sketches, etc. These relays are designed for use in small radio transmitters, and aircraft control circuits.

Bulletin 104 will be forwarded upon request to *Ward Leonard Electric Co.*, 31 South Street, Mt. Vernon, New York. —30—

QTC

(*Continued from page 45*)

lines . . . All of the maritime nations of the world except the U. S. have rapidly moved toward combining sea and air transport for the better interest of commerce in their respective countries. . . . Four strong maritime countries, Sweden, Denmark, Holland and Norway have already established overseas air routes to various points throughout the world in which private shipping enterprises either control outright or have a substantial interest—five more nations, France, New Zealand, Canada, England and Australia are starting integrated government operation of steamship and air lines in overseas commerce. Nearly fifty other nations have the right to compete with American shipping and air lines under treaties which the U. S. must honor—all such lines have or will be approved by the CAB. Nine American steamship companies attempting to obtain the same permission to operate joint air-sea lanes have been refused. This certainly appears as though the American firms are not being given the fair break which is necessary if they are to compete with foreign firms . . . this will mean a big drop in sea commerce if the foreign lines operate combination services via both sea and air transport. To radiomen and all maritime workers this would seem to be of great importance, however their interest seems so far to be of the mild variety or they would be demanding some type of legislation more to their advantage.

THE Liner America, the largest U. S. built ship, former north Atlantic passenger vessel, is being held up in her reconversion to commercial use by the shortage of materials for furnishings—she is being refitted at Newport News and will make a good berth for several marine radiomen upon her return to service after several years as the transport Westpoint. 73

FORTY AND TWENTY REOPENED

EFFECTIVE July 1st at 3:00 A.M. EST, the FCC announced Order No. 130-H allowing the resumption of operation on the bands from 7150 kc. to 7300 kc. and 14,200 to 14,400 kc. for type A1 emission.

In addition, the band from 14,200 kc. to 14,300 kc. may be used for type A3 emission by those operators holding a Class A license, provided that the station is also licensed to a Class A operator.

The 3900 to 4000 kc. band has been enlarged to now read 3850 to 4000 kc. under the same conditions applying to the 14,200 kc. to 14,300 kc. band.

The use of type A3 emission on the 28 mc. band is now limited to the portion from 28,500 kc. to 29,700 kc.

—30—

Spot Radio News
(Continued from page 14)

berg) runs, and from the Union of South Africa—of all places—we heard the other day that radar is being used to hunt whales. (Radar-equipped subchasers got a few whales by mistake during the war.) First skippers to use it had such good luck that other installations are being made and U. S. whalers are considering it.

MORE SEA-GOING radar may result from current research by the Navy Electronics Laboratory, where a study of the effects of weather changes on high frequency radio transmission is underway. Hoped-for by-product of the work is the possible application of high frequency radio transmissions to the science of weather forecasting. Scientists have long suspected that temperature, air pressure and humidity conditions in the lower atmosphere cause the wide variations in the range of ultra short-wave radio and radar transmissions, which have been received at times from hundreds and even thousands of miles away. At other times, they travel only a few miles. Different frequencies are known to operate best under certain weather conditions. By determining the right frequency for each particular weather condition, the scientists hope to extend the range of ultra short-wave transmissions, which have been generally limited to the optical horizon, or at best 150 miles.

THE RESEARCH is being conducted at an abandoned Army air base at Gila Bend, Arizona. It's costing $500,000. "Our data is still in a preliminary stage," says Lt. A. P. D. Stokes, chief aerologist for the project, "but we have already been able to detect subtle atmospheric changes which precede approaching weather fronts two days before our most sensitive meteorological instruments have been able to pick up the change." Such advance notice would, if perfected, be invaluable to ship captains and all others interested in weather conditions coming their way. But of major interest to the radio world is the hope of Dr. John B. Smyth, civilian scientist on the Gila Bend project. He believes that the experiments may open the way for the extension of the range of ultra short-wave radio and radar transmissions, not to mention television, as much as 2000 miles. Usable conclusions from the research are not expected before the first of next year.

Personals

New director of public relations at FCC is **George O. Gillingham,** former newspaperman, Army chemical warfare service lieutenant-colonel, and Tennessee Valley Authority information director. It's not a new job for Mr. Gillingham—he held it 'til he joined the Army in 1942. **Earl Minderman,** who handled the work while Gillingham was away, will undertake

WANTED!

Articles by Radio Amateurs

2000 to 2500 words

Covering any material of genuine interest to radio amateurs, such as:

- **Transmitters**
- **Receivers**
- **Antennas**
- **Test Equipment**

Articles should be typewritten (double spaced) and accompanied by suitable diagrams, photos, and parts lists. Liberal payment will be made upon acceptance.

Address all communications to

Box 419

RADIO NEWS
185 North Wabash Avenue
Chicago 1, Illinois

a special assignment under the direction of the chairman of FCC.

Release of RMA statistics to the general public has been okayed by **Fred D. Williams**, chairman of the Association's industry statistics committee.

—30—

"Juke Box" Analyzer
(*Continued from page 44*)

wire-wound volume control-type component.

The following procedure must be followed in the a.c. calibration: (1) Set S_3 to *"AC"* and S_6 to *"Off"*; (2) Set S_4 to 1-volt range; (3) Set potentiometer in calibration circuit for 0.1-v. deflection of std. voltmeter; (4) Connect calibration circuit leads to jacks J_2 and J_1; (5) Depress meter pushbutton switch S_2-S_5 and observe deflection of instrument milliammeter; (6) Inscribe this deflection as 0.1 volt on the meter card or on a calibration chart or graph; (7) Advance calibration potentiometer for 0.2-v. deflection of standard voltmeter, depress S_2-S_5, note milliammeter deflection, and record as 0.2 volt; (8) Repeat entire procedure every 0.1 volt until 1-volt limit of meter scale is reached; (9) Set S_4 to 10-volt range, and repeat procedure, checking every ¼-volt point from ¼ to 10 volts.

D.C. Milliammeter. No d.c. milliammeter calibration is required if the milliammeter and shunt resistors are accurate and if the circuit is wired correctly. The 0-1 scale of the meter will indicate automatically 0-1-10-100-1000 milliamperes. Should it be necessary to check the milliammeter circuit, however, the test circuit shown in Fig. 5B may be utilized. In this setup, a single dry cell supplies the direct current which is controlled by a rheostat, *R*. Best rheostat values for each current range of the meter also are listed in Fig. 5B. The standard meter is an accurate 0-1-10-1000 d.c. milliammeter.

The following procedure must be followed in checking the current ranges of the juke box tester: (1) In juke box tester, set S_3 to *"DC,"* S_6 to *"Off,"* and S_4 to 1-ma. range; (2) In test circuit, select proper rheostat *R* for 1-ma. range (See Fig. 5B), set rheostat to highest resistance, and connect test circuit leads to jacks J_4 and J_5; (3) Set standard meter in test circuit to 1-ma. range; (4) Depress meter pushbutton S_2-S_5 and advance rheostat *R* in test circuit to obtain 0.9 ma. deflection of standard meter; (5) Observe reading of milliammeter in juke box tester, which should be identical with reading of standard meter in test circuit; (6) Repeat entire procedure, checking 9-ma. point on 10-ma. range of juke box milliammeter, 90-ma. point on 100-ma. range, and 900-ma. point on 1000-ma. range. The latter checking operation must be completed as quickly as possible, since it is not wise to draw a current of very nearly 1 ampere from a dry cell over a long interval.

Signal Circuit. To determine if the signal generator circuit is operating correctly: (1) Connect headphones to signal output jack J_1; (2) Close battery switch S_1 and advance output control R_1 until comfortable signal is heard in headphones; (3) Adjust buzzer contact screw (or oscillator grid capacitor value) until signal tone has desired pitch; (4) Vary output control potentiometer from minimum to maximum to ascertain if full control of volume is obtained.

The juke box tester is operated like a regular radio set analyzer of the selective type. Most servicemen are familiar with the proper procedure. Several illustrations which are typical of all tests made with this instrument are given below, however, for the benefit of those readers who desire specific instructions.

CASE 1. *Measurements at Socket of 2A3 Tube.* (1) Remove 2A3 tube from chassis socket; (2) Insert plug adaptor *A* (See Fig. 4) on octal test plug at end of instrument cable, and insert "adapted" plug into empty 2A3 socket on chassis; (3) Connect test cable alligator clip to juke box chassis (ground); (4) Insert socket adaptor *A* (See Fig. 4) into octal socket on panel of tester, and plug 2A3 tube into this "adapted" socket; (5) Switch-on power to juke box. *Plate Voltage:* Connect J_2 to J_{13} and J_4 to J_6; set S_4 to *"1000 v.,"*

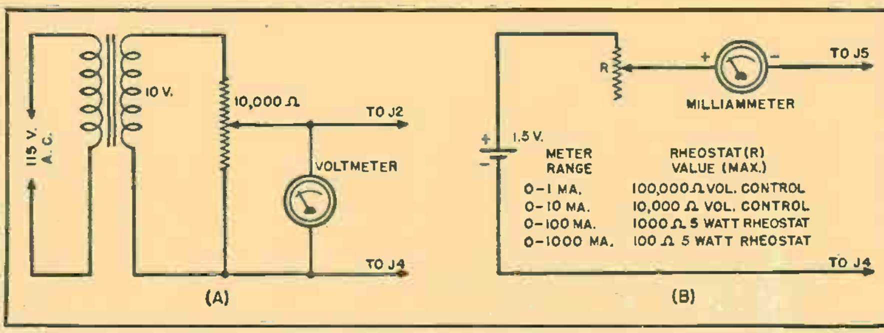


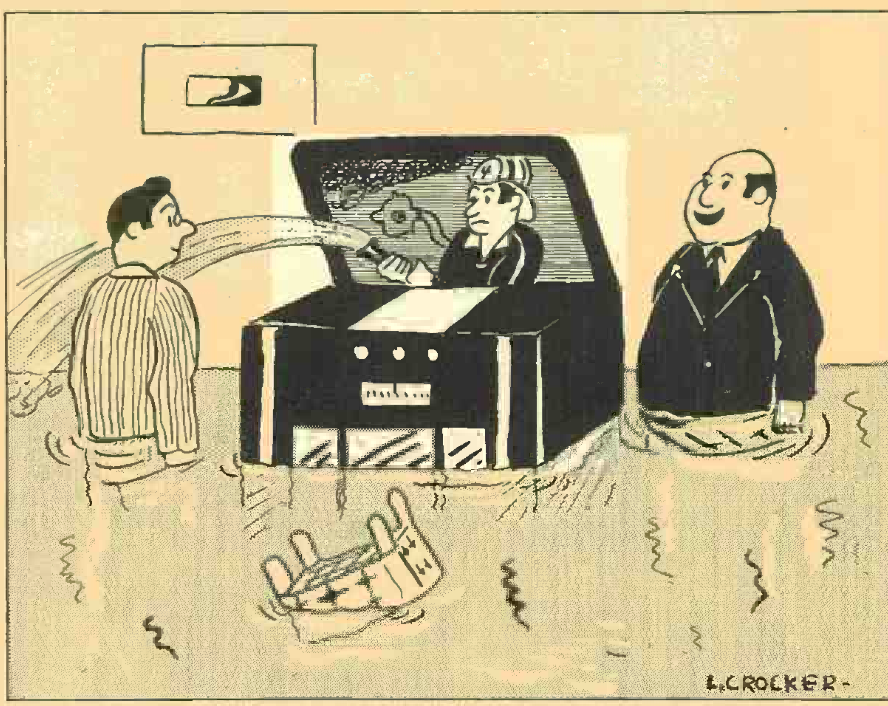
Fig. 5. Diagram for a.c. voltmeter calibration, (A); and for milliammeter calibration, (B).

S_3 to *"DC,"* and S_6 to *"Off"*; depress meter pushbutton switch S_2-S_5 for plate voltage reading. *Grid Voltage:* Connect J_2 to J_6 and J_4 to J_{12}; set S_1 to *"100 v.,"* S_3 to *"DC,"* and S_6 to *"Off"*; depress meter pushbutton switch S_2-S_5 for grid voltage reading. *Filament Voltage:* Connect J_2 to J_{14} and J_4 to J_{11}; Set S_4 to *"10 v.,"* S_3 to *"AC,"* and S_6 to *"Off"*; depress meter pushbutton switch S_2-S_5 for filament voltage reading. *Plate Current:* Set S_3 to *"DC,"* S_1 to *"100 MA.,"* and S_6 to position 2; depress meter pushbutton switch S_2-S_5 for plate current reading. *Grid Current:* Proceed as for plate current, except set S_1 to *"10 MA."* and S_6 to position 3.

Measurements are made in the same fashion at *any* tube socket, except that in making voltage measurements other jacks along the J_6-to-J_{14} string are involved (those corresponding to the tube socket numbering), other plug and socket adapters are required, other settings of meter insertion switch S_6 are involved (the switch position numbers corresponding to the numbers of the tube socket lines—and terminals—in which current measurements are to be made), and very likely other meter ranges will be required.

CASE 2. *Checking Power Output or Amplifier Action.* (1) Connect signal output jack J_1 to input circuit of juke box amplifier by means of shielded line; (2) Close signal switch S_1 and advance output control R_1 until strong, undistorted signal is obtained; (3) Set S_3 to *"AC,"* S_4 to *"1000 v.,"* and S_6 to *"Off"*; (4) Connect J_3 and J_4 to speaker voice coil terminals or to plate load resistor terminals (connections to ground and to plate of tube will suffice if tests are made along J_6-J_{11} jack string), and depress meter pushbutton switch S_2-S_5 to obtain audio output indication; (5) If readable deflection is not obtained on *"1000 v."* scale, step range down successively lower until good reading is obtained.

This is a good audio signal tracing test for determining which amplifier stages are defective or inoperative. It is convenient to feed the signal into the grid circuit of a stage by connecting J_1 to grid and ground terminals along the J_6-J_{14} jack string, and to check the output signal (as described above) by connecting J_3 and J_4 to plate and ground jacks respectively in the J_6-J_{14} group. If all circuit voltages (d.c. and a.c.) have been found to be correct, poor amplification or no sig-



"Television is getting realistic now, isn't it?"

nal at all usually indicates a defective tube.

CASE 3. *External Use of Meter.* The voltmeter, milliammeter, and output meter circuits are available for external use in conventional testing. Regular test leads may be inserted into appropriate pin jacks in the J_2-J_5 group. The a.c. and d.c. voltmeter is available through jacks J_2 and J_4, the d.c. milliammeter through jacks J_3 and J_6, and the a.c. output meter through jacks J_3 and J_5. When using the meter circuits externally, switch S_6 should be set to its *"Off"* position and the octal plug on the end of the test cable should be placed out of reach. If the operator requires both hands to manipulate the test prods, meter pushbutton switch S_2-S_5 should be locked down.

CASE 4. *Checking Phonograph Pickups.* Most juke box pickups can be checked by connecting the a.c. voltmeter (set to 0-1 or 0-10 volts) directly across the pickup terminals through packs J_2 and J_4, while a record is running under the pickup needle. In most cases, it will not be necessary to disconnect the pickup from the amplifier grid circuit in order to make this test. However, should a high value of d.c. grid bias voltage deflect the a.c. voltmeter, the 1 μfd. isolating capacitor may be introduced into the circuit to correct the trouble by employing jacks J_2 and J_3. When checking a pickup in this manner with record music as a signal source, the operator must not place too much importance upon the actual a.c. voltage value read, since the meter rectifier is not efficient at the music frequencies and the voltage indication is apt to be in considerable error.

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For the Record

(*Continued from page* 8)

In testing a receiver it has been found best to start with the speaker (unless something more apparent is first detected) and work back in a methodical way through preceding stages to the antenna until the failure is found and is isolated. In this manner the repairman always knows just where he stands and in the long run he will be able to determine the fault faster than with haphazard random testing. Truly service ability lies in *Knowledge, Logic* and *System* more than in "Solve-All Instruments" as some people might have you think. It is usually wise to look a set over well before starting a test. In this way you acquire knowledge of the chassis layout, as well as form a mental picture or "block diagram" of the circuit functions. This little measure will usually give you some insight into the set from the start.

Adhering to sound business principles, doing accurate, high quality work and developing a pleasing business personality are the essentials for building a sound and secure radio repair enterprise. ................O.R.

Practical Radio Course

(Continued from page 47)

changes of voltage on this electrode are in direct opposite phase (anti-phase) to those on oscillator grid *G1* (which is relied upon to modulate the main electron stream at oscillator frequency) and consequently tend to *reduce* the effective oscillator voltage applied for frequency changing.

Converter Tube Operation

This simple form of pentagrid converter may be considered as operating very much like a conventional variable-mu tetrode inner-grid injection type *mixer* with an associated triode *oscillator*, except that the oscillator triode grid is located next to the cathode and, being in the main electron stream, is common to both the variable-mu tetrode mixer and the oscillator triode. The main electron stream reaching the tetrode section of the tube is modulated by the oscillator grid voltage on *G1* in such a manner that there is no danger of driving the control grid of the tetrode positive.

Electrons emitted from the cathode surface are influenced by the various grid and plate voltages and divide up[3] so that oscillator grid *G1* receives only about 3 to 6 per-cent of the electrons, the oscillator plate *G2* receives about 40 per-cent of the electrons (mainly through secondary emission from inner screen grid *G3*), grids *G3* and *G5* (screen grid) receive about 25 to 30 per-cent of the electrons, and the main plate receives the remainder of the electrons emitted. Because of the oscillator grid's strategic position next to the cathode, any oscillator voltage impressed on this grid will modulate the entire electron stream regardless of the ultimate destination of the electrons.

Referring to the circuit diagram at *C* of Fig. 2, it is interesting and instructive to review the various actions that take place within the tube when it and the associated circuit components are operating normally.

When the receiver is first turned on, the oscillator control-grid *G1* is at zero potential because it is tied to the cathode by the grid leak R_g (of about 50,000 ohms). As the cathode heats up and begins to emit electrons the feedback between the oscillator plate and grid circuits (through magnetic coupling between the osc. plate tickler and oscillator tank tuning coils) causes regeneration which immediately starts the triode circuit to oscillating. When the oscillator circuit is oscillating, oscillator grid *G1* is driven alternately positive and negative at oscillator frequency. While this grid is positive, grid current flows through the grid lead resistor R_g and bias resistor R in such a direction as to tend to make this grid *negative* with respect to the cathode. This grid swing may make the grid negative by as much as 30 to 40 volts, and this be-

[3] Sylvania News, March 1943.

comes the grid-bias point about which the grid varies in amplitude alternately in a positive and then a negative direction under the influence of plate circuit feedback. From this it can be seen that the maximum instantaneous negative potential on the oscillator grid *G1* may be as much as 60 to 80 volts.

Such a high negative potential on the oscillator grid would ordinarily be more than sufficient to reduce the tetrode electron stream (plate current) to zero over a substantial portion of each oscillator cycle were it not for a secondary source of electrons available to the signal grid *G4*. This second electron source is commonly referred to as the *virtual cathode* because it is employed exactly as though it were another electron-emitting cathode.

As the oscillator grid potential swings alternately positive and negative during each cycle of the impressed oscillator voltage, it varies the intensity of the electron stream shooting through it from the main cathode. Consequently, *this electron stream pulsates at oscillator frequency.*

Most of the electrons comprising this pulsating stream possess high velocities. Those that strike the wires comprising the inner screen grid *G3* cause secondary emission of electrons that are mainly attracted back to the two *positive* plate rods *G2*, and so contribute to the oscillator plate current. Those that shoot through the

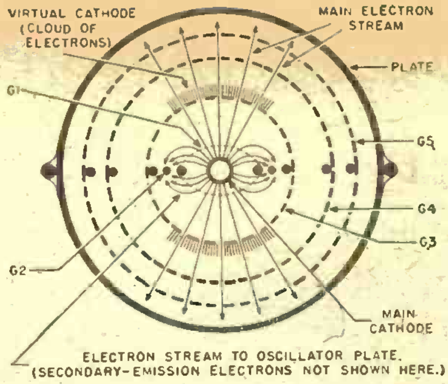

Fig. 3. Pictorial representation of the various grids in the simple pentagrid converter, the electron streams in the tube and the virtual cathode. The shading illustrates the instantaneous density of electrons.

openings in *G3* approach the signal grid *G4*. This grid has a *negative* potential at all times (due to the sufficiently negative bias voltage applied to it). This negative potential, (aided by the geometry of *G3* and *G4*), retards the oncoming electron stream so that a great many of these electrons are slowed down and so form a pulsating cloud of electrons between grids *G3* and *G4* as illustrated in Fig. 3. *This pulsating cloud of retarded electrons constitutes a "virtual cathode" for the tetrode (mixer) section of the tube.*

Electrons may be drawn away from this pulsating source (virtual cathode) in a manner quite similar to that by which they were accelerated away from the main cathode. Therefore, the signal control grid *G4* operates just as if it had its own cathode, with the exception that this virtual cathode is not a constant (steady) source of electrons, and has no inertia.

The quantity of electrons in this electron cloud or *space charge* comprising the virtual cathode is not constant, but is instantaneously varying at the oscillator frequency. As the plate current of the tetrode mixer section at each instant depends on the transconductance of the signal-grid-to-plate system at that instant, which, deriving its electrons from the pulsating virtual cathode, is itself a function of the oscillator-grid potential at each instant, it follows that the plate current of the mixer section must be proportional to *both* at each instant. Consequently, *both* the signal and oscillator voltages effectively modulate the plate current, and the desired sum and difference (i.f.) frequencies are produced. Hence, frequency conversion by means of electron coupling has been accomplished!

It is apparent that the tetrode mixer section operates somewhat independently of the triode oscillator section, except that the electron stream supplied to the mixer section is modulated at oscillator frequency by the grid potential of the triode oscillator.

With the exception of a special action that will be explained presently, the operation of the oscillator portion is controlled almost entirely by the oscillator grid *G1* and not by the signal grid *G4*. Accordingly, the latter is incapable of producing electron (plate current) cut-off in the oscillator section, (because the oscillator triode secures its supply of electrons *first*, direct from the main cathode, as a study of Fig. 3 will show). Consequently, the *gain* of the mixer section of the tube can be controlled over a considerable range by a variable negative bias applied to signal grid *G4*, without substantially affecting the performance of the oscillator section. Therefore, automatic volume control (with all its desirable advantages) may be incorporated into the receiver by applying suitable a.v.c. bias to the signal-grid circuit of the tetrode section, as indicated in the circuit shown at *C* of Fig. 2. This is one important advantage that the pentagrid converter possesses over previous types of converters such as the autodynes.

It is apparent from the foregoing detailed explanation of its operation that this general type of pentagrid converter tube possesses many of the advantages of a two-tube frequency converter system. It provides, in addition, several improvements in the performance on the broadcast band of frequencies. These include: (1) a higher conversion gain. (2) An oscillator system which is fairly independent of the r.f. signal system (up to certain frequencies). (3) The possibility of applying a variable bias voltage to the signal grid for satisfactorily controlling volume. (4) The possibility of employing a.v.c. with a minimum number of tubes.

The general circuit arrangement illustrated at *C* of Fig. 2 is the most widely used with this type of pentagrid converter and performs very well over the standard broadcast band. The oscillator usually is of the tuned-grid type as shown, since the comparatively large oscillator voltage required on the oscillator grid *G1* can be obtained more easily from a tuned-grid than a tuned-plate type oscillator.

Inherent Disadvantages of Simple Pentagrid Converter Tubes at Frequencies above 10 mc.

The ordinary pentagrid converter tubes, as represented by the 6A8, 1A7 and other tubes of similar construction employing the relatively simple design described here, have given excellent frequency-conversion performance at the standard broadcast band frequencies and on the short-wave broadcast band up to frequencies of approximately 10-13 megacycles—developing conversion transconductances as high as 550 micromhos, compared to about 350 or less for other types. Consequently, they are popular converter tubes for use in those receivers that are designed to operate over the standard broadcast band and possibly a few of the lower-frequency short-wave bands.

At frequencies above approximately

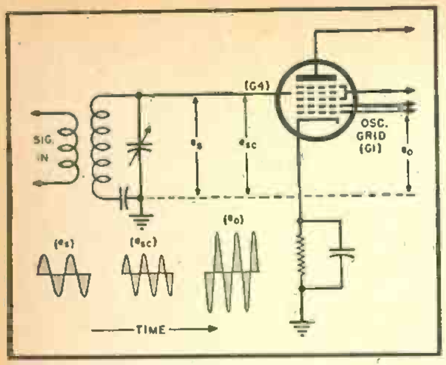

Fig. 4. How antiphase voltage of oscillator frequency developed in signal-grid circuit of single pentagrid converter due to space-charge coupling between G1 and G4 opposes modulating action of voltage impressed on oscillator grid and causes gain reduction at the high frequencies.

10-13 mc. certain inherent undesirable characteristics appear. (1) The conversion transconductance and gain fall off (the sensitivity drop being particularly rapid above about 15 mc.). (2) The oscillator stability decreases, for supply-voltage variations and the varying a.v.c. bias voltage applied to the signal grid cause the oscillator frequency to drift.

Reason for Drop in Gain of Simple Pentagrid Converters above 10 mc.—Space Charge Coupling

The reason for the drop in conversion transconductance at the higher frequencies is important. As the potential of oscillator grid *G1* (see Fig. 3) approaches zero and swings *positive* during its voltage cycle, the quantity of electrons that get through it and join the cloud of electrons forming the "virtual cathode" between *G3* and *G4* increases. Consequently, this cloud takes up a larger space and the center of this space charge moves nearer to *G4*. As the potential of oscillator-grid *G1* goes more negative, on the other hand, the quantity of electrons getting through it decreases, so the quantity of electrons in the cloud forming the virtual cathode decreases and the center of this space charge then recedes nearer to *G3*. Consequently, the virtual cathode shifts back and forth in the space between *G3* and *G4*, and it is partially this shifting that causes the grid-to-plate transconductance of the mixer portion of the tube to change [2] from a maximum to a minimum, at oscillator frequency.

Thus far, in our discussions we have regarded the negatively-biased signal grid *G4* and its attached circuit as being entirely independent of the flow of electrons passing through it. Unfortunately this is not exactly true—especially at the high frequencies. The virtual cathode, consisting of a cloud of electrons each bearing a negative charge, constitutes an electrical charge in space—a *space charge.* This space charge, pulsating in value and approaching and receding at oscillator frequency, causes electrons to flow in and out of the wires comprising signal grid *G4*—that is, a current at oscillator frequency flows in and out of it. This is known as a *displacement current*, and the effect is called the *space-charge coupling* effect.

As a result of this action, displacement current of oscillator frequency oscillates back and forth through the signal-frequency tuning circuits associated with the signal grid, and due to the impedance of these a voltage e_{sc} of oscillator frequency is built up across the input grid *(G4)* circuit as illustrated in Fig. 4. The oscillator-frequency voltage developed on signal grid *G4* will be greatest when the difference between the oscillator frequency and the resonant frequency of the signal input circuit is small—*percentagewise*—which is the case at the high signal frequencies. Furthermore, this voltage on *G4* will be in-phase with that on the oscillator grid *G1* if the input circuit reactance is *inductive* with respect to the oscillator frequency, and will be 180° out-of-phase with it (antiphase) if the input circuit reactance is *capacitive* with respect to the oscillator frequency.

In receivers in which the ganged signal-tuning and oscillator-tuning circuits are designed so the oscillator frequency, f_o, is at all times *higher* than the frequency, f_s, of the incoming signal (as is the case in the usual receiver), the reactance of the signal circuit between the signal grid and cathode is *capacitive* at the oscillator frequency (because this frequency always is *higher* than the resonant frequency to which the signal circuit is tuned). Consequently, under this mode of operation the a.c. voltage e_{sc} of oscillator frequency developed across the signal-grid circuit due to the flow of displacement current occasioned by the space charge will be 180° out of phase (antiphase) with the oscillator grid voltage as shown in Fig. 4. Therefore, the modulating effect of this a.c. voltage upon the electron stream is directly opposite to that simultaneously being produced by the oscillator grid voltage. As a result, the *effective* modulation of the signal-grid-to-plate transconductance accomplished by the oscillator grid is *reduced*, so the value of the conversion transconductance (and conversion *gain*) obtained—which is proportional to this modulation—is also reduced. Since the displacement current occasioned by the space charge, and the voltage drop it produces, both increase as the frequency is increased, this loss of gain increases seriously at the higher frequencies.

As the oscillators of most superheterodyne receivers are designed to operate at a frequency always *above* that of the incoming signal, this degenerative effect and consequent drop in gain occurs in increasing degree as the signal frequency is increased above about 10-13 mc.

In a receiver in which the oscillator is designed to operate at a frequency always *below* that of the incoming signal by the amount of the i.f., the result of the space-charge coupling in the pentagrid converter tube is opposite to that just described—i.e., the voltage produced by it in the signal-grid circuit is *in-phase* with the oscillator grid voltage, so a *regenerative* effect results. This is why the manufacturers of some all-wave receivers design the receiver so the oscillator operates at a frequency *below* that of the incoming signal on the highest frequency band—even though it may be operated at a frequency *higher* than that of the incoming signal on all the lower-frequency bands in order to secure other advantages that result from such operation.

The effect of this voltage of oscillator-frequency set up in the signal-grid circuit due to space-charge coupling is more or less the same as if the voltage had been set up by direct interaction. There are several ways of reducing the effect of such coupling. One can partially neutralize the space-charge coupling by inserting a small neutralizing capacitance, C_n of approximately 1 μμfd. across the *G1* and *G4* grids as illustrated at *C* of Fig. 2. This is popularly known as a "gimmick" and usually takes the form of two short insulated pieces of wire twisted together with their outer ends left unconnected. An extension of the useful performance of the converter tube into somewhat higher frequencies is possible by this means.

However, neutralizing the space-charge coupling in this way is only a partial remedy. The main difficulty is, of course, that the amplitude of the oscillations set up in the signal-grid circuit via this influence is very large compared with the amplitude of most short-wave signals received from distant stations. If we could only reverse matters, by making the inner grid, *G1*, the signal grid while applying the oscillator frequency to an *outer* grid, (outer-grid oscillator injection) a great improvement would result. As we shall learn in the next article of this series, this is precisely what has been done in several improved forms of frequency converter tubes for the higher frequencies, such as the triode-heptode and the triode-hexode converter tubes.

Reason for Excessive Oscillator-Frequency Drift in Simple Pentagrid Converter at the Higher Frequencies

Excessive oscillator-frequency drift resulting from variation in the a.v.c. bias applied to the signal-grid, or from fluctuations in the operating voltages at frequencies above about 10-13 mc. is another trouble encountered in the simple form of pentagrid converter. This is due to the fact that as the a.v.c. voltage applied to the signal grid *G1* is made more negative, the space charge comprising the virtual cathode is partially forced back through the meshes of the positive inner screen-grid *G3* (see Fig. 3). This causes more of the electrons to be attracted by the *positive* oscillator plate (side rods), *G2*, resulting in an increase in the oscillator plate current. As this increase is not being produced by an increase in oscillator plate voltage, it means that the plate conductance of the triode oscillator has been increased, but, as this altered conductance, or its reciprocal resistance, is coupled to the oscillator tuned circuit via magnetic coupling existing between the plate tickler coil *T* and the tank coil (see Fig. 2), it follows that as this changes so does the oscillator frequency. This resistance change alters the oscillator frequency a certain *fixed percentage* at all times. Consequently, at low radio frequencies the oscillator frequency shift in kc. is so small as to be negligible, but at high radio frequencies the shift in kc. (or mc.) is much larger.

This action can be overcome by the use of a separate oscillator tube (as is done when a 6L7 type pentagrid mixer tube is used with a separate oscillator tube), or greatly reduced by employing special oscillator-section constructions in the converter tube, as is done in the 6SA7 type of pentagrid converter, the 6K8 triode-hexode converter, etc. In each case greatly improved high-frequency operation results. These improved forms of mixer and converter tubes will be described and their operation explained in the next article of this series.

(To be continued)

LETTERS from our readers

RECORDING SERIES

"IN THE July 1941 issue of RADIO NEWS you wrote an article on "Building a Deluxe Recording Amplifier." As I am interested in building an amplifier for recording purposes which will give full professional results, I am writing you regarding this circuit as published.

"I intend to use 2A3 push-pull output with the *UTC* Linear Standard Series Transformers for the entire job. In converting from the *Thordarson* to the *UTC* line, I find that some of the items you listed in your article are no longer found in the *Thordarson* catalog.

"I would appreciate information regarding the above, and also information as to whether there has been any improved circuit or improvements on the above mentioned circuit since the issuance of the July 1941 RADIO NEWS."

Leon Troshinsky
Washington, D. C.

* * *

"IN THE early 1940's you published a series of articles on disc recording. After having read these articles I have become very much interested in semi-professional recording.

"I would like to have you print some more articles on this subject.

"I would also like to know if there are any books on disc recording or perhaps a portion of a book, which goes into quite a bit of detail. I have tried several of the local book stores and they don't seem to know of anything on the subject."

Louis Kroot
Bridgtown, Maine

A second series of articles, covering up-to-the-minute information on recording techniques and equipment, has been scheduled to begin in the November, 1946 issue of RADIO NEWS. *In addition, a book on this subject is already in preparation, and should be ready for publication in the not-too-distant future.*

* * *

CLASS D LICENSE?

"RECENTLY I learned that the FCC has been requested to issue a new class of amateur license to be known as Class D. This would permit the operation on amateur frequencies above 200 mc. simply by passing the present Class B exam, less the code test. The arguments advanced for this radical change in policy are that there are thousands of highly trained men who are technically capable of operation on the higher frequencies, who do not know the code.

"As a prospective amateur who is at present preparing for the license exam, I wish to protest this sudden and unjustified relaxation of the high standards we have been trying to maintain in ham radio.

"Personally, I believe that the 'thousands of highly skilled persons' story is a myth. My experience during the war was that most of these so-called experts worked with a technical manual in one hand and had little knowledge of what made the wheels go round. The exceptions in almost all cases were those who had been in radio long before the war.

"If this Class D license is adopted we can look for an influx of the curious, who know nothing of the traditions of ham radio, and are only interested in getting on the air to further their own interests. Little or no bona-fide experimentation will be done by this group, and the entire amateur fraternity will be judged by the operation of these few."

Roger Harris
Los Angeles, Calif.

At the most recent meeting of the Amateur Section of the RMA, your editor advocated the encouragement of new amateurs. An educational program was proposed, which would stimulate a genuine interest in ham radio. There was to be no relaxation in the qualifications necessary for a license. This proposal was opposed by certain "official?" interests who maintained that there were enough amateurs at the present time, and that any encouragement would be a mistake. Now these same interests have made a sudden reversal and are advocating a form of license which would seriously weaken the position of ham radio—at best!

* * *

MANY THANKS

"I HAVE a deep interest in all technical phases of radio and its allied fields. Consequently, as far as I am concerned, there is no magazine which comes anywhere close to RADIO NEWS.

"Recently, to be specific, I have been particularly well satisfied with insight into radio trends as expressed in "Spot Radio News," with such radar articles as the current "Highway in the Sky" since I was acquainted with pioneers in this field while in service and I have joined with many others in welcoming the RN Circuit Page.

"Most of all I am determined to stay abreast of the field by following new developments. With regards to the modern principles of television, I have never come across so valuable an aid as the series of articles by Noll. I regret that in my many moves I lost several back copies of RADIO NEWS and would like to know if there is any possibility of replacing them. Even with these numbers replaced, I would still like to have all the articles of this television series under a single cover. Will any such form be made available? I am a resident of Chicago but am, at present, pursuing a course in electronics and would find such a volume very helpful.

"My congratulations to you on these and all your other articles which so ably answer the needs of radio enthusiasts."

Kevin J. Murphy
Michigan State College
East Lansing, Michigan

Our thanks to Mr. Murphy for his letter. It is nice to know our efforts are appreciated.

* * *

BOUQUETS

"READING the July issue of my favorite magazine, RADIO NEWS (it tops them all I've ever read). I think the Circuit File Department is swell.

"The 'Home-Built V. T. Voltmeter' by Lt. N. M. Smith, U.S.N.R. brings home a practical instrument within reach of 'most any radio experimenter or ham.

"You may count me as one of 'The Circuit Filers,' it's sure a swell idea."

Frank H. Coxson
Reynolds Village
Greenville, Pennsylvania

We are glad you like the Circuit File as it is liable to be with us for quite a while.

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The Multiamp
(*Continued from page* 59)

recording and the output of the other booster is fed directly to a 16 ohm magnetic cutter.

The above makes an ideal arrangement for the recordist inasmuch as he has at his disposal two identical channels. He then hears exactly the same relative sound as appears on the cutter and, in addition, is provided with audible monitoring of the equalizer channels. This combination has afforded excellent results.

The modernistic cabinet which houses the amplifier, as well as additional booster units, is made of cast aluminum. This type of construction affords a substantial housing and at the same time permits the stacking of additional units either above or below the case.

The input controls are recessed and illuminated from above and are within easy reach of the sound engineer. All connectors go in through the rear where they are completely out of the way.

Other applications for this type of amplifier will be evident to the reader, as it represents the latest advancement in low cost, high quality units.

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International Short-Wave

(*Continued from page 132*)

roads; latest official schedules are 4 a.m.-12 noon, 7.645 and 9.670; 9 a.m.-12 noon they also operate on 13.360; at 5:30 p.m. they operate on 15.930, 17.820, and on a new frequency of 18.050; sign-off time is not given, presumably varies. Present power is 3 kw.

Guatemala—TGWA, 9.760, Guatemala City, has strong signals evenings; news in Spanish at 9 p.m. TGQA, 6.401, Quezaltenango, signs off at 11 p.m.

Holland—Now that WLWO, Cincinnati, has vacated 9.590 (went to 9.700 as of June 22) PCJ, Hilversum, is coming through nicely on 9.590 in the *"Happy Station Programs"* produced and presented by Edward Startz. I cabled him a report that PCJ was in the clear on its 10 p.m. broadcast of June 23, and he replied by cable that he was sending schedules to me airmail. Henry Callahan, Lansdowne, Pennsylvania, made a recording of the broadcast of June 26 (in which Eddie thanked me for the cable) and sent the recording to me; the reproduction was quite good. The schedules which Eddie sent airmail follow:

To East and Near East, Sunday and Wednesday, 15:22, 11:73, 6.025, 10:30 a.m.-12 noon. To Africa and Mediterranean, Sunday and Wednesday, 11.73, 9.59, 6.025, 4-5:30 p.m. To the Americas, Sunday and Wednesday, 11.73, 9.59, 6.025, 10-11:30 p.m. To Pacific and Australasia, Tuesday, 11:73, 9.59, 6.025, 3-4:30 a.m. On 9.590, *"The Happy Station of a Friendly Nation"* is now in the clear on the 10 p.m. period, Sunday and Wednesday, and should be heard with good strength throughout the Western Hemisphere. Mr. Startz is eager to again build up his vast American audience which he had prior to the German occupation of Holland. He sends a nice verie card promptly and will acknowledge reports over the air in the Mailbag portion of his *"Happy Station"* period. *His theme song (recording), "A Nice Cup of Tea," by Henry Hall's Orchestra, a Columbia release of the middle thirties, was destroyed by the Germans and he is desperately seeking worldwide to get a replacement. If anyone, anywhere, can locate this number, please send it direct to Edward Startz, m.c., "Happy Station Program," c/o PCJ, Postbus 150, Hilversum, Holland (Netherlands), which address may be used also for reception reports.* Mr. Startz informs me that PCJ will expand its services as conditions permit, and there will soon be a "special period" for American listeners.

Honduras—HRN, 5.875, Tegucigalpa, *"La Voz de Honduras,"* signs off at 11 p.m.

Hongkong—ZBW, 9.570, Victoria, has good signals some days in Australia, but there is sometimes bad interference from KWID, San Francisco, on the same frequency. About 7:30 a.m. musical programs are featured. "This is ZBW, Hongkong, calling," is announced in *English* on a number of occasions during the broadcast, and news from the BBC (in *English*) is relayed at 8 a.m.

India—Direct from Delhi, via airmail, comes these late summer schedules of *English* periods (mostly newscasts) of *All-India Radio:*

9:30 p.m.—15.160, 11.760, 9.590, 7.290, 6.190. 10:30 p.m.—17.830, 15.350, 15.190, 15.160, 11.870. 12:30 a.m.—17.830, 15.350, 15.190, 15.160, 11.870. 1:30 a.m.—17.830, 15.350, 15.290, 15.190, 15.160, 11.870. 3:00 a.m.—17.760, 15.290, 15.190, 9.670, 9.590. 6:30 a.m.—17.830, 15.350, 15.190, 11.870. 7:30 a.m.—15.290, 15.130, 9.670, 9.590. 9:30 a.m.—15.160, 9.590. 10:30 a.m.—15.350, 11.870, 11.850, 9.670, 9.590, 7.290, 6.190, and 4.960. 11:00 am.—(BBC news relay)—15.350, 11.870, 11.850, 7.290, 6.190. In addition, the Troops (India and Ceylon) period is now scheduled, 8:30-9:15 a.m. over 7.210 and 4.960.

"This is *All-India Radio* calling from Calcutta" is the announced call-sign of the station on 9.535, heard in Indian dialects around 7 a.m. here in the East with fair to good signals. Australians report news in *English* at 7:30 a.m., followed by weather reports and talks on life in India. Station identification is given at frequent intervals during this *English* period, which concludes at 8 a.m. Another "down under" report states Calcutta sometimes announces as *"the center of All-India Radio."* Calcutta normally uses the lower-frequency bands, and is reported in the 31-meter band rarely.

VUM-2, 7.255, Madras, broadcasts a special program of request recordings, 6:30-7 a.m. *Saturdays;* signal is poor with interference from San Francisco.

Iraq—An improvement has been noticed by Australians in the strength of signals from Baghdad at 2 p.m. on 9.084 when oriental music was heard to 2:55 p.m. after which recorded English-type music was presented. *No English language was used during this session.*

Italy — *Radio Italiana,* short-wave outlet at Busto Arsizio, "Gruppo Nord," transmits with 50 kw. on 9.630, 12 midnight-1:10 a.m., 5-6 a.m., and 1-6 p.m. Busto Arsizio II uses 10 kw. on 11.810, 1-5 p.m. Address, *Radio Italiana,* Via Arsenale 21, Torino, Italy. Rome, 6.030, is being heard in Ohio, 6-7 p.m., with Italian news and music. A late report from a Mid-west DXer indicates that Milan on 9.630 is actually heard until about 1:20 a.m. sign-off, with news in Italian at 1 a.m., followed by music at 1:15 a.m.; Milan on 11.810 also runs past 5 p.m., but is blotted out by WGEA, New York, from 5 p.m.

IFV, 19.330, Rome, calls WPU, New York, during the day; ICJ, 18.035, also Rome, was heard recently with news reports and news recordings point-to-point with New York, 12:28-1 p.m. sign-off.

Japan—JLS, 9.652, Tokyo, is heard some mornings around 5:50 a.m. contacting Guam's KU5Q. Tokyo is being heard on several additional channels; JLU3 on 15.140 and JLT3, 15.225, varying as low as 15.215, in the afternoon and evening; and JLG2, 9.505, and another one on 9.560 during the morning hours; sign-off is 8:30 a.m., as with other transmitters and the above seem to parallel JVW, 7.258, at all times checked (Dilg).

Java—West Coasters and Australians report many new Java stations are now taking to the airwaves again. Australians report one on about 4.790, heard to announce as *"Radio Bandoeng,"* at 7:30 a.m.; this announcement followed the playing of the march, "Colonel Bogey," and the sound of clock chimes; the usual Indonesian-type of entertainment followed. Another outlet of *"Radio Republic Indonesia"* has taken the air on 19.380; when first heard by Australians at 6 a.m., it was good strength with a wailing type of musical program; news in Indonesian was read at 6:15 a.m.; this station is in all probability using the old PMA transmitter which operated on this frequency prewar.

A Service directed to Australia has been inaugurated by the Indonesian authorities. The broadcast begins at 4:30 a.m. on a prewar frequency used by the Netherlands East Indies station PLP, 11.000. *English* is spoken to 5 a.m., followed by an Indonesian program until 5:30 a.m. closedown. This station has been heard also beamed to the *United States,* beginning at 3 a.m.; announces as *"Radio Free Indonesia."* Correspondents in Australia report poor reception, and say that apparently badly-worn recordings are being played.

"The Voice of Indonesia" has been logged in Australia at 8 a.m. on about 9.870, when it was stated that the 30- and 50-meter bands were being used.

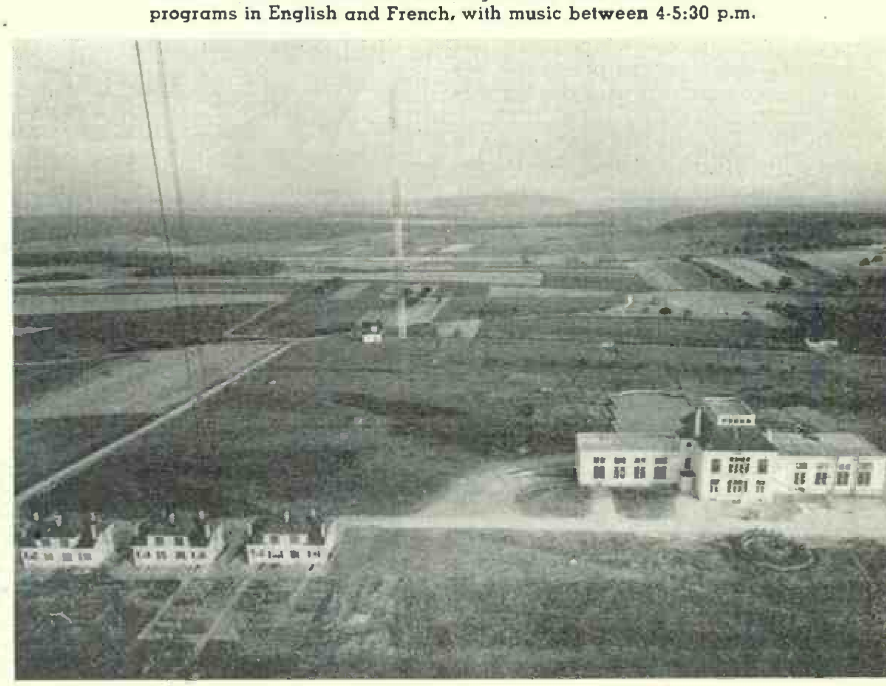
Kenya—Good signals are being heard in Australia from VQ7LO, 4.949, Nairobi, at 1 p.m., when the BBC news is relayed from London, followed by local news (also in *English*).

Korea—From Hugh C. Ware, Signal Corps, stationed in Seoul, comes this information regarding JODK:

"This is the key station of the Korean Broadcasting System. Studios are in Seoul, the capital (formerly known under the Japanese as 'Keijo'). It is staffed by Koreans under the supervision of civilian American technicians of the Military Government. The transmitters are in the outskirts of the city. The equipment is fairly old—although the p.a. section is less than five years old. There are three transmitters. One is on 970 kcs. and uses 5000 watts in the daytime and 20,000 watts at night, although the maximum output is about 50,000 watts. The second transmitter is on 2.510 and uses 5000 watts at all times. There is also a 300 watt transmitter on about 710 kcs., which is *not* being used at present. The broadcast day runs from about 0630 to 2230, local time (probably is 4:30 p.m.-8:30 a.m. EST), but not continuously. Korean is used, but there is an *English* news broadcast in the early afternoon (local time). Sign-off is in Korean and *English.* There are three AFRS stations in Korea (*not* short-wave). WVTP, Seoul, WLKC, Fusan (or Pusen), and WLKJ, Chanju; their respective frequencies are 1480 kcs., 1540 kcs., and 1400 kcs. Output is about 600 watts."

Lebanon—New England DXers report very weak signals again at 4 p.m. from *Radio Levant,* FXE, 8.11, when French news is presented prior

Antenna mast of Radio Luxembourg, 6.090. The station features programs in English and French, with music between 4-5:30 p.m.



to 4:10 p.m. sign-off with "La Marseillaise."

Luxembourg—A report from England states that *Radio Luxembourg*, 6.090, is heard *daily* at 4 5:30 p.m. with dance music and *English* announcements, but there is heavy interference from the BBC's European Service. This reporter quoted a statement from the British press that "they will be resuming the commercially-sponsored programs scon, the same as before 1939."

Mayala—*"Radio Malaya Broadcasting from Kuala Lumpur"* 6.165, is scheduled 5:30-10:30 a.m., Sunday to 11 a.m. BBC news is reported *heard* at 8 a.m., and *English* news, relayed from Singapore, is read at 9 a.m.

Australians report *Radio Singapore*, 4.780, is good strength at 5:30 a.m. They also list *English* news from *"Radio SEAC Calling From Singapore,"* 11.735 and 6.77, at 3:50, 7:15, and 7:30 a.m., scheduled from 3:45 to 9:05 a.m. closedown.

Martinique — *Radio Martinique* broadcasts in French, with much dance music, at 5:30-8 p.m. on 9.708; chimes are used between announcements; the station reaches Australia where observers report opening with "La Marseillaise" and "Marche Lorraine."

Mexico—XEHH, 11.880, Mexico City, has fair signals late evenings, news in Spanish at 12:45 a.m.; sign-off is at 1:02 a.m. XEUW, 6.020, Vera Cruz, can be heard after HJCX, 6.018, Bogota, Colombia, signs off at 11 p.m.

New Guinea—VIG, 15.090, Port Moresby, has been heard recently in the Eastern U.S. at 8 p.m. calling Sydney, Australia.

New Caledonia—Noumea on 6.208 is being received with good signals throughout the Pacific area and should be heard some mornings here in America. *Only* French is used. Programs of good music are scheduled for around 3:45 a.m. The news in French is read at 4:05 a.m. and the music continues to around 5 a.m. sign-off.

Norway—From "down under," it is reported that a feature of the program from LKJ, 9.540, Oslo, at 1:45 p.m. is a classical music session. This station has been logged there with good strength to fade-out around 4 p.m. The new 6.200 frequency of Oslo is reported heard in Australia at 2:30 p.m. in relay with the 9.540 outlet. Schedule of the 6.200 Oslo relay is 11 a.m.-5 p.m. (news at 1 and 4 p.m.) which means it is usually inaudible in the U.S.

Panama—HP5H, 6.122, Panama City, signs off at 11 p.m.

Poland—The words, *"This broadcast comes to you from Warsaw,"* precedes the reading of news in *English* at 3:10 p.m. on 6.100, according to Australian observers, who say the news period lasts but 5 minutes. They also report that classical music is usually featured around 2:45 p.m.

A Massachusetts monitor reports a Polish station on 13.120 at 4 p.m. with talks in Polish and *English*.

Rumania—*Radio Bucharesti*, 9.250,

is heard in Sweden after 8 a.m., using foreign languages.

Siam—*Radio Bangkok,* 6 002, is being heard to about 8:30 a.m. in Australia; the language used seems to be mainly Siamese.

South Africa—Henry Ecksteen, Pretoria, sends me this information which he got personally from the South African Broadcasting Corporation:

"Altogether the number of their transmitters total 21, the short-wave stations are, Johannesburg No. 3, 5 kw., 3.45, 4.89, 6.007, 9.523; Johannesburg No. 4, 1 kw., 6.094, 9.902; Johannesburg No. 5, .2 kw., 4 581; Capetown No. 3, 5 kw., 5.883, 9.608. Durban No. 3, .5 kw., 6.169; Pietermaritzburg No. 2, .5 kw., 4.878. Mr. Collett, Division Engineer, stated that *no station call-signs are allocated to South Africa.* Please make note of this."

Southern Rhodesia—Address of ZEA, Salisbury, is c/o G.P.O., P.O. Box 792, Salisbury, Southern Rhodesia. In a letter received by a correspondent, little information was given except to state that programs are intended only for Southern Rhodesia. Is heard well in South Africa on approximately 7.600.

Spain—Madrid's 9.370 outlet has news in French at 4:10 p.m. and is heard evenings around 9:30 p.m. The *English* news period is scheduled for 3 p.m.

Sumatra—*"Radio . . . . Sumatra"* is heard daily until 8:30 a.m. sign-off on 7.450; at 8:30 a.m. they begin to radiotelephone. *(This is probably Bukit Tinggi.)*

Sweden—Transmissions from this country are not coming through to the U. S. so well this summer; best bet is at 10 a.m. from SBT, 15.155, in the North American beam; there is usually bad interference. Verification cards are now being sent. Swedish observers write that "they are not much to look at, but do have some interesting information regarding the Swedish Radio."

Swedish sources report SBO, 6.065, Stockholm, heard with recordings, 9:35-10 a.m. and with an *English* period between 7-8 p.m., with the *English* news at 7:03 p.m.

Switzerland—HBZ3, 14.460, Geneva, is now audible with the Tuesday and Saturday, 12 midnight, beam to Australia; is heard well in New Zealand.

Tahiti—August Balbi, Los Angeles, reports that FO8AA, 6.980, Papeete, has much-improved signals now; heard irregularly to midnight on Tuesdays and Fridays.

U.S.S.R.—Swedish sources report Moscow currently, 2:15-2:45 p.m. and 3:15-3:45 p.m. on 6.160, 7.165, 9.720, and 9.780 in "foreign languages." Leningrad is being heard on 9.600 and 11.630, with no schedules listed.

Radio Centre, 12.260, Moscow, is reported heard in the East at 11:30 p.m. with news and music in Russian and *English.*

Revised Moscow schedules on the North American beam include the morning transmission, 7:20-8:15 a.m., 11.63, 11.83, 15.17, 17.81; *English* news at 7:30 and 8 a.m. Evening transmission, 6:20-9 p.m., 7.36, 9.48, 11.83, 15.17, and for the period, 6:20-7:30 p.m., also on 11.88 and 15.23; *English* news is at 6:30, 7:30, 8:30 p.m., and irregularly.

A little-reported outlet of *Radio Moscow*, 9.860, was heard recently in Australia at 7:45 a.m. with a program of Swiss yodeling music.

The Moscow transmission to Latin America, 7:30-10 p.m., is now carried on 15.410 and 11.630 and is heard with good signals to sign-off.

Moscow in Spanish for Spain is heard at 5:30 p.m. on 11.876.

The 17.818 frequency is now heard opening at 10 p.m. in the Home Service.

A recent evening after signing off the *English* transmission to North America at 9 p.m., the 15.17 transmitter continued in a foreign language (I believe Russian), following the usual interval (chime) signal.

Vatican—HVJ, 17.445, is reported with *English* news at 10 a.m.

Venezuela—YV5RN, 4.915, Caracas, has good signals evenings; all-Spanish.

Yugoslavia—*Radio Belgrad*, 9.420, has a broadcast of news in several languages from 10:30 a.m., closedown is 11:25 a.m. Verifies from Kneza Milosa Velikog 16/V, Belgrade, and encloses a schedule of their short-wave broadcasts which are *all* beamed to Europe at present. Currently they use 9.420 at 12 midnight-2:30 a.m., 6:20-8:45 a.m., and 10:10-11:25 a.m., while 6.150 is used 11:30 a.m.-5 p.m., followed by approximately an hour of news dictation for the press. Belgrade was heard some weeks ago on an announced frequency of 11.735 (actually 11.740), contacting WEC, 8.930, New York, testing for a special broadcast for NBC; call letters of YCC1 were given.

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Last-Minute Tips

August Balbi, Los Angeles, flashes that KZRH, 9.64, Manila, the Philippines, is back on the air; heard 3-10 a.m. with QRM from XGOY, 9.635, Chungking, from 5:35 a.m. to sign-off; fair signals; *All-English* program is sponsored by P. I. Airlines. The 9.64 frequency is a bad spot for KZRH and it is hoped they will shortly try another frequency. During the war, while controlled by the Japanese, KZRH was known as PIRN. PCJ, 15.22, Hilversum, Holland, has been heard testing to the Far East between 12 midnight-1 a.m. Prague's OLR5A, 15.23, has not been heard lately on its 12 midnight-1 a.m. transmission. *Radio Australia* has replaced VLG3, 11.71, with VLG4, 11.84, to the West Coast, 12 midnight-12:45 a.m., news continues at 12:15 a.m., and VLG, 9.58, has replaced VLG4, 11.84, on the 11 a.m.-12 noon beam to the same area. VLQ3, 9.66, Brisbane, not heard lately 11 p.m.-2:15 a.m., may be off the air. Other recent Australian changes include VLG10, 11.76, has replaced VLG3, 11.71, 2:30-3:10 a.m. to Japan; VLC11, 15.21, and VLA4, 11.77, are now heard, 2-3:15 a.m. to Britain, while VLC6, 9.615, and VLA3, 9.68, are in dual to Britain, 10-10:58 a.m.

Balbi reports that Paris is often heard on 11.886 instead of 11.845, 9-10:45 p.m. and 12 midnight-12:45 a.m., and is now used 11-11:45 p.m. in dual with 15.24. Singapore on 11.735 and 6.77 now signs off at 9:15 a.m. and has "complete news" in *English* at 9 a.m. XGOA, 9.72, Nanking, China, has a nice signal some mornings to 9 a.m. when it fades badly.

Delhi's VUD3 is using 15.130 instead of 15.210 for the 7:30-7:45 short *English* news period; this is a new frequency for Delhi. (Legge)

VUD10, 17.830, Delhi, is being heard nightly in the Mid-West with fair to good signals at 10:15 p.m. sign-on until well after midnight; *English* news at 10:30 p.m.

According to a letter received by Paul Dilg, California, Singapore's Dept. of Broadcasting, Cathay Bldg., Singapore, Malaya, verifies reception with a yellow card and a letter which gives their domestic service schedule as 7.220 at 11:30 p.m.-1:30 a.m. and 4.780 at 5:30-10:30 a.m. A special transmission to the BBC, London, is given on 9.548 at 10:40-11 a.m. It was stated that the *Radio Kuala Lumpur* frequency of 6.092 (actually 6.165) broadcasts at the same times, except it does *not* carry the BBC special. *Radio Malacca* was not mentioned.

Details of programs from *Radio Tirana,* 7.850, Tirana, Albania, have just some in from Roland Astrom, Sweden, as follows: 2 p.m., news in Russian; 2:15 p.m., news in French; 2:30 p.m., evening news in Albanian; 2:45 p.m., news in Greek; 3 p.m., news in Yugoslavian; 3:15 p.m., news in Bulgar; 3:30 p.m., news in Rumanian; 3:45 p.m., news in Turkish; 4 p.m., *news in English;* 4:15 p.m., news in Italian; 4:30 p.m., Albanian music for Albania and abroad; 5 p.m., dictation for Legations and attaches; 6 p.m., end of program.

Paris on 11.886 has news in French at 6:15 p.m., excellent signal. (Norris)

An unconfirmed report has been received from the West Coast that Siam is being heard early mornings in Texas on 10.160, around 8 a.m.

Moscow's Home Service opens at 10 p.m. on 15.17, 15.23, 15.27, 15.44. Komsomolsk on 9:565 starts the Home Service, *Sundays,* at 1:30 a.m. (Balbi)

Tokyo is using JLT3, 15.225, 10 p.m.-2:30 a.m. in Home Service.

CKNC, 17.82, Montreal, Canada, was scheduled for after July 1 to West Indies, *daily* at 6:30-7:30 a.m. (Balbi)

The BBC is now using 18.080 to join the North American Service at 4:15 p.m., sign-off is at 6:45 p.m. on this frequency (GVO).

VLW3, 11.830, Perth, Australia, is being heard in Indiana, 3-5:15 a.m. sign-off; *English* news, 4 a.m. (Green)

The SABC is now reported heard well in South Africa on the 11-megacycle band. This probably means that Johannesburg III has shifted to its 11.710 frequency, most logically replacing 9.523 in the 3:15-7:10 a.m.

transmission; it could, however, be an inaccurate reference to 10.540.

A verification received by Art Cushen, New Zealand, covering the medium-wave (990 kcs.) station at Hangchow, China, shows call letters now are XOPD (was XGOD but is listed by Chungking now as XOPB) and that XOPD is also the short-wave call of the 600-watt transmitter, frequency given as 7.400. The station's address, Chekiang Broadcasting Station, 46 Yin Tye street, Hangchow, China.

The official Dutch station at Bandoeng, Java, on 3.015, is heard daily, 6:30-9:30 a.m., with *English* program at 9 a.m. (Cushen)

It is believed that *Radio Bangkok,* Siam, has shifted from 6.000 to 5.990 where it is now heard *daily* to 9:15 a.m. sign-off.

HH3W, 10.105, Port-au-Prince, Haiti, is sending excellent signals here in the East both mornings and evenings; good music; announcements in French. A Texas reporter writes that at 8:30 p.m., identification is usually given also in *English,* including a reference to the effect that the station is affiliated with the Columbia Broadcasting System in the U. S.

KRHO, 9.65, has terrific signals here in the East, peak around 6-7 a.m. The other outlet of this Honolulu station, 17.800, is good all evening.

A late report from Australia lists a Shanghai station on 11.860 as being heard 6 a.m. onwards, with *English* at 7 a.m.

I have been hearing XGOY, 11.913 (actually 11.920) here in the East most mornings lately with a fine signal around 4-5:25 a.m. sign-off. The 9.635 transmitter is heard from sign-on at 5:45 a.m. to around 7 a.m. fade-out here.

The 9.590 frequency of PCJ, Hilversum, Holland, is now coming through in the East on Wednesday and Sunday in the repeat of the *"Happy Station Program,"* 4-5:30 p.m., which beam is to Africa and the Mediterranean. But for better reception of this frequency, tune on those nights to 9.590 at 10 p.m. EST when the same program is directed to the Americas.

A Swedish correspondent flashes that he has received a verie from *Radio Italiana* setting forth that the owner of the station is "Ente Italiana Audizioni Radiofoniche"; address, Via Arsenale 21, Torino, Italy. Frequencies, 9.630 and 11.810. The short-wave transmitters are located in Busto Arsizio, near Milan. The programs consist largely of music, heard best around 1-2 p.m. The 9.630 transmitter has programs for ex-internees and war prisoners also, at 9-10 a.m. and 5-5:45 p.m., Monday; 10:30 a.m.-12:30 p.m. and 5-5:45 p.m., Tuesday; 7-8 a.m., 12 noon-1 p.m., and 5-5:45 p.m., Thursday; 10-11 a.m. and 5-5:45 p.m., Friday; and 4-5 a.m., Saturday.

From Pretoria, South Africa, Henry Ecksteen reports that as a part of the South African Broadcasting Corporation's "expansion program," they have ordered six new 5 kw. transmitters of the *Marconi* type; a seventh transmitter is now being built. Four of these transmitters are to be used for commercial programs. It will be over a year, however, before the transmitters come into operation.

Mr. Ecksteen has received a letter from James Sheeley, Director, National Broadcasting Service, P.O. Box 3045, Wellington, New Zealand, that they are installing two 7½ kw. jobs at Titahi Bay Station with the callsigns, ZL1, 6.08; ZL2, 9.54; ZL3, 11.78; and ZL4, 15.28. *(These long-promised transmitters should be on the air soon; watch for them!)*

A weekly Australian Newsreel is heard at 7:30 a.m. Fridays from VLC5, 9.45, Melbourne, in the morning East Coast beam; program preview follows the 7 a.m. news, or approximately at 7:10 a.m.

The British Short-Wave League reports that Ankara's 15.200 channel, TAQ, is now in use, heard at 6:15 a.m. in Balkan languages.

Australians flash that after an absence of many weeks, CR6RA, 9.470, Angola, has reappeared on this frequency and can be heard at 3 p.m., but suffers some interference from nearby TAP, 9.645, Ankara, Turkey. Novelty musical numbers are sometimes featured. I believe this is the station I have heard with good strength around 3 p.m. lately, usually with typical African vocals.

The British Short-Wave League's Palestine representative, Reuben Sikolovsky, recently reported that *"The Voice of Israel,"* operated by the Jewish Resistance Movement, is on the air; this station, he reported, is operated on 6.589 and broadcasts *daily* at 7 a.m. in Hebrew; *and on Sunday only in English.*

Bill Cooper, Vancouver, reports LSM7 (announced), 18.050, Argentina, heard at 6 p.m. calling HJY2, Bogota, Colombia, fair signal, and that HJY2 on 18.440 was heard answering with weak signal. Other tips from Cooper are Kalgan, 9.625, China, has oriental music at 4:45 a.m.; XTPA, 11.650, Canton, is heard weakly before 3 a.m., is strong by 5 a.m.; XGOY, 11.913 (actually 11.920), is being heard at 4:40 a.m. with Western dance music (*new* records), and after 5 a.m. with Chinese music; modulation is much improved, formerly was "terrible." Guam has recently been heard at 6 p.m. to RCA, using an old frequency of 17.820. A Tokyo station on 15.230 is heard with Japanese program from before 12:45 a.m. to 3:10 a.m. close-down; JLU3, 15.145, is heard after 2 a.m. in dual with 15.230 to 3:10 sign-off. (May mean JLT3, 15.225 instead of the 15.230 one.) The *"Free Indonesia"* station at Djajkarta, 9.870, has news at 8:15 a.m. and then closes down; wants letters, reports, any kind of correspondence; address, Indonesian Broadcasting Company, RRI, Djajakarta, Java. Cooper reports that program times and frequencies are given at 5:30 a.m. Petropsvlovsk, 6.070, Kamchatka, now relays the

English news from *Radio Centre*, Moscow, at 8 a.m. and then signs off.

Late tips from John J. Kernan, Boston, include HED4, 10.405, Bern, Switzerland, excellent afternoons, 2:20-2:50 p.m., *English* news at beginning. VLG10, 11.76, Australia, heard 1-1:45 a.m. *daily.* OLR4A, 11.84, Prague, heard with *English* news at 7:15 p.m. *(may be using 15.23 now).* VUD11, 11.83, Delhi, heard at 5:15 a.m. in *English. Radio Vienna*, 12.21, heard with good signal at 8 p.m.

Charles S. Sutton, Ohio, reports VWW3, 17.482, Kirkee (Bombay), India, heard testing point-to-point with WQB, 17.940, at 4:45-5 p.m. He also is hearing GSK, 21.600, GVR, 21.675, GSJ, 21.530, and GSH, 21.470, London, with good signals, 6-10 a.m.

Australian Newsreel may be heard at approximately 12:28 a.m. on *Fridays only* over VLC4, 15.320, and VLG4, 11.840, in the West Coast night beam.

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Acknowledgements

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Electronics Afloat
(Continued from page 57)

11. *Ultraviolet Tubes*

Ultraviolet conditioning is a new and practical method of controlling mold, and destroying bacteria and other airborne micro-organisms through the use of selected ultraviolet radiations. Scientifically designed ultraviolet conditioning provides continuous purification of the air you breathe. Extensive tests have proven that common maladies such as colds, influenza, measles, scarlet fever and diphtheria are usually transmitted by airborne germs. In a room equipped with ultraviolet conditioning fixtures, the natural thermal circulation passes these airborne germs within the scope of the ultraviolet rays, subjecting them to the destructive powers emanating from this germ-killing band of light. By materially reducing these disease causative agents in the air, contagious infections have been, by actual test, greatly reduced. The ozone generated by the ultraviolet rays will also revitalize musty air produced by lack of oxygen and will dissipate most undesirable odors.

Ultraviolet conditioning systems, properly installed, maintain more desirable health environment. Today, ultraviolet conditioning is being utilized to a great advantage by an extensive list of industries.

Ultraviolet marine fixtures are now available to afford their conditioning features to the marine field.

12. *Shipboard Electronics*

The electron found its place aboard ship originally in the field of communication where it was ever on the alert to receive and send distress messages. Today the compact, high powered electronic equipment is always in touch with land or nearby vessels, no matter where on the vast sea the ship may be sailing. Furthermore the ocean passenger who is worried about home or the office may, with the new radiotelephone equipment, simply pick up the telephone in the stateroom and be connected, through the regular telephone switchboard, to the desired shore station.

For the smaller luxury yachts the modern radiotelephone unit can be color styled and shaped for decorative harmony with the vessel's surroundings.

With the advent of radar as a tool of navigation, the possibility of occurrences such as the Titanic disaster are greatly reduced.

Although the established and accepted form of electronics afloat is quite naturally in the field of communication, the far seeing shipowner does not permit electronic communication to form the boundary of his use of electronics. For the electron has already found new and useful work which it can do efficiently in other departments of ship operation. In this era of marine electronics the profit-minded ship owner investigates every electronic item which can save time, effort, materials and even life itself. A casual glance at the electronic equipment adaptable to marine service shows a wide range of ideas for promoting safety, economy, efficiency and convenience.

Much of the electronic equipment which is useful in the shipbuilding industry is equally useful aboard ship. Special adaptations to actual operation aboard ship are listed briefly below:

1. Electronic control of shipboard motors and generators means that prefixed adjustments will not be affected by ship rolling.

2. Electronic air conditioning is a development whereby the air may be cleansed by electronically created charges which attract the dust particles and keep them out of the ventilating systems. In shipyard shops electronic air conditioning produces more healthful working conditions, keeps storerooms clean and protects delicate processes. On shipboard it will be a boon to those suffering with colds or congested nose and chest conditions.

3. Great strides have been made in the development of marine direction finders. It is expected that pleasure craft and fishing boats will utilize the improved equipment which should sell at about $250.

New techniques of direction finding have been developed and marine beacons will probably be employed in the future to "home" vessels. The navigators of the future will only have to keep their ships on the beam in the same manner that aircraft pilots are guided between airports. Others besides cargo vessels and passenger liners will probably use this new principle of beam navigation. Simple homing stations could be established for the fishing fleet to enable them to gain a few hours time in the marketing of their product.

4. The electronic tube with all its possibilities is of little importance by itself. It is its application with other tubes and apparatus that is valuable. The applications described herein are just a hint of the wide range of jobs that electronics can master. The limits to which electronics can be used in the marine field will be that of the marine man's ingenuity.

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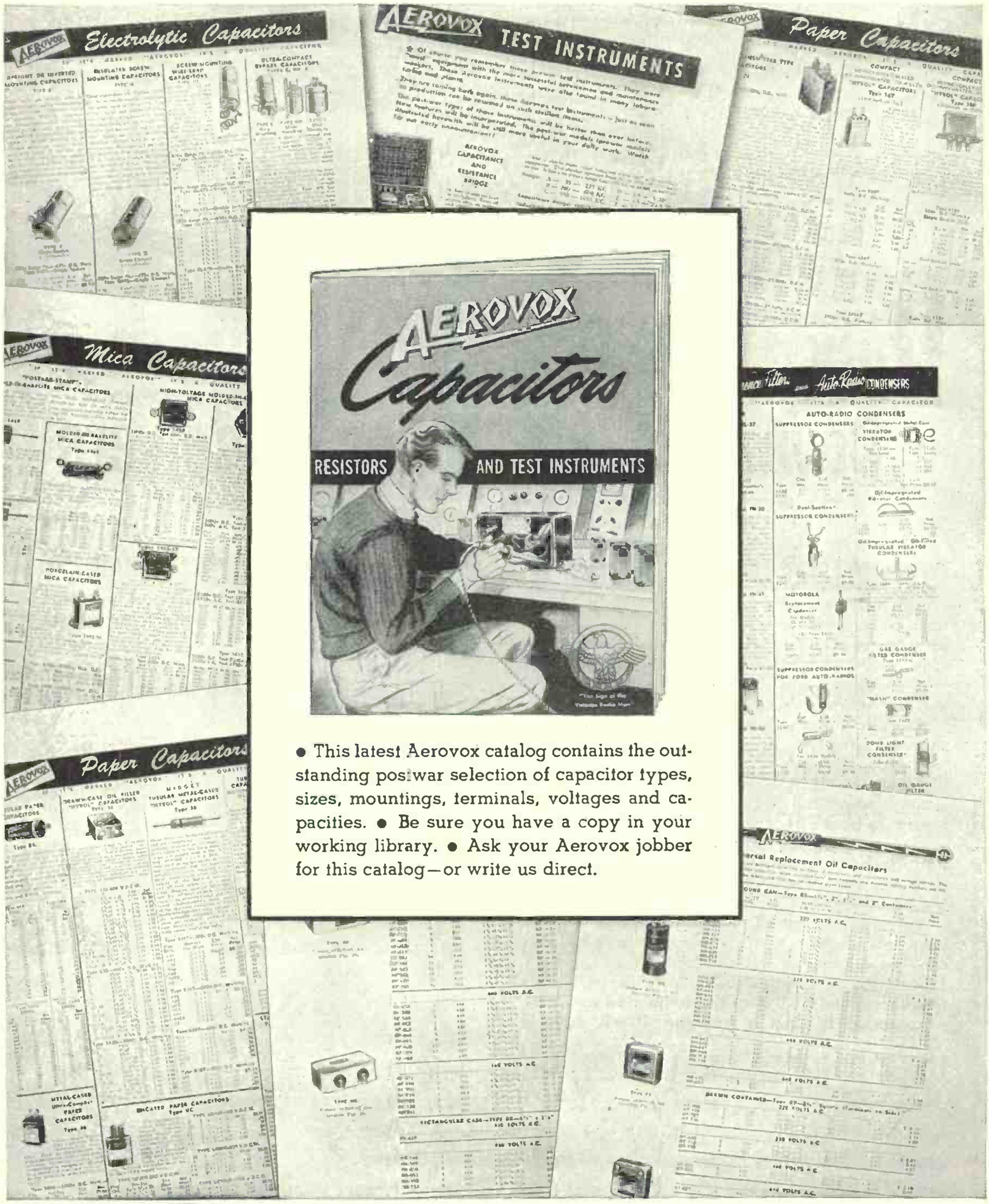

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