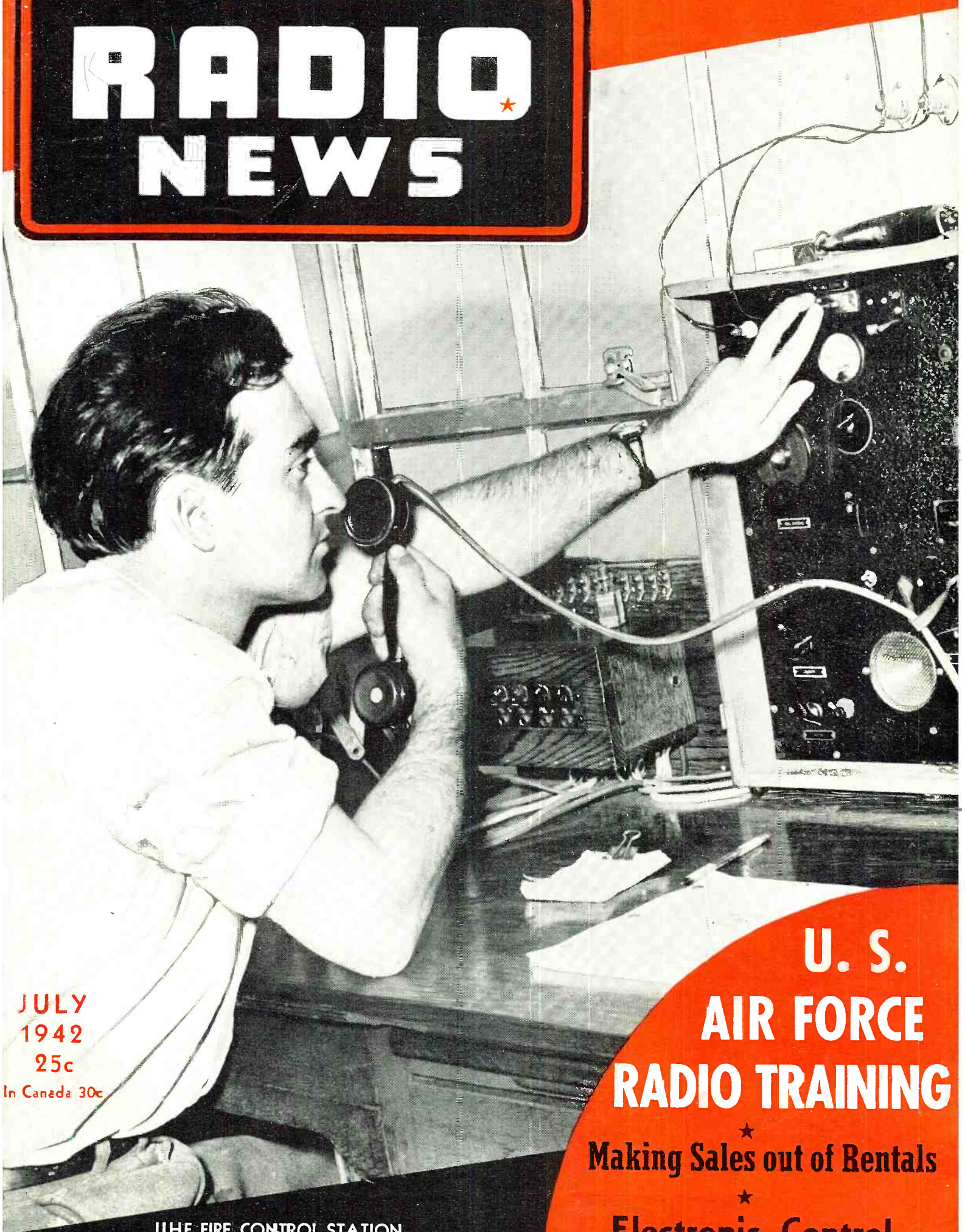
RADIO NEWS



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1942
25c
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Making Sales out of Rentals

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$54.50 *Immediate Delivery!*

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9 Tubes
CRYSTAL
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545 K C-44 MC

Complete With Speaker **$89.50**

Echophone Model EC-3

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The new 1942 Super Skyrider Model SX-28 sets a new high in quality performance. 15 tubes, two stages preselection, calibrated bandspread inertia controlled, micrometer scale tuning inertia controlled, Tone and AC on-off, beat frequency oscillator, AF gain, RF gain, crystal phasing, adjustable noise limiter, send-receive switch, AVC-BFO switch, bass boost switch, phono jack, 80/40/-20/10 meter amateur bands calibrated, band pass audio filter, push-pull high fidelity audio output, 6-step wide range variable selectivity. $179.50.

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I WILL TRAIN YOU TO START

A SPARE TIME OR FULL TIME

RADIO SERVICE BUSINESS WITHOUT CAPITAL

I Trained These Men

These Men Have SPARE TIME BUSINESSES

"I repaired many Radio sets when I was on my tenth lesson. I really don't see how you can give so much for such a small amount of money. I made $600 in a year and a half, and I have made an average of $10 a week—just spare time." —JOHN JERRY, 1729 Penn St., Denver, Colo.

"I do Radio Service work in my spare time only, operating from my home, and I net about $40 a month. I was able to start servicing Radios 3 months after enrolling with N. R. I."—WM. J. CHERMAK, R. No. 1, Box 287, Hopkins, Minn.

"I am doing spare time Radio work, and I am averaging around $500 a year. Those extra dollars mean so much—the difference between just barely getting by and living comfortably."—JOHN WASHKO, 97 New Cranberry, Hazleton, Penna.

I Trained These Men

These Men Have FULL TIME BUSINESSES

"For several years I have been in business for myself making around $200 a month. Business has steadily increased. I have N. R. I. to thank for my start in this field."—ARLIE J. FROEHNER, 300 W. Texas Ave., Goose Creek, Texas.

"I went into business for myself 6 months after enrolling. In my Radio repair shop I do about $300 worth of business a month. I can't tell you how valuable your Course has been to me."—A. J. BATEN, Box 116S, Gladewater, Texas.

"I started Radio in the Marines in 1917. I also built sets in the early days of Radio. Later I started studying Radio for a living. I recommend N. R. I. Training to any man no matter how long he has worked in Radio. I now have my own business."—CHARLES F. HELMUTH, 16 Hobart Ave., Absecon, N. J.

YOU Build These and Other Radio Circuits

with Standard Radio Parts I Send You With My Course

I send you SIX BIG KITS of Standard Radio Parts as part of my Course. With them you conduct SIXTY sets of experiments, build, test and align Radio circuits, and get the experience needed to make extra money while learning.

Super-Heterodyne Receiver

with pre-selector, oscillator-mixer-first detector, intermediate frequency stage, diode detector a.v.c. stage and audio stage, which you build from parts I send you in my SIX Big Kits.

Measuring Instrument

you build early in the Course. This instrument, known as the N. R. I. Tester, is a vacuum tube voltmeter and multimeter with a sensitivity better than 20,000 ohms-per-volt. You will be able to make the following measurements: a.c. volts up to 550 in 4 ranges; d.c. volts up to 450 in 4 ranges; d.c. currents up to 45 ma. in 2 ranges; resistance values up to 100 meg. in 4 ranges; output measurements of receivers in 4 ranges.

F. M. Signal Generator

really a miniature frequency-modulated transmitter. With it you study frequency modulation, the newest method of Radio communication.

A. M. Signal Generator

The circuit is exactly like the signal generator the serviceman uses. It provides an amplitude-modulated Radio signal for experimental purposes.

$600 BEFORE GRADUATING, KITS HELPED

"From your Experimental Units I learned how electricity worked, how to connect the three stages of a Radio together, also the practical basis for the operation of different parts of a set. I made about $600 or $700 before I graduated." S. G. PIERSON, Box 71, Dry Creek, W. Va.

SAMPLE LESSON FREE

Get my Sample Lesson "How Radio Programs are Sent from the Studio to Your Home." It traces a Radio program from the studio microphone to your loudspeaker. 32 diagrams, pictures and photographs explain every step clearly. You learn the appearance and use of Radio parts, learn to read simple diagrams, become acquainted with coils, condensers, resistors, power supplies, sound, modulation, R. F. and A. F. circuits. See for yourself how complete, how practical my Lesson Texts are. MAIL THE COUPON—NOW.

The men above are just a few of many I have trained at home in spare time to be Radio Technicians. Today they are operating their own successful spare time or full time Radio businesses. Hundreds more of my men are holding good jobs in practically every branch of Radio, as Radio Technicians or Operators. Aren't these men PROOF that my 50-50 method of training gives you, in your spare time at home, BOTH a thorough knowledge of Radio principles and the practical experience you need to help you make more money in the fast-growing Radio industry?

Train This Practical N. R. I. Way "Learn It, Do It, Prove It"

My Course is NOT just "book-work" training! No indeed! You get practical experience with Radio parts and test equipment almost from the start. First, you **LEARN** the fundamental facts about Radio parts and circuits by reading my Lesson Texts, prepared especially for home study training. Next, you **DO** what you have learned, by working with these parts and circuits. **Doing** with your own hands and seeing with your own eyes makes you remember what you learn. Finally, you **PROVE** what you learn by making measurements with your test equipment before and after you change your Radio circuits or adjust your Radio parts.

You Get SIX Large Kits of Standard Radio Parts

In all, I send you Six Large Practical Kits which contain more than 100 standard Radio parts, including tubes, condensers, resistors, punched chassis bases, a meter, a soldering iron, solder, hook-up wire, hardware and a host of other Radio parts. With all these, you perform 60 different sets of experiments—you make hundreds of tests and measurements and secure a wealth of practical experience. You build the N. R. I. Tester (see column at left), and learn how to use it to measure voltage, current, and resistance. You build dozens of different Radio receiver and transmitter circuits one after another, and secure practical experience with each. You learn how to recognize, locate and repair troubles in Radio circuits.

Beginners Quickly Learn to Earn $5, $10 A Week Extra in Spare Time

I show you, too, how to get practical servicing experience at home. Many begin doing real Radio work in their neighborhood only a few months after enrolling. Furthermore, right from the start I begin sending you Practical Job Sheets—over three dozen in all—which give plans and directions for doing increasingly more profitable Radio service jobs. This is why so many of my students start building their own spare time Radio businesses while still learning, and make $5 to $10 a week extra.

It's Smart to Train for Radio Now— for Good Jobs Like These

Radio is one of the country's busiest industries. The 882 U. S. broadcasting stations employ Radio Technicians with average pay among the country's best paid industries. Radio manufacturers are getting millions of dollars worth of Government orders. The Radio repair business is booming due to shortage of new home and auto sets (there are 57,400,000 in use) giving good full time and spare time jobs to thousands; offering many opportunities for Radio Technicians to open their own Radio businesses without capital—on spare time earnings. The U. S. Government needs Operators and Technicians for civilian Radio Jobs. Aviation, Police, Marine, Commercial Radio and Loud-Speaker Systems offer good-pay jobs for trained men. Television promises good future opportunities. My Course can lead you to a good job in any of these profitable fields.

Extra Pay in Army, Navy, Too

Men likely to go into military service—soldiers, sailors, marines—should mail the Coupon Now! Learning Radio helps men get extra rank, extra prestige, more interesting duty at pay up to several times a private's base pay! Also prepares for good Radio jobs after service ends. IT'S SMART TO TRAIN FOR RADIO NOW!

MAIL THE COUPON NOW—for a Sample Lesson and 64-page book FREE. Get the details of how I can give you practical training to be a Radio Technician at home in your spare time. Find out about my Course, my 6 Big Kits of Radio Parts. Read letters from more than 100 men I trained, so you can see what they are doing and earning. MAIL THE COUPON in an envelope, or paste it on a penny postcard.

J. E. SMITH, President
Dept. 2GR
National Radio Institute
Washington, D. C.

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J. E. SMITH, President, Dept. 2GR
National Radio Institute, Washington, D. C.

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- ☐ Service Technician for Radio Stores and Factories
- ☐ Spare Time Radio Servicing
- ☐ Auto Radio Technician
- ☐ Aviation Radio
- ☐ Operating Broadcasting Stations
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(If you have not decided which branch you prefer—mail coupon for facts to help you decide.)

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Address .....

City ..... State 2FR

by THE EDITOR

THE long awaited rulings of the FCC on the *Civil Defense* set-up, involving the use of amateur stations, amateur operators and professional operators have been made and will now be put into operation. As pointed out last month, the FCC will license operators for this special work, although the jurisdiction of the local systems will be under the supervision of the OCD. All operators chosen will have to be approved by the local police or some equally effective policing body. Regular test periods will be allowed for the transmitters, and schedules of operations will be formed too. These will be predicated on the specific duties allotted to the stations.

At Our Radio Training Centers

We have just completed an extended trip which has taken us over 3,000 miles. We have seen Uncle Sam's radio men at work and at play. We have visited their classrooms, have inspected their laboratories, witnessed their operating procedure and have heard the never ending oscillator tone signals in the code rooms. We met many outstanding officers entrusted with the responsibility of training men in radio to satisfy the huge demands of the military for operators, maintenance men, instructors, linemen, etc. This trip was most enlightening as we were able to witness the actual study of, and the progress made on certain types of equipment.

Radio, in peace-time a leading servant of man, is now one of the most potent weapons of our military forces. Without it, we could not hope to achieve the efficiency and modern techniques now employed to combat our enemies. It was very helpful to get the reactions of these officers and students regarding their problems. *They mean business. They do not handle radio as a plaything. No time is wasted. Every minute counts. Morale is high*—yes, very high in these radio training centers and men by the thousands are leaving these schools to find their places in various branches of the services where they arrive well qualified for the task to which they are assigned.

We met many old friends on this trip, including Capt. John Rider, S. Gordon Taylor, Maj. Bob Hertzberg, only to mention a few who are now contributing their radio experience at

(*Continued on page* 53)

Vol. 28 RADIO NEWS No. 1

Trade-Mark Registered

The Technical Magazine devoted to RADIO in WAR, including articles for the Serviceman, Dealer, Recordist, Experimenter and Amateur

Contents for July, 1942

FEATURES

SERVICE SECTION

INDUSTRY

DEPARTMENTS

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★

IT TAKES

MACHINES

TO CRUSH OUR ENEMIES

This is not a war of men! It's a war in which the intelligence, the ingenuity and the war-machine production capacity of the Allies are hurled against the Axis! *Inventive genius is our most potent weapon!* Let's permit none of it in America to remain idle!

Radio inventions will help us win the war! To stimulate their creation, RADIO NEWS is offering handsome cash prizes totaling $600.00 through

A NATIONAL COMPETITION FOR RADIO INVENTIONS!

ENTRANTS WILL RECEIVE:

1. PRIZES TOTALING $600.00 IN CASH!

FIRST PRIZE	$300.00
SECOND PRIZE	$125.00
THIRD PRIZE	$75.00
FOURTH THROUGH THIRTEENTH PRIZES, EACH $10	$100.00

2. Submission of all entries, deemed by the judges to be of value, whether a prize-winner or not, to the *National Inventors Council* of the U.S. Department of Commerce with the judges' recommendation.

ANYONE CAN ENTER—

providing he is a citizen of the United States or of a friendly nation. *No models are necessary!* Only a brief, written description of the invention is required, although it may extend to 3,000 words and be illustrated with photographs and/or diagrams.

DON'T DELAY! SEND FOR YOUR OFFICIAL ENTRY BLANK TODAY!

RADIO NEWS

540 NORTH MICHIGAN AVENUE
CHICAGO

Students working with breadboard layout of Colpitts circuit. The voltage regulators help to maintain a stabilized power source.

Working with airplane transmitters is an important part of the technical training.

RADIO TRAINING FOR

These men are operating in close co-ordination with the gun crews.

Ground equipment of portable trailer unit used by the Air Forces with great success.

Here is the high power portable transmitter and receiver unit of the Air Forces. The forward part houses transmitters—the rear holds receivers.

THE AIR FORCES . . .

by Maj. J. R. JOHNSTON

Air Forces, Public Relations, Scott Field, Ill.

The famous "Radio University of the air" is responsible for training thousands of operators for the Air Forces

DEEP-ROOTED in the heart of every true American is a love of freedom that has been traditional since 1776. That love of freedom always has burned like an unquenchable flame. No enemy has ever succeeded in extinguishing it before and, in common with men of the ground forces, those of the Army Air Forces are determined no Axis gun or bomb shall do it now.

By nature, Americans are a peace-loving lot, but when they are forced to do battle, as they are now, they can be the fightingest race in the world. Since colonial days Americans have been famous for their marksmanship, and on land, on the sea, and in the air they have always given a good account of themselves.

Marksmanship still is of primary importance in winning battles, but in modern warfare other factors loom equally in importance. One of the foremost of these is *Radio Communications,* particularly in the air arms.

Comparatively unsung—yet as vital to success in aerial combat as the pilot—is the radioman. Upon him depends the maintenance of the line of communications, the receipt of orders, the dispatch of information concerning approaching enemy units which permits a "gathering of the clans" above and around invasion hordes as in the battle of the Coral sea.

Col. Wolcott P. Hayes
Commandant, Scott Field

Without radio—so say military experts—modern warfare in its present tremendous scale would not be possible. A fighter pilot handles his own radio contacts, communicating with other pilots in his squadron, or with ground stations direct.

But in a big bomber, where the multiplicity of duties would overwhelm one man, a trained radio operator is indispensable. Upon him the pilot and the rest of the bomber crew depend for accurate reports of weather conditions necessary to the success of their mission, for orders from base stations, and for a hundred other reports. In actual battle, he often is called upon to man a machine-gun, but if not, he sits at his radio controls, unprotected by armor, coolly attending to his duties.

Thousands upon thousands of radio operators must be trained for the 185,000 planes ordered by President Roosevelt. And upon Scott Field, Ill., 20 miles east of St. Louis, falls the burden of preparing young Americans for combat radio work.

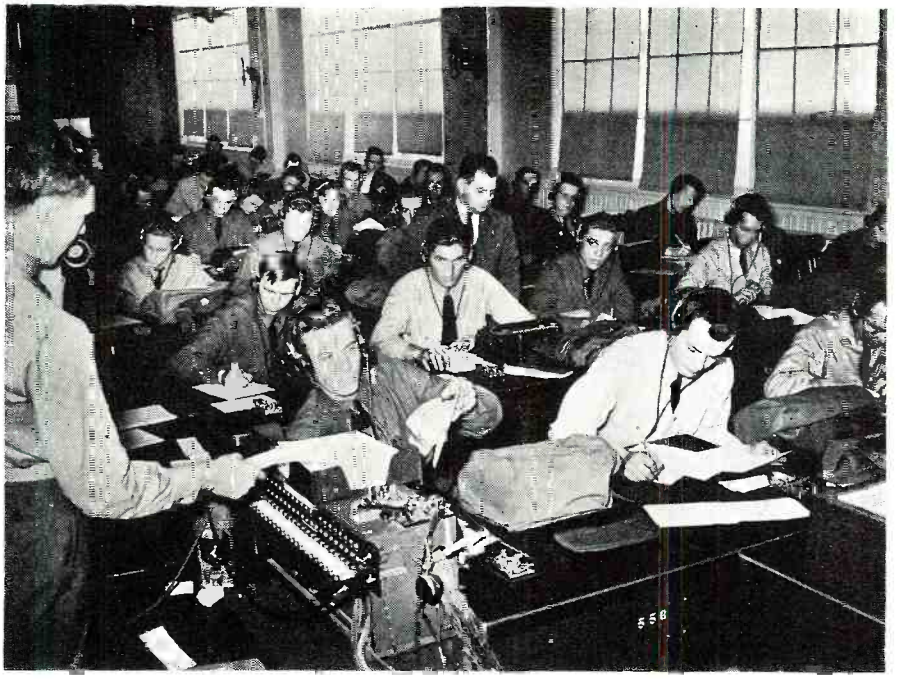
Never has the demand been so great or so vital to the continued existence of the United States. And never has the answer been quite so spontaneous.

16 wpm code in Flight Net Operations.

Directional loop for radio compass.

Students taking voltage measurements.

The business end of the tape transmitters.



Automatic code senders feed into hundreds of channels. In foreground is a channel panel containing amplifiers and mixers—a valuable accessory.

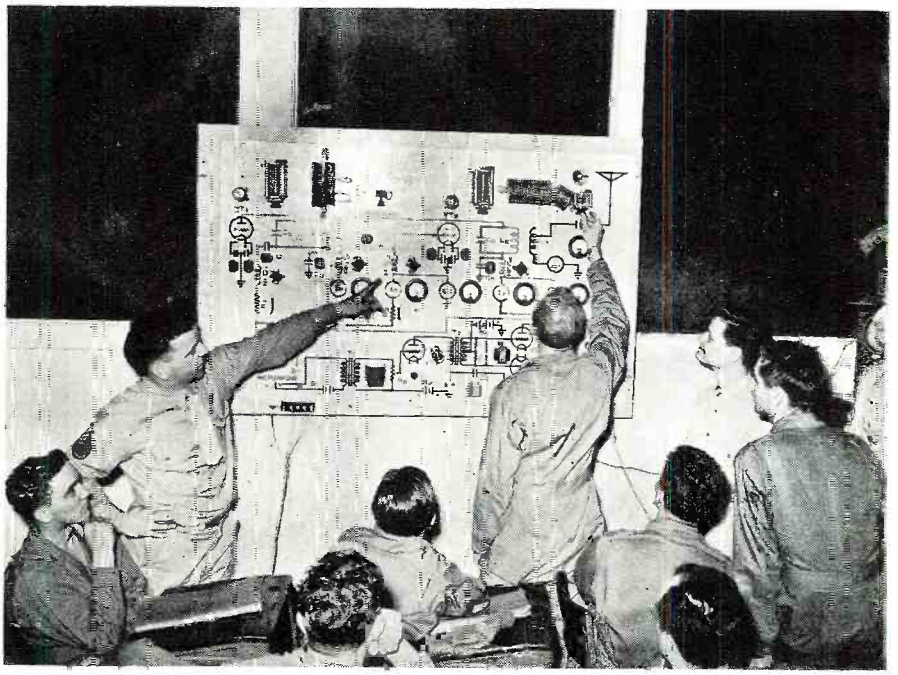
From farms, from towns and cities, from mill and factory and office come youths determined to do their part to whip the Axis. Many of them are former amateurs, but the majority never before saw a radio transmitter.

In a few short months these youths must master the principles of direct and alternating current, voice and sound transmission. They must learn how to operate and maintain intricate radio equipment. They must acquire a thorough knowledge of complicated wiring circuits of the radio receiver, transmitter and radio compass—the latter used in plotting courses in flight.

From the first week in school until the last, these students listen day in and day out to the drab, monotonous humming of an automatic code machine. As the weeks pass, the incessant, unintelligible mutterings coming through the earphones begin to take on definite meaning, and at last blossom forth in the language of the International Morse code. Test follows test, until the radio operator can handle smoothly a rate of 16 words per minute. This is twice as fast as is required of an army pilot.

After a student passes into the 12-word class on his way to becoming an

Class in advanced transmission. Students studying circuits on large panel board. Each component is fastened firmly to its proper place.



Maintenance and operation of medium-power transmitters and study of receivers. Units are very rugged and are capable of taking much abuse.

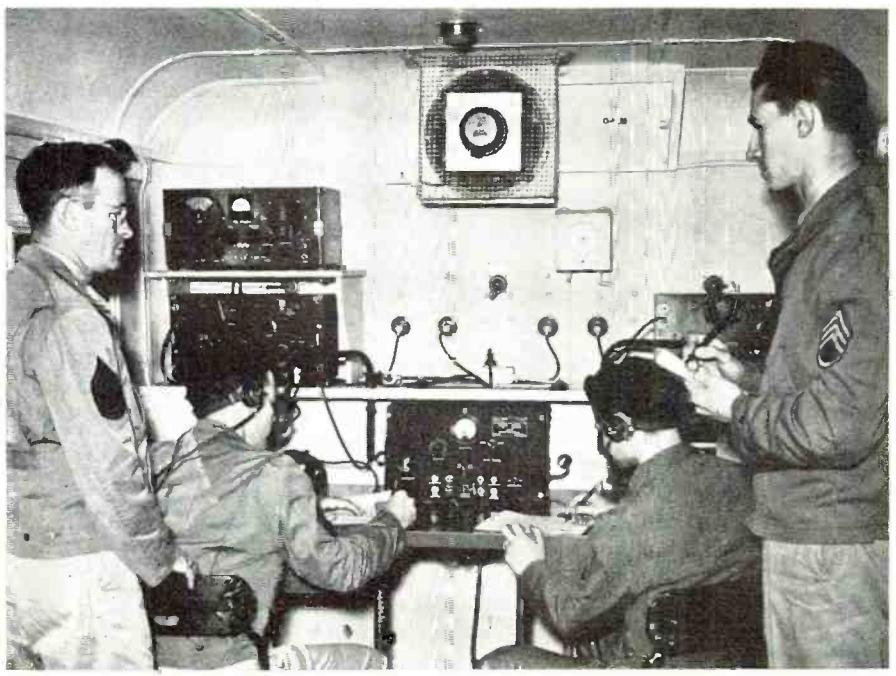
important member of a bomber's crew, he begins the study of transmission and reception of coded weather reports, the rudiments of aerial navigation, and tactical procedure for use with a fighting unit of the air force. As if this were not enough to crowd into a single course, before he has become a full-fledged radio operator he must study radio telephone procedure, weather information, position location, winds, traffic conditions, and landing instructions.

But the army is in a hurry. Men must be trained with the greatest possible speed, but they must be trained without sacrificing the skill and ingenuity which will make our Army the most formidable in the world.

Scott Field, now known throughout the service as the radio university of the Air Forces owes its prominence among army schools to the organization genius of one man—Col. Wolcott P. Hayes. In 1917 Scott Field was established as a training center for aviators in World War I. Later it served as the headquarters of an air ship and balloon squadron, and still later was practically abandoned until the national emergency of 1939. In July,

(*Continued on page* 62)

Inside of the trailer shows elaborate receiving equipment. The students use 4 different receivers, each covering 4 frequencies. Note ventilator fan.



Checking power pack for continuity.

Working on "breadboard sets."

Time-out for some Kelly pool.

Machine grades exam papers.

Radio students at the Chelsea Vocational High School checking condensers.

The Civilian Radio Army

by ALFRED TOOMBS
Washington, D. C.

Every radioman should read this interesting analysis on training now being offered in almost every state.

THE Signal Corps is the communications branch of the Army. Its thousands of highly-trained troops are strung across the face of the earth and their job is to maintain contact between all units of the Army. The soldiers of the Signal Corps are operating one of the world's most extensive communications systems—and they are keeping it going in the face of bombs, shells, arctic blizzards and tropical hurricanes.

Behind this great army, there is another—the army of civilians. They are doing the jobs which make it possible for the Signal Corps soldiers to keep the contact between all units of the Army. These civilians are employes of the Signal Corps, hired for and trained in highly specialized tasks. Without them, the Corps would be hard put to function at its present high level of efficiency.

This civilian army is made up of older men, of women, of young men who have not yet been called by Selective Service. They are soldiers without uniforms—doing jobs which soldiers would otherwise have to do. They have been employed by the Signal Corps because the tough, physically trained troops of the Signal Corps are needed in the battle areas—and cannot be spared for work on the home front.

The growth of the civilian organization in the Signal Corps has been at the same breath-taking rate as that of the military organization. In January, 1940, the Signal Corps employed about 1,500 civilians. In May, there were more than 30,000 civilians working in the Signal Corps—and before the end of the year there will be more than 50,000.

This vast army of civilians is engaged in all the non-combat activities of the Signal Corps including assist-

ance in procuring, designing, maintaining, storing and shipping the equipment which is used by the Signal Corps soldiers on the fighting fronts. In addition, their duties include sending and receiving messages over the Army nets in this country; the operation of aircraft warning systems, and other functions which are vital to the protection of the United States.

To obtain these workers for jobs which require highly specialized skill and knowledge, the Signal Corps has found it necessary to organize and supervise what is probably—in the aggregate—the greatest radio schooling program ever undertaken. In dozens of schools operated under supervision of the Signal Corps, men and women by the thousands are learning radio. When their training is completed, they will step into their place in the ranks of the civilian army.

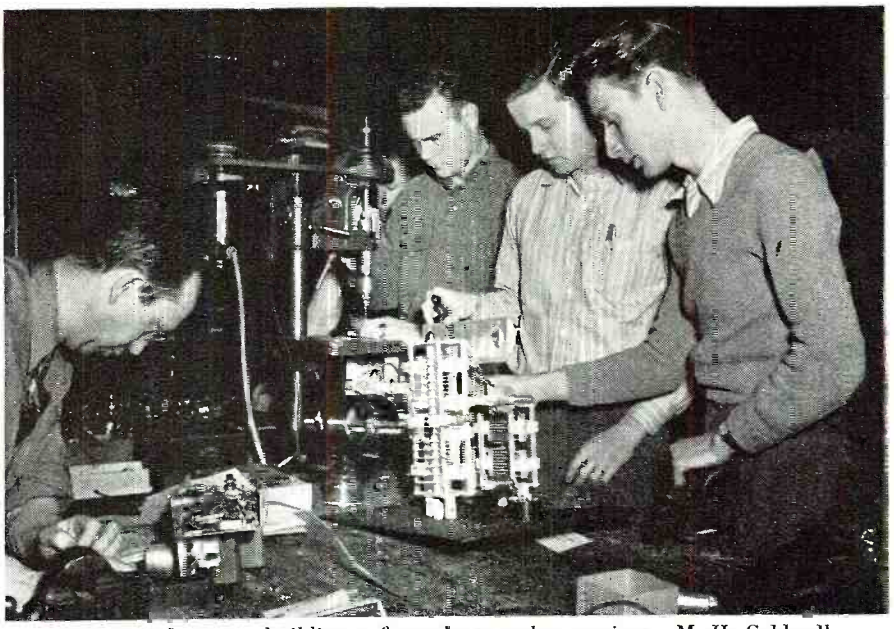
When it became apparent, about two years ago, that this country was about to launch a great program of preparedness, Secretary of War Stimson appointed Mr. Lawrence Appley, an expert in training and organization, as a consultant. Last July, Mr. Appley inaugurated a comprehensive program for civilian training. During the Fall, Mr. W. H. Kushnick was named by the Secretary as Director of Civilian Training for the War Department and was given the job of coordinating the training of the thousands of workers needed.

The problem which the Signal Corps faced when it began to recruit the civilian army was monumental. Engineers were needed—but most of the radio engineers had been employed by war industries or had been commissioned by the Army or Navy. Skilled radio operators and maintenance men were needed, but they, too, had mostly gone into war work or the armed services. It was obvious that there were not nearly enough trained people to fill the bill. There was no alternative—the Signal Corps would take untrained people and school them for the jobs that were to be done.

The Civil Service Commission was called upon to furnish candidates for training. The United States Office of Education and other Federal, state and local training agencies were brought into the program of education. This program is gathering impetus now and the opportunities offered to unskilled civilians are great.

Training programs are being carried out by the headquarters of nine Army Corps areas, under the direction of the Signal Officers of these areas. In addition, training is being given in the various Signal Depots, where radio equipment is sent for servicing and distribution; in the Air Depots, where aerial radio equipment is centered; in the procurement districts and radio experimental laboratories.

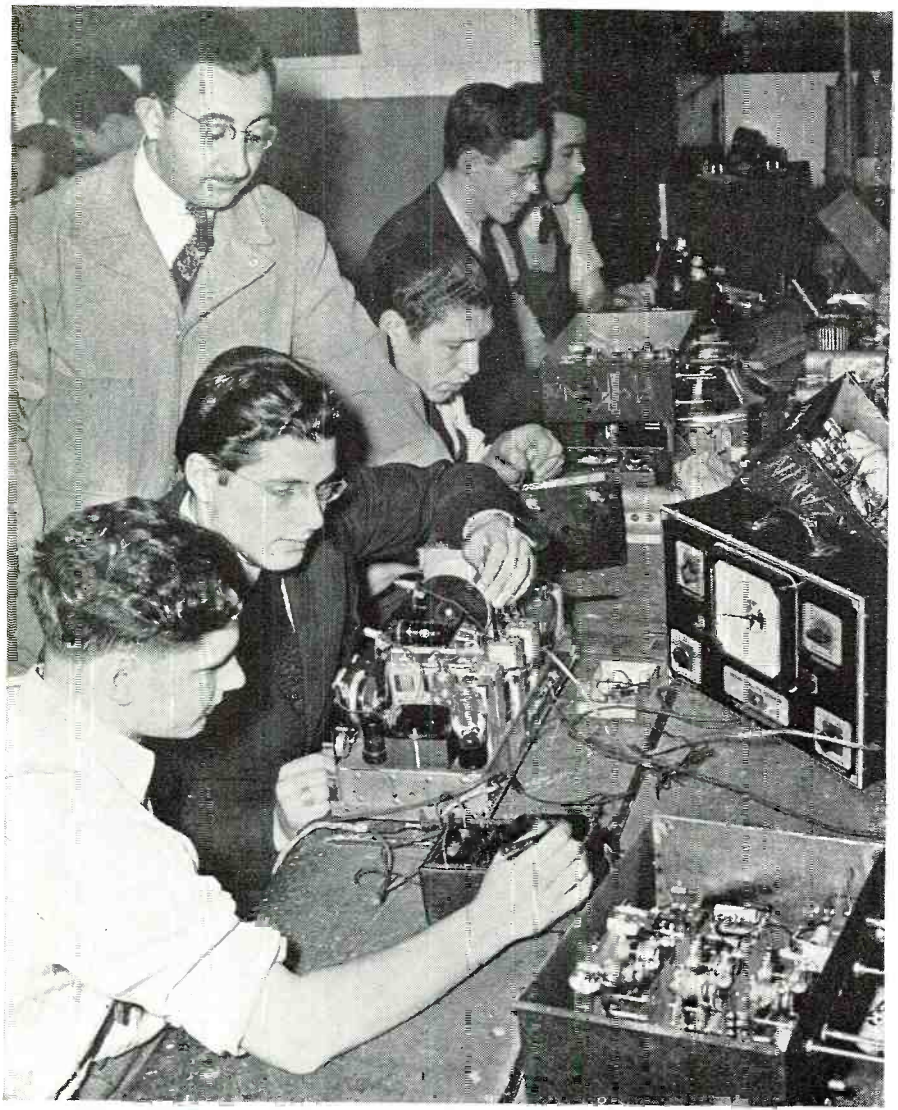
There are two types of civilian training conducted by the Signal Corps. The first is Pre-Service training, which is given to those applicants who have not enough skill to under-



These students are building a five tube superhet receiver. M. H. Caldwell builds a five tube super; Harold Smith drilling chassis for receiver; H. L. Morris with transmitter, and Wilbur Dent, Instructor.

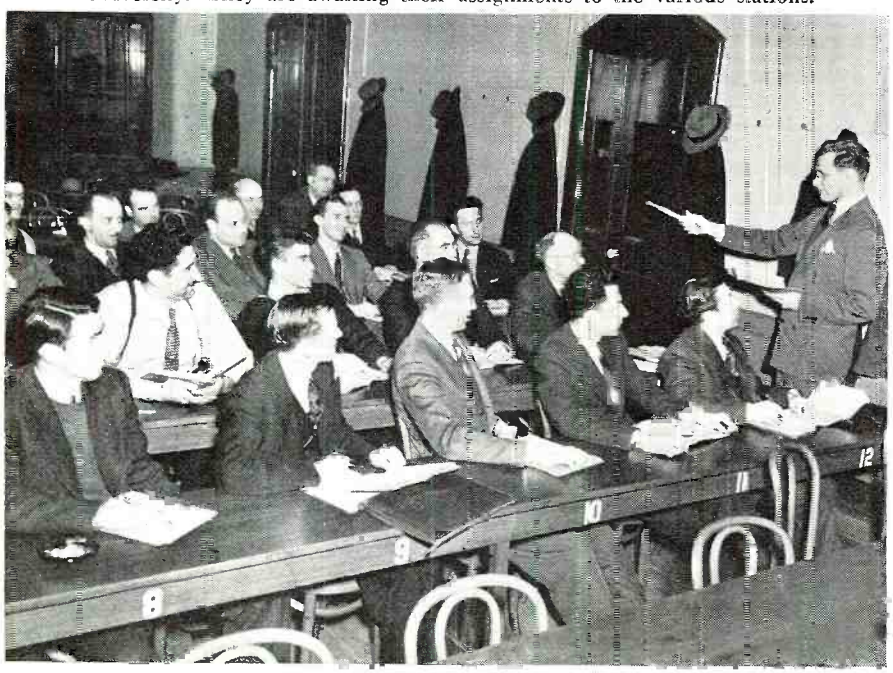
Miss Sarah McConnel examines the radio board prepared by students of the Junior Repairman's school. Lt. J. W. Hudgins is seen looking on.

A "must" for future radio personnel is the mastering of both code and typewriter. This is necessary for maximum operating procedures.



These Chelsea students are continuity testing all of the various parts used in an elaborate superhet receiver. This work is very appealing.

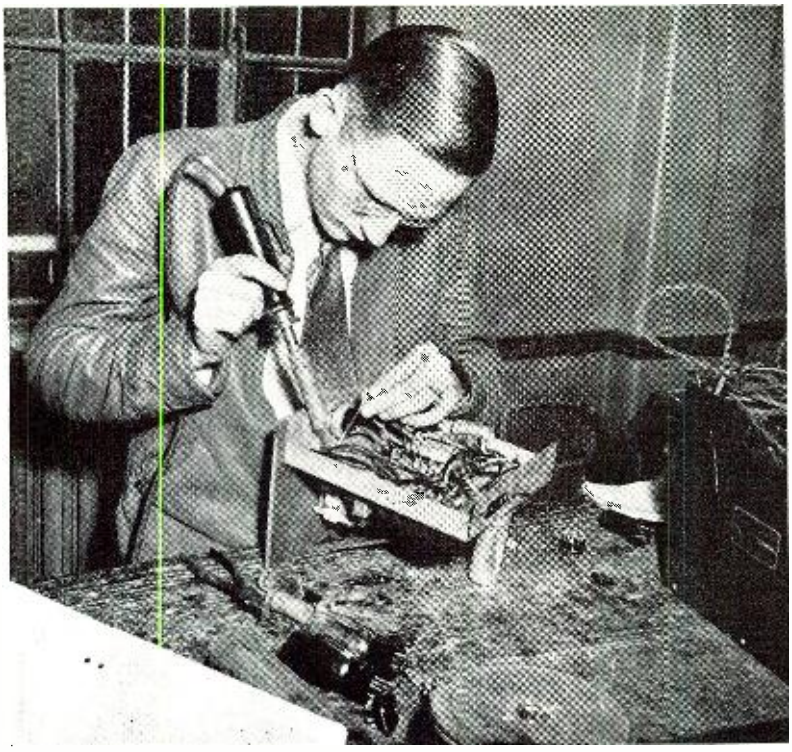
Class of mechanics and engineers at Signal Corps School at New York University. They are awaiting their assignments to the various stations.



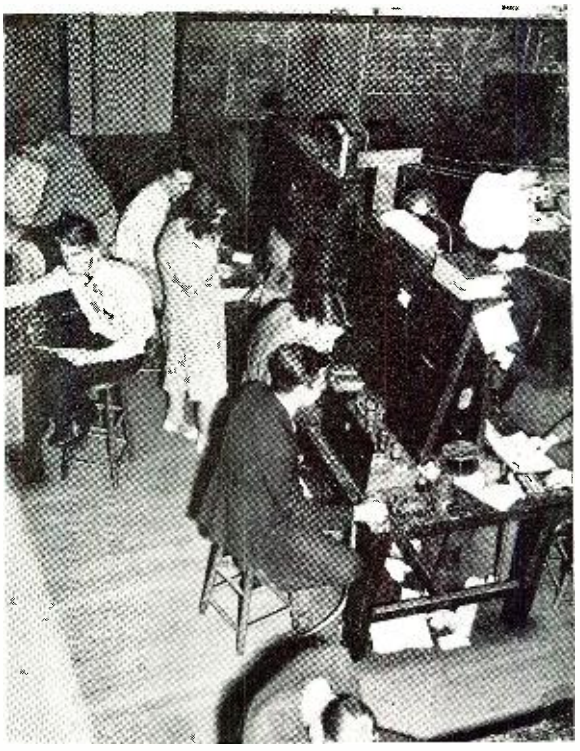
The assembly table in one of the classes at the Junior Repairman's Training School. The students show a lot of interest.

take their jobs without preliminary instruction. Many public and private schools throughout the country have made their facilities available for this Pre-Service training. The U. S. Office of Education cooperates in the Pre-Service program by approving most of the courses under the National Defense Training Program. In the course of a few weeks, workers who may have been taxi drivers or law students but who have had some radio experience or who pass radio aptitude tests, are taught the fundamentals of radio and are qualified to go into the shops at various depots to perform simple jobs and to take further training. The second type of training is called In-Service, which is designed to increase the skill of persons already employed. These workers may have adequate experience and knowledge to qualify them for the jobs they are now doing, but the Signal Corps is anxious to increase their skill—so they may perform more difficult tasks.

The Signal Corps is training radio workers in many classifications. There are the mechanic learners, who are given a short training course which qualifies them for comparatively simple jobs. There are the Junior Repairmen Trainees, who are qualified to perform more complex maintenance operations. There are the Junior Engineering Aides, who are given, in as short a period as possible, much of the technical training received by college engineering students. There are Radio Operators, trained to send and receive Army messages, and operators of aircraft-warning devices. The technical training which these workers receive



R. A. Hendricks, student in the Technical High School, puts the finishing touches on a five-tube superheterodyne receiver.



This view in one of the classrooms, Ft. McPherson, Ga., shows some of the students examining units.

is given at no cost to themselves—in fact, they are paid regular salaries while they are learning.

At this time, college-trained electrical engineers are hard to find. The Signal Corps needs 15,000 men of this calibre at this time and so must train substitutes. The men and women who are trained in this category are called Junior Engineering Aides. They receive a brief preliminary training period in vocational schools and then are entered in leading engineering colleges throughout the country for an intensive study course of a few months. When they have completed their Pre-Service training they are assigned to Signal Corps duty and In-Service training. After some practical experience, they assume sub-professional duties and responsibilities.

Girls who have been recruited in the Signal Corps training program have made very satisfactory progress. There was Pamella Windham of Marietta, Georgia. Pamella finished high school and then took up radio and code transmission. In 1941 she was granted ham license W410G. When the Signal Corps began to recruit trainees, she passed the Civil Service examination and entered Pre-Service training in Atlanta. Having a "flare" for code, she was enrolled in a course in High Speed Code, completed the course and qualified as an Army operator.

Then there was the girl in Philadelphia, who was a graduate of Temple University, majoring in Social Service. But work was a little slack in Social Service around Philadelphia so she applied for employment as a Signal Corps trainee. Entering a Mechanic Learners' School in Radio, she learned something of radio fundamentals and how to perform skillfully the common tasks in radio repair. Now she is at her post in the civilian army of the Philadelphia Signal Depot and is giving real service.

In-Service training is conducted at all field establishments from the large depots employing several thousand persons to small field stations employing only a dozen. Jobs are analyzed for their training requirements, and all employees are trained for greater efficiency. Training plans provide also for looking ahead and preparing at least one understudy for each civilian position. As a result, there are always trained employees to step into positions vacated for any reason.

In-Service training is imparted by two methods. Supervisors or foremen check the efficiency of an employee against the requirements of his or her position and, as work continues, the supervisor, foreman, or a trained worker designated by them, instructs the employee until proper efficiency is attained. This is generally known as on-the-job training and has been found, in many instances, to be superior to other methods.

The second method is group instruction given by a foreman or supervisor. These "classes" are usually held after regular working hours, and may total from two to six hours a week.

In Sacramento Signal Depot a janitor, desiring to make a greater contribution to the war effort, enrolled for In-Service training, made progress, and soon was given a job as aircraft electrician's helper. By continuing his In-Service training, he increased his efficiency and is now a leadman.

Following is a summary of the training activities being conducted in typical Signal Corps Field establishments:

1. Number of civilian employees to be more than doubled in 1942.

2. Civilians being trained to handle all kinds of technical work previously done by soldiers.

3. Full-time vocational courses being given for Jr. Repairman Trainees and Jr. Draftsmen.

4. Advanced training being conducted in radio, physics, electronics, testing procedures, radio theory and mathematics.

5. Eight vocational schools now cooperating in conducting courses.

Signal Corps, Second Corps Area, Governors Island, New York:

1. Pre-Service training courses for Mechanic Learners and Trainees in Radio being conducted in several New York schools.

2. Short courses for pre-assignment training of employees given at New York University.

3. Plans under way for increasing school facilities and employment of several hundred additional trainees.

4. Training courses being conducted for specialists in several industrial laboratories.

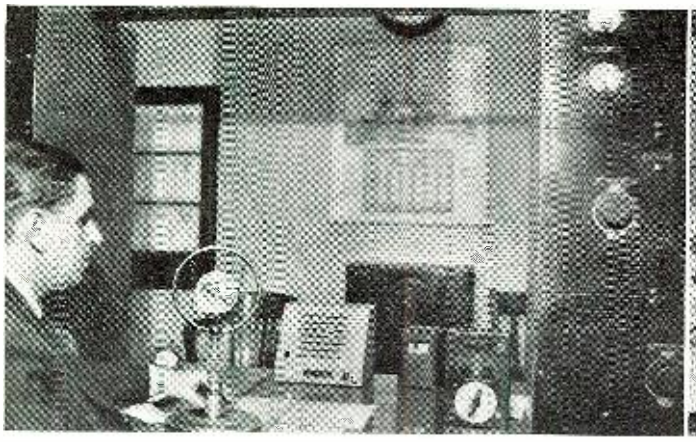
Signal Corps, Third Corps Area, Baltimore, Maryland—Pre-Service training for Mechanic Learners and Jr. Repairman Trainees offered in vocational schools:

1. Radio courses to extend from 4 to 6 months on Pre-Service basis.

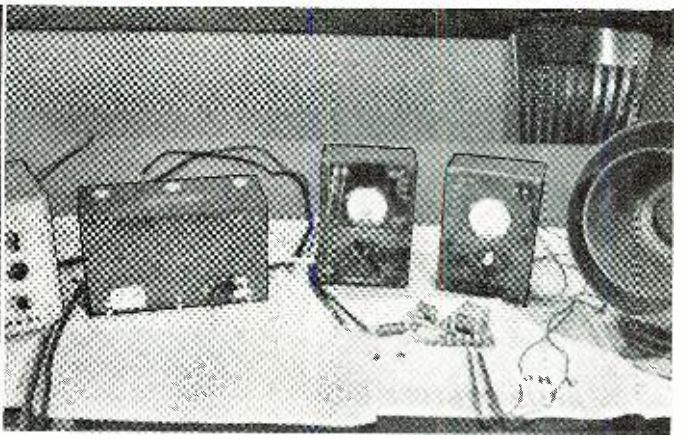
2. Quota of several hundred civilian trainees established for the year.

3. In-Service training programs in

(*Continued on page* 56)



Sgt. P. Dankovics, radio officer, at the microphone in the central control room of the police radio system.



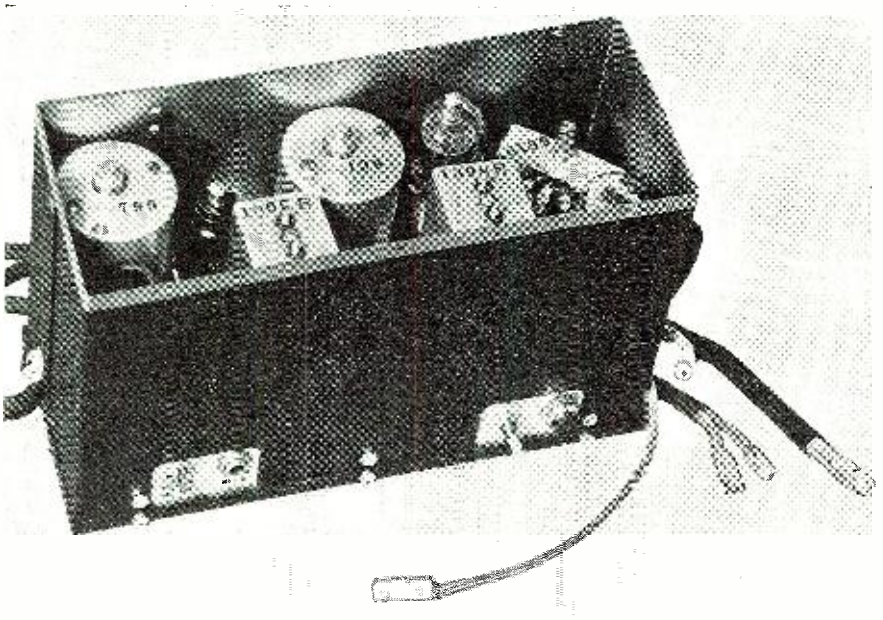
The relay and filter circuit under test with police car radio. Signal generator sends control tone to set.

Air Raid Warning Problems and Remote Control

by E. J. MADDEN
Radio Instructor, Armored Force School

The author of this article has had much experience in the design of control systems for the protection of the public.

Closeup of the radio car unit employed in the tests, a 1 watt superhet.

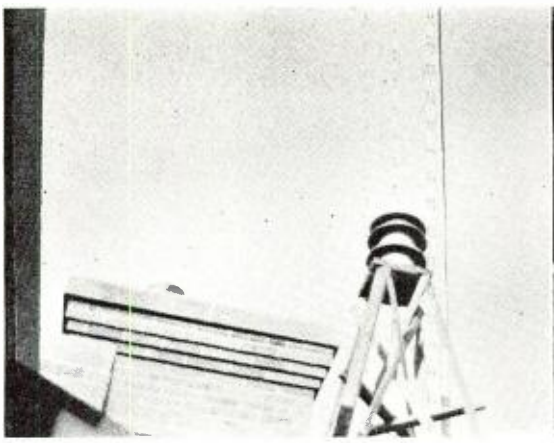


THE following is a discussion of air raid warning problems and a report of tests on remote control of sirens made during February 1942, for the Air Raid Precautions Service of Yonkers, N. Y., by E. J. Madden and P. Dankovics. A city of twenty square miles, with plenty of hills, and traffic, in a metropolitan coastal area, offers most of the problems in air raid warning now being faced by many civic officials today. In order to more effectively discuss how to meet them, it is considered useful first to consider just what some of these problems are. The following include various ideas.

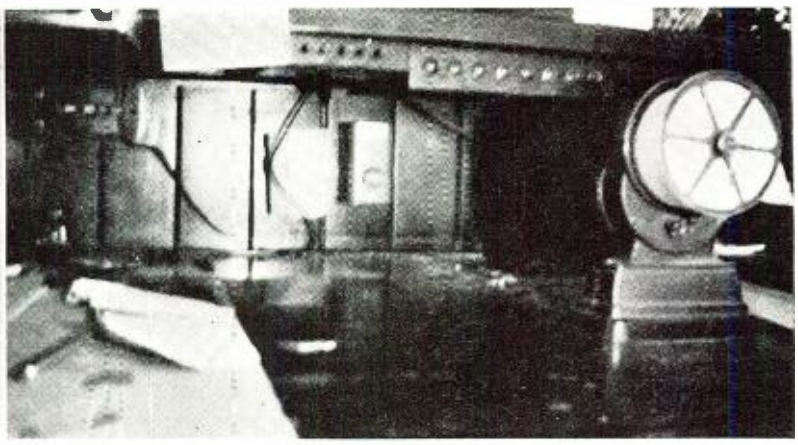
The ideal raid warning would be a sound that every one in the affected area could hear, one of unmistakable characteristics, which could not be set off by accident, which would infallibly go on in time of need. The sound of a *nearby bomb explosion* satisfies all these requirements except one — in point of time it comes a little late! In many places here and abroad, it is still the only warning given, but it is definitely not the kind of air raid warning we plan to have. The problem varies from place to place, but essentially the difficulties are similar.

In small communities a single loud siren or air horn may serve the area, although people near it may get too much sound, more distant people not enough. In the larger cities it is quite impossible to cover all sections with a single unit; a unit for each district serves better, but brings in the complications of multiple control. These problems are discussed in detail below. Additional problems arise from the desirability of distinguishing between the beginning and end of the danger period. Various codes are in use, but the most widely accepted is a series of intermittent blasts for the "alert," and a sustained long note for the "all clear."

The peculiarities of sound itself make this coding of the signal none too simple especially in a large community using several sound units. Even though the units may emit intermittent sounds in exact synchrony—which requires some engineering—the sound reaching the ears of listeners in



One of the twenty or more sirens mounted on police stations. Each covers 1 sq. mile.



This illustration shows the push-button control in the center of the photo. It is within easy reach of the operator at the controls.

many parts of the area will not be intermittent, but a continuous wavering tone. This is because sound travels relatively slowly, approximately eleven hundred feet per second, so that the sound from a unit a half mile distant will start and stop more than two seconds later than the sound from a nearby unit. When several originally synchronous sounds are combined at a point which is at various distances from their origins, the result is hardly if at all distinguishable from a prolonged tone.

Add to this the echoes and reverberations from irregular contours, the jagged topography due to large buildings, and the high levels of noise from vehicles and industrial machinery. Add to this the astonishing ability of sound to "crawl in a hole and pull it shut after"—the basic principle of many specially designed sound absorbing surfaces. Add to this the fact that it takes real power, in horsepower lots, to make noises that sound big outdoors; and you have a few of the reasons why the solution of the air raid warning system is not simply a matter of buying a lot of sirens, and having wardens turn them on.

In the smaller communities the problems are less than in large cities, but there are enough to require careful consideration by competent engineers, and a practical survey of the warning area, before equipment and installations can be intelligently procured. In this matter of self protection for their very lives and homes, few men will fail to volunteer and give their ready cooperation. Such men as the engineers-in-charge of the local utilities, telephone service, and fire signal system, should be consulted, as well as field men from the various manufacturers of sound signal equipment.

Without specifying or recommending any type of equipment, it may be suggested here that there are several types of units, some of which may be more suited to local needs than others. For example, to mention a few, there is the centripetal impeller type, commonly called a siren or screamer, which consists of a motor or hand driven bladed wheel in a housing with openings around its circumference through which air is forced out by the blades and is cut off at the openings, causing a pulsing tone which increases in frequency with the speed of rotation, attaining a loud high wailing note or shriek at maximum speed, dying down, as speed is reduced, to inaudibility.

The siren is credited with high efficiency in converting energy into sound. On the other hand it is most audible and efficient only at certain speeds or tones, and it is slow to start and stop. To facilitate coding some models are equipped with shutters, which may be operated by hand or power, to shut off or open up the housing as required. In the larger models, this feature would require additional electrical and mechanical considerations, and the installations must be planned to accommodate them. Another factor is the weather. Units must be ready to work instantly in all kinds of weather, hot or cold, wet

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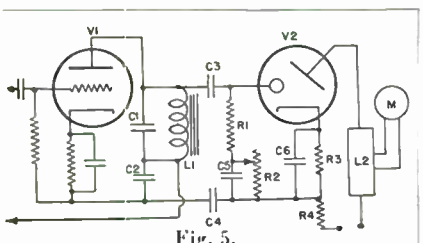
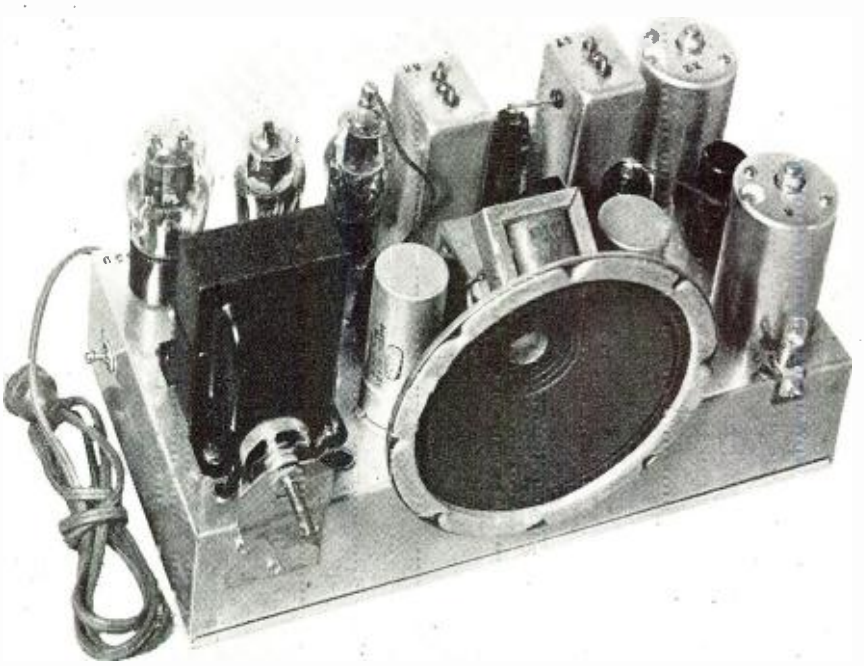


Fig. 5.

C_1—*Bypass for frequencies above control tone*
C_2—*Bypass for plate supply*
C_3—*Coupling condenser for control frequency*
C_4—*Isolating condenser*
C_5—*Timing condenser*
C_6—*Cathode bypass condenser*
R_1—*Delay resistor*
R_2—*Time adjusting rheostat*
R_3—*Bias resistor*
R_4—*Blocking resistor*
V_1—*Final audio amplifier of communication receiver*
V_2—*Gas discharge trigger tube*
L_1—*Filter for frequencies below control tone*
L_2—*Solenoid in power relay*
M—*Siren Motor*

The barracks model of the police car radio receiver operates from 110 a.c.

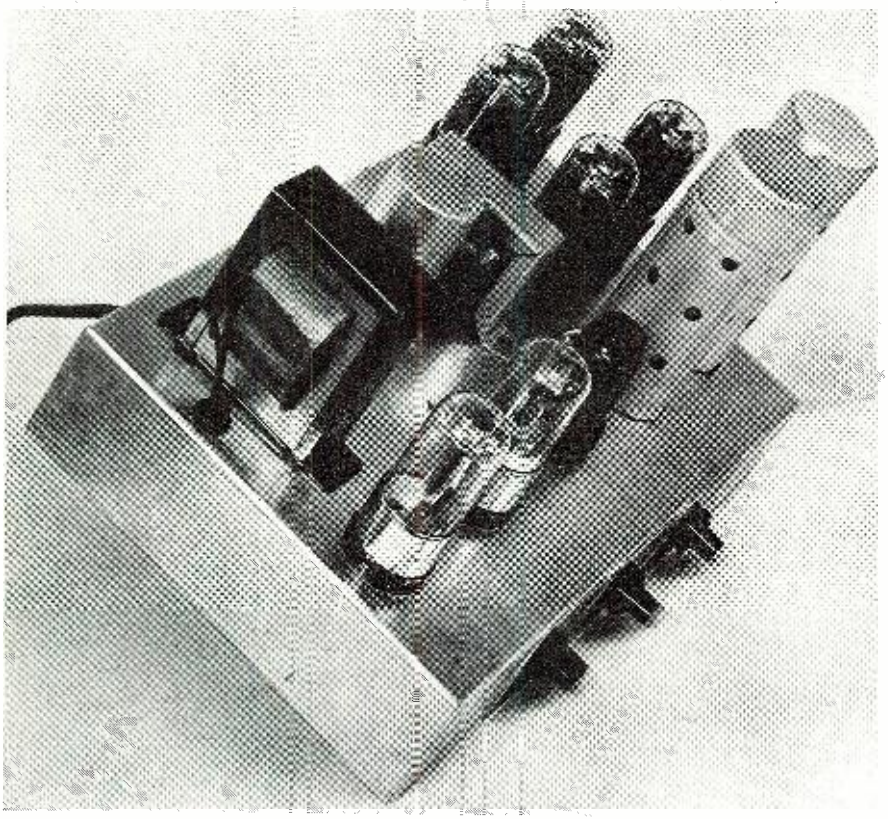


New Amplifier Features R. C. Equalizing

by MILTON T. PUTNAM

Broadcast Engineer

Using but few easy-to-get parts—this unit is capable of excellent reproduction and features several tone control innovations.



The two shields cover the two 6C8G's and prevent grid hum pickup.

WE must necessarily make a number of compromises in the design of an amplifier from the standpoint of available parts, and sometimes out of these compromises grow new ideas. At any rate, in this particular case, a little more thought was given to eliminating specific items, and consequently it led to the use of a new system of tone compensation.

The big items to eliminate in amplifier construction when they are not available are transformers, chokes, or any other form of inductance which are difficult to obtain. The elimination of the power transformer necessarily dictates the use of a voltage doubler or a simple half-wave system, and in this particular case, the plate voltage needed to give the required output necessitates the use of a voltage doubler circuit. The current requirements for the whole amplifier were such that it was necessary to use two rectifier tubes.

In order that we have sufficient filter and keep the hum level down, at least one choke had to be added.

Since it was of prime importance to have a very flexible tone control system in this unit, this also presented somewhat of a problem. Almost every system used, which actually gives a *boosting* effect at either the high or low frequencies, employs a resonant type filter, requiring the use of an inductance or choke. These parts, being unobtainable as they are, it was thought desirable to spend enough time and give a little thought to this problem in itself. Out of this necessity for eliminating inductance in the tone control circuits, came the use of "R"-"C" Filters for low and high pass filters. Out of the need for a means of controlling their effectiveness, and supplying gain to make up for their insertion loss came the use of a mixing circuit, with the low pass filter into one grid, and the high pass filter into the other.

The phase inverter provides a very satisfactory means of eliminating an interstage transformer and contributes somewhat to the gain of the amplifier. There is no satisfactory means of eliminating an output transformer for push-pull operation and this is the one transformer used in the whole amplifier.

Through the necessity of designing the amplifier to be operated from a low voltage power supply and with its tube filaments to be operated in series, we are restricted in the choice of tubes. As a general comparison between power output tubes is made, it may be noted that the tubes suitable for "a.c.-d.c." circuits have a considerable amount of harmonic distortion inherent in them, and usually the beam power tubes and others which give the greater output are those with a greater amount third harmonic distortion. Since it is possible to cancel second harmonic distortion by push-pull operation, the most important consideration is to choose tubes with low third harmonic distortion.

One of the requirements of this unit was that it have a 6 to 8 watt output in order to handle the range of compensation desired. Even though it could be obtained with only two push-pull output tubes, we compromised in favor of 25A6s in push-pull parallel, since they give us a fairly low order of odd harmonic distortion and meet the necessary requirements as far as power output is concerned.

The phase inverter circuit is of the balanced type, employing a 6C8G. After consideration of most every type tube for the phase inverter and mixer, the 6C8G was used, primarily because it was more easily obtainable than the metal type 6SC7. Whatever type tube is used here must of course have .3 amp filament, since the filament current of the 25A6 is .3 amp.

In this same connection you will note the 250 ohm resistor indicated in the circuit across the three 6.3 volt tubes. This has a very definite purpose and though it looks like a violation of ohms laws it actually isn't. The explanation is that due to the fact that the 25 volt tubes take longer to heat and their resistance cold is comparatively low, the 6.3 volt tubes have an instantaneous surge of voltage across them sometimes 2 to 2½ times their rated voltage and damage may result.

The 250 ohm resistor caused slightly more current through the 25 volt filament and slightly less through the three 6.3 volt tubes. The final voltage across the 6.3 volt tubes is approximately 5.55 volts with a 118 volt line. In the 6.3 volt tubes the resistance varies from about 3 ohms cold to 22.5 ohms hot.

Electronic Equalization

The use of mixers is well known to most of us in connection with the mixing of two input devices, and combining them in a common output. This same idea has been applied to a frequency control system and the results are very satisfactory. As stated previously, the use of a resonant type filter employing any form of inductance was avoided, due to the scarcity of these "bass boost" and "high lift" chokes, etc. It is possible with an "RC" network and a single tube to accomplish a boost at any given frequency range giving results comparable, and in some respects better than with the use of chokes.

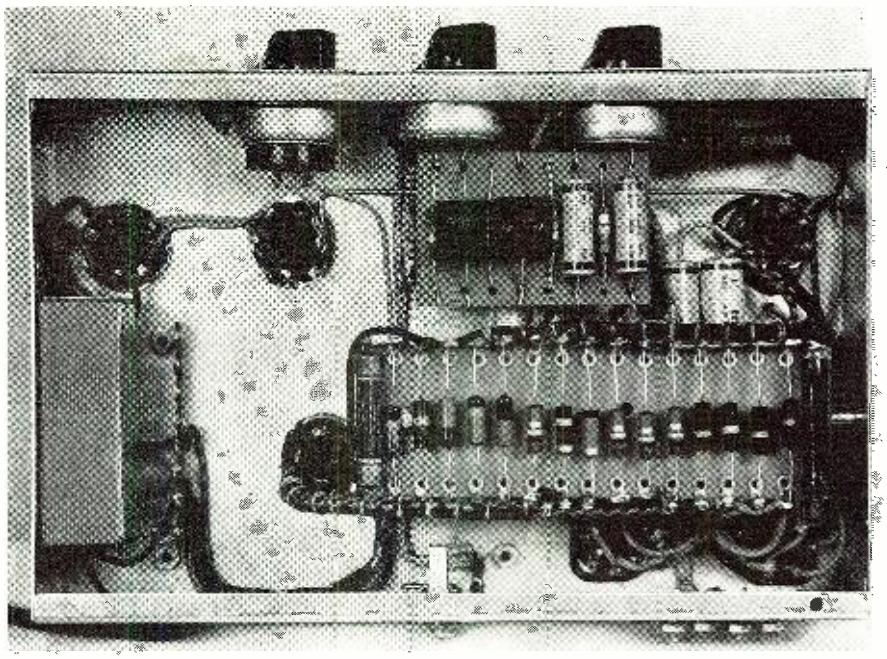
An equation for the solution of these filter circuits is given and it may be applied to the design of any similar network to enable any one to attain various ranges of frequency compensation. At any given frequency the ratio of output to input voltage in the filter shown in Figure 1 is

$$\frac{E_o}{E_i} = \frac{X_c^2}{R^2 + 2RX_c + X_c^2}.$$

This holds true for the low pass filter. In Figure 2, the high pass filter, the equation would be

$$\frac{E_o}{E_i} = \frac{R^2}{X_c^2 + 2RX_c + R^2}.$$

The attenuation may be shown in DB thus: $DB = 20 \log \frac{X_c^2}{R^2 + 2RX_c + X_c^2}$ for the low pass filter, and $DB = 20 \log \frac{R^2}{X_c^2 + 2RX_c + R^2}$ for the high pass filter.



Small parts are mounted onto homemade bakelite strips for simplicity.

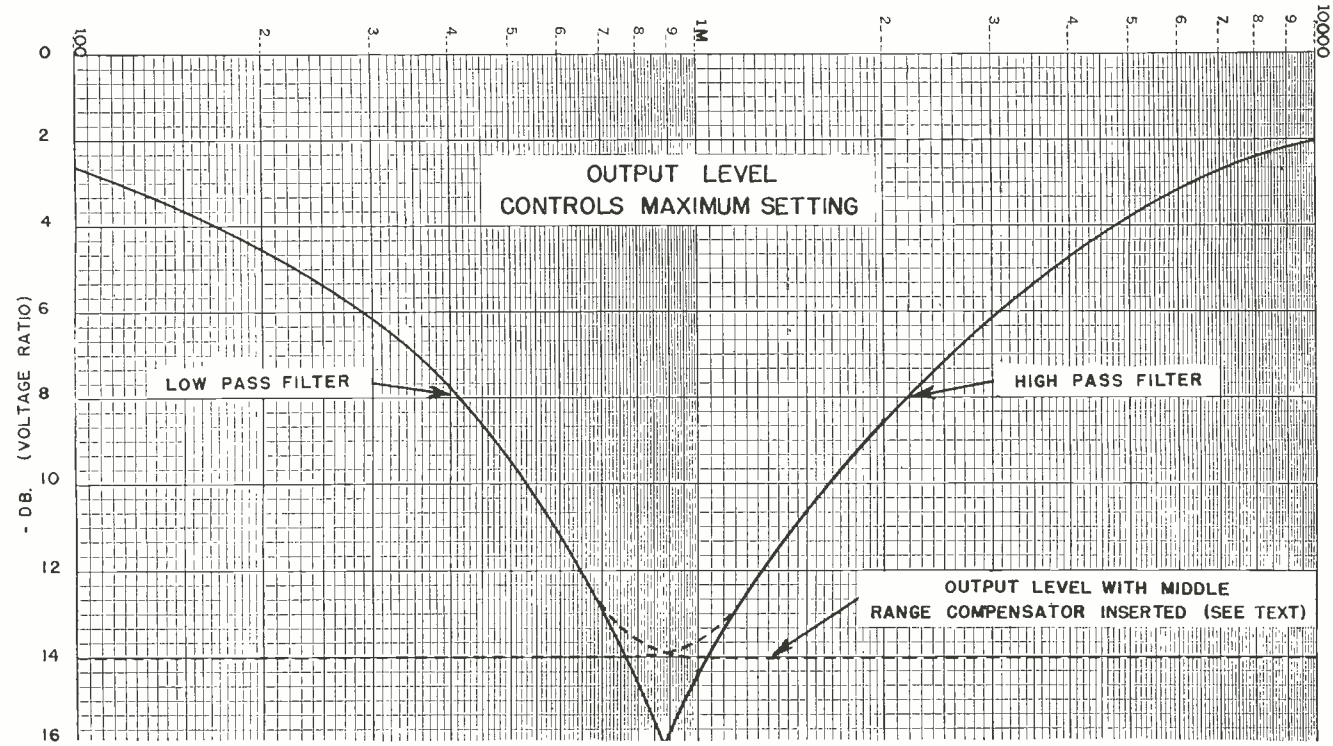
A curve shown in Figure 3 represents the frequency response of the network employed in the amplifier.

These networks have a loss even at the frequencies which have the least attenuation. In order to increase the output of our amplifier in the desired ranges, the mixer tube, 6C8G, must amplify the frequencies passed by the networks in either grid to such an extent that the loss is negligible.

In this same connection, it might be well to point out that in the original design, a resistor was used in series with the network pass filter and ground in order to pass the middle frequencies. This is shown by the dotted line in the schematic diagram. Later it was dispensed with when it was found that the characteristics of the two filter sections alone gave slightly different response but very pleasing to the ear.

It is true however that more flex-

Fig. 3.



ibility may be obtained if the series resistor is used. By proper adjustment of the input volume control and the low and high pass band filter controls, most any balance of frequency response may be obtained. If the bass and high frequency controls

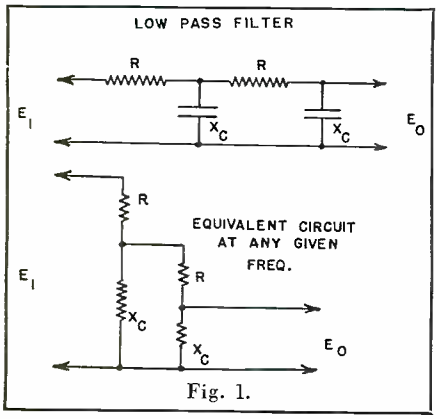


Fig. 1.

are set near minimum position, the fidelity curve will be asymptotic to a straight line over the normal range of the amplifier.

This particular type of response may not look so good on paper, but it is a fact that the audition curve of the ear at lower levels show a distinct deficiency in these ranges. To compensate for these deficiencies, the advantage is in being able to control the low and high frequency response to any degree and yet that they remain independent of one another.

In order that the amplifier might be used with any type pickup or even with a receiver, no attempt was made to incorporate in the amplifier any equalization for the pickup itself. In using a crystal pickup you will find that the bass response with the bass control in maximum is much too great. You may use the resistor condenser combination shown in Figure 4 with your pickup and flatten the response characteristic considerably.

There are any number of possibilities for different response characteristics from a system of this kind and at least one advantage is that the high and low frequency equalization are independent of one another. A point which is worthy of mention in connection with equalization of this kind is that the amplifier must be capable of handling sufficient output to make this compensation effective. For example when the bass control is set at maximum the amplifier may be required to deliver 6 to 7 watts at 80 cps while in the middle range it is only putting out around .2 of a watt.

The mixer tube is a 6C8G, however, any duel triode with a .3 amp filament

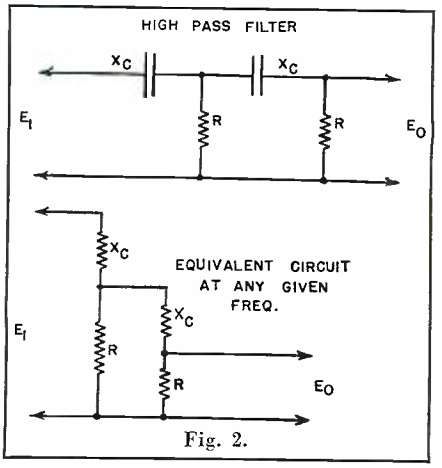


Fig. 2.

could be used. A 6SC7 might provide more gain, but being a metal tube, in this day and age that is out. During the stage of development it was found in experimenting with various type mixers and phase inverters, using dual triodes, that the 6C8G would stand considerably more input voltage than the 6SC7. The 6Z7 is another good choice but they are just as hard to obtain as a 6SC7 since they are not a very popular type and most suppliers do not handle them. Everything considered, the 6C8G is the logical choice.

If you desire to use this system of electronic equalization in another amplifier where filament current is no limiting factor, a 6N7 is a good tube to use especially since it will stand more input voltage than the 6SC7. Wherever this mixer is used, it must be isolated from the pickup by at least one stage since the pickup should work into a constant resistance load of better than ½ megohm and looking into the grid of our mixer we have a large reactance.

Another reason being that this type filter is designed to operate from a constant voltage supply such as we have from a triode vacuum tube and not from the output of a crystal pickup.

General Consideration

The "front end" or first stage as explained above does not necessarily have to provide a lot of amplification, but rather serves as an isolating device for the pickup to the mixer. A triode is a constant voltage generator, and a pentode is a constant current generator when operated into a load much smaller than its plate resistance. Since these filters are required to operate from a constant voltage supply a triode should be used.

Due to the fact that a small amount

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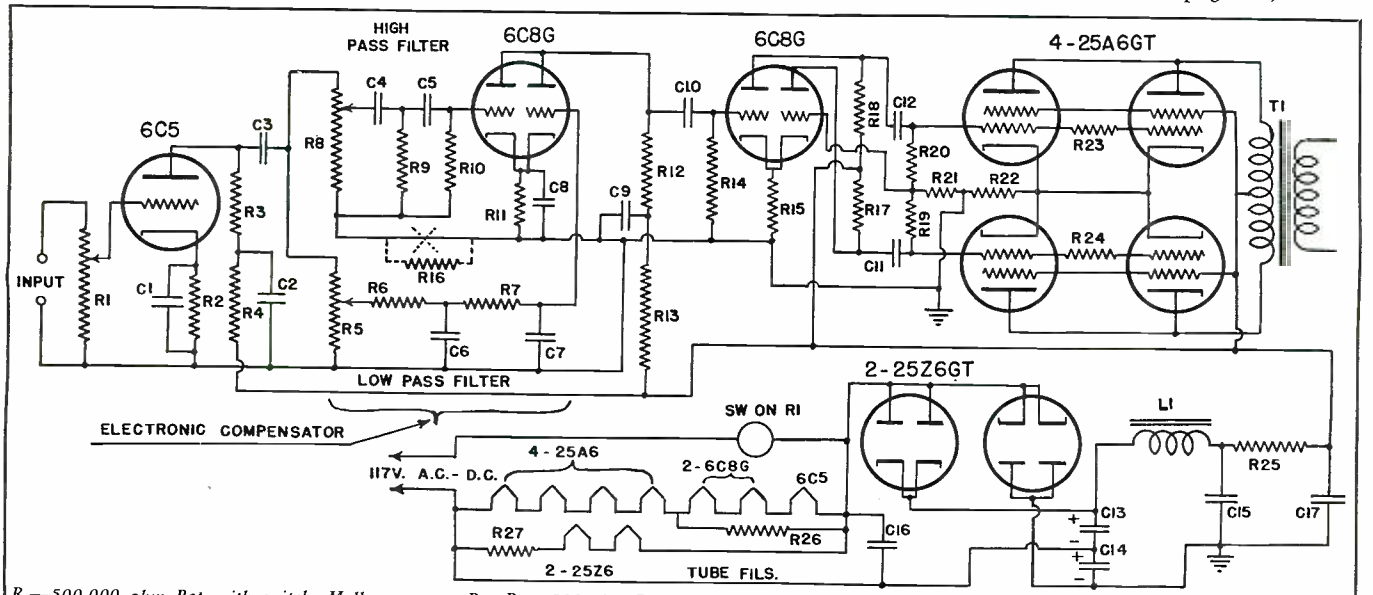


R_1—500,000 ohm Pot, with switch, Mallory
R_2—2,000 ohm Resistor ½w, IRC
R_3, R_4, R_6, R_7, R_9, R_{10}, R_{13}—25,000 ohm Resistor ½w, IRC
R_5, R_8—250,000 ohm Pot, Mallory
R_{11}, R_{15}—2,500 ohm Resistor ½w, IRC
R_{12}—50,000 ohm Resistor ½w, IRC
R_{14}—250.000 ohm Resistor ½w, IRC
R_{16}—60,000 ohm Resistor ½w, IRC
R_{17}, R_{18}, R_{21}—100,000 ohm Resistor ½w, IRC
R_{19}, R_{20}—500,000 ohm Resistor ½w, IRC
R_{22}—35 ohm Resistor 5w, Ohmite
R_{23}, R_{24}—500 ohm Resistor ½w, IRC
R_{25}—750 ohm Resistor 5w, Ohmite
R_{26}—250 ohm Resistor 5w, Ohmite
R_{27}—220 ohm Resistor 25w, Ohmite
C_1, C_8—20 mfd. @ 25 w.v. tub. condenser, Sprague
C_2, C_3, C_9, C_{10}—.1 mfd. @ 400 w.v. tub. condenser, Sprague
C_4, C_5—.005 mfd. @ 400 w.v. tub. condenser, Sprague
C_6, C_7—.01 mfd. @ 200 w.v. tub. condenser, Sprague
C_{11}, C_{12}, C_{16}—.05 mfd. @ 400 w.v. tub. condenser, Sprague
C_{13}, C_{14}—30 mfd. @ 150 w.v. Elec., Sprague
C_{15}, C_{17}—30 mfd. @ 250 w.v. Elec., Sprague
T_1—Output trans. 5,000 ohms to v.c., Thordarson
L_1—Filter choke 10 Hy. 150 ma., Thordarson
Metal chassis 7"x12"x2", Bud
4—25A6GT tubes, Hytron
2—25Z6GT tubes, Hytron
2—6C8G tubes, Hytron
1—6C5 tube, Hytron
2 tube shields

Manufacturer's Literature

Our readers are asked to write directly to the manufacturer for this literature. By mentioning RADIO NEWS and the issue and page, we are sure the reader will get fine service. Enclose the proper sum requested when it is indicated. This will prevent delay.

C-D Capacitor Manual for 1942

A definite contribution to the government's paper conservation program and to the serviceman's convenience has been made by the novel arrangement adopted for the *Cornell-Dubilier Capacitor Manual* for 1942 which is now off the presses. Heretofore it has been the practice to include in this manual each year all the replacement information from previous editions, plus data on new receivers. This year, the new manual takes the form of a supplement with provision for attaching directly to the cover of the 1941 Manual. With no more effort than that required to seal an envelope, the serviceman is thus enabled to convert his 1941 Manual into a 1942 edition so that in a single handy volume he has complete capacitor replacement data on all receivers up to and including current models.

This 50-page supplement adds information on approximately 2000 receiver models, including not only capacitor and voltage values and recommended replacement types, but filter and bypass circuits employed in each. Also given is the page number in Rider's Manuals where the complete circuit and other data for each of these receivers will be found.

Servicemen can obtain copies of this supplement without cost by addressing requests to *Cornell-Dubilier Electric Corp.,* South Plainfield, New Jersey.

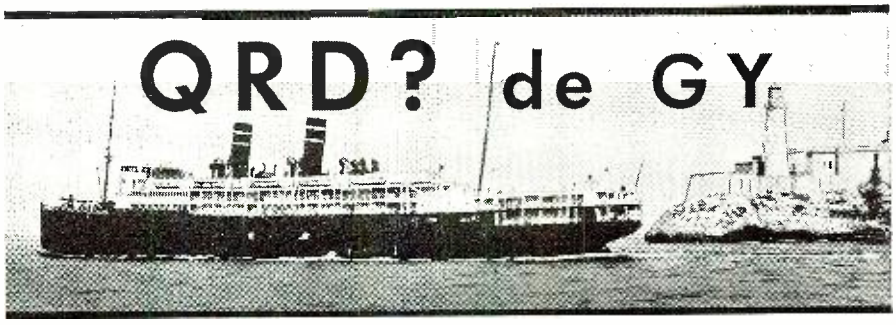
Allied's New 1942 Catalog

Allied Radio Corporation, Chicago, announces the release of a new 1942 Spring and Summer catalog, designed to supplement the 1942 Fall and Winter catalog by bringing prices up to date and keeping pace with the latest developments.

The new edition is a complete catalog in itself, offering "Everything in Radio and Electronics" from a single source of supply. It is excellently planned and organized for quick reference. Special emphasis is placed on quick shipments from varied stocks to the nation's armed forces, governmental agencies, industrial concerns engaged in war production, and schools and universities.

Servicemen and Dealers (with new responsibilities to keep the country's radio sets in operation), Sound men, Experimenters and Kit Builders, and the Radio Amateur (duty-bound to

(*Continued on page* 50)



by JERRY COLBY

ONLY a few short months ago someone sed that news from and about radiops would be scarcer 'n scarce because everyone would have to go under cover, but when our sleuth-hounds keep bobbing up with news like these herein juicy items, it goes to prove that war or no, radiops carry on. Brother CB Bolvin out of Police billet WPDO, Akron, sez quote One of the "lost" brethren has shown up again. Was reading the latest copy of the "APCO" bulletin a few days ago and ran across the name of Howard Willoughby . . . stated that he had joined up with the Illinois Police and was being assigned to WQPP. Article described the guy as "a booming morse op" and having a voice that "peaked at 40 cycles." So I figgered there couldn't be two of such mugs in the U.S.A. And so it turned out to be that "HY" had decided to take to the salt water when he left WFK last spring. His letter really makes interesting reading. He made a trip to Suez and returned via such places as Aden, Bombay, Singapore, Miri, Honolulu, Canal Zone, etc., and got a chance to see some of the war at close range while in Suez. I gather that five nights of bombing out of thirteen spent there was entirely too close a view—hi! Anyway, HY is now quietly settled at WQPP trying his hand at police operating.

AND CB adds as for myself, I'm still here but the doggone foot is itching something fierce. The XYL treated me to a beautiful chrome plated deluxe Vibroplex for Xmas (didn't I tell ya I got a really smart gal when I married that babe?). And it hasn't got enough use to satisfy me on this zome police circuit. So could be that I might drap ya a line from another QTH one of these days. D'ya know, GY, I think mebbe I got it figgered why a radiop moves around. It isn't cuz us dopes are really dissatisfied with the job we're on. Fer example this one: The pay ain't bad, there's enuff key pounding to keep the fist in shape, there's enuff patching up to do on xmtrs and rcvrs to keep a guy from forgetting which end of the iron is hot, the hours are fair, and a reasonable time off including a nice regular vacation with pay. But doggone it, GY, a guy gets to feeling he may be missing something interesting "out yonder" and just hasta go out and take a look-see! Sometimes I think it's just too bad that the old system of "let's swap ships for a trip or two" isn't applied to present day operating. It would keep a heluva lot of the gang from turning into fozzilized-metergazers and others from getting tin ears . . . which is enuff philosophy for one letter. And ye ed adds that the feller maybe's got something there as we've always contended that when there'll be only one radiop union shoreside and shipside

(*Continued on page* 46)

"He's a RADAR man!"

INDUCTION CONTROL FOR EXPERIMENTERS

by **WILBERT T. PETERSON**

Police Radio Operator

This article is designed to furnish a background to those entering the new field of controlling models and sending code within inductive fields.

INDUCTION transmission is becoming an increasingly popular playground for radio experimenters, yet it is merely a renovation of a theory discovered by Hertz and Maxwell back in the early days when radio was just a phenomena not quite understood.

As you may have read many times, at the birth of radio communication, it was proven that a coil of wire, commonly called an inductance, sets up lines of force around itself if its terminations are connected to a potential which is pulsating or alternating. If this alternating potential varies to an extent of some 20 to 30 thousand times per second, now termed as radio frequencies, not only will these lines of force terminate in the immediate vicinity of the coil, but they will transverse out into space. This phenomena, proven by Hertz and Maxwell, is called radiation, and it is the basis of our radio communication systems today.

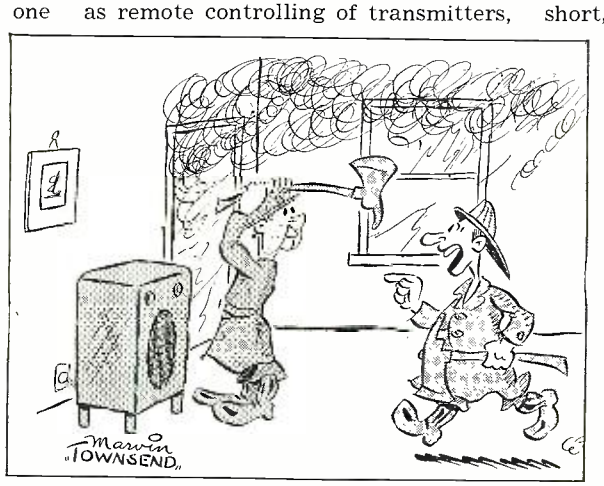
All of these mythical lines of force, however, do not leave the coil in the form of radiation. Some of them merely encircle the coil, their intensity decreasing as the distance from the coil increases. This magnetic field of lines of force surrounding the coil is called the *induction field.*

This induction field, although used extensively in practically every radio circuit devised, never has played much of a role as being an actual means of communication from one place to another. The reason for this of course is very simple. Since the induction field of a coil is very limited, it would only be of value as an agent for transversing space at comparatively short distances. On the other hand the radiation field of this same coil with the addition of a coupled resonant line of antenna, is a much more efficient means of propagating into space and overcoming distance. Since the object of radio communication is to overcome distance it is easily understood why the radiation field of a coil is utilized extensively today, and the induction field forgotten.

Why the sudden surge of interest among the amateur fraternity and radio experimenters in this induction transmission which had been shelved all of these years? Everyone knows the answer in the FCC ruling of Dec. 8, 1941, barring the radio transmissions of amateur stations. Since their radiation field has been taken away, it is only natural for the hams to turn to their forgotten friend the induction field to continue tinkering with their beloved hobby.

Although we admit that induction transmission is utterly inefficient in its use as a media of overcoming distance, perhaps we have not realized that because of this reason it may have tremendous possibilities in other fields where radiation is definitely not desired.

For instance its use in remote control circuits where the distance is short, and the use of wires an impracticability, it may serve its purpose beautifully. It is the only practical method to use in operating a wireless inter-communication system. It is already proving its worth in the phantom volume control of P.A. systems; in the new popular "wireless record players"; and in the "mystery control" of radio receiving sets. These are only a few of the circuits in which it has been put to use. Undoubtedly many more circuits will be devised by the amateur and experimenter such as remote controlling of transmitters, wireless inter-com systems for civilian defense headquarters and outposts during the national emergency, wireless juke-box controls, etc. The field is virtually unexplored, offering wonderful opportunities to ambitious experimenters.



"Hold on, Joe—we'll match for it!"

As a matter of fact, induction transmission can perform any of the feats in which radio circuits have been used, but at exceedingly smaller distances. The induction field is measured in feet, whereas the radiation field is measured from miles to infinity.

This is indeed the answer to an amateur's prayer as far as pursuing his hobby is concerned. He need not dismantle and store his equipment for the duration as long as he has neighbors or friends who can set up induction transmitters and receivers and continue maintaining communication with him even if it is only across the back yard. This is an excellent means of keeping up code practice, and since there are no restrictions as to the type of modulation used, whether it be music or voice, the entertainment angle can be featured in this type of communication system. No license is required.

The radio experimenter who enjoys dabbling with remote control circuits will find the field entirely satisfactory for controlling ships, airplanes, trains, etc., by radio. In these instances the controlling distances are usually very short, and the induction field will adequately suffice to carry the impulses needed to operate the devices.

Inter-communication systems that must be installed quickly without unsightly wiring can be designed. The main advantage here would be portability and ease of installation. The various stations of an inductance inter-comm system can be readily moved from room to room or at any place within a room providing a power outlet is available, whereas a wired system is usually a permanent installation. The advantage of such systems for war plants is tremendous.

These examples definitely prove that the induction field is virtually unexplored, offering wonderful opportunities to the ambitious experimenter.

Since the radiation efficiency of a coil increases directly with its frequency, naturally the lower radio frequencies can only be used for induction transmission. Frequencies now in use range anywhere from 50 kc. to 500 kc. into the standard broadcast band. It is good practice to keep away from the group of intermediate frequencies used by the radio manufacturers such as 175 kc., 262 kc., 465 kc., etc., to prevent interference to nearby B.C. receivers.

Frequencies ranging into the low frequency end of the B.C. band are popular inasmuch as the transmission can be received on the regular B.C. receiver, and no special receiving equipment is needed.

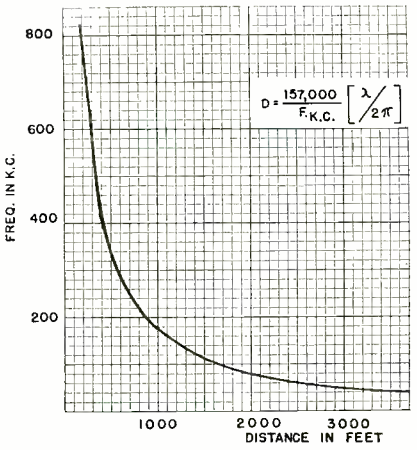
The F.C.C. has set forth the following regulations controlling the operation of inductance transmission:

Section 2.101 General. Pending the acquiring of more complete information regarding the character and effects of the radiation involved the following provisions shall govern the operation of the low power radio frequency electrical devices hereinafter described.

2.102. Apparatus excepted from requirements of other rules. With respect to any apparatus which generates a radio frequency electro-magnetic field functionally utilizing a small part of such field in the operation of associated apparatus not physically connected thereto and a distance not greater than $\frac{157{,}000}{f_{k.c.}}$ ft. $[\lambda/2\pi]$ the existing rules and regulations of the commission shall not be applicable provided:

(a) That such apparatus shall be operated with the minimum power possible to accomplish the desired purpose.

(b) That the best engineering principles shall be utilized in the generation of radio frequency currents so as to guard against interference to established radio services, particularly on the fundamental and harmonic frequencies which might be evident.



This chart shows the safe limits for control.

(c) That in any event the total electromagnetic field produced at any point at a distance of $\frac{157{,}000}{f_{k.c.}}$ ft. $[\lambda/2\pi]$ from the apparatus shall not exceed 15 microvolts per meter.

(d) That the apparatus shall conform to such engineering standards as may from time to time be promulgated by the commission.

2.103 Exceptions: Interference to radio reception. The provisions of sections 2.101 and 2.102 shall not be construed to apply to any apparatus which caused interference to radio reception.

2.104. Inspection and test certificates: Upon request, the Commission will inspect and test any apparatus described in sections 2.101 and 2.102, and on the basis of such inspection and test, formulate and publish findings as to whether such apparatus does or does not comply with the above conditions, and issue a certificate specifying conditions of operations to the party making such request.

The type of equipment used in experimenting with induction transmission is very simple. The transmitter may consist of a one-tube oscillator with another tube modulator using receiving type tubes such as the 6SA7, 6C5, etc. The antenna consists of a loop coupled to the tank coil of the transmitter.

In case B.C. frequencies are not used, the induction receiver is generally a straight forward TRF job with a loop antenna in the grid circuit of the first r.f. stage. Bias detectors are used with one or more stages of audio amplification depending on whether the circuit will be used for voice or control. A sensitive relay in the plate circuit of the detector is usually sufficient for control purposes.

Since the receiving and transmitting loops act as the primary and secondary of an air core transformer, orientation will be necessary for best results.

If a signal generator with calibrated output is not available to determine whether the signal is 15 microvolts or below, it may generally be assumed that if just enough signal is received from the transmitter on a fairly sensitive receiver operating under normal conditions at the calculated distance $[\lambda/2\pi]$ the 15 microvolt condition will not be exceeded. Wherever possible when an induction circuit is placed in permanent operation, the field strength should be checked at the receiver so as not to exceed the limit.

Editor's note: A field-strength meter for measuring Induction fields is now being prepared and will appear shortly in RADIO NEWS.

By using the lowest practical frequency of around 50 kc., the maximum distance at which a 15 μ v. signal is allowed is in the neighborhood of 3,000 feet, which is better than one-half mile. This distance should easily include practically any type of remote control application.

Very little work has been attempted in this field and for that reason many interesting devices should be produced in the experimenter's work shop. This will be an exceptional opportunity to bring forth some new practical ideas for the RADIO NEWS Inventors Contest now in full swing.

This article is the beginning of a series on induction transmission and the results of some of the experiences we have encountered with the subject will follow. Your ideas, suggestions and data will be very welcome.

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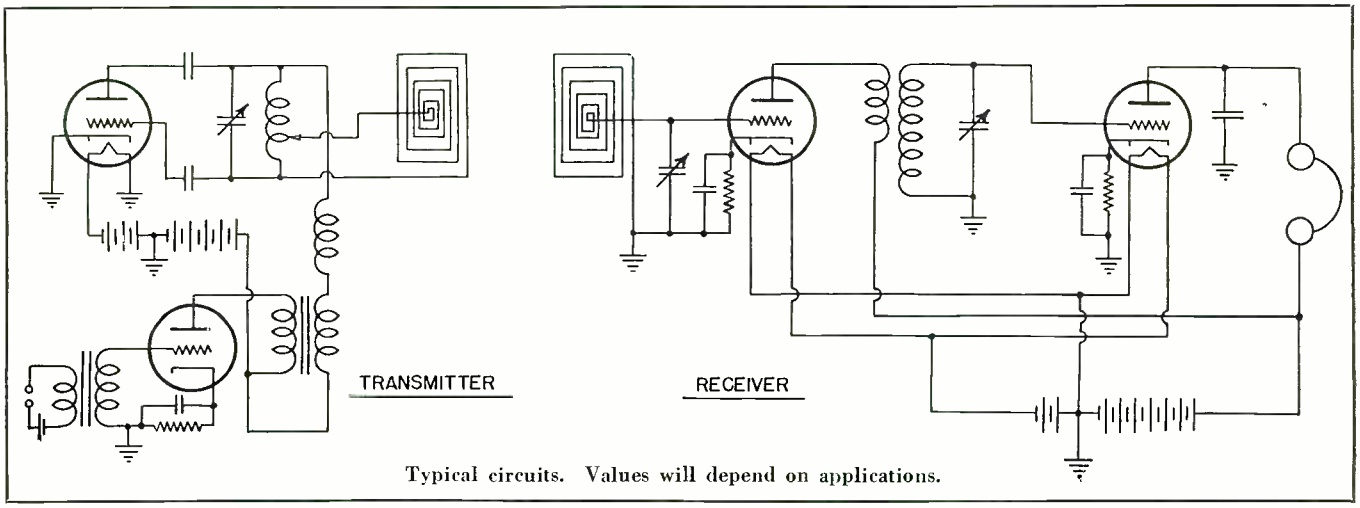


Typical circuits. Values will depend on applications.

AVIATION RADIO COURSE

by PAUL W. KARROL

This complete course is proving to be very popular with students. Part 3 includes the study of aircraft generators.

WHEN testing radio equipment in an aircraft on the hangar ramp, or when making tests of the electrical system, external batteries should be connected to the input terminals at the main terminal panel or to the input relay, if the latter is used. Of course, the ship's battery would be disconnected while tests are being made or repair work being consummated. If external batteries are used, especially on "cold engine starts," wear and tear on the ship's battery is averted.

Nearly all aircraft generators found in modern aircraft today are of the air cooled mechanically driven type. The old wind driven generator is now practically obsolete, it being found only on a few of the older aircraft. The main reason it has been replaced with the mechanically driven type is that its power output capabilities were quite small. Increased air resistance because of its bulk also caused its demise. Most aircraft generators are either of the 12 or 24 volt types. That is, they are used in either the 12 or 24 volt systems. Their power outputs vary from a low 200 watts to a high 3000 watts. On multi-engined aircraft two or more generators may be used, depending on current requirements of the entire electrical system. Usually, flexible couplings which connect the generator's armature to the driving shaft are utilized. These couplings reduce vibrational effects which may cause undue wear and consequent damage.

Generators should be inspected at least every 35 hours. This inspection should include a visual examination of the brushes, commutator segments, bearings if possible, and terminal connections. A check should also be made on lubrication. If the generator is equipped with condensers (usually .5 mfd.) these should be tested with either a manufactured condenser tester or a high range ohmmeter. When testing these condensers with an ohmmeter, the leads should be applied to the condenser and immediately reversed. A kick of the meter needle will indicate a good condenser. If the condenser is shorted, full scale deflection will be noted; if partially shorted, a high reading will be indicated; if open, the needle will remain stationary.

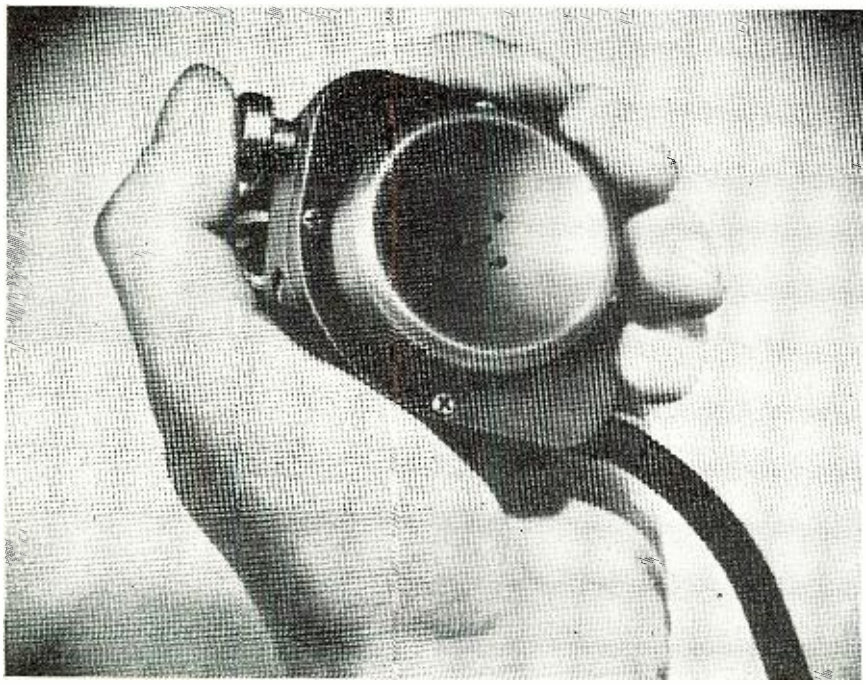
When sparking occurs at the brushes and noise having a characteristic high scratch sound is heard in the output of the radio receiver, the following may be causing the sparking: protruding mica on the commutator; brushes may be chipped; scratched, dirty or pitted commutator; worn bearings causing armature to run eccentrically; brushes incorrectly fitted to commutator; brushes too tight in holders or too loose acting like an intermittent open circuit; and commutator may be grooved. Most of the troubles mentioned should not occur when systematic maintenance is performed. When brushes are replaced they should be "run-in." That is, the generator should be operated with load for about an hour and without load for about two hours. Commutators should be cleaned with a light sandpaper (crocus cloth) and carbon tetrachloride. The color of the commutator should resemble a chocolate color after a few hours operation; a bright copper colored commutator indicates excessive brush pressure and improper brush spring tension.

Accumulations between commutator segments may be readily removed by using an old hacksaw blade. Lathe work on an armature should be performed by a skilled machinist.

Because the generator is connected to the battery, some means must be provided to prevent the battery from discharging into the generator when the battery voltage exceeds that of the generator. The device used for this purpose is called a *reverse current cut-out*. As the generator voltage exceeds the battery voltage the cut-out connects the generator output automatically across the battery; thus charging voltage is made available. The adjustment of the cut-out is relatively simple if a volt-ammeter is used in conjunction with a fully charged battery. Voltage and current readings are taken when the generator is operating at low, normal, and high speeds. Most cut-outs are adjusted so that the contact points open when a reverse current of from 4 to 7 amperes flows.

To maintain constant voltage at the generator proper, a *voltage regulator* is used. This device maintains constant generator voltage from a no-load condition to the generator's full output. The adjustment of this unit is not critical, but the inexperienced should not attempt it. The unit consists of an electromagnet, lever switch contacts, tension spring and a fixed resistance. Its operation is quite simple. As the voltage increases from increased generator speed, the electromagnet is energized, pulling open the switch contacts. These contacts place the resistance in the circuit, thereby cutting down the voltage to the correct value. As the speed decreases, the contacts again close and remove the resistance from the circuit, there-

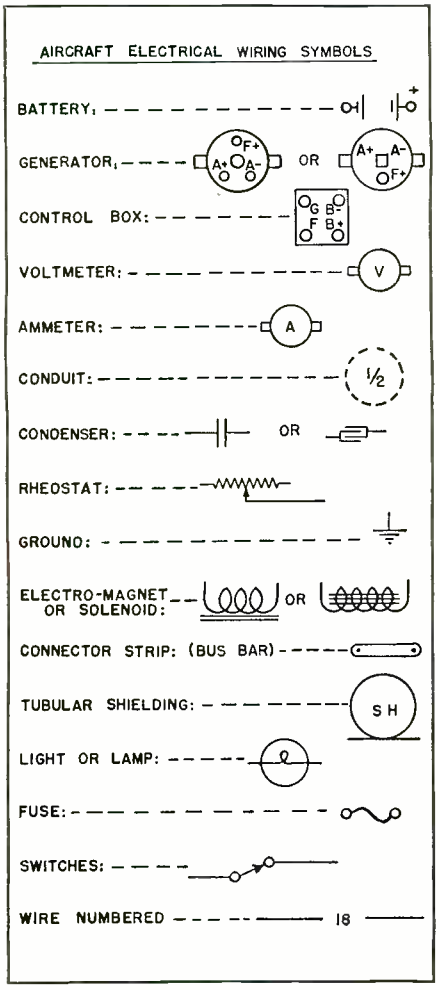
This push-to-talk mike is most efficient at voice frequencies and is designed for close talking to eliminate unwanted background noises.

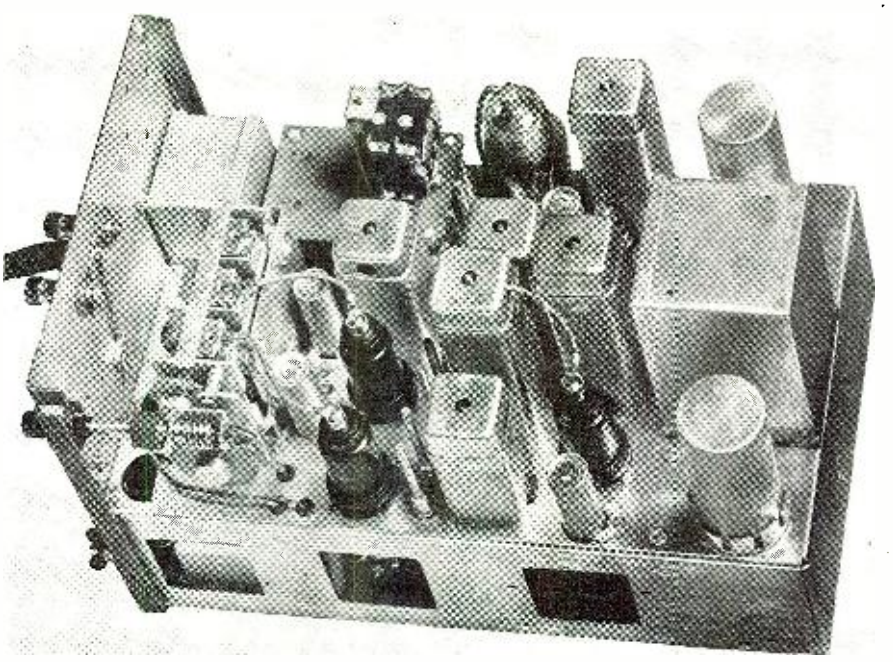


by allowing the generator to develop the correct value of voltage. With the proper size of resistance in the circuit and correct adjustment of the contact points, a constant voltage output is assured. In operation this unit can be heard. The correct amount of tension on the retaining spring which holds the contacts together of course establishes the value of voltage available.

If a generator rated at 50 amperes capacity is connected to a load requiring 70 amperes it is assumed to be overloaded. Overheating will take place and in time ruin the generator. For this reason, a device known as a *current limiter* is used to maintain constant current output regardless of load. Some generators are compound wound; an additional field being used to "buck" the load and reduce current output to the required amount.

The reverse current cut-out, voltage regulator, and current limiter are usually incorporated in one box known as the *control box*. Bypass condensers may also be found in this box for assisting in the elimination of undesirable radio noise. Contact points found on the units in the control box should be cleaned often, but not too often. Where points stick due to improper spring tension or high current, the trouble should be corrected and the points dressed clean with very fine sandpaper and a point file. *Never use emery cloth.* Pitting will result if you do.





Typical aircraft receiver of rugged design withstands the severe punishment inflicted by continual vibrations while in the aircraft.

Wiring systems found in aircraft are of either the grounded or two-wire types, the latter predominating. Conduit is nearly always used to carry electrical wires. Shielding and bonding will be taken up in subsequent lessons.

Vibration, the common enemy to the electrical and radio installations, not only plays havoc with connections but also has a detrimental effect on mechanical structure. Certain connections made on the rear of certain connecting panels will tend to come loose due to vibration. Landing light assemblies often require periodical tightening, as well as those connections located relatively near the engine or engines. When making connections on a grounded system using braided wire, enough slack should be left in the grounding strips to cope with vibration. The resistance of these connections should not be more than .004 ohms nor less than .001 ohms.

Master control switches should be inspected frequently for pitted or burned contacts. Starting relays used in conjunction with starter motors and relays used for carrying large amounts of current to other equipment should also be inspected frequently.

A voltmeter and ammeter are usually found in most aircraft systems for indicating generator-battery voltage and current. In some cases a combination volt-ammeter is used. The ranges of these instruments will depend on the size of the generator and general voltage-current requirements. Where dual generator equipment is used, two instruments (volt-ammeter) will be used for each generator circuit and more than likely be mounted at or near the main control box.

The amount of wire used for an entire electrical installation depends upon the following: number of electrically operated instruments used; whether the system is a grounded or two-wire system; number and location of connector panels; and, location of electrically operated mechanisms.

When replacing burned or worn wire, the new wire should be installed in exactly the same way as the old. Smaller gauge than is specified by the electrical diagram should never be used under any circumstances. Nor should additional electrically operated equipment be installed until it is determined that the current and voltage capacities of the power system will adequately take care of the increased load. The entire electrical system should have an overload factor of at least 50% under normal circumstances; when additional equipment is added that factor is reduced.

Trouble-shooting the modern aircraft electrical installation is simple procedure after some experience. The point that should always be remembered, whether trouble shooting an aircraft-ground radio or electrical installation is: *Always look for the simplest causes of trouble first.*

If the lights, radio, and other electrically operated instruments fail to operate, fuses would be examined first. If these were all right, one would test the battery, relays, etc., in order.

The following is a list in order of likely trouble occurrence: 1. Fuses; 2. Battery; 3. Relays; 4. Control box mechanisms, including condensers; 5. Switch contacts; 6. Generator; 7. Instruments, radio, etc.; and 8. Wiring.

The technician should be provided with a volt-ammeter, ohmmeter, indicating light; replacement units; and

(*Continued on page* 58)

Theory and Practice of DISC RECORDING

by **OLIVER READ**

Managing Editor, RADIO NEWS

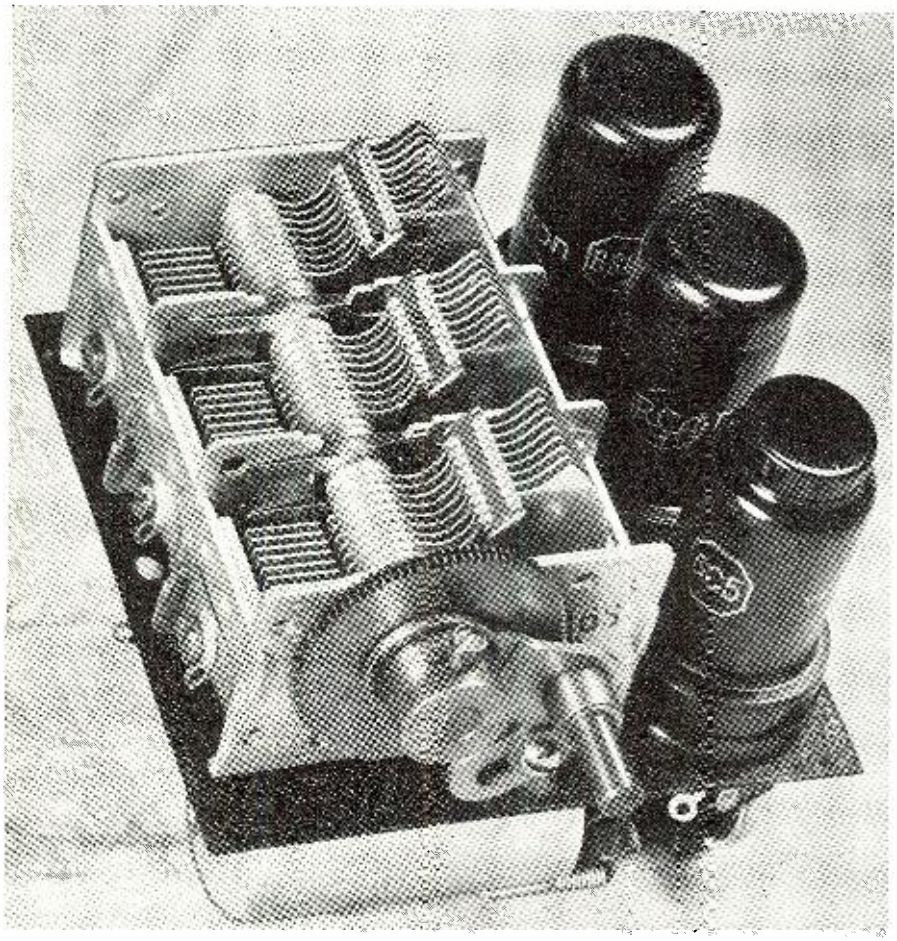
Many requests have been made for the design of an inexpensive tuner that would provide the necessary range for good disc recording.

THIS month we are going to deviate a bit from the usual procedure by presenting an extremely compact T.R.F. tuner. This type of unit has met with wide favor with the home recordists, principally due to its ease of construction, the use of available parts and the general knowledge required in getting the unit to operate properly. Furthermore many readers will have many, if not all, of the parts on hand; and inasmuch as it is not necessary to follow exactly the compact design, good results may be obtained by using components of larger dimensions. At any rate, this little tuner is capable of giving a good account of itself and will furnish the necessary high quality from local broadcast stations so necessary for good recording.

The chief advantage of using the T.R.F. type of circuit is that the band-pass characteristics of the average T.R.F. transformer is such that the over-all selectivity is just enough to include practically the complete 10 kc. channel (5000 C.P.S.) response. Most superhets, on the other hand, are too selective and therefore do not include the full bandwidth of the carrier, and as a result, many desirable high frequencies are lost. By limiting the selectivity of the tuner and by using a very short antenna, it is possible to receive local stations without interference from outside transmissions.

The resulting drop in background noise means that we will be able to obtain better recordings. Last, but not least, is the cost comparison between the T.R.F. and the superhet types. As a rule, the latter is the least expensive to construct and is far easier to align, as no test oscillator need be used if one has an assortment of local broadcasters to use as reference points in setting the various trimmers.

The 4"x4" panel holds the complete parts components and occupies but little space. It may be mounted in conventional portable cabinets.



Assembly

The complete tuner components, believe it or not, are mounted and wired on a 4"x4" steel cover plate taken from one of the popular size 4"x4"x2" steel boxes. Reference to the illustration will show that a 6-1 step-down gear assembly is provided, in order to make tuning of stations more accurate and to prevent vibration caused by the other assemblies which might be within the case or cabinet from jarring the condenser plates from their proper positions.

The tuner consists of a total of three tubes. The first (antenna stage) uses a 6SK7. Likewise the second (r.f. stage). The detector is a 6C5 and utilizes the conventional power detector type of circuit. This type of circuit is insensitive to weak signals and therefore is ideally suited to the purpose. It has an over-all output so that it may connect directly into practically any conventional amplifier. The 6C5 was chosen in preference to other types; first of all, because it was obtained easily and secondly, due to its low plate impedance, it may be connected to conventional potentiometer type controls of either medium or high resistance values. Most amplifiers have a phono input. A few make provisions for more than one. The tuner may be connected directly to such an input where sufficient gain will be had for maximum power output of the amplifier.

All of the parts, with the exception of the three-gang tuning condenser and tubes, are mounted below deck. The illustration shows how the small shielded r.f. coils are mounted. These are laid upon their sides with the exposed end of the shield facing the tube sockets.

All filament circuits should be wired first and wherever possible, connecting leads to the transformers made before covering up the wiring with the balance of the miscellaneous parts, such as the paper and mica condensers and the resistors.

Finally, a five-lug terminal strip is mounted to one of the mounting lugs on one of the coil shields. These are used to tie in the leads coming from the male plug. This plug need not be used if the builder is to include a power supply on the same chassis as the tuner.

Inasmuch as this little tuner occupies very little space, it is ideally suited for mounting into conventional portable phonograph cases. In one of our own applications, we added one into a portable recorder and took necessary filament and plate voltage from the recording amplifier. Almost any B voltage will be sufficient, best results being obtained with approximately 250 v.

Alignment

There is nothing mysterious or tricky when it comes to aligning a T.R.F. tuner of simple design. No automatic volume control has been used, which simplifies the adjustment.

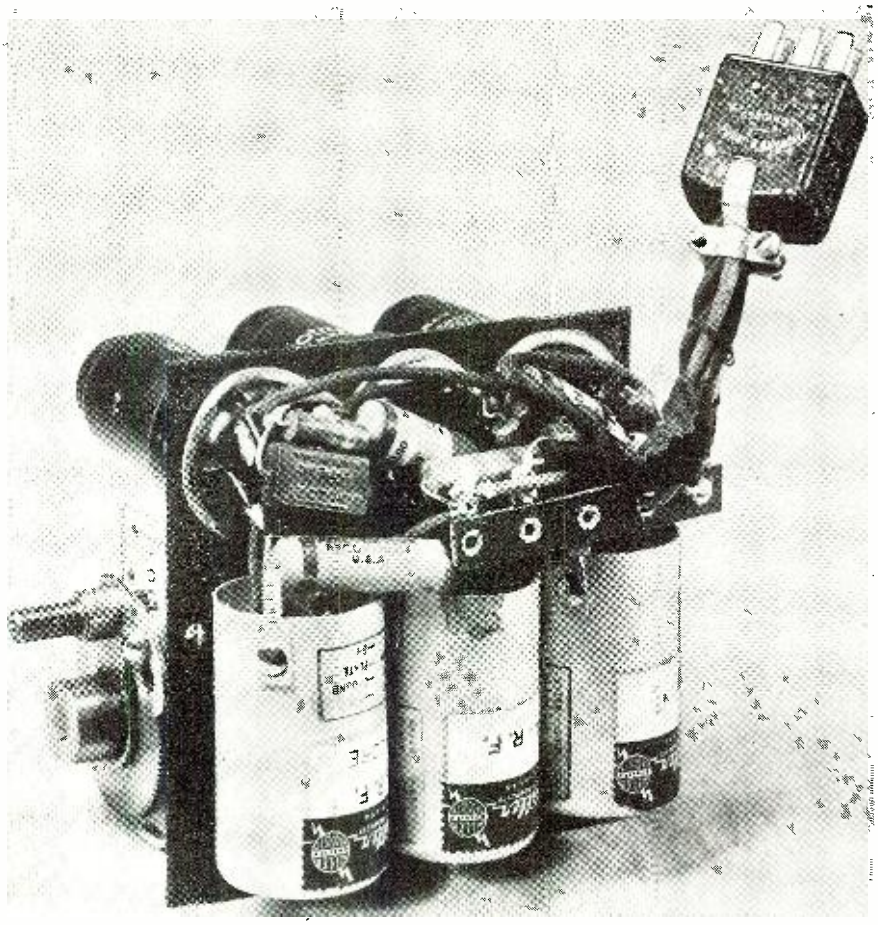
String a length of wire of approximately 20 feet anywhere within the room and connect it to the antenna lead of the coil, as indicated on the diagram. Allow the tuner to reach operating temperatures and then tune for whatever station in your vicinity operates on the low frequency end of the broadcast spectrum. This station should preferably have a frequency somewhere between 550 and 650 kc. After the station has been tuned to loudest signal proceed to adjust each trimmer of each condenser section for loudest response. It is good practice to "rock" the condenser back and forth over the signal during the process of alignment.

Repeat the above procedure at the high frequency end on a station having a frequency somewhere around 1500 or 1200 kc. Continue to rock the condenser during these adjustments and finally tune in the weakest station that you are able to find and make final slight adjustment to the trimmers until the station is received with greatest clarity and volume. If these adjustments are made properly, the tuner will track over the entire range and no further adjustments will be required. Finally, the antenna should be shortened until it will receive the weakest station with satisfactory volume and not any more.

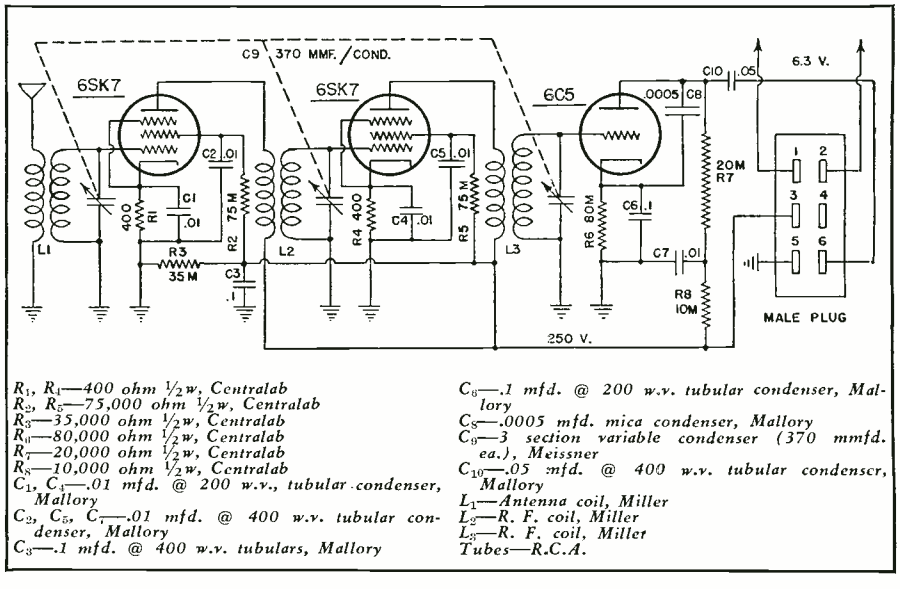
The assembly may be mounted within the box from which the cover plate was taken and you will possess a complete tuner which measures approximately 4"x4"x5" over-all. The total cost including tubes will depend upon the quality of parts used but should in no case exceed $10.00. The results will be comparable to many tuners costing considerably more. The time needed for construction is approximately four to five hours (a good evening's work).

Next month, we shall continue our discussion of specific recording components and their use.

(To be continued)



The three coils are mounted on their sides so that the connecting wires may be as short as possible to the tube sockets and parts.



The schematic of the inexpensive tuner shows the TRF circuit.

R_1, R_4—400 ohm ½w, Centralab
R_2, R_5—75,000 ohm ½w, Centralab
R_3—35,000 ohm ½w, Centralab
R_6—80,000 ohm ½w, Centralab
R_7—20,000 ohm ½w, Centralab
R_8—10,000 ohm ½w, Centralab
C_1, C_4—.01 mfd. @ 200 w.v., tubular condenser, Mallory
C_2, C_5, C_7—.01 mfd. @ 400 w.v. tubular condenser, Mallory
C_3—.1 mfd. @ 400 w.v. tubulars, Mallory
C_6—.1 mfd. @ 200 w.v. tubular condenser, Mallory
C_8—.0005 mfd. mica condenser, Mallory
C_9—3 section variable condenser (370 mmfd. ea.), Meissner
C_{10}—.05 mfd. @ 400 w.v. tubular condenser, Mallory
L_1—Antenna coil, Miller
L_2—R. F. coil, Miller
L_3—R. F. coil, Miller
Tubes—R.C.A.

PRACTICAL RADIO COURSE

by ALFRED A. GHIRARDI

Part 5. The study of alternating current.

Alternating Current

ATTENTION given to electrical circuits thus far in these lessons has concerned primarily circuits in which direct current flowed as the result of the application of constant values of e.m.f. Before going further, it is desirable that an understanding of alternating current be gained.

Perhaps the best known examples of alternating current circuits are the normal "a.c." electric light lines and the various lighting and appliance circuits which they supply. However, alternating currents of other types play a very basic part in radio—in fact it would not be too much to say that alternating current provides the very foundation of radio. The signal applied to a transmitting antenna from a radio transmitter is an alternating current. The signal applied to the radio receiver by its antenna is an alternating current.

Loudspeakers and headphones reproduce speech and music by converting alternating (or pulsating direct) currents into sound waves, and microphones in turn convert sound waves into alternating currents. The signal voltages applied to successive stages of a radio receiver or transmitter are alternating. All of this gives some indication of the importance of alternating currents to the study of radio.

An alternating current, commonly abbreviated to "a.c.", is an electric current which reverses its direction of flow periodically and is constantly varying in value. It results from the application to a circuit of an e.m.f.,

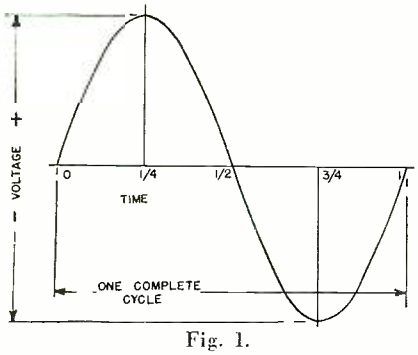


Fig. 1.

the voltage of which rises, falls and reverses its polarity rhythmically. This action is illustrated by the sine-wave curve of Figure 1. Here it will be noted that at time T-O, which represents the start of a cycle, the voltage is zero but rapidly increases to a maximum value at T-¼ which represents completion of one-fourth of its cycle. Between T-¼ and T-½ the voltage just as rapidly falls to zero again, then rises in the opposite direction (polarity) and finally returns to zero at the end of one full cycle. Subsequent cycles would duplicate this one.

The distance along the horizontal axis, in point of time, depends upon the *frequency* of the a.c. Thus if this illustration represents one cycle of the 60-cycle supply line, the time between T-0 and T-1 would equal 1/60th second (since 60 such cycles would occur in 1 second). If it represents an *audio-frequency* rate the time lapse during a single cycle might be anywhere from 1/30th to 1/15000th second. If it were a cycle of radio-frequency voltage it might represent as little as 1/300,000,000th second or even less. As more commonly expressed, the "frequency" of commercial a.c. light lines is usually 25 or 60 cycles per second. Audio frequencies include the range of approximately 30 to 15,000 cycles per second while the radio-frequency spectrum extends from about 10,000 cycles per second (c.p.s.) to the vicinity of several billion c.p.s. Normally for these higher values the terms kilocycle (1000 c.p.s.) or megacycle (1000 kilocycles or 1,000,000 c.p.s.) are used as a matter of convenience.

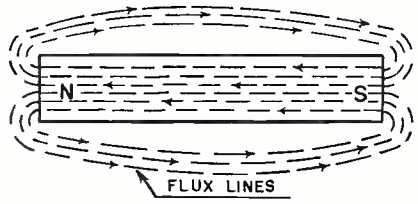
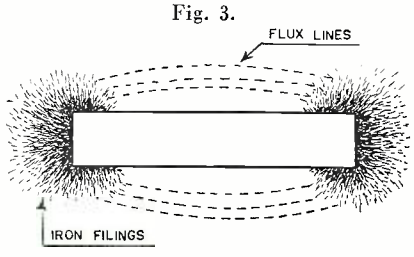


Fig. 2.

All alternating currents do not have precisely the characteristic of change shown in Figure 1. In some instances, the rise and fall of voltage may not be symmetrical, the halves of the cycle above and below the zero line may not be symmetrical, the peaks may be more pointed, etc. The wave-form shown is that of a *sine wave* and this is the normal form and the only one which need be considered here.

In a.c. circuits there are two important voltage and current ratings. These are the *peak* and the *effective* values. It is apparent from Figure 1 that the peak voltages at T-¼ and T-¾ are maintained during only a small part of the cycle, while during another small part of this cycle the voltage drops to zero. The *effective* value is therefore somewhere between these extremes. Because the current in a circuit necessarily varies with the applied voltage it also follows that the *effective* value of the current in an a.c. circuit will be less than its peak value.

Fig. 3.



Such being the case it is apparent that an alternating-current supply with *peak* voltage of 115 would not be capable of as much work as a constant voltage of this value supplied from batteries or from a direct-current supply line. A 115-volt electric lamp, for example, if connected to the former would give less light than when connected to a constant source of 115 volts.

It is therefore more convenient and practical to rate alternating voltages in terms of *effective* rather than *peak* values. Thus an alternating e.m.f. rated at 6 volts effective value will have the same heating effect when applied to a lamp (for instance) as will a battery or other direct-current source of the same (6-volt) rating.

The *effective* voltage of an a.c. source having the sine-wave characteristic of Figure 1 is determined by multiplying the peak voltage by 0.707. Or, if the effective value is known, then the peak value can be determined by multiplying the effective value by 1.41.

While we are normally most interested in the work that the current can perform, and therefore in the *effective* value of an alternating voltage or current, it is also at times important that the *peak* values be known. In a circuit in which a capacitor is subjected to application of alternating voltage, for example, it is necessary that the capacitor have a sufficiently high voltage rating to safely withstand the peak voltage. Thus a capacitor rated at 125 volts, d.c., would be entirely satisfactory for use across a 115-volt direct current line but not across an a.c. line of this same rating because then the capacitor would be subjected to peak voltage of $115 \times 1.41 = 162$ volts twice during each cycle and its limitations for safe operation would therefore be exceeded.

Alternating current measuring instruments are calibrated to provide readings in terms of effective voltage and current, or "root mean square" values which mean the same thing.

(*Continued on page* 63)

The SERVICEMAN and the NEW RULINGS

by LEWIS W. MARTIN

Here are the most-asked questions and their answers for those having trouble in getting needed parts in order to make radio repairs.

HERE THEY ARE!

Q.—Probably the most important order issued to-date, that should be of assistance to the radio service man, is that concerning the PD-1X form. However, this form, which affords replenishment of distributor stocks, does not include radio supplies. It refers to, among many topics, electrical supplies. Does that mean that radio will be left out of this new assistance plan?

A.—No; radio will not be omitted from the plan. The plan will be applicable to radio supplies and will be included or allowed when the system goes into operation.

Q.—Does this new form apply only to distributors?

A.—Yes. Dealers and service men cannot use it, nor can producers.

Q.—Will the operation of this system provide the distributor with a continuous supply of all his needs, so that the dealer or the service man can secure what he needs?

A.—Insofar as materials and supplies can be made available without interfering with the war effort, priority assistance will be given to distributors or wholesalers who apply on the new form, so that they can keep sufficient stocks on hand to maintain essential productive and service industries in operation, and that means radio. A plan for special and direct allocations of the necessary materials required to make replacement parts to parts manufacturers is now under consideration. A complete list of types of replacements parts and their manufacturers is being compiled by the War Production Board, with a view to future supply to parts manufacturers, probably on a three month inventory basis. Thus, the distributor should be able to replenish his stocks, on an established basis.

Q.—Does that mean that the service man will be able to obtain all of the parts he needs, when and as he needs them?

A.—It means that every effort will be made in this direction, but it must be remembered that critical shortages are still present, and more may be in the offing, and thus such "unusual" delivery service may be blocked.

Q.—How can a service man get replacement parts?

A.—By simply applying to his dealer for them. But he should be absolutely certain though, that the parts required are for an actual repair or replacement, and not for a circuit improvement on that set to be repaired. He must be certain, too, that this request for a new part is absolutely the last resort. In other words, he must have tried every other means of repair, such as circuit changes, or the use of alternate parts, or even the repair of defective components, before he requests a new part. If circuit latitude allows the use of higher or lower capacities or resistances, or even their omission, it may be necessary to follow this plan. This does not mean that the effectiveness of the receiver should be impaired deliberately. It means that the utmost of repair technique should be applied to effect a conservation of parts, and thus provide the availability of parts when there is a real emergency.

Q.—Can service men purchase several items at a time and thus build an inventory to facilitate their repair work and delivery too?

A.—There is no law to prohibit this, but it is not a wise policy to follow. For first, it will mean that others will suffer by this "self-preservation" operation, since they may not be able to get that particular part or parts; and second, it will not only make it difficult for the dealer to replenish his stocks in future orders, but it will sour the dealer on your future demands and provoke delivery problems in the future. In addition, the inventory of the distributor is, of necessity, limited by law. It is believed that an interpretation may be issued to suggest the common sale of duplicate parts where such parts are believed to be daily essentials. But until your dealer assures you that this step has been suggested, accept what he can give you with the assurances that he is doing all he can to help you and his country too.

Q.—If the service work is to be done for an industrial plant, and the dealer cannot secure the part, what can be done?

A.—The company for whom the work is being done can apply to the manufacturer of the needed part under the rating they have received for the Production Requirements Plan, for such materials, if they have filled out this form. If they are not operating under the PRP system, they can then apply to the manufacturer to supply this material, under the preference ratings assigned to them.

Q.—Will servicing instruments be available under this new plan?

A.—At the present, no direct decision has been reached on this subject as yet. The situation is a difficult one to solve, for one of the most important elements in the instrument, the meter, has become an increasingly difficult component to make. This has been prompted by shortages of jewels, and other delicate pieces essential to such instruments. Attempts are being made to provide allocations of these materials for radio test instruments, but the problem is indeed a serious one. Instruments with "jewel-less" meters and other recording means may become essential. In view of the gravity of the situation, service men are urged to maintain their present instruments with unusual care. If it should fall on the sick list, every attempt should be made to repair it with the material on hand. While such pieces as condensers, resistors, etc., may be obtained from your dealer, there may be sudden shortages of these usually special pieces, which will hold you up for a time. But the one element that should be guarded with the greatest care, against any damage, is the meter. This, there may be little likelihood of replacing. So, don't take chances. Be sure that fuses are employed where permissible, and don't insert instruments into circuits, unless you're familiar with surrounding power values. Better make sure first . . . than be sorry later.

Q.—How do the recent OPA price ceiling orders affect the service man and dealer?

A.—These rulings establish ceilings

(*Continued on page* 55)

Battery Substitutions for Portables

by

GERALD GARVIN

It is becoming more and more difficult to buy exact replacement batteries for home sets. Substitutes may be used instead.

RADIO SET NAME AND MODEL	BURGESS BATTERY TYPE	PLUG CHANGE REQUIRED
AIR KING		
4112, 3950	2-M30, 1-2F4L	.....
4016	2-M30, 1-2F4L	.....
3916	2-M30, 1-4F	.....
3906, 3910	2-M30, 1-4F	.....
3905, 3912	2-W30P1, 1-2F	274, 2-273
CROSLEY		
B429A, 429	2-M30, 1-4F	.....
27BD, 27BE	2-M30, 1-24FL	.....
45BV	1-XX45, 1-#2 Uni-Cel	.....
5549A	2-M30, 1-F4P1	.....
EMERSON		
CE259	2-M30, 1-4F	.....
CE263, CT275, CX305	2-M30, 1-4F	.....
DC308, CX263, CX283, CX284, CX308	2-M30, 1-4F	.....
DJ-310, 311, 312, EA-338, 339, 357, DF-302	2-M30, 2-G3	.....
EA-312, 357A, 385, 389, 402. EA1-341	2-M30, 2-G3	.....
EE-340, 390. 401, EF-363	2-M30, 2-G3	.....
DU-379, 380	1-XX45, 2-#2 Uni-Cels	.....
KNIGHT		
E10775-178BL, E10777-171AS	2-M30, 1-4F	.....
E10716-XL28, 10715-PL29	2-W30P1, 1-2F	274, 2-273
5N, 5NL	2-M30, 1-G5	.....
A10761	2-M30, 1-2F	.....
A10748	2-M30, 1-F4P1	.....
A10795	2-M30, 1-F4P1	.....
A10700, A10701, A10725	2-W30P1, 1-4F	274. 2-273
B10521, B10522, B10523, B10524	2-W30P1, 1-F4P1	.....
B10540, B10545	2-W30P1, 1-4F	274. 2-273
B10562, 63, 64	2-M30, 2-G3	.....
MOTOROLA		
52D, 41-D1, 41-D2, 51-D1, 51-D2	2-M-30, 1-4F	.....
57BP1, 57BP2, 57BP3, 57BP4, 65BP1, 65BP2, 65BP3. 4	2-M30, 1-G3	.....
41H	2-M30, 1-4F	.....
B150	2-W30P1, 1-2F	274. 2-273
51F	2-W30P1, 1-4F	.....
PHILCO		
39-71, 72, 73, 40-74, 504	2-M30, 1-4F	.....
40-88	2-W30P1, 1-4F	274, 2-273
41-84, 85, 41-841, 851	2-W30P1, 1-F4P1	2793. 2-273
41-842T, 843T, 844T, 853T, 854T	2-M30, 1-G3	.....
RCA		
94BP1, 4, 61, 62, 64, 66, 80, 81, 96GA, T4	2-M30, 1-4F	.....
BP55, 56, 85, RC455	2-M30, 1-2F4L	.....
15-BP-1 to 15BP7, P5. 25BP	2-M30, 1-4F	.....
AVR102	2-M30, 2-G3	.....
RC 527 527A	2-M30, 1-4F	.....
RC 407 410	2-M30, 1-4F	.....
TRAV-LER		
553B, 554, 1555	2-M30, 1-4F	.....
1556, 556	2-M30, 1-F4P1	.....
B70	2-W30P1, 1-F4P1	.....
B71, FB73	2-M30, 1-F4P1	.....
B81, FB82	2-M30, 1-F4P1	.....
ZENITH		
4K400D, M, S, V, L	2-M30, 1-4F	.....
4K402D, M, F, L	2-W30P1, 1-4F	274, 2-273
5G401, L, M, Y, 5G403, 405	2-W30P1, 1-F4P1	2793. 2-273
5G500, 501, 504	1-G4B50	.....

FIG. 2.

RADIO batteries are taking their place among the items becoming increasingly hard to obtain for civilian use.

As the American war effort goes into high gear and absorbs more and more materials, including batteries of all types, it is to be expected that those allotted for civilian purposes will be greatly curtailed. This will be especially true of the types designed for and used with portable receivers.

Certain battery types will no longer be manufactured at all. These include the more or less odd sizes which ordinarily are not widely used.

Other types will be available only for requirements having priority rating and essential to the furthering of the war program.

For the most part it is indicated that the batteries which civilians will no longer be able to obtain besides the discontinued odd sizes will be the heavy duty types which, by their construction, use more vital material.

This will mean that radios formerly operated with the types which can no longer be secured will have to be adapted to operate with those that can. In a great many cases radio service men will be called upon to make any changes necessary to permit operation with what might be called *substitutes*. Usually the manufacturer designs a radio for operation with one or more batteries having certain voltages and also taking into consideration the physical dimensions of the individual batteries.

This is particularly true in portable receivers where the exact length, width and height of the space allowed for batteries is limited.

In selecting substitute batteries these points have to be considered. First the voltage and then physical dimensions.

The batteries which will be available for civilian use are mostly the smaller lighter duty types, and knowing that units can easily be chosen having the same voltage as the heavier types they are to replace, a person might assume, any of these having the proper voltage could be used.

This is not the case because although the lighter types do have smaller overall dimensions they do not always conform to the requirements of a set having an exact length, width and height to the space into which the batteries will have to fit.

In a great many cases one dimension of the lighter duty units will prevent their being used. Most of the time this dimension will be the depth which, when a battery is placed on its side will prevent the user from sliding it into the shelflike space in the radio.

This does not mean, however, that all of the lighter duty types will be available for the selection of substitutes. Certain of these have been discontinued or will be available only for

essential use along with those already mentioned.

In preparing this article the attempt was made to provide a condensed picture of the battery situation on the basis of current information and also give practical data to the serviceman or any other person called upon to adapt a radio for continued operation under wartime conditions.

Figure 1 shows the most popular and widely used battery types listed in columns by brand names. The three left hand columns list the units which will no longer be available or extremely hard to obtain for civilian use.

The batteries listed in the three right-hand columns are types which should be available and will serve as replacements to the corresponding numbers listed at the left. The units listed by brands on a given horizontal line are interchangeable also and this may be a further aid in selecting replacements.

At present it is indicated that any batteries not listed in the three right-hand columns will not be available to civilians. It will be noticed that some type numbers listed in the right-hand replacement columns do not have corresponding types listed in the left-hand columns. These are units which should be available although they are not readily adapted for replacement purposes. They are included, however, to complete the list of radio types which should be available.

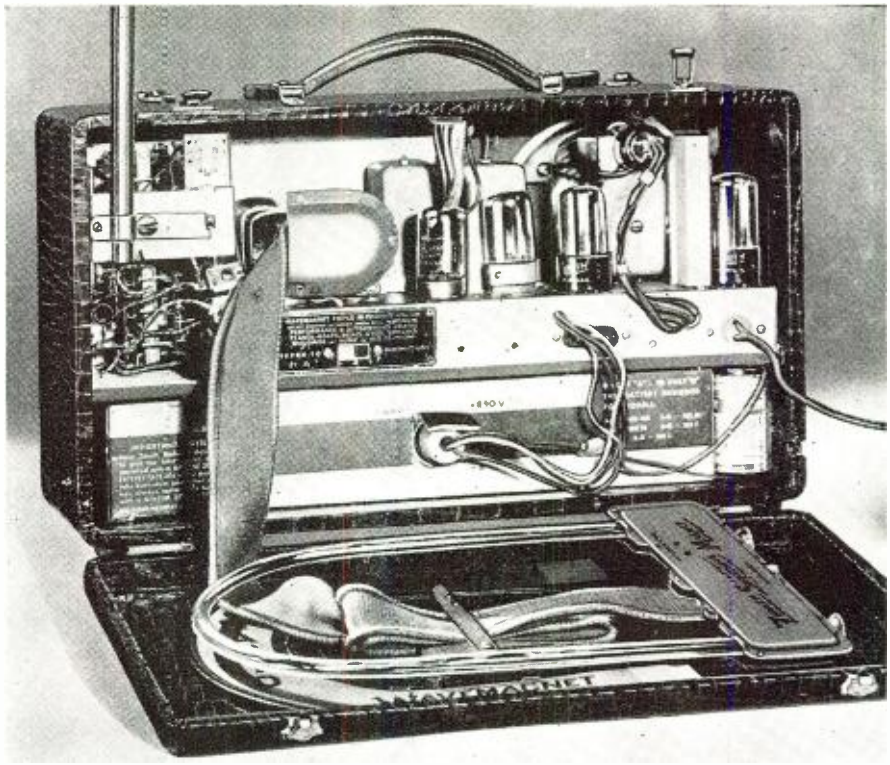
It can be seen in Figure 1 that there is only one battery pack listed in the right-hand columns. The number is G4B60 and it is likely to be the sole combination pack obtainable. Practically all sets designed to operate with a single A and B pack will have to be changed to permit the use of individual A and B units having the equivalent A and B voltages of the pack and also having dimensions which will allow them to be installed in the space formerly occupied by the pack.

How this is done is shown in Figure 3. For purposes of illustration the widely used battery type number 3FA60 was chosen. Looking at Figure 1 it will be seen that the replacements types for this pack in the Burgess column are 1-2F and 2-W30P1. The equivalent numbers on the same line under Ray-O-Vac and Eveready will serve equally well if these brands are used.

Using these three batteries to replace the single pack we will have A and B voltages of 6 and 90 equal to those supplied by the pack. The F4P1, the A voltage and the two 45 volt W30P1 when wired in series will supply the required B voltage.

Also the individual dimensions of these three batteries will permit them to be arranged in a group to occupy a space not exceeding on any dimension the size of the F4B60. Actually as shown in Figure 3 the space occupied is somewhat less in one dimension.

As mentioned the batteries which will be available are the smaller



This popular type of portable is just one example of the many types of sets that have been designed to operate from special B battery packs.

lighter duty types and as a result they may not in all cases fill the space allowed in the radio. After the replacements are installed this extra space should be filled in some manner to prevent the batteries from moving.

Paper or cardboard cut to proper size and fitted around the batteries will work very well. This is, of course,

(*Continued on page* 62)

			REPLACEMENTS		
BURGESS	RAY-O-VAC	EVEREADY	BURGESS	RAY-O-VAC	EVEREADY
2F4	P698A	718	F4P1	P694A	....
4FL	P94L	....	2F	P24A	....
6F	P968A	743	4F	P94A	742
8F	P98A	741	4F	P94A	742
8FL	P98L	745	2F	P24A	....
F4P1X	.....	....	F4P1*	.....	....
.....	.....	....	2F4L	P698L	747
.....	.....	....	G3	P83A	746
.....	.....	....	G5	P85A	687
A30	430P	....	W30P1	P3A30	....
B30	P5303	762	M30	P7830	482
Z30	P7R30	738	W30P1	P3A30	733
A60	BB60P	....	2-W30P1	2-P3A30	....
.....	.....	....	XX45	....	467
4FA60	.....	....	1-4F, 2-W30P1*	.....	....
5DA60	.....	....	1-2F, 2-W30P1*	.....	....
6FA60	84	....	1-4F, 2-W30P1*	1-P94A, 2-P3A30*	....
6TA60	.....	....	1-2F, 2-W30P1*	.....	....
2F4B60	10896	....	1-F4P1, 2-M30*	.....	....
F4B60	.....	....	1-F4P1, 2-W30P1*	.....	....
3FA60	46093	....	1-2F, 2-W30P1*	1-P24A, 2-P3A30*	....
2F4A60	.....	....	1-F4P1, 2-W30P1*	.....	....
.....	.....	....	G4B60	.....	....

*Plug change required.

FIG. 1.

SERVICE SECTION

Centralized Sound Systems Aid War Production

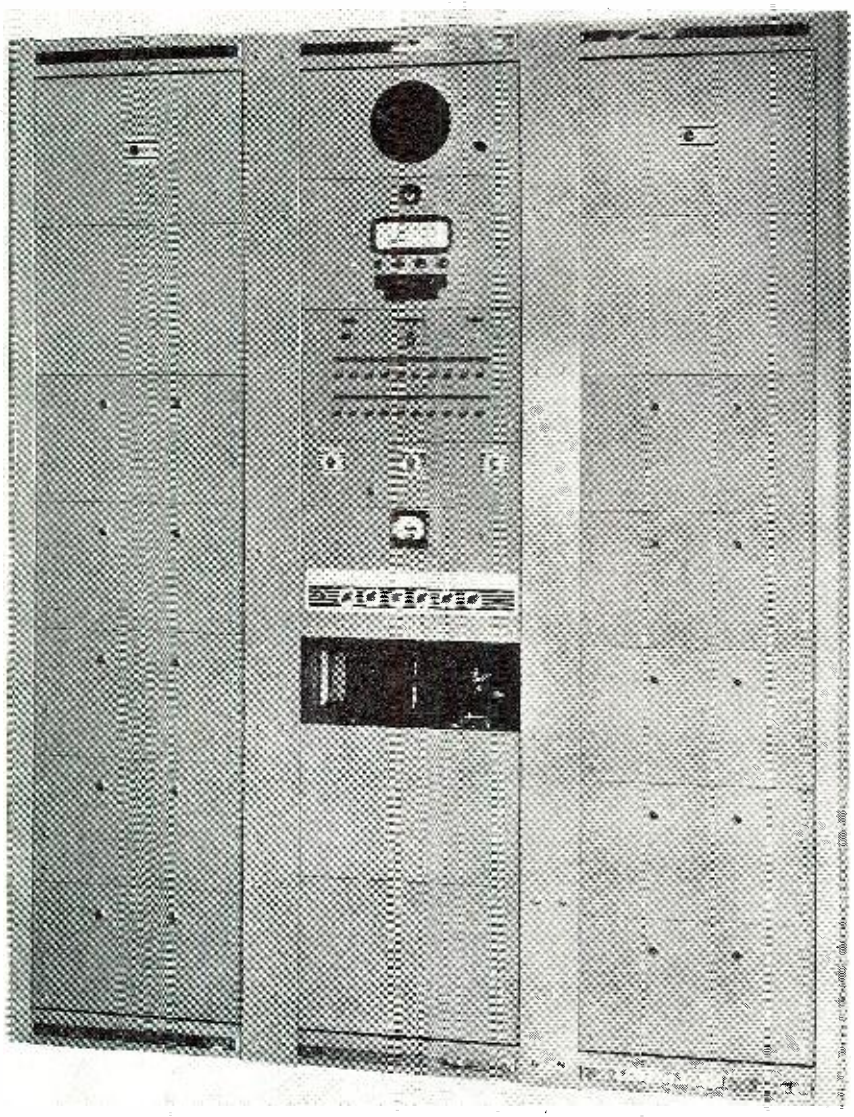
by SIDNEY HARMAN

and

HASKEL BLAIR

The David Bogen Co.

Servicemen should follow the rapid strides being made by the Sound Manufacturers. This system features new innovations.



Front view of an elaborate system designed especially for large plants.

IF necessity has ever been the mother of invention, the war has caused it to rear a fabulous family. This is particularly true in the sound industry, and it is true in two contrasting ways.

As the war program has taken definite shape and the requirements of the Army, Navy, air force and war plants have become more fully defined, the sound industry has converted much of its development to solve their problems and much of its production to meet their demands.

At the same time—because development and new production take time—the basic American ingenuity has found new applications for standard sound equipment.

The real story in sound, however, concerns itself with the new streamlined custom built systems — engineered to meet the complex requirements of the Army, Navy, air force and war plants—and designed to solve the varied problems which war has created and for the solution of which, standard equipment is simply inadequate.

The Centralized Sound System illustrated is essentially a product of the war. Speed is of the essence today in war plants, at Naval Air Stations, in shipyards and at Army camps, and the ceaseless drive to increase efficiency, accelerate production and establish instant complete communication fostered the development of this equipment.

It is very true that in pre-war days, standard microphone-amplifier-speaker systems were in use at Army camps and in factories, but today's requirements are so complex that such systems often prove completely inadequate. Procurement Officers and Plant Engineers recognized early that equipment would have to be built to do the bigger jobs the war had created —but there was no wide experience

in this field; it was essentially new! The *David Bogen Company* is one of the STILL far too few organizations which began to specialize in this new field, and in large measure, a wide program of education became necessary.

The Army camps and the industrial plants, engineers soon learned, were aware of their needs, but completely unaware of the potential solutions.

In war plants, equipment was needed to locate any man in the factory wherever he might be—at a moment's notice. It was essential that important messages be sent to the workers (all at one time or in selected groups) without interrupting the progress of production.

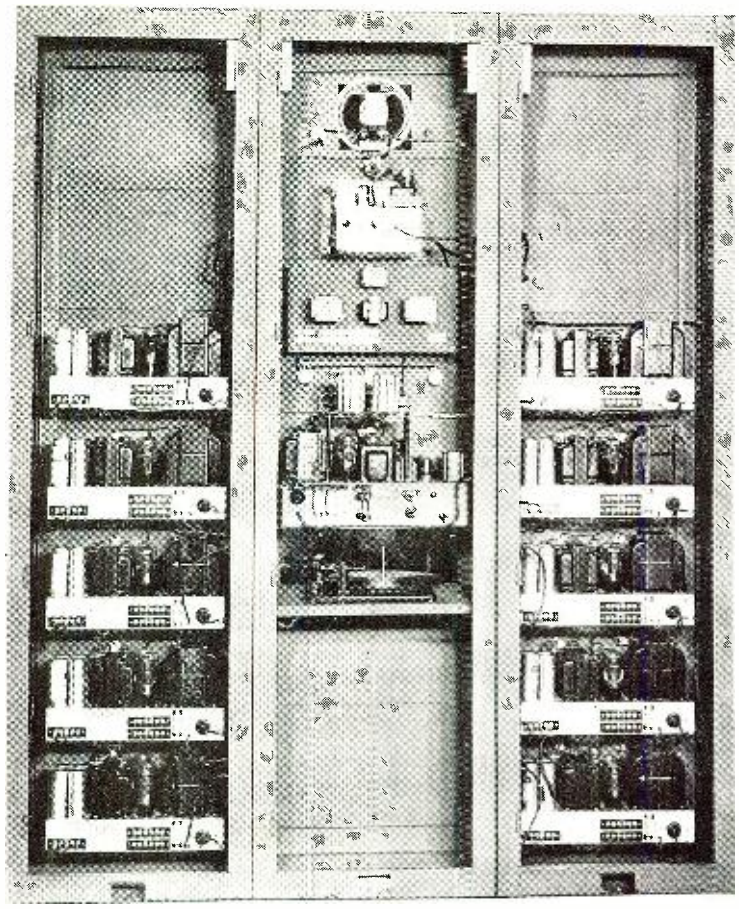
In shipyards, centralized systems were required to issue orders under conditions in which noise levels varied greatly and vibrations and physical disturbances were continuous.

In Army air depots, centralized systems were needed to page officers, located anywhere in the depot, and in training centers, systems were essential in the education program. Efficient air raid alarms systems were, of course, a positive need of most large cities and muncipalities.

These then were the fundamental requirements. Practically without fail, engineering surveys exposed other problems which centralized systems could satisfy, and which sound equipment had never faced before. Each installation became a specially surveyed, specially engineered custom built system—and the differences in location, in function, in size—in innumerable other conditions, varied the final form of each complete system. Certain standardized functions, however, have been developed.

Fire danger is more intense during a war period—and the damage caused can be far more costly than any dollar estimate. Practically all Centralized Systems today, regardless of where they they are employed, are equipped with some form of fire alarm generator. In the simpler systems the alarm is initiated at the amplifier control rack by operation of a manual switch which feeds a fixed frequency signal into the driver amplifier. This signal can be manually warbled to indicate an "all clear" or to operate as an air raid alarm. In some systems, switches mounted in metal or glass enclosed boxes are strategically located throughout the plant. Each of these switches controls the same relay in the control rack and the relay, when activated, connects a tone generator into the input of the amplifier.

The more complex systems utilize switch boxes, located in each department or plant section; each box operating an automatic timing device which transmits a coded signal, designating the point at which the fire has occurred; facilitating the immediate marshalling of all fire fighting apparatus and, equally as important, permitting the "uninterrupted production of tools for victory." In



Plenty of space is left for additional amplifier units when they are needed. Note monitor speaker at top center, just above the radio tuner.

most major systems, there are locations in which the fire alarm switch is incorporated in a control box which is also equipped with a microphone for paging. In such application, it is possible to immediately follow the alarm signal with verbal instructions. Such units are invariably located in guardhouse and watchmen's stations.

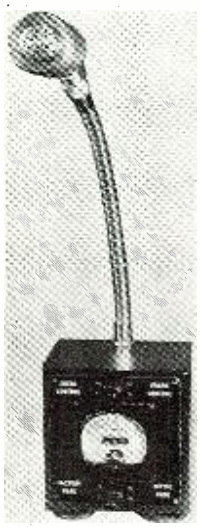
The need for air raid alarm equipment is, of course, quite obvious. The incorporation of relay controlled, automatic alarms in the centralized equipment marked the first integration of paging, fire and air raid alarms in one complete system. The bitter experience of the English as they weathered the ceaseless bombings of 1941, has provided a wealth of information concerning air raid alarms. It is now known that the prime danger is fire—yes, more to be feared and more wasteful in life and property than direct air raids.

We have learned from the tragic lessons of Britain, that fire and air raid alarms must be co-ordinated—that, if fire develops as the result of a raid and during the issuance of the raid alarm, it must be possible to interrupt the raid alarm with the fire alarm, and often to add verbal instructions. The present system is so designed that when a fire alarm key is thrown, the fire alarm relay switches a tone generator into the input of the amplifier and disconnects the air raid tone generator. This precedence can, of course, be given to any one function over another, and surveys often present situations in which different positions or functions require priority. The usual order is (1) Fire Alarm, (2) Air Raid Alarm, (3) Paging, (4) Radio or Phonograph.

The air raid alarm is normally initiated in a manner similar to the fire alarm described above. In many cases, however, the fixed signal is warbled to indicate an all clear, and in the most complex systems, different tones are employed to sound the alert, the actual alarm and the all clear. In most war plants, a guard or raid warden is permanently stationed on the roof, and this watcher is equipped with a remote control unit consisting of a microphone for verbal instruction, and a switch for the air raid alarm. It is customary to give precedence to the guard over all other stations, and this is especially true during night shifts when telephone operators, executives and clerks are away.

Sound systems have always been used primarily for music distribution and paging, but the demands of war have accentuated the need for thorough surveying, and the custom designing of equipment. There is no comparison between an installation which must completely cover every foot of a plant manufacturing airplane propellers and an installation in a

quiet hotel or schoolhouse. Noise levels are often so high that a man cannot be heard three feet away. Area covered is measured in acres, conditions differ from plant section to section, and equipment must be ready for instant use 24 hours a day. All Centralized systems are designed so that the filaments of all tubes are continually lighted and maintained at operating temperature. Each amplifier in the central control rack is provided with a master relay which supplies plate current to its respective amplifier and is controlled by the microphone, air raid or fire alarm relays, arranged so that the amplifier is supplied with the proper plate voltage whenever the control relays are in operating position. The drain is negligible; the system is ready for instant use, and every important call is sent out without a moment's delay. Paging in air depots or war plants may initiate at many widely separated points. Today's complex centralized systems generally employ the type of microphone control box, described earlier in the article, providing precedence for the more important calls.



Bogen Signal Control.

Many a war plant has a Plant Protection Center which is essentially an emergency room, operated as the focal point of its own air raid precaution system. Workers in the plant are trained as plant wardens, and signals are received at the center directly from the Interceptor Command. These signals and any related vital messages are then transmitted to the entire plant from the Protection Center.

There are cases in which return speech is necessary—in which replies to the paging call are required. Intercommunication is then integrated with paging. Supervision, detection and sabotage protection are related functions of the paging feature, and are effected in various ways.

The value of a radio tuner in a centralized sound system cannot be overestimated. In Army camps and Naval stations particularly, it has a morale value, difficult to estimate. Soldiers and sailors, away from home are eager for local news, for championship fight broadcasts, and for programs of the "Bill of Rights" type. Each of the radio networks produces one or two variety programs, designed primarily for the pleasure of the men in armed services, and the incorporation of a tuner in the sound distribution system makes all these programs easily available for everyone.

In a number of war plants, it was found that men were bringing small portable radios to work so that they might listen to vital news broadcasts. It was recognized that for the man producing weapons of war, news of our progress was vital, but it was also seen that the attention to a small radio and the distraction for other workers was delaying production. The simple, progressive solution was to provide plantwide distribution of one or two regularly scheduled news broadcasts during the day.

The use of music in mills, shipyards and war plants to motivate increased efficiency by reducing fatigue has proved of immense value. In America, this application became widespread coincident with the war, although it has been practiced in Germany and South America for many years. Estimates as high as 85% have been made of English plants employing recorded music in this way. In plants where the nature of work is continuously monotonous, automatic record changers have been built into the Centralized Systems.

The Army is employing variable speed turntables to play martial music for drilling—and the very system used for paging and alarms throughout a camp is adapted for this purpose also. In many camps, recorded bugle calls have been substituted for the almost legendary bugler.

It has been the intent of this article to present a general picture of the new special sound equipment, manufactured for the various war industries and branches of service—to outline some of the problems which exist and some of the solutions which have been reached. In subsequent articles, specific installations will be analyzed—the peculiar problems of each will be presented—the nature of the surveys will be explained and the actual equipment supplied will be thoroughly examined in terms of design, installation and operation.—Editor.

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MONEY-MAKERS

This System Works 100%

A UNIQUE system of keeping track of sales, service and machines is used by Jean W. Lier of Lier Radio and Television Company in San Bernardino, Cal.

Three clip boards are used on the main desk (near the telephone), one for all incoming calls, which also includes calls "in the mill" or being worked up; (2) one for finished jobs; (3) one for billing or handling the cash.

In other words as soon as a call comes in it is written upon a standard form provided for the purpose, and put on a clip board. After the service man has attended to the matter, it is moved over to the finished job board, and it is then examined for completeness and make up ready for billing and placing on the clip board to be billed the customer, and invoice mailed.

Carrying Repair Parts

To systematize stock keeping and to carry everything in one place with a place for everything, Jean W. Lier, of Lier Radio & Television Company in San Bernardino, Cal., dropped into a grocery fixture store and bought some second hand cases that had been used by a grocer for housing dried beans, peas, etc., with glassed in fronts, to pull out like drawers for storing repair parts and labelling each drawer.

Then Lier went to buy show cases that had been used for notions, gloves, and stockings, in which he keeps still smaller parts—also visible behind glass—and which pull out like drawers.

Thus, at very little expense, he bought the finest kind of fixtures for housing parts and keeping them systematically arranged.

—30—

ANY SPARE METERS?

Oscilloscopes Are Needed!

IN these days, when test instruments are becoming increasingly more difficult to purchase, it is important that full advantage be taken of whatever units are available. The entire servicing technique has changed in recent years and one of the old standbys (the oscilloscope) no longer finds itself in use more than even the more elaborate service parts.

These "scopes" are badly needed by those engaged in the manufacture of radio equipment for our Armed Forces. In fact, they are easily saleable, if in good condition, to many of the aircraft companies, schools, etc. We suggest that you drop a line to those nearest, stating in full the exact type, age, price, condition, to the purchasing departments of those schools and plants, offering them for sale.

There is also a terrific demand for all types of meters used in radio work. Many experimenters, servicemen and Hams have several *extra* meters for which they have no possible use. After the war is won, the meters will be easily obtained in almost any quantity and one will have the opportunity to restock even at less cost than those now being held on the shelves. *Do not sell any meter that might be needed for your own work.*

To those of you who are Hams, remember there is a demand for manufactured communications receivers and transmitters of standard makes. Only those for which schematic diagrams and instruction books are available should be offered for sale to the government. No others will be considered for purchase.

Send your list to The American Radio Relay League, West Hartford, Conn.

—30—

Ringing-up extra sales by applying three specific sales appeals.

SELLING SERVICE BY 3-WAY FORMULA

by EUGENE CONKLIN

This serviceman dislikes PA. See if you agree!

MATTRAW RADIO of Watertown, N. Y., in business for twenty-two years, has evolved what he considers a workable, practical service formula:

a. Charge a price which assures the serviceman a fair profit.

b. Advertise consistently in the local newspaper.

c. Eliminate any free services—be they ever so humble—no matter how valued the customer involved may be.

Taking the "a" segment of the formula first, just what constitutes a fair price? Mattraw's answer is a long and lusty $1.50 each and every hour, plus replacement parts at full retail value. Mattraw points out that his is the highest rate in the city for pure unadulterated radio service, and, by a strange coincidence, his business value is tops also. He finds that people have a wholesome respect for the man with high rates, feeling that he "must be good."

He believes *now is the time for all servicemen to get together* on a standardized rate, because of the war situation. People are glued to their loudspeakers for all newscasts and they will want their radios in operative condition in case of local war defense orders. Price will be no argument, especially with the high work rate scale paid many defense industry workers. By establishing a uniform rate now, there is a possibility that it may be maintained after the war is ended. Mattraw also recommends a $2.00 hourly rate for calls made after the close of the service day in the event a call summons the trouble-shooter from a nice warm bed or a late snack. It is worth the extra charge to both the public and the serviceman.

Considering the "b" portion of the successful service formula, Mattraw finds that a classified insertion daily, six times weekly, or a display ad Thursday or Friday night will work wonders. People read classified ads avidly now, according to Mattraw, in search of bargains of all sorts. A classified ad, running day in, day out, does get the attention of the readers, through the power of repetition. If a display ad is used, the latter part of the week is recommended, because paydays usually fall on Thursday, Friday or Saturday.

Mattraw advises against the use of circulars and prefers a spot in both the city and phone directories. He advises contacting all hotel managers and rooming house proprietors, leaving with them business cards for guest distribution. Many a transient has a portable which goes on the "fritz" in a strange town. If the town has a shopping guide or a freely distributed shopping paper, by all means utilize that in preference to the regular news channels. Contrary to opinion, Mattraw finds that the average person reads a shopping bulletin from cover to cover. He has advertised in local Watertown "give-away" papers for a decade.

Approaching the home stretch, we come to point "c" or the no-free service angle. At present, Mattraw charges 50c for the inspection of tubes, when the customer brings them to the service shop. Mattraw says that under the free inspection scheme, in order to break even, servicemen must find one bad tube, even if all of the tubes are O.K. He prefers charging the customer for testing expense involved and giving tubes a fair reading. Mattraw gives *no* free inspection. He charges $1.50 for driving out to the house and giving a set routine and from then on, full hourly rate for all time spent at the customer's house or in the shop. Whenever possible, he yanks set into shop, as he believes he can accomplish repairs more effectively and economically to all concerned that way.

Mattraw forecasts that, after the war, men trained by Uncle Sam in radio and signal work will open shops in direct competition with established servicemen, even though these individuals have had only fundamental training. He suggests that wherever possible repairmen, having to go into service, arrange with local individuals to carry on the shop during his absence, so that his name will be kept before the public. Otherwise, friend serviceman may return to find clientele missing and good will conspicuous by its absence in many cases.

Incidentally, Mattraw advises against going in for P.A. work, as he believes headaches far outnumber advantages. Organizations want to use the outfit at no charge and commercial business houses want to rent system at virtually profitless figure. Many cities have ordinances against noise and P.A. comes under that category. Finally, summer carnivals, band concerts, picnics, etc., use the system exhaustively in so short a time that replacement of worn out portions of the unit eat up the profit. Mattraw has tried P.A. over a lengthy span of time. It is all right for those already in the business with grade A contacts—otherwise, "don't" is his advice to service operatives.

Mattraw finally offers this bit of practical advice. "Be a joiner." Belong to as many social organizations as your budget will allow. Even if time doesn't permit attendance at these functions, the very fact that you are a member of Rotary, Kiwanis, Moose and so on will garner your business. Appear at noon Rotarian banquets, make a speech on "Importance of Radio in National Defense." It won't hurt your reputation a bit and business will have wholesome respect for you.

—30—

SERVICE SECTION

ELECTRONIC CONTROL— New Business for Servicemen

by WILLARD MOODY

This analytical article explains many points that should be carefully studied by those servicemen that are making a determined effort to increase their knowledge of this rapidly expanding field.

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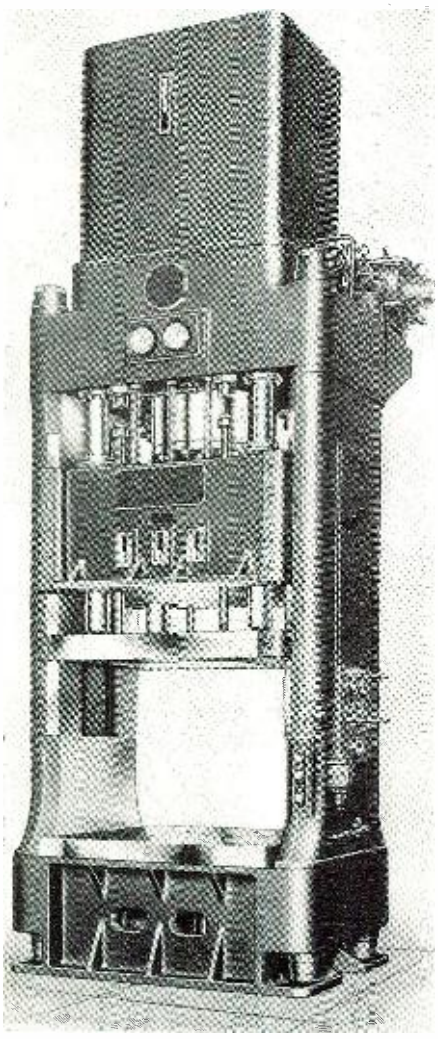


Even large machinery such as the one shown above may be controlled easily.

ONE of the most promising of radio fields is "electronic control." The turning on and off of a switch automatically, doors opening mysteriously and a thousand and one humdrum tasks turned into novel and exciting jobs, is the intriguing field which looms before the well trained radio man or master electrician. We have had the steam age, the great progress in electricity and radio and now the vista that opens up before us with regard to electronic control as the most marvelous of all.

Dreams are fine things so far as forecasting the future is concerned but the man who dreams about electronic control today is simply not awake. It's here, now, and you can make money by using it wisely. It is not a crowded field, and men skilled in the work are so scarce that they can almost write their own ticket as to wages, if properly qualified.

The field is not open to the average radio serviceman but to the man who is a little above average, who has studied radio and electricity diligently. If the screwdriver mechanic has no place in radio today, the same man certainly cannot aspire to electronic control.

A few reasons why electronic control is valuable are listed so that you will gain an idea of the importance of this new field and how it may be exploited.

1. Reducing the cost of a manufactured article.
2. Effecting a saving in maintenance of equipment.
3. Insuring more uniform quality of manufactured products.
4. Safeguarding life and property.
5. Speeding industrial operations.
6. Counting objects accurately.
7. Eliminating the "human error" in production of precision parts.
8. Controlling irregular actions of machinery.
9. As integral parts of advertising displays or systems.
10. Control of processes not handled by human senses.
11. Controlling delicate operations in mechanical assembly.
12. Improving efficiency of human workers.

The first step in an electronic control job should be to make a study of the manufacturing process and just what the client has in mind to accomplish, just what his problem is and how it may most efficiently be solved. If a simple mechanical arrangement will serve the purpose, electronic control should not be used. There would be no economic or practical justification for the system.

In cases where suitable electronic control would be useful, would save your client money and man-hours of labor. Draw up your plans carefully and then present them in as clear and understandable a light as possible. If there is something about the machine or process you don't understand, be frank and say so. In this way less time and money will be wasted and satisfaction all around assured.

When you have estimated the cost, make out a written agreement and have the client sign that agreement in the presence of a witness, and get the signature of the witness. This eliminates argument later.

The basic structure of an electronic control system may be subdivided into four main parts. The first is the detector which has the job of changing physical movement into electrical

movement. Where a photoelectric cell is used a change in the amount of light hitting the cell results in a change in cell current; where a temperature device is used, such as a mercury thermometer, the temperature changes the level of the mercury solution and a change in pressure or height is used for control of a secondary device or system; in the case of some humidity controlled devices, such as the radiosonde, used for weather observations in test balloons, a human hair or combination of hairs change their physical length due to moisture absorption and allow release of a spring controlled electrical contact. All of these systems work with electron tubes and are called electronic controls.

The second part of the basic structure is the discriminator, the selector which brings before the detector the object to be examined or analyzed. An example of a selector would be a round hole cut in a soup dish, the size of the hole being just big enough to let a certain size marble or round object pass through and yet exclude slightly larger

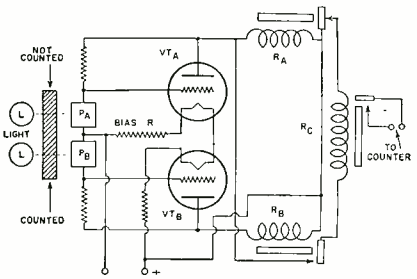


Fig. 1.

objects; or it might be a conveyor belt in a factory or a special light filter in the case of an optical system using a photoelectric cell.

The third part of the system, basically, is a power gain device. It may be a d.c. amplifier using ordinary tubes and a sensitive relay or some special form of thyratron. Its function is to use the small change in energy of the detector so that it can be harnessed to control a relay or switch.

The fourth part of the system con-

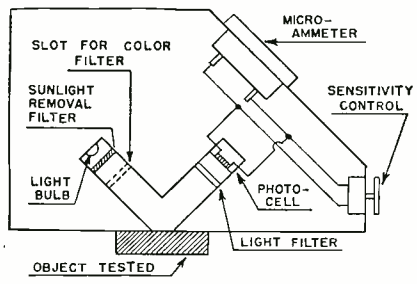
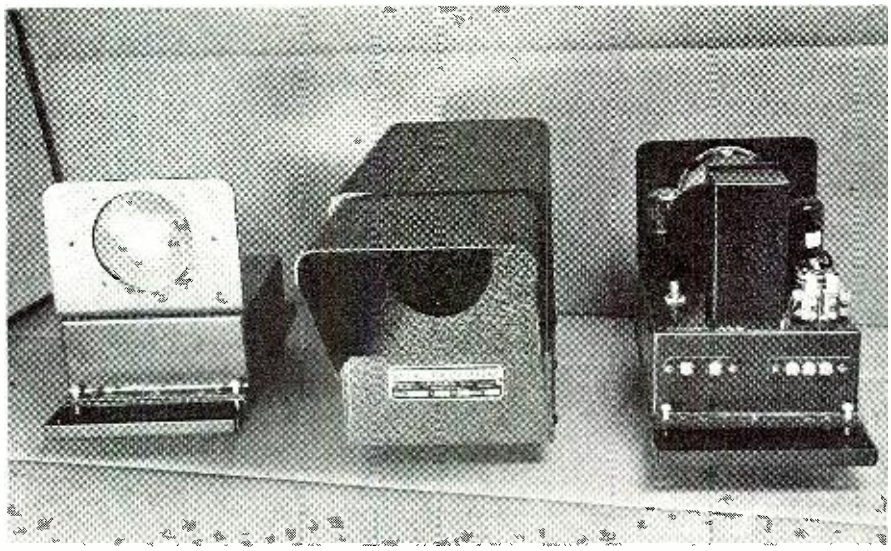


Fig. 2.

sists of the motor or pressure control system used for opening a door, shutting off a valve or doing any other sort of purely mechanical work.

The photoelectric type of electronic control has received the greatest attention in recent years. It consists, essentially, of a light-sensitive cell, light source and associated optical system, amplifier and relay, power relay



These are typical units that comprise a complete system that may be used for protection of our civilian and military industrial plants.

and the device or operation jig being controlled.

The detector in the photoelectric system is, of course, the photo cell. The three types of cells commonly found in practice are the photoemissive, photoconductive and photovoltaic. When the light beam is invisible to the eye, infrared is the type of light used. Photovoltaic cells give preference in such infra-red systems to the high red sensitivity photoconductive (selenium) and photoemissive types.

A source of artificial light, using a 6 to 8 volt auto lamp of standard 32

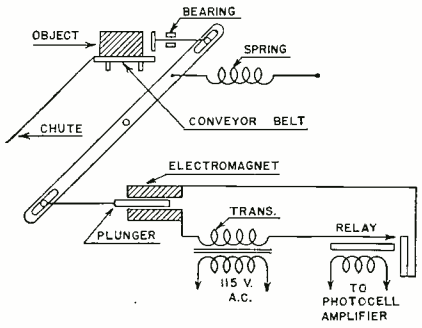
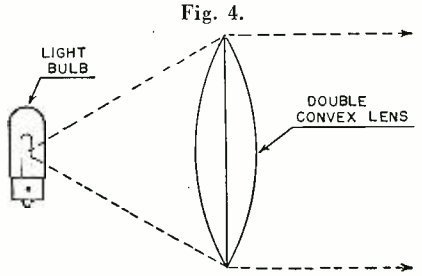


Fig. 3.

candlepower, in conjunction with a lens system for the efficient focusing and utilization of that light, is included in all photoelectric systems except those using special lamps or depending on natural light for operation. In some units a home movie projection lamp is used and the bulb in such systems operates directly from the 115

Fig. 4.



volt line, a.c. or d.c. With low voltage lamps, a.c. only is used, as a transformer is necessary to step down the voltage from 115 to 6 or 8 volts. The bulb is always operated at the lowest voltage which will give adequate light output, thus prolonging the useful life

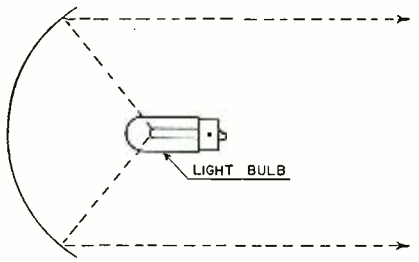


Fig. 5.

of the lamp.

Twin filament lamps are generally used, so that burn-out of one filament merely means the turning of the lamp in its socket and restoration of service. These lamps, possessing high infra-red output, can be used with suitable filters for invisible light operation. Par-

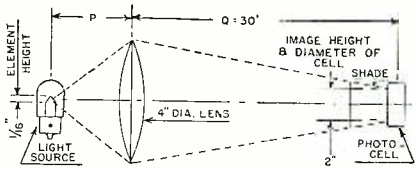


Fig. 6.

abolic mirrors or lenses can be used, with lenses finding greater favor commericially due to the fact that they are less critical to adjust, are lower in cost, and permit easy focusing.

Photoelectric sources must, of necessity, be rugged in construction as they are subject to abuse at the hands of the public or may be damaged by accidental contact with passing objects. A rugged steel case is generally used for protection of the fragile lamp and lens.

Commercial light sources generally

(*Continued on page* 51)

Making Sales out of Rentals

by FRED E. KUNKEL

Here is one way to turn rentals into cash sales if you are able to purchase sets.

EVERY rental agreement used by J. G. Bradburn of the Bradburn Radio Company in Houston, Texas, also contains an option to purchase. Thus Bradburn frequently sells a rented radio or phonograph or allows the renter to buy a new one, applying the regular payments as down payments on the purchase.

Thus rentals frequently and continually lead to sales and when they do not, rentals show a nice profit. Thus for example, Bradburn cleared $775 last year on rentals alone, net.

The way it works is this: In order to save the cost of checking credit through a credit agency, which would cost money in so many cases, Bradburn's retail agreement form will cover enough information from a few telephone calls for him to size up the customer and appraise his credit standing.

The form shows whether the applicant owns or rents a home, if he has a telephone and in whose name it is listed, where he is employed and in what capacity or department. In addition Bradburn requests him to show some personal identification.

The radio is then rented for a day or a week. If the customer is a transient, Bradburn makes him pay a deposit. If a call comes in from a hospital, Bradburn checks up on who it is and charges $2.00 the first week instead of $1.00.

"That takes care of our delivery and pick up system," he explained. "We hold them responsible for the safe return of the radio. Then we have an option-to-purchase clause which is all written in this form of rental agreement.

If they continuously rent it they can apply the rental payments on the purchase of the radio they are renting. The value of that radio is stated in the agreement, as well as the terms. And of course the price of that radio is ten percent over the cash price. So there is always a nice profit, no matter which way it is handled.

Say a woman comes in and rents a radio for five weeks and pays $5 down. Thus she has accumulated a $5 optional purchase that she can use. Suppose she decides she wants a console radio worth $69.95 (second hand) which we have on hand that we want to sell her. We deliver it immediately and allow that $5 as a down payment taking back the rental.

This optional agreement works out to our advantage every time. If they rent it for 10 or 12 weeks . . . what happens? We require payment in advance. Supposing at the end of 11 weeks they fail to pay the next week in advance. We simply pick up the radio and have our $11. The average value of the set might be only around $9.00.

BRADBURN RADIO CORPORATION

1817 MAIN ST. — Lil' Pal Records — PHONE CAPITOL 9259

1817 Main—Thrifty Repair Service—C. 9259

HOUSTON, TEXAS, _____ 194____

RENTAL AGREEMENT

The Bradburn Radio Corporation hereby rents to the undersigned, the articles as described below, at the weekly rate as designated, and the undersigned agrees to assume full liability for the value or the safe return in good condition as received. at expiration of rental period.

OPTION TO PURCHASE

The undersigned rentor will be credited with all rental payments to apply on the articles rented herewith. Or on any Radio or Phonograph sold by us at regular List Term Prices. However, this option will be VOID UNLESS RENTAL IS CONTINOUS AND PAID IN ADVANCE and will not be retroactive.

Rentor's Name _____

Address _____ (Private home—Apartment / Owner—Rentor)

Phone _____ (In whose name)

Reference

Employer _____ Dept. _____ Phone _____

Identification

Verification _____ CD — PB — X

Model Rented _____ Phono Radio Serial _____ Value $_____

Cash Deposit (unused portion to be refunded) _____ $_____

From _____ to _____ 194__ PAID $_____

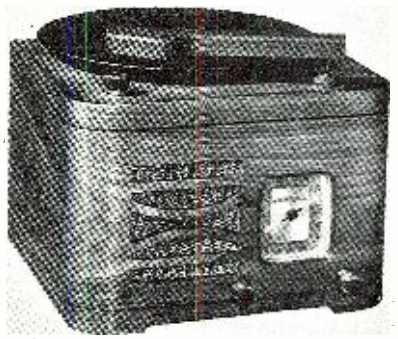
And from _____ to _____ 194__ at $_____ weekly

PAYABLE IN ADVANCE

Received/Delivered Signed _____

NOTICE: All rentals PAYABLE IN ADVANCE at 1817 Main Street, or may be sent by U. S. Mail. For other information regarding this Agreement Phone C. 9259, "ask for RENTAL DEPARTMENT"

Portables are easy to rent out.



Combinations are appealing to many.

So we can take all of our good trade-in models and all of our obsolete models and run them as rentals and sell them as sets afterwards. We do phonographs the same way, but have a different arrangement. We will rent a spring wound model for a dollar a week. But if they want an amplifier model electric, we rent it for $1 or $2 a night. We also rent dance records for 50c a dozen.

We rent a short wave set for $6 a month. But we always have a good chance to get rid of a used set. Thus we don't have any problem on our used sets and there is hardly any money out on used sets since the rentals take care of it. Yet two years ago we were losing 33⅓% on our used purchases and sales. Today we lose less than 10% and get rid of practically all of them. It is surprising the way it works out.

If they purchase a radio during the time they are renting it, we try to find an excuse to interest them in something bigger and better. It may be a phonograph combination. We say, 'You have already paid $12 and your credit is good, why not put that down on this $100 model and pay it out by the month?' Meantime if there is any maintenance cost, we charge it against the renting service.

Thus instead of selling for a dollar down, like most stores do, we use our rental system to take care of that."

Another form used by Bradburn is one evolved to cut down on the number of forms used, by combining many in one. He calls it the "Utility Form," which serves the purpose of a packaging slip, shipping order, radio service call, receipt of a shipment, notation, or acknowledgment.

—30—

Spot Radio News

IN DEFENSE AND INDUSTRY

Presenting latest information on the Radio situation.

by **LEWIS WINNER**
RADIO NEWS WASHINGTON CORRESPONDENT

THE NEEDS FOR CHLORINE IN WAR have increased by leaps and bounds. We have seen it at home . . . at the office . . . where paper has become dimmed with yellowish tinges, wearing apparel in off-white has become popular and packages, boxes and wrappings in off-whites have become the theme of the day. And in radio, chlorine shortages are prompting changes too, some of which will be visibly seen, while in many instances the changes will be evident from the results. The changes, for instance, are taking effect in the materials used in fixed capacitors, as a result of which life and breakdown voltage characteristics will have to be readjusted. Larger type units may appear in some instances as a result of this shortage. Other places where the shortage will be evident will be in dial faces, particularly those with complicated scales. Reversed or white on black and colored scales will become the vogue.

Among wartime paper problems we also find insulating papers that have been affected seriously because of the scarcity of manila rope, most of which came from the Philippines and Europe. The problem is so acute that many plants engaged in manufacturing electrical insulating papers, parachute flare papers, gasket papers used in the manufacture of tanks and airplanes, and other special applications may have to shut down. The only solution, says Washington, is immediate and thorough collection of manila rope scrap normally used by steamship companies, barge, tug and ferry lines, marine stores handling boat supplies which get back old rope in exchange for new, railroad freight yards, fisheries, coal mines, quarries, electrical repair companies, stevedore clubs, etc. The Industrial Salvage Section of the Bureau of Industrial Conservation either in Washington or in the local areas should be notified when scrap is available.

SILVER, AS WE HAVE INDICATED, in the past months, has rapidly become an important substitute. However we never realized that such a precious metal as silver would be used for, odd as it seems, bus bar. Legal authorities have recently given Secretary of the Treasury Morgenthau authority to lend the idle stores of the white metal to the aluminum industry as a wartime substitute for copper. Under this program, large quantities of the 3,300,000,000 ounces of silver which the Treasury has piled up in compliance with the silver-purchase laws will be converted into such practical items as bus bars and other electrical conductors now made out of copper. Thus valuable copper will be saved for shells and alloys needed in war production. After the war, the silver on loan will be returned to the Treasury.

WARTIME DEMANDS HAVE RE-EMPHASIZED the importance of wired radio, and the use of power lines for such speech transmission. It has become an important phase of communication, where other forms of contact are impossible, due to terrain, emergencies or the necessity for privacy of communications. A system developed by engineers of Westinghouse is now widely used for this work. In this system, tubes affording automatic voice control, provide the transmitting and receiving functions. Speech into the transmitter causes the tubes to start the carrier current, and connect the transmitter and listener's receiver into the line. This switching is done within nine thousandths of a second after the first sound is uttered.

This automatic exchange is designed to select any one of ten stations along the power line and any one of ten extension dial phones at each station. By this method 100 telephones using the dial system are all connected to a single pair of wires over which the conversation can be carried without interruption or disturbance from the high voltage carried on the same wires. The power lines act as guiding channels to prevent the high frequency radio waves from escaping into space and interfering with regular radio broadcasts.

AVIATION RADIO HAS AN IMPORTANT 10th year anniversary to celebrate this year. For ten years ago, the first "blind" solo flight was made, thanks to radio. Captain Albert F. Hegenberger of the Air Corps at Dayton, Ohio, made this epochal flight. Until Captain Hegenberger's solo flight, no man had landed "blind" and alone, although the famed "Jimmy" Doolittle, now Brigadier General Doolittle, three years previous, had landed blind with a check pilot aboard to take over duplicate controls in case the distances were miscalculated. Captain Hegenberger was guided into the field by radio signals which marked the point at which he was to begin gliding. A super-sensitive altimeter indicated his altitude above the landing area. Another radio beam warned him when he neared the field boundary.

ALTHOUGH BRIGADIER GENERAL DOOLITTLE DIDN'T use radio on his first "blind" flight, he certainly used it to advantage in the recent bombing of Tokyo. The story is quite spine tingling, especially as revealed recently at the NAB convention by Colonel R. Ernest Dupuy of the War Department.

"The story of the bombing of Tokyo and other Japanese cities, not so long ago, includes a very neat bit of shoe-fitting, on the other foot," said Col. Dupuy.

"The bombers who performed that task winged their way in broad daylight into battle, riding on the radio beam of a Japanese station, which at that time was broadcasting a little rhapsody on the scenic beauties of Japan, nestling peacefully in the assurance that it could never be bombed. That's exactly what the Nip was saying in English. Suddenly he went off the air. The radio monitor in the bomber formation heard this cut, and then an excited voice talking in Japanese came on. The monitor, who, of course, understood Japanese, listened while the Jap announcer screamed. 'Enemy bombers coming! Coming Fast! Many bombers! They are flying low . . . they go too fast to be caught!'

"As the bomb sticks whirled down, this Nip announcer kept on the job. Screaming in high pitched panic, he called our shots in a play-by-play description, and shouted the casualty bulletins. Our bomber-monitor kept him on, as our ships winged their way to . . . where was it they were bound . . . Shangri-la? And from the Nip station they received the fullest information that anyone would want on their accomplishments. It was not until twenty-four hours later that the tone began to change . . . that casualties and damage were played down. But in the meanwhile, we knew. We had received from the enemy precious confirmation of our successes. Why? Because it was complete surprise, because there existed at that time in Japan no internal defense against psychological warfare . . . no linking of

national effort to combat panic.

"This brings me to that vital point of interest to American radio. Someday we are going to get a token air raid. Its object will be the production of fear, panic, and uncertainty in the minds of people. Are we going to play it like soldiers, or are we going to cackle and squawk on the air like a barnyard hen when a hawk flies over? There need be no advice, were I talking of the twenty-first raid; by that time you would know all the answers. But this is the first raid I am talking about. There is always a first step, and as the French say, it is only the first step that counts. Remember this is total war . . . and I urge you to play the game."

FREQUENCY MODULATION RELAY STATIONS are gaining wide acceptance. The latest f-m station to install studio transmitter equipment to relay programs to the main transmitter via f-m, instead of by wire, is W47A, Schenectady, New York. The main transmitter of this station is in the Helderberg Mountains, some twelve miles from the studio. The equipment used operates in the 330 to 342 mc band and consists of a General Electric 25 watt transmitter, a crystal control receiver and a temporary directive antennae at both ends of the circuit.

HOUSE TRAILERS HAVE BECOME RADIO TRAILERS. For they're in the Army now serving the Signal Corps as mobile radio laboratories. They carry a variety of equipment, service benches and test instruments. In addition they also serve as a base of communications to afford synchronized action of army units.

EVEN RADIOSONDES ARE BEING AFFECTED by shortages. Radiosondes are automatic transmission devices which are sent to the upper atmospheric regions reporting to ground receivers the temperature, humidity, altitude, etc., and as such certainly serve an important purpose. Yet it has been necessary to issue preference ratings that are comparatively low. Records show that production of a variety of parts required for this instrument and other similar recording units, is now, fortunately on the increase. Thus better ratings are in the offing.

SPECIAL COMMENDATION HAS BEEN MADE to two civilian radio mechanics, Max M. Hochstadt of Brooklyn, New York and John Basso of Asbury Park, New Jersey, who were assigned last winter to make a radio installation on a Puerto Rican mountaintop by the Signal Corps. The official citation made by the Chief Signal Officer said, "Working conditions at this site were very bad at the time. There was a hard driving rain most of the time and a walk of some three miles from the barracks to the peak. Work which had to be done outside was particularly trying in view of the high wind, rain and mud. Due to the importance of completing the job in the shortest time possible, you frequently worked twelve and thirteen hours per day without pay for overtime. Throughout it all, you were always cheerful and willing workers with high appreciation of the importance of your work. It is noted that you possess technical ability of high order and although without previous experience on this type of equipment, you were capable of quickly acquiring and applying the necessary information."

Hochstadt and Basso are now studying advanced radio technology at the Signal Corps Laboratories, Fort Monmouth, New Jersey, to which they were assigned upon the successful completion of their mission in Puerto Rico. Good luck to Hochstadt and Basso who have so ably shown what American radiomen can do!

"PRIORITIES INSTRUCTIONS" IS the title of a pamphlet recently issued by the War Production Board for the Army and Navy munitions board in Washington, that should be of inestimable aid to many engaged in Government activities. Invaluable data on preference ratings, priorities agencies and their functions, preparation of preference certificates, responsibility and authority of Army and Navy contracting, procurement and inspecting offices, channels of communications, help from the Army and Navy munitions board, etc., are included. If you are producing Army or Navy material, or engaged in any affiliated work, be sure you see this material. It's available from the WPB, upon special request.

MORE SHIP RADIO OPERATORS ARE NEEDED, and thus the Federal Communications Commission has relaxed the existing examining standards for operating speeds and technical knowledge. The new classification will be known as Temporary Limited Radiotelegraph Second-Class. Holders of this new license will be restricted to operation of radiotelegraph keys. The license will be valid for the duration and for six months after. The creation of this new classification will be of material aid in meeting an anticipated shortage of second and junior radio operators aboard ships. Another ruling issued by the Federal Communications Commission permits Latin-American students engaged in the study of flying in courses conducted by the Civil Aeronautics Administration, to operate radio communication equipment, essential to their complete training. Such students must meet all requirements for licensed radio operators, except that of United States citizenship, and hold a certificate issued by the FCC showing qualification. Permissible radio operation will be limited to equipment used or designated by the CAA and to periods when training of the students

is actually in progress and the operation is part of their training.

THE PRESIDENT'S RECEPTION room in the Union Terminal in Washington will soon have a new modern receiver, thanks to efforts of a large radio manufacturer. The receiver, the last of the civilian line of this manufacturer, was offered to Donald Nelson for the Army or Navy for use anywhere. The reception room in which it will be placed is being remodeled and refurnished to serve as a waiting room and lounge for the soldiers, sailors and marines who pass through Washington.

METROPOLITAN NEWSPAPERS are now running advertisements that may startle many service men. For if these advertisements are successful, and from many reports, it appears as if they will be, there'll be plenty of service women in radio soon. Many shops, upon finding themselves without service men, because they have either joined the army, navy or marines or the civilian divisions of these services, decided to try the feminine angle, and it seems to be working. Of course, there aren't too many women about who can be called qualified servicers, but a bit of training will help that. And since many of the training schools are crowded, some shops are setting up their own training courses and inviting trainees.

Interesting examples of the effectiveness of training of women are already evident in broadcast stations, who have been accepting women operators for quite a while. One product of this training, Ruth Lloyd, has been engaged by WGAR in Cleveland as an engineer-operator. While she studied radio engineering at Fenn College, she had no previous commercial operating experience, at all.

Well, it appears as if the war is certainly everything upside down!

APPROVAL PLACARDS ARE BEING granted by the War Production Board to builders of authorized projects, these to be displayed conspicuously on the premises during construction.

Printed in blue on a white background, the placard carries the initials WPB on which are superimposed the words . . . Authorized Construction—War Production Board. A serial number will also appear. Although applications for authorization to start construction are recommended by several agencies, final approval must come from the WPB.

These placards will be issued for each project and must be destroyed when the project is completed.

NEW METHODS FOR ADAPTING MOTION PICTURES to television transmission were explained and demonstrated at the 51st semi-annual convention of the Society of Motion Picture Engineers. The equipment was developed by a division of Paramount Pictures. Featured at this convention also was a talk by Harold Burris-Meyer of Stevens Institute of Technology, Hoboken, New Jersey, who described a new method of sound control. He told of a means by which reverberation can be controlled on recordings so that the acoustic properties of any other type of a building, such as a church, may be reproduced in a theatre. He said that it is done by recording and re-recording the sound at different levels of volume, fractions of seconds apart. By controlling the volume and time elements, virtually any type of acoustic condition can be reproduced.

Development of a new type of test instrument which eases the burden of the theatre sound engineer was told by Adolph Goodman of RCA service division, at the convention. It was pointed out that the instrument, described as an audio chanalyst, makes it possible to detect faults in sound systems by sending a signal through the system to the point of trouble in order to locate it. The method is similar to that used by instruments used in radio servicing.

DIATHERMY MACHINES GO UNDER FCC jurisdiction, as a result of a recent ruling. All diathermy machines will have to be registered, whether they are manufactured or made at home. For some time, illegal transmissions have been emanating from these type machines, and although it was possible to trace the signal, it was sometimes impossible to trace the owner. This new regulation will serve to fill that missing link and assure capture of delinquents.

Just why this step wasn't taken previously hasn't been explained, for the FCC have been conducting campaigns for years against this form of transmission. They have consistently pointed out that it is a mistaken notion that ultra high frequencies are open to transmission without license or regulation. Most vital safety services are assigned to this particular part of the radio spectrum. Included are police communication, utility communication, aircraft navigation aids and countless others.

The courts have held that a radio signal is interstate in character, and that the Communications Act applies to all radio emissions intended for reception. Accordingly any person operating a radio transmitter must be licensed by the Commission and certainly a diathermy machine is a fine little transmitter.

DID YOU KNOW THAT FROM APRIL 1, 1941 to April 1, 1942, the number of stations on the air grew from 837 to 897, and that with the number under construction, it will be 924? Only during two months of last year was the increase of stations at a standstill, and that was in August and September, when the count was 859. Although wartime restrictions have been invoked for many months, the steady increase of stations hasn't stopped as

yet, officialdom having declared that there were still many primary areas in this country to be served and thus in need of transmitters. The latest recommendation of the DCB curbing all construction may halt operations to a great extent, although at this late writing, no official ruling has been issued by the WPB on this subject. Present indications are that while many forms of construction will be curbed, construction in the vital service areas will be permitted.

USED SETS ARE HAVING A FIELD DAY. Department stores, furniture stores, music stores, small shops, large shops . . . they're all buying up used sets to bolster their inventory and also to pave the way for the rainy day, when there'll be no new sets and renovated receivers will become the fashion of the day. Many wide-awake merchants have put staffs of engineers and service men to work on their accumulated used receivers, and either stored them away for future use, or begun offering them to the public in small lots. Several dealers have placed advertisements in papers and on hand-bills, offering these "practically new" receivers at attractive prices, with exceptional results. One small chain conducted a one day-a-week "used-set" campaign for a month, and was so surprised at the results, that he has spread it to a week-end proposition.

The complete effect of the value of these used sets cannot be felt now, for there are still a sufficient supply of all types of receivers. However, the call for these receivers may become a healthy one late next fall, when the supply of new models will have disappeared.

Another important contribution the used sets are making, are the parts. Many shops are building inventories of replacement parts from dismantled used-receivers. Of course, there are many components that will be found during these "tearing-apart" sessions that will not be suitable. But there are quantities of basics that will have many uses.

IRON AND GLASS CAN NOW BE SEALED tightly, affording a new effective way of leading wires into tubes and thus eliminating the need for nickel and cobalt. The new process has been made possible by an invention of Dr. Albert W. Hull and Dr. Louis Navias of General Electric Laboratory. Since nickel and cobalt are critical war materials, this new development provides a release of these precious metals and a corresponding increase of tube production. In their invention, they have devised a series of glass compositions that can be used with iron and certain iron alloys, affording a rate of expansion of the glass very close to that of the iron.

The difficulty has always been that most kinds of glass expand with heat at a different rate from that of the metal. Glass and metal may be tight at one temperature, but when they are heated the glass will either crack or pull away from the metal, because the change in their dimensions is not the same. From the early days of the electric lamp, this problem of construction prevailed. Even with tubes in which the glass shell is replaced by one of metal, the lead-in wires pass through glass insulating bushings.

In the first electric lamps, platinum was used. This precious metal was used, since it has nearly the same rate of expansion as the glass then used. Various substitutes for platinum were devised, which were satisfactory for lamp seals, but they were not adaptable to the large seals used in huge vacuum tubes, for example. However, Dr. Hull and others developed the special nickel-iron-cobalt alloys for this latter application, which now are replaced by the material offered by the latest development of Dr. Hull and Dr. Navias.

TELEVISION PROGRAMS WILL CONTINUE to be aired and stations will be allowed to provide but four hours of service a week, instead of fifteen hours weekly which up to now had been the minimum for all stations. This new ruling, based on hearings held in April, was issued to prevent a recession of television activities to a purely experimental or laboratory stage. By allowing this new minimum, executives, engineers and directors will be able to continue to study the many ramifications of the art from actual "on-the-air" cases, rather than artificial "studio-test" programs. Of course, there is no denying that the studio type procedure affords helpful information, but field tests are always superior. In addition, the field tests always prompt an incentive for continued expansion of effort. The new ruling does not mean that stations cannot continue to operate fifteen hours a week if desired, but if they should decide to reduce operations during a period, they can do so.

Another benefit from this relaxation will be in the increased life of equipment that will naturally result from the diminished use of the transmitter. Unfortunately, this does not hold true in the case of many types of the tubes, for because of their filament construction, their life is actually decreased by shutting the power off and on repeatedly. As a result efforts will be made to concentrate this complete shut-down only in those portions of the equipment where tube life will not be affected.

The ruling is very flexible, allowing stations to use the four hour minimum in one day if required. In addition licensees serving the same geographical area are also free to arrange and alternate their program schedules so as to increase the number of programs available to the public. This is a step that may take place in New York or the West Coast where several television transmitters are on the air.

No decision has as yet been reached as to whether or not any new television transmitters will be permitted to go on the air, or whether or not construction of new stations will be permitted to continue or start. This is similarly true of the receiver picture. It is believed that where sufficient equipment is on hand to continue with all operations, authorization will be granted. The decisions will depend, to a great extent, on the requirements of Government services for either the equipment or personnel involved in these operations.

RECEIVER PRODUCTION IN CANADA has not as yet been completely curtailed, and it appears as if such production will not halt until the first of next year. A statement recently issued by Alan H. Williamson, Supplies Controller, shows that parts are still available in factories and being used to assemble receivers, but that as soon as this supply of parts is used up, no further parts will be available, and production will halt. Many of the factories are manufacturing a victory type of receiver, such as was planned here, and which, by the way, may be produced here next fall. The receiver is of the table type, having five tubes. While the parts used in the receiver are similar, as well as the circuit, chassis sizes and cabinet styles are varying, to afford appearance variations for sales impetus.

Production in Canada has, of course, been reduced considerably, although the percentage of reduction cannot be compared with that originally ordered here. For it must be remembered that the total production of receivers in Canada was always relatively small in comparison to that in the United States.

A majority of the parts used in Canadian receivers are made in Canada. They are, however, patterned along the American lines of design, and in many instances, are made by the Canadian affiliates of American companies.

ANOTHER CHAPTER IN BROADCASTING HISTORY was written several weeks ago when the Columbia Broadcasting System inaugurated its new 76 station Latin-American network. Three transmitters, two of 50 kw (WCBX and WCRC) and one of 10 kw (WCDA) serve as the key units for this newest chain.

Thirteen directional antenna systems are used. Four of these direct on a beam on the West coastal region of South America, three on the East coast region of South America, one on Mexico and Central America, one on Europe, and three are reversible between Europe on one side and Mexico and Central America on the other. These directional antennae consist of stacked horizontal broadside arrays with parasitically excited reflectors. In this array, the reflectors are used to obtain an additional gain, in this instance, of almost 3 db, in the desired direction of radiation. This result is equal to doubling the carrier power of the transmitter, with the additional advantage of reducing backward radiation. On the higher frequencies, this is important, for oftimes quality of reception is impaired due to echo effect.

A feature of the 50 kw transmitters is the unique design of the three r-f amplifiers. These may be connected easily and quickly to either of two sets of modulating equipment, and with any of the thirteen antenna systems. The third r-f assembly is normally pretuned, connected to a third antenna and held in readiness for instant service in connection with the instantaneous frequency change feature of this equipment. A motor-driven dolly arrangement operating on a worm drive beneath each power amplifier permits the operator to tune any of the three amplifiers to the proper frequency in any of six international bands automatically. The r-f generators, modulating units, and power amplifiers are completely interchangeable. Any of the power amplifiers can be connected with any of the thirteen antenna systems by the turn of a wheel. In view of the simplicity of this method and other operational methods, among which are the setting up of the r-f channel in advance, many advantages are apparent. For instance, by the simple turning of two switches on the control panel, a program may be switched instantly to another frequency and to another antenna, re-directing it to another part of the world. In many systems, "off-the-air" periods are necessary during this frequency shift period.

In the antenna switching system, the switches are mechanically interlocked in vertical sequence and electrically interlocked in a horizontal sequence.

Three direct circuits carry the programs from New York. However, in the event of a breakdown of these circuits, a fourth or emergency circuit using f-m relay transmitters located on a roof of a New York City skyscraper, can be placed into operation. This transmitter feeds signals to a unidirectional antenna, which in turn is beamed to a similar type receiving antenna on the transmitting area plot. This plot is on the outskirts of New York City.

In addition to short wave rebroadcasting, the new facilities will be capable of transmitting programs from New York to Mexico City, Buenos Aires, Rio de Janiero, Santiago, Bogota, Lima, Havana and other distant points. According to field strength test reports, these new transmitting stations increase the intensity of CBS signals to Latin America by at least 20 db. This is equivalent to a hundredfold increase in the power of the former facilities.

ONE OF THE MOST UNUSUAL EXHIBITS on wartime materials is now on display in the auditorium of one

of the new administration buildings in Washington, as an explanatory assist to students of warfare as well as prospective contractors and sub-contractors. If any doubt existed as to the tremendous proportions of an all-out effort, they will soon disappear after a visit to this exhibit. Hundreds of thousands of pieces are on display, pieces with arrays of patterns and materials that dazzle everyone. As you study these parts and the complicated uses to which they are put in warfare, you begin to wonder how it's all done. Probably no particular exhibit within this exhibit displays our all-out effort more effectively than that of the Signal Corps, with its rows and rows of equipment that are truly miracles of design and manufacture . . . a true tribute to American ingenuity.

Personal Notes

JOHN M. CLAYTON, advertising manager of General Radio, has been given a leave of absence for the duration to join the Naval Research Laboratory. . . . **R. A. BACHHUBER** and **JOSEPH F. ANDERSON** of Hygrade Sylvania (radio tube division) have joined the army. Mr. Bachhuber has reported for active duty in the Signal Corps with the rank of First Lieutenant, and Mr. Anderson is preparing himself to join the Air Corp. . . . **A. B. CHAMBERLAIN,** chief engineer of the Columbia Broadcasting System has been called for active naval duty in Washington as a Lieutenant Commander. He has held this commission since 1935. . . . **WILLIAM M. BAILEY** and **PAUL McKNIGHT DEELEY** have been elected vice presidents of Cornell-Dubilier. Both of these men have been actively associated with the company since its formation, Mr. Bailey as chief engineer in charge of the Industrial and Transmitter Capacitor divisions and Mr. Deeley in charge of the Chemical Laboratories, the Electrolytic Capacitor division and the Export division. . . . **BARNEY RAPP,** famous orchestra leader, is now working in one of the General Electric plants in Pennsylvania. He operates a huge planer, and received his training at one of the War schools inaugurated by General Electric, eighteen months ago. . . . **FRANK H. McINTOSH,** formerly technical supervisor of the Fort Industry Company at Toledo, which owns and operates several radio stations, has been appointed chief of the radio section of the Communications Branch, WPB. In addition to handling problems in the commercial radio field, the Communications Branch is now charged with the responsibility for problems arising in the domestic radio industry. This was formerly handled by the Consumers Durable Goods Branch of the War Production Board. . . . **DR. CHARLES B. JOLLIFFE,** assistant to the president of RCA and chief engineer of the RCA laboratories, was recently awarded the honorary degree LL.D. by the West Virginia University. Dr. Jolliffe was chief engineer of the Federal Radio Commission in 1930 and of the Federal Communications Commission in 1934. He joined RCA in 1935. . . . **HERBERT DUVAL,** General Electric radio engineer, who recently addressed the American Institute of Electrical Engineers on the subject of alternate materials and improved designs, pointed out that in spite of a reduction in quantity of such materials as steatite, copper, rubber, and particularly aluminum, design and production has not suffered. For instance, a 57% reduction in aluminum in a two-way device actually provided improved results, for in the elimination of trimmers and IF cans and the use of powdered iron core transformers, not only was the selectivity improved, but the tuning eased too. . . . **UNIVERSITY LABORATORIES** is now located in larger quarters at 225 Varick Street, in New York City. . . . **PRECISION APPARATUS COMPANY, INC.,** has moved from 647 Kent Avenue, Brooklyn, New York to 22-27 Horace Harding Boulevard, Elmhurst, Long Island. . . . **RADIO CITY PRODUCTS CO., INC.,** has moved to 127-133 West 26th Street, New York City.

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New Amplifier

(*Continued from page* 18)

of gain is sufficient we may use low values of plate load resistance and improve the high frequency response. A large value of coupling condensers provides good low response and the grid resistance of the following stage should not be much more than four times the plate load. A type 6C5 tube was used in this application, however, a 6J5 or a 6J7 triode connected may work equally well. *Do not use a pentode* ahead of the mixer for the reasons outlined previously.

The 6C5 was decoupled with 25,000 ohms and .1 mfd. to prevent "motor boating" which sometimes results from having a common plate supply to both input and output stages. The overall gain through the low and high pass filters and the 6C8G tube is less than two. This is also decoupled with 25,000 ohms and .1 mf., with a slight increase in stability and reduction of hum.

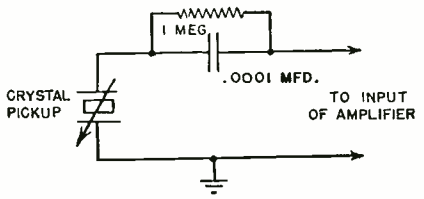

Fig. 4.

Due to the fact that the amplifier is operating at fairly low coupling impedance all the way through, no great problem of hum should be encountered. Although the hum problems are reduced considerably, it may be wise and is considered good practice to keep all leads as short as possible, particularly to the input grid.

Even though we have 9 tubes in the amplifier don't expect it to fill an auditorium with its output. It is not meant for that purpose in the first place. Remember, 2 tubes are rectifiers, 4 tubes are push-pull parallel output tubes only doing about half of what 2 6V6G's could do if we had a power supply with a transformer, 1 6C8G is the phase inverter and provides the drive for the 25A6G's, the other 6C8G stage has practically no gain and just serves as an equalizer to provide varying amplification at different frequencies and the 6C5 isolates the pickup from the mixer grids with just enough amplification to drive the 6C8G to maximum output.

The results you will obtain from the amplifier of course depend a great deal on the type of speaker and baffle you use with it. It is a good idea to use as large a baffle as practicable and if possible an infinite baffle should be used. The speaker itself should be 10" or 12" either P M or electro-dynamic. There is no provision for a field in the amplifier but this could of course be connected in series with the other choke in the power supply if the voltage drop across it was not too great. Other good articles on reproducers appear frequently in RADIO NEWS and should be consulted for further information along this line.

Due to the extreme flexibility of the equalization in this amplifier, most any balance can be attained between low and high range response. The low range is usually referred to as the "rhythm" range, and the "tonal" range consists of the middle frequencies, which contribute to the tone or pitch of a sound. The higher frequencies are those which go to make up the "timbre" of a given instrument, consisting for most part of the harmonics of that instrument, and is some times called the "sensual" range. It is within this sensual range, unfortunately, that the "scratch" frequencies lie.

This explains the fact that in order to reproduce the higher frequencies and attain the true "timbre" of an instrument we must contend with reproduction of some "scratch."

We hope that in constructing this amplifier you will find the results you have always desired, as far as frequency response is concerned. Remember that it has been designed to provide the best results possible with parts which may easily be obtained.

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QRD? de Gy
(*Continued from page* 19)

ops would and could swap billets for a trip or two. ROU please note.

BROTHER Norm Underwood, prexy of ye old WLO, Mobile, rushes this scoop to us from Brother Ken Maynard who was radiop on the torpedoed SS China Arrow. Quote Dear Underwood: I was very glad to hear from you again, and sorry that I couldn't answer your letter any sooner. Right after the torpedoing, and arrival at the Coast Guard Station in Delaware, I was so busy answering questions and getting ready to go home that I couldn't write or answer any letters.

If it won't bore you too much, I will try to relate what happened on the fateful day of February 5, and the two days that followed. At the time the torpedoes struck, I was busy in the shack typing up some logs. I threw the necessary switches, starting the emergency m.g., then connected the antenna and disconnected the auto alarm and started to work the key. I noticed that there was no indication of any radiation, so I stepped out on the boat deck to look at my antenna. It had been snapped. For some unknown reason, I had a premonition that something would happen on the return trip, so I had sent home all but four dollars of my money. I also had a carton of cigarettes, a carton of safety matches, my own personal identification and other things that would come in handy, including a crew list.

After finding that the antenna had been snapped, I took the articles of clothing and cigarettes and put them in number 2 boat before they lowered it, then went back to the shack. I then connected the output of the emergency transmitter to the emergency receiving antenna and tried sending. But still there was no indication of any radiation. I had previously turned on the main xmtr but couldn't get any radiation with it either. I grabbed two pair of pliers and a coil of emergency antenna wire out of the spare gear locker and ran up on the bridge where the skipper was wanting to help me. Neither of us knew how long the ship would last so we decided to connect the D.F. antenna to the deck insulator and try that first.

All this time the tweendeck was burning fiercely because the explosion had spread oil all around. The fire on deck raged from the mainmast to the after house. Most of the decking on the starboard side, aft of the mast, had been blown out. There was a piece of deck plate hanging in the shrouds on the port side.

Nothing happened in the second attempt to get a signal out either, so I left a book on the key figuring that if the power was getting to the antenna I would have no trouble finding that out if I held the wire. Back again to the bridge I went and cut the main antenna so that it could be hauled taut and connected to the deck insulator. There was no indication of radiation on any of the transmissions but there may have been enough to get out a short distance because the crew of the Army bomber which sank the sub that got us spoke over the radio, they said they had been sent out in response to a distress call. Maybe some ship nearby heard me, took a bearing on my sigs and sent in a CDE msg about it.

The forty-five minutes went very fast. I was working the rig and thinking of other systems for an antenna when the skipper yelled from the bridge that the sub was "coming to the surface. Let's get out of here." So I grabbed my flashlight, broke the glass over my license which I put in my wallet, and ran to the skipper's room and got his rifle. The skipper had a blanket, two or three overcoats, some shells for his rifle and a half pint of rum.

Out on the main deck the skipper cut loose a line from the foremast which he secured to a couple of belaying pins and then put the end over the side. He signaled for the closest lifeboat to come and get us. We were only about a thousand feet away from the ship when the sub opened up with

her deck guns. They fired twenty shells but only hit six times. I figured that the gun crew must have been green but the skipper must have been an old timer because the younger sub commanders are taught to have little regard for human life.

The first night in the boats wasn't bad. One man was continually moaning because of bad cramps in his legs which kept me awake most of the night. When I finally did sleep I too woke up with a cramp in my right leg. I stood up to try and fix it but when I tried to sit down again I found that someone had moved into my place. So I braced myself against the gunwale and went to sleep standing up. I figure that I managed four hours of sleep that night. The morning and first half of the second day we just stayed together and drifted. About two-thirty the sound of high speed marine engines were heard about twenty miles to the westward, we hoisted our sails and put out a set of oars and started towards the sound. At about nine that second night the wind reached gale force so all the boats were tied together (about 150 feet apart) and our boat took the lead towing the other two until about 1:30, when the line parted. We rowed back to the boats and made fast again but we didn't raise the sail again because the wind was too strong and the water too choppy. The weather was continually getting worse. The temperature was dropping, the wind was increasing in velocity and the sea was getting very choppy. Rain was falling in sheets when we began to drift the second night and I have no idea when it stopped because I had been asleep.

When I awoke the third morning, the wind had died down some and the rain had stopped but the sea had become worse with swells 15 to 20 feet deep. The temperature was fairly close to freezing. It was impossible to hoist a sail because we were afraid of capsizing. At about 11:30 that morning one of the famous PBY Navy flying boats flew over and the officer in each boat shot a parachute flare into the sky. When the men saw the plane they were almost hysterical with thanksgiving.

About seven that night the lookout in the second boat sighted a searchlight about three miles off. He awakened the men in his boat. Flares and hand signals were shot off again and again.

A few minutes later a searchlight shot out of the dark and picked us up. Every able man grabbed an oar and rowed towards the cutter. To me, there had been no more welcome sight than the cutter.

We were all brought aboard in spite of a heavy sea and needless to say that we all consider ourselves very

lucky to get out of such an experience alive and with such few injuries. On the cutter we were quickly brought into the galley for coffee and sandwiches and we drank up fifteen gallons of coffee.

In closing let me say that I was speaking to the skipper about making a rig similar to the one you made but he wasn't certain that the navy would approve of such an arrangement. It is a very good idea and I think it should be adopted by all the ship and radio companies. It should be made to fit in a watertight compartment or buoyant case. I imagine that such a xmtr will be installed aboard every ship when things get settled and working in a routine manner. Unquote. And others will say that nothing exciting happens in the life of a radiop. Ho hum. . . .

BROTHER Underwood's idea about that emergency aerial is that each ship op make up a loading coil for the short emergency receiving aerial so that it will draw current from the emergency xmtr. If no bakelite tubing is available, each operator may get a rolled oats box from the galley and if forty or fifty turns of wire are wound on the form, a loading coil will be made that will enable the emergency or main transmitters to feed an aerial of any length. Number 18 bell-wire is plenty large enough and even No. 24 is better than nothing. The form should be varnished before and after winding. Taps should be made every three or four turns for about half the winding, and the proper tap selected by experiment. Precaution should be taken to avoid RF burns. The loading coil should not be mounted permanently, of course, but should be kept in a handy place so that it can be utilized without delay. So sez Norm Underwood and all we can say is if we were on topside shipside we'd give heed to these words of wisdom.

SO "Remember Pearl Harbor" and keep plugging to plug up those Japs. And cheerio . . . 73 . . . ge . . .GY.

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Air Raid Problems

(*Continued from page* 15)

or dry, and as they are usually in exposed locations, this is no small matter. Another type of signal in wide use is the air horn, which comes in sizes small enough to use on a passenger automobile, up to great navigation types on ships, and still larger fog horns along the coast.

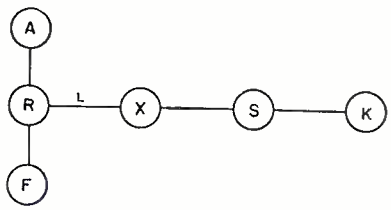

Fig. 1.

Air horns may be made to have tremendous power, and they are capable of giving a rapid succession of stentorian staccato blasts, for code signalling. One such gigantic horn can literally rattle the windows all around a large harbor. But they are big, and costly, and not readily portable or easily installed, and they are quite loud enough to deafen as well as frighten persons in the vicinity when they let go. There is now being developed a new type of air horn, which has many interesting possibilities. In tests at New Haven, Conn., and Boston, Mass., recently it has been considered effective for air raid warning. The general principle is the modulation of the compressed air output at the throat of the horn, by a valve electrically controlled to vibrate at any desired frequency in a given range. Thus by applying the current from a speech amplifier to the throat valve, any audible tone may be emitted. Spoken warnings, instructions, or a special audio oscillator tone may be amplified through this device, in volume sufficient to cover an entire town. Different tones may serve other purposes. Many other types of signals are made, but those mentioned will serve to suggest that some study of various types is warranted.

The principal objective of this article, a review of problems related to the remote control of raid warning signals, is not affected by the kind of signal to be controlled, except in respect to the distance between the control point and the units, or between units.

The first requirements, then, for a large community warning system are:

1. A distinctive sound producer for each area that one unit can cover.
2. Means of coding the several units in synchrony.
3. Effective prevention of false operation.

Additional considerations for continuous service are:

4. Dependable power supply.
5. Auxiliary control.
6. Maintenance.

Item (1) can best be selected by trial. Item (2) has several possibilities. It is obviously impossible to obtain synchronous operation of several units by individual manual control initiated by successive telephoned instructions. A multiple system of remote controls operated by a master key is required. The control circuit may be over special wires run for the purpose, or on existing fire signal or telephone lines. It may also be effected via radio impulses transmitted from the local power transmitter, or from a radio car with the two-way equipment, or from a special transmitter.

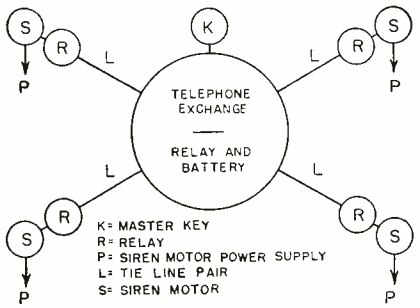

Fig. 2.

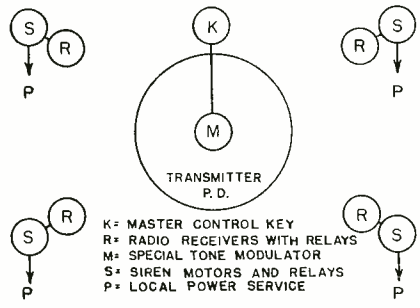

Fig. 3.

Among the engineers consulted, most agree that a direct wire system is preferable where practicable. All agree that the job can be done by radio, where land lines present greater difficulties. Some have the opinion that both systems should be installed, one to stand by for the other. It is probable that there are places for each system, wire and radio, and perhaps places where both should be used. In very large communities a combination of several systems will doubtless be needed. It is assumed in all cases that electric power is available at each signal center to drive the sound generating device, of whatever type. Special land wires need be run only where there are no telephone "tie lines" or fire signal wires available. In some cases short extension of existing lines may be advisable. In general, where special lines must be run, the cost factor may equal or surpass that of a radio control unit, in which case application of radio control to the entire system may well be considered. However, in most cities, lines exist which can function as the control net. Telephone lines may be rented, with relays, batteries, and their maintenance, from the telephone company in each area. This is probably the best solution for most air raid warning control systems.

Suggestions and diagrams for various workable remote control systems, follow:

Fig. 1 shows a suggested arrangement for operating sirens using the fire alarm network. Ordinarily the fire signal device (X) sends the alarm signal over lines (L) to relay (R) which closes circuit to fire signal-whistle (F). If a key (K) is connected across the signal device, and a reversing switch (S) is installed in the lines, the current through relay is reversed causing it to close the cir-

cuit to the air warning siren (A).

The relay may also be connected to sound both signals when an air warning is given. Another relay may be so connected that the closing of the key will electrically change the reversing switch to air warning operation, returning to fire signal operation when key is up.

This system would obviate the need for special lines to siren locations which coincided with placing of fire whistles.

Fig. 2 shows a warning system using telephone tie lines and batteries to operate relays at each siren location for closing local power circuits to siren motors. An additional line is required for the master control key unless it is located in the central telephone exchange.

Telephone company may furnish lines, relays, batteries, and maintenance on these. Power lines and local wiring are separate service. A power relay is usually required between telephone relay and motor circuit. Some siren motors use three phase motors and service.

Fig. 3 shows a remote controlled warning system using a central radio transmitter and local radio operated relays to close siren motor circuits. Master control key (K) operates audio modulator (M) to send special control tone of desired duration. Receivers (R) translate tone into current which operates sensitive relay, which closes circuit to power relay, which turns on sirens. Relays open when tone ceases.

Police radio transmitter may be used for this purpose without interfering with normal operation.

Tone used may be audible or inaudible. If audible, prowl cars will also get individual warnings. Receivers may be used to keep in touch with wardens in each area, as the tones of speech will not set off sirens.

In Figs. 4A and 4B the control key (K) closes and opens circuit of special tone generator (TG). Audio tone actuates announcer microphone (A) which modulates transmitter (X) (PA).

In Fig. 4 (C, D, E) the radio receiver (RR) receives signals, demodulates control tone, amplified through power stage (PA). Usually part of standard police type receiver. Special tone *only* is let through frequency filter (FF) and time filter (TF) to trigger tube (VR). The plate circuit of (VR) operates power relay (PR) which closes circuit of siren motor.

Units B and C are part of every municipal radio set-up. Unit E is a standard siren installation. Units A and D must be specially made for this purpose.

Type of transmission uncritical, although FM will be less subject to false operation by interference.

Power of transmission need be no greater than that used for normal communication, but signal-noise ratio should be favorable to control tone.

Most important factor is the time filter, which rejects any impulse not sustained. Thus transient modulations by voice or interference are eliminated.

For additional protection, two or more tones may be used with a frequency filter for each tone. The degree

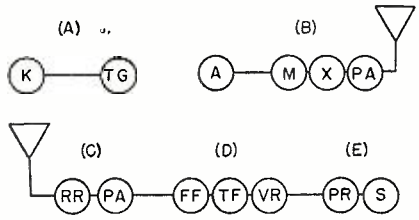

Fig. 4.

and characteristics of local interference will determine the extent and nature of preventive features required to assure that false operation will not occur.

The values for the circuit in Fig. 5 will vary with the type of receiver used, the control frequency, type of transmission, size and type of siren, etc., and can be worked out by any competent radio engineer. There is nothing essentially new here, but effective operation may be a matter of trial and error.

It is a simple matter to effect operation by the tone, but care and ingenuity must be used to assure that operation will not occur by voice or interference when an alarm is undesired.

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Mfrs. Literature

(*Continued from page* 19)

keep his rig in perfect condition for emergency use), are assured of continued fast service consistent with present conditions.

Of outstanding interest is the radio set section covering forty-two *Knight* 1942 models, setting new high standards in design and improved features. Included are plastic and wood models, consoles, FM combinations, auto sets, farm radios, phono-players and radios, recorders, and a complete section of recording and phono accessories.

A varied line of P.A. sound systems and intercommunication units for all requirements is illustrated.

This new 1942 Spring and Summer catalog may be had free of charge from *Allied Radio Corporation,* 833 West Jackson Boulevard, Chicago, Illinois.

Precision Tube Bulletin

Precision Tube Company of Philadelphia has just released its newest Bulletin No. 201, which gives complete mechanical and electrical specifications of Packard Electric Wire to specification AN-J-C-48 and specification 95-27074.

Included in this bulletin are capacities and power factors of Metal Shielded Wire at various frequencies.

Sent free upon request. —30—

Electronic Control

(*Continued from page* 35)

house the step-down transformer, lens and lamp in one box and the lamp socket or lens may be adjusted for focusing. The lamp is set at the focal point of the lens if the beam is to be a parallel pattern and back of the focal point if the converging beam is to be focused on the light sensitive cell—but not back farther than twice the focal distance. The beam of light which the unit throws is adjusted until it more than covers the light sensitive cell. In this way, if the position of the light source is moved slightly, or of the cell, the alarm or system controlled by the photoelectric system will not be put in operation falsely.

The average commercial photoelectric installation requires that approximately 5 foot-candles of illumination be the light intensity upon the photo cell. The light intensity will vary inversely as the square of the distance for ordinary lamps. An ordinary lamp will generally be unsuitable for producing powerful beams, since its filament is too large in area.

A practical operation of a beam of light would be the case of a beam being interrupted by a small car on a railroad track in a coal mine, the beam being situated a little distance from the opening or entrance to the mine door. By the time the relay system operates, the car is up to the door and the door swings open.

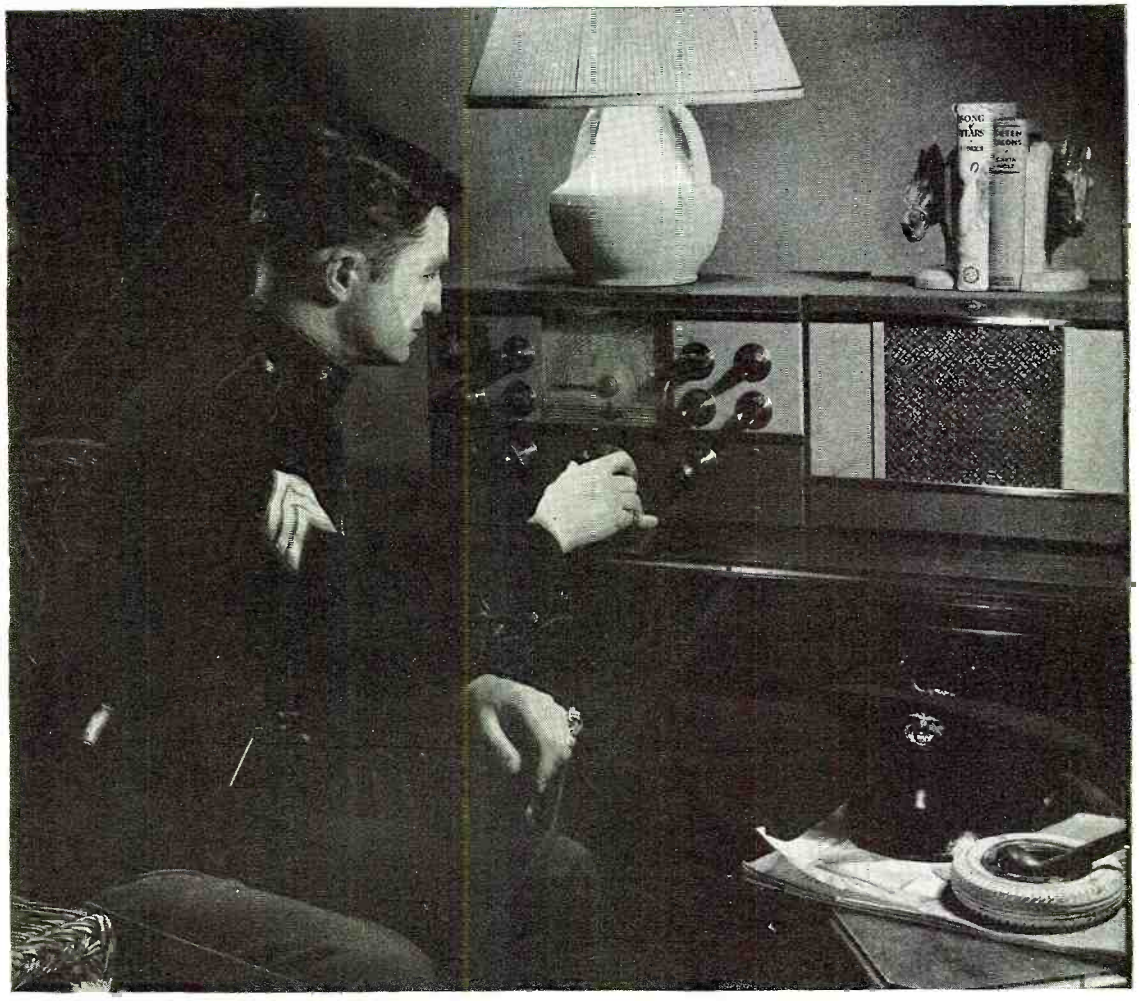
Where a considerable distance separates the light source and the photo cell, a special pickup lens is used, just as in the case of a telescope or camera. Reflection from a mirror can also be used, but losses of about 45 per cent occur.

The amplifier stages and relay following the detector (photocell) are generally placed in a single rugged housing. The power pack may also be included in the same box. Heavy relays are generally placed near the device or machine being controlled. High sensitivity photovoltaic cells feed into supersensitive relays which in turn control heavy relays.

The greatest use of photoelectric equipment is generally in connection with other electrical apparatus; a motor may be used to raise a platform, an electromagnetic valve may be opened and control the flow of water or oil, a pneumatic pressure may be built up for the purpose of operating a drill, the pressure being controlled by a valve operated by electricity.

A novel unilateral counter is shown in Fig. 1. It numbers the autos going in one direction on a two way road.

With cells connected as shown, cell illumination corresponds to lower cell resistance and the amplifier tube grid becomes more negative, lowering the plate current to the tube. When beam is interrupted, the bias on the tube decreases as the result of increased cell resistance and the plate



current increases, this change in current being used to operate a relay which in turn controls a counter.

Only objects in an upward moving path will be counted, for when light is on both cells the plate currents of the two tubes are at minimum value and all three relays are in drop out position, as shown, and an object moving upward first interrupts the beam on Pb, causing relay Rb to pull up. The contacts of Ra and Rb are now closed, but Rc cannot pull up for the reason plate current in VTa is still at a minimum value and is not sufficient to operate both Ra and Rc which are now in parallel with each other. The object moves farther up, to a position where it interrupts both beams and then the plate current of VTa increases. However, the coil of Rc has so much lower a resistance than the coil of Ra that only Rc pulls up. In other words, relay Ra cannot get sufficient current for its operation when Rc is in parallel with it. The pulling up of Rc closes the contacts with which the electromagnetic counter is controlled and a single count is registered.

As the object moves on, the beam of Pb is restored first, causing Rb and Rc to drop out. With Rc no longer taking current away from Ra, the latter relay pulls up and no further action occurs. When the object passes the last beam, restoring light to Pa, Ra drops out, closes its contacts, and the system is ready for another cycle of operation.

The reason no count is made for a downward direction is given by the following explanation. The beam of Pa is interrupted first and Ra pulls up. Nothing happens further until the object moves into the lower beam, cutting off light to Pb and relay Rb now closes. But, since the contacts of Ra are open, Rc is not energized and there is no count. When light is restored to Pa, the contacts of Ra close and Rc cannot pull up now because VTa has a minimum plate current and the electromagnetic counter does not operate. When light finally is restored to Pb, the contacts of Rb open and the system returns to its original condition. Objects shorter than the separation between the two beams are not counted since both beams must be interrupted at the same moment and in correct sequence. Equipment of this kind is generally built to special order, serving a specialized need.

High speed photoelectric circuits have also been devised for counting cigarettes, small screws and other objects passing in rapid order. Light beam arrangements have been successfully used for production of spark plugs and other fairly close tolerance work, for smoke detector apparatus in cities having ordinances against poorly adjusted furnaces and chimneys. Photoelectric devices measure the amount of foreign matter in a liquid due to the ability of a material to transmit light and also forms the basis for certain forms of egg candling units.

But one of the most interesting of photoelectric applications is the control of products whose final merit is determined by the color of the light that the material reflects or emits. The heating and tempering of steel, the selection of various grades of paper, the roasting of coffee; and, yes, even the baking of cake or bread are all processes rendered more complete and more exact because of electronic control. A simplified drawing of one form of color analyzer is shown in Fig. 2. A means for selection of certain objects is shown in Fig. 3. The use of a lens to produce a nearly parallel beam of light is shown in Fig. 4. The use of a parabolic mirror for the same purpose of parallel light beam production, is shown in Fig. 5.

In Fig. 6, a system of transmission for a distance of 30 ft. is shown. For transmission of light over a long route, the converging or focusing of the light at the distant point results in better efficiency. If we wish to know the proper value of P, we take into account the fact that the element distance P divided by the image distance Q will be equal to the element height of 1/16th inch, divided by the image height of 2 inches. Then, P/30 equals (1/16)/2". P is then equal to about .94 foot. Note that distances are given in feet and height in inches, which is all right so long as distances are in the same units and heights are in the same units. Knowing that P is .94 ft. and Q is 30 ft., the focal length of the lens is determined from the formula:

$$\frac{1}{P}+\frac{1}{Q}=\frac{1}{f}$$

Substituting known values,

$$1/.94+1/30=1/f$$

This gives for f a focal length of about .91 ft. or 11 inches and a lens of this size would be chosen for the job. Any diameter lens could be used, just so long as the focal length is 11 inches. However, the larger the lens, the more light it will intercept and concentrate into the transmitted conical beam. Under ordinary conditions, a shade or blinker arrangement is used on the photocell to keep out unwanted light. Incidentally, the image height in this example is equal to the diameter of the beam at the light sensitive cell.

Practically all large radio distributors handle photocell apparatus and they may be contacted for commercial information relative to installation and other problems which may arise in connection with a given electronic control job.

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SEE PAGE 5

For the Record
(*Continued from page 4*)

Fort Monmouth and all of whom in the past have written many articles for RADIO NEWS.

The Signal Corps School

We arrived at *Fort Monmouth* during a downpour and were met by Lt. H. E. Timmerman. Later we had a nice long chat with Col. W. O. Reeder at Russel Hall. The Colonel conducted us through the grounds with its huge group of building and showed us the progress which has been and which is being made to expand this vital radio institution. Even though this, a Saturday, was a holiday to many, there was nothing to indicate any lack in regular activities of these serious minded students.

After lunch we proceeded to the Enlisted Men's Department, where we were received by Lt. Col. M. G. Wallington, in charge of this branch. Col. Wallington conducted us through the various classrooms and we saw the students engaged in the study of all phases of radio communications. We can remember no case where any loafing was apparent. There was no mumbling or unnecessary conversation. As a matter of fact, these boys give the same strict attention to a soldered connection as they do to an elaborate transmitter. In the code room, we had a most enlightening chat with a real old time radio man, Lt. Reuben Abramowitz, Chief Code Instructor. This interesting personality boasts 15 years of service, devoted to the training of radio ops. Thousands of men have learned their code under his instruction. Code students at the Signal Corps School lose no time is becoming proficient, not only with key and bug but with the typewriter.

Following the visit to the Code rooms, we proceeded through each and every classroom where various subjects are skillfully taught. All in all, we enjoyed this visit immensely and are looking forward to another in the very near future.

The Radio University of the Army Air Forces

Our most recent trip, just completed, took us to the Radio School at *Scott Field,* Ill. We were the guests of Maj. J. R. Johnston and spent a most profitable day in his company. We had our first ride in an Army "jeep." These iron clad buggies certainly get around! First of all, we attended the annual track meet held every year and witnessed some outstanding running by ex-college allstars now learning radio for Uncle Sam. These boys certainly take their sports seriously and a keen rivalry exists between the various companies.

This day was dedicated to the celebration of the 25th Anniversary of *Scott Field.* We were conducted to headquarters and had the honor of meeting Col. Wolcott P. Hayes, Commandant of *Scott Field* who has directed the development of the field since July 1940, when radio became number one on the activity list. The colonel, a most likable officer, prefers riding in a "jeep" to the comparative luxury of a comfortable sedan. After interviewing Col. Hayes, we can appreciate why *Scott Field* has become so successful under the leadership of his dynamic personality.

Later we were joined by Col. Meyer and we were conducted on a tour through the classrooms. The student at *Scott Field* does not lack any equipment necessary to give him complete training in the art of radio theory, transmission, reception and maintenance. The business-like atmosphere is reflected by the students themselves. They are a healthy looking bunch and smiles are conspicuous.

We had our noonday meal in one of the finest of all mess halls. In this one building alone, which seats about 6,000, food fit for a king is served. We were impressed with the cleanliness and well planned layout, not to mention the impression left after eating two large halves of fried chicken, candied sweets, salad, olives, corn niblets, a handful of cookies, ice cream and

Maj. J. R. Johnston

finally, a piece of the 25th Anniversary Birthday Cake. In fact, the cake looked so good, that we sat in suspense while many pictures were being taken of Col. Meyer and Maj. Johnston engaging in the "knifing activity."

Finally, we attended Guard Mount,

Col. W. T. Meyer, one of our hosts.

which was witnessed by several thousand visitors.

We reluctantly said "73" to the officers who had made our visit so enjoyable.

Read the interesting story on *Scott Field,* "The Radio University of the Air," beginning on page 6 of this issue.

Transportation

We hear a great deal about this subject every day. It just occurred to us that during the two trips just concluded that we included rides on the following: civilian passenger cars, airport bus, airliners, taxicabs, school bus, reconnaissance car, subways, elevated, street cars, ——— aircraft, "jeep," military trucks and train.

It's a small world!

An Open Letter

A major problem that confronts the various radio schools is of such vital importance that it deserves a careful study by Maj. Gen. Lewis B. Hershey,

Cutting the anniversary cake.

Director of Selective Service, and the various individual draft boards.

Many young civilian radio instructors are now employed at the various military radio schools. These jobs are essential to the proper teaching of various radio subjects and most of these men have spent many years in civilian life as professional radio men and are well qualified for this work. Many of these men suddenly find themselves reclassified and put into 1A. When they are called for induction into the military service, it is necessary for them to give up these jobs and to go to whatever place is designated by the draft board. In many cases, these men must serve for duties for which they are less qualified than that done during their former employment. These men should have the opportunity to remain at their posts where they can serve to greater advantage.

We can sympathize with the various organizations as to the huge amount of clerical work and responsibility needed for determining the status of the various personnel, but on the other hand, we feel that a concentrated effort should be made in instructing the draft boards to examine the background of these men, to analyze the importance of their work and to take necessary steps so that they may continue as radio instructors, the only difference being the change from civilian to military.

Our radio schools certainly need as many qualified radio instructors as are available in order to teach the thou-

The Editors of RN at Scott Field.

sands of students now engaged in the study of radio communications. The success of this move depends largely upon the individual. It is necessary that these civilians notify their draft boards well in advance, stating the exact type and the importance of the work that they are doing and including the full title and name of the commanding officer at the post in order that any statements made by the individual can be verified and so that the officer in charge can make his recommendation. This certainly will help the draft boards in deciding upon the status of the civilian radio instructors.

Congratulations

The *Signal Corps* has awarded another capable soldier and administrator with a well earned promotion. We refer to Lt. Col. C. J. McIntyre, who was formerly a Major. Lt. Col. McIntyre is the author of many interesting articles, the latest of which

appeared in the January 1942 issue of RADIO NEWS.

Thought for the Month

Up until several months ago, the employment of the fairer sex as radio "servicewomen" was just thought of as a final alternative if and when local servicemen left for service in the Military.

Now, women are finding their places in this field; in fact, it is not uncommon to receive mail now signed by Miss Mary Doe, instead of Richard Doe, radio serviceman.

We feel that the employment of women for radio work should be definitely encouraged. How about it, you girls? Let's hear from those of you now engaged in the servicing of Mr. John Q. Public's receiver.

By this same time next month, we will have visited other military schools where radio is being taught and we'll have more to tell you at that time.

73, O. Read.

—30—

Serviceman's Rulings

(*Continued from page 27*)

on prices for services and materials, based on the maximum prices or their equivalent charged in March, 1942. The ruling provides for the filing of a complete statement with the nearest OPA War Price and Rationing Board, showing the maximum prices. The dead-line for this filing is July 1st. In addition a complete statement must be kept in the store for examination by any person, showing his "base-period" prices for every item carried for sale in his store during March. Although it may appear as if the service man is not in the dealer category, he really is, for with most repairs made a part is sold, unless of course, the repair work involves only inspection and repairs without actual replacements. In the first instance, if the services rendered involve neither material used nor work executed in March, then the charges will have to be based on work of the closest similar nature, performed in March, with the March list prices of the replaced items, as the guide for the prices of the parts replaced. If the work is entirely different from ever before, a charge based on the customary labor charge of time involved for an operation or operations completed in March should be used as a basis. And the material used should have the March list price, as a guide. If only inspection work and repairs without the use of any new parts are involved, similar March operations should be used as a charge guide. No ruling has as yet been affected on minimum service charges to be made, where such charges were not in effect in March. It is assumed that the customary charges made either by others in the neighborhood will be allowed, or a level believed equitable for the area will be allowed.

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COMING NEXT MONTH!

MAINTENANCE IN THE SIGNAL CORPS

Civilian Radio Army

(*Continued from page* 13)

progress throughout the Corps Area for all Signal Corps employees.

4. Approximately 50 In-Service training groups organized throughout the Corps Area.

Signal Corps, Fourth Corps Area, Atlanta, Georgia:

1. Training being given in many fields; Pre-Service courses for Mechanic Learners (Radio) and Junior Repairman Trainees (Radio) being emphasized.

2. Radio theory, code transmission and typing being given on both In-Service and Pre-Service basis.

3. After code trainees can handle up to 25 words per minute, they are eligible to enter the High Speed Course.

4. On-the-job and after-hours training available to all employees and many volunteering for such training.

Signal Corps, Fifth Corps Area, Columbus, Ohio:

1. Pre-Service courses for elementary radio repair being conducted in vocational schools.

2. Additional trainees to be employed and courses to be opened in several localities.

Signal Corps, Sixth Corps Area, Chicago, Illinois:

1. Pre-Service training program geared to turn out several hundred trainees a month after July 1st.

2. Greater number of trainees recruited from amateur operators.

3. Training quotas and school facilities being increased.

4. In-Service training program being formalized and improved.

Signal Corps, Seventh Corps Area, Omaha, Nebraska:

1. Approximately 200 employees per month being recruited and In-Service training being given all employees.

2. Courses for Trainee-Repairman being given on Pre-Service basis.

3. Special introductory course being given preparatory to air-raid warning service.

Signal Corps, Eighth Corps Area, Ft. Sam Houston, Texas:

1. In-Service training being given in posts and stations throughout the Corps Area.

2. Training for greater efficiency of radio technicians based upon job analysis.

3. Pre-Service training to be increased in general radio repair and aircraft radio.

Signal Corps, Ninth Corps Area, San Francisco, Calif.:

1. Junior Repairman Trainees (Radio) enrolled in eight California Trade Schools and Junior Colleges.

2. Quota for trainees being greatly increased and additional courses and schools to be established.

3. Opportunities for Pre-Service trainees to advance to technical positions or to more specialized training.

Signal Corps Laboratories, Fort Monmouth, New Jersey:

1. Training several hundred civilians in a number of highly technical phases of communications work.

2. Specialized courses in radio interference suppression in progress.

3. The training program includes a practical training program for civilian instrument makers.

4. Plans exist for the immediate enrollment of approximately 1,000 additional trainees.

Aircraft Radio Laboratory, Wright Field, Ohio:

1. A large scale training program for civilian workers in the development, design, and inspection of aircraft radio.

2. Several hundred trainees recruited through U. S. Civil Service procedure being trained as Jr. Engineering Aides.

3. University of Cincinnati, the Case School, Fenn College, and Toledo University cooperating in Signal Corps training.

4. Courses stripped of frills and covering engineering fundamentals, mathematics, aircraft radio theory and practice.

5. Number of civilan employees and trainees to be greatly increased.

Signal Depot, Lexington, Kentucky:

1. Full-time training being given to several thousand employees in 15 vocational schools throughout the area.

2. The number of trainees to be more than doubled and scores of new schools to be established.

3. Trainees enter training as Mechanic Learners (Radio) at a salary of $1020.00 per year; may be promoted in three months to Jr. Repairman Trainees (Radio), at $1440.00 per year.

4. Trainees completing successfully Jr. Repairman Trainee courses will be promoted to technical positions in the Depot or to more advanced training.

5. In-Service training courses available for employees after being assigned to duty.

Signal Depot, Philadelphia, Pa.:

1. Pre-Service training courses in operation in 13 colleges and vocational schools.

2. Approximately 2,000 trainees now in Pre-Service courses for Mechanic Learners, Repairman Trainees and Junior Engineering Aides.

3. Trainee allotments being expanded, and additional courses to be established.

4. Comprehensive In-Service training program now effective. More than 1,500 employees engaged in evening courses in 50 different subjects.

Signal Depot, Sacramento, California:

1. Organized In-Service training program.

2. Pre-Service training course at Grant-Union High School. More than 200 trainees already have completed this course.

3. The City of Sacramento is cooperating by making additional school facilities available.

4. Additional trainees to be recruited and entered in courses.

Other Signal Corps Field Establishments Conducting Similar Civilian Training Programs:

San Antonio Air Depot, San Antonio, Texas.

Ogden General Depot, Ogden, Utah.

Middletown Air Depot, Middletown, Ohio.

Chicago General Depot, Chicago, Ill.

Chicago Procurement District, Chicago, Ill.

Additional Signal Corps installations at various locations.

The extremely important part that radio communication is playing in the war, and evidence that activities in the radio communications field will greatly increase, indicate the great need for radio technicians in scores of varied capacities. No one questions the tremendous importance of Signal communications to our armed forces. Civilians can make no greater contribution to the war effort than to become a part of this great organization which acts as the eyes and ears of the Army.

—30—

Aviation Radio
(*Continued from page* 23)

proper tools to efficiently trouble shoot an electrical installation. Those instruments and tools found in the aircraft radio technician's possession are quite adequate. Special tools for bending conduit; connector wrenches, etc., should be available if much wiring of electrical installations is done.

Design Considerations

All equipment including radio, intended for aircraft; the aviation ground station; and other aviation facilities, must be designed with certain specific service requirements in mind. Because finished design has much to do with correct installation and maintenance, we will discuss a few of the most important of the many design considerations with which the aviation radio technician should be familiar.

Perhaps these questions are in mind: Do all aviation ground radio stations utilize the same types and quantities of radio equipment? If not, what governs design? How about the same type of aircraft utilizing the same types of equipment? Do one or more manufacturers of aviation radio equipment manufacture exactly the same types of equipment under some circumstances? Why is it necessary that equipment which is to be installed in an aircraft used in scheduled air transportation service bears the CAA Certificate of Approval? How is this Certificate obtained? Is it necessary for equipment used in private aircraft? Is it required by the Army and Navy?

We will answer these questions in order.

All aviation ground radio stations *do not* utilize the same types and quantities of radio communications equipment. Most equipment found in the Airlines ground radio stations, however, is somewhat "standardized." That is, in each station operated by the Airlines, one will find the same type of receiver, transmitter, etc., which bears the manufacturing stamp of one particular manufacturer. Most equipment found in Airlines stations has been manufactured according to specifications promulgated by Airlines Communications Engineers. In those stations at licensed airports owned by a private corporation one will find many types and quantities of radio equipment. The equipment utilized in most ground stations is designed to take care of communications requirements of a particular zone or area, very little thought being paid to general service requirements.

Aircraft of a particular make and type may, if manufactured on large scale contracts, utilize radio equipment of one manufacturer. Again referring to the Airlines: most aircraft used by one company will contain one type of equipment; if the aircraft is of the same make and type. It must be realized that equipment of particular design will not always find space in many different types of aircraft. If one were to examine the interior of ten of the many private aircraft found at airports throughout the nation today, one would find that out of the ten examined, only three would contain the same type and make of equipment.

One or more manufacturers may be on contract to the Airlines or our Air Forces to supply them with equipment of a particular design. Where one manufacturer may not possess the facilities to turn out the required number within a given time, sub-contracts may be allocated to take care of mass production difficulties, this usually being the case. On the other hand, one manufacturer cooperating with another may produce equipment for a particular service requirement. Because each is unable to produce certain component parts for the equipment, a third manufacturer may step in, and with his facilities aid the other two. Today, there are very few manufacturers who produce all equipment necessary for complete unit manufacture. There are usually a few component parts which cannot be produced economically and must be procured on contract.

The way equipment is produced and utilized by aviation radio manufacturers has a decided bearing on installation and maintenance problems of the aviation radio technician; and it would be well to obtain as much information as possible about modern production methods.

The CAA is primarily concerned with the SAFETY of aircraft in the air. In order to increase the safety factor, equipment that is both reliable and efficient must be employed in aircraft used in scheduled air transportation.

Radio equipment in many cases is both "eyes and ears" for the pilot of a modern day aircraft. "Equipment failure just cannot happen." But with all the precautions taken, equipment does fail. The CAA Certificate of Approval does not guarantee that the equipment it covers will not fail, but it does guarantee that every precautionary measure has been taken to insure highest dependability and reliability of performance.

The CAA Certificate of Approval is obtained by a manufacturer by first subjecting his equipment to certain tests prescribed by the Authority, utilizing his own test equipment. Manufacturers delight in the knowledge

that they are manufacturing equipment which has the Certificate of Approval; they realize that they now have a voucher attesting to fine construction and design.

Equipment manufactured for the Army and Naval Air Forces is usually designed in their own laboratories. Each has certain set standards of construction and design. The tests which must be passed by equipment which is to be used in Government aircraft parallel those of the CAA and in some ways are more rigorous. Army and Navy equipment does not require CAA approval.

Of interest at this time are the seven prescribed tests given all radio equipment intended for use in scheduled aircraft.

Prior to the actual testing of equipment in the manufacturer's laboratories, a very rigid visual examination is given all equipment to ascertain the quality and type of materials used in construction of the model; and whether or not highest engineering standards have been followed in mechanical layout and construction. If the equipment passes the preliminary requirements, it is then subjected to the following tests: (briefed) 1. Spray test; 2. Drop test; 3. Vibration test; 4. Variable power input and temperature test; 5. Pressure test; 6. Humidity test; 7. Orientation test.

The spray test will show up any or all defects caused by faulty insulation, improper connections, and parts whose operation would be drastically influenced by water or excessive moisture. The drop test will give indication of either poor or good mechanical construction; and the equipment's ability to withstand severe shocks of sudden occurrence. Vibration tests show up parts subject to vibration which in turn would cause mal-functioning of the apparatus. The variable power input and temperature test will make known the equipment's capabilities of withstanding greater power input (usually 20%) than it was designed for at various operating temperatures.

A pressure test will indicate the equipment's ability to operate in high altitudes where the air is relatively thin. Insulation losses, improper parts spacing, poor component part design, etc., will readily show up under this test. The humidity test of course indicates the equipment's ability to withstand radical changes in humidity which may cause corrosion, the enemy of good electrical conductivity. The orientation test determines the set's ability to operate in any position. After these tests are consummated, corrective measures may be taken if needed; the set installed in an aircraft and actually flight tested. It is to be remembered that the equipment is operated while undergoing the tests just mentioned, if possible.

The aircraft having only a receiver installation is much safer in the air than one without; and the aircraft having a two-way radio, viz., transmit-

ter and receiver, is much safer than both. It still stands, however, that the receiver is the instrument around which the many radio aids to air navigation are primarily designed.

The radio receiver designed for operation in aircraft must be as small as is consistent with good circuit design and mechanical construction. Weight is a most important factor to be considered when designing radio equipment for aircraft. When the design for an aircraft is commenced, much consideration is given to the amount of space which can be made available for the installation of radio equipment; the capabilities of the central power system in supplying adequate power to operate the equipment; and how heavy the equipment can and must be. Consideration is also given to the methods to be used in wiring the aircraft and provisions are usually made for supplying the equipment with power from the nearest power source.

The lightest and strongest metals obtainable are utilized for chassis construction. Supporting braces, mounting brackets, etc., should all be constructed of material having high tensile strength and lightness.

Individual parts specifications must be followed by the designing engineer when designing either a transmitter or receiver intended for aircraft or the ground radio station.

Cardboard containers for electrolytic condensers, wood for mechanical bracing, unmarked resistors, uncoated coils, etc., are all prohibited in aircraft receiver and transmitter construction. Those parts having low electrical operating tolerances and no major overload characteristics are also prohibited. Plugs of the screw-in or lock-in types cannot be used unless provision is made for mechanical and electrical stability. Insulation material should be as nonporous as possible and should be capable of standing extreme temperature changes without cracking. Isolantite is one example of a material which is used extensively in aircraft radio construction. This material possesses those qualities essential to good insulation.

Those parts susceptible to vibration must be mounted to minimize shock, especially those components inherently affected by vibration such as tubes, variable condensers, trimmers, coils, etc. Rubber, not of the sponge variety, cannot be used as damp mounting material, nor can springs which are readily affected by abrupt temperature changes be used for "swing mounting."

Parts interconnection must be made by using flexible material when vibration would have undesirable effects if transmitted between components. Rigid connection between members is allowed if vibration will not weaken the connection or affect parts thus connected.

Resistors, condensers (fixed), etc., cannot be floated if connecting leads are incapable of carrying the part under extreme vibration. Standoff insulators must be mounted on material which will absorb shock. All bolts and machine screws must be provided with lockwashers or pins in order to prevent loosening of connections. Safety catches on all equipment must be safetied with soft wire which will not readily break if catches accidentally open. Self-tapping screws must not be used in material which will tend to lose its holding qualities under conditions of extreme vibration, nor should they be used on panels that must be removed frequently.

Removable components such as tubes, vibrators, plug-in type condensers, crystals, coils, fuses, etc., must be readily accessible; this being accomplished by either providing removable panel coverings or hinged doors. Tube sockets should be provided with tube locks and should be floated if possible, to minimize the effects of vibration. Tube shields, unless an integral part of tube locks, should be grounded with flexible braid. Fuse receptacles should be fool-proof, readily accessible, and consistent with cost, a spare receptacle should be provided for a spare fuse.

All tuning mechanisms should be provided with tuning locks (on transmitters) and all direct and indirect reading dials should be treated so as to prevent glare. Characters (letters and figures) on tuning dials proper should be clear, sharply defined, and if possible, should be "raised" or metal stamped. If the set must be operated under poor lighting conditions or at night, suitable dial lights must be provided.

For frequency stability, all variable condensers must possess a minimum amount of "end-play." The material used in the construction of those condensers having major tuning roles should be a material not easily affected by temperature changes which would produce expansion and contraction resulting in capacity changes. Invar, a new metal, is being used successfully in the manufacture of condensers. Variable condensers should be floated if directly coupled to tuning cables; and for purposes of synchronization, if remote control is used, two dials are usually employed (or should be employed) one at the receiver proper and one at the remote tuning control.

Interconnecting cables between various components of an installation should be as short as possible in order to prevent undue voltage drop.

High voltage (d.c.) is usually supplied by a dynamotor or a vibrator. Dynamotors are used much more extensively than vibrators because they are capable of supplying higher current and higher voltage with a given input. These units must be capable of continuous operation and must not heat excessively under load. In some large aircraft, 110 volt (a.c.) generators supply all high voltages in conjunction with step-up transformers and tube rectifiers.

Because receivers are designed with specific service requirements in mind,

frequency coverage is a very important consideration. Where a receiver is used in aircraft which only operates "locally," a receiver which would tune to the control tower frequency and the frequency used for aircraft to aircraft contact would suffice. On the other hand, a receiver which is used in an aircraft which makes extensive cross-country trips must be capable of receiving radio range frequencies as well as those frequencies used for aircraft to aircraft-ground to aircraft communication; this necessitates employing a multi-band receiver.

Frequency control in receivers is not difficult if voltage input is stable and provisions are made for thermal expansion of tuning elements. In some receivers (as used by the Airlines), two or more frequencies may be crystal tuned by merely flipping a switch. It is conceded that crystal control is the answer to the problem of frequency stability; however, for reasons financial, it is not always possible to utilize it. Crystal control limits receiver operation to those frequencies covered by the crystal only; or on harmonics. However, it is entirely possible to design a receiver to cover two or more frequencies using crystal tuning, the balance of the selected range being covered by the conventional coil-condenser tuning circuits.

Of course, crystal control is mandatory in transmitting design if frequency stability is to be attained.

Automatic volume control circuits are incorporated in most aircraft receivers. However, AVC is not desirable when flying radio ranges. Often, one will find that receiver manufacturers have installed a convenient switch which will cut out AVC circuits when desired; or the cut-out switch may be connected to the band change switch, and as it is rotated to "range frequencies" the AVC circuits are automatically stilled.

Headphones are nearly always employed with aircraft radio receivers, and even in the ground station are used to a very large extent. Receivers are designed to employ headphones having a wide range of impedances. If it is desired to employ crystal phones, it will be necessary if direct current is present in the output to connect a condenser in series with the phones in order to prevent direct current from damaging the crystal units.

Most aircraft receivers and those used in ground stations are superheterodynes. Tuned radio frequency (TRF) receivers are used to a large degree but the superhet seems to be the set which receives most consideration.

The ground radio receiver found in the average ground radio station differs from the aircraft radio receiver principally in physical construction; is usually larger, operated from the electric mains and is designed so that both a loudspeaker and headphones may be used. Where highest efficiency is desired, ground radio receivers are designed for definite frequency coverage. Because vibration is not present in the ground station it is not necessary that exacting care be taken to mount component parts. However, much thought must be given to parts layout for electrical reasons.

When designing the aircraft transmitter, those principles which hold good in receiver design should prevail, and additional thought be given to insulation requirements because of the use of higher voltages.

Ventilation is a big problem when tubes dissipating much power are used; however, this problem is solved by employing both air and water cooling systems in ground equipment.

In the smaller aircraft transmitters, tubes having filaments that are directly heated by the plane's storage battery are often utilized. When the microphone button is depressed a relay connects both dynamotor and low voltage circuits allowing instant communication. Some transmitters are provided with a switch which allows the filaments to heat up and the instant the microphone button is depressed the dynamotor supplies the high voltage necessary for operation. This system saves wear and tear on the dynamotor between standby periods and is the system most generally used.

Where only one dynamotor is used for both receiver and transmitter, a power change-over relay is employed which shifts the high voltage between receiver and transmitter; at the same time, another relay may "kick-in" and connect the common antenna between either the transmitter or receiver depending on whether the microphone button is depressed or released.

The microphone utilized for voice communication in an aircraft must be a highly damped instrument. That is, it must not respond to exterior noises, such as are created by the propeller of the aircraft. Throat microphones have been used with great success. The advantage that this microphone has over the "older" hand mikes lies in the fact that it need not be touched with the hands when communicating. The vibrations (voice) are carried directly to the microphone from the throat eliminating all exterior noise.

Every aviation radio technician, potential or otherwise, should studiously peruse all available instruction manuals published by aviation radio equipment manufacturers in order to obtain better insight as to maintenance methods and installation problems. Much information is usually given in equipment manuals on circuit design and effect of overall design on installation and maintenance.

By understanding a few of the most important design considerations, set repair and parts replacement are simplified. By comparing circuit diagrams of various manufacturers and noting types of set construction, it is possible to arrive at somewhat of a generalized conclusion as to the avenue one should pursue in undertaking a complete understanding of the many considerations.

(To be continued)

Radio Training

(*Continued from page 9*)

1940, when Col. Hayes took command, the post was so small and the personnel so meagre that there were not enough officers to occupy its quarters.

With the transfer of the radio training section from Chanute Field, great changes began to take place. Hundreds of new buildings were constructed and more than 10 million dollars in up-to-date radio equipment was installed. Thousands of young men from Air Corps posts all over the nation—selected for high standards of education and technical knowledge—were sent to the field for training as radio operators. Thousands of these young men already have been graduated and are serving in bomber commands wherever American forces are fighting. Thousands of men are still in school, thousands are constantly arriving in new classes and will be sent to combat units when they have completed one of the most intensive courses ever to be offered in an army school.

In addition, hundreds of aviation cadets, including men of the new War Department Deferred College Plan, are being trained as commissioned officers. Upon graduation, they will be commissioned second lieutenants in the Army Air Force Reserve and sent to duty at various air force ground stations.

Not only is it a large army post, Scott Field is a city in itself. It has its own water system, its own heating and lighting systems, laundries, hospitals, dental clinics, fire department, libraries, theaters, and even a court room and guard house.

And it is continuing to grow—just how much is, of course, a military secret—for until the bloody hands of the Japanese and their Axis partners are beaten back forever from our shores, Scott Field will continue to supply radio operators whose principal slogan is, "Keep 'em sparking."

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Battery Substitutions

(*Continued from page 29*)

recommended when any replacement unit is used and they do not completely fill the space provided in the radio.

To complete the picture of replacing type F4B60 the electrical connections have to be considered. The plugs ordinarily used with this battery will not fit either the F4P1 or W30P1.

By looking in the extreme right-hand column of Figure 2 any plug change required to operate with a given replacement is indicated. In a great many cases no change will be necessary as the plug used on the original battery will work with the replacement. It is of course recommended that the plug connections and arrangement be checked carefully because tubes can be blown or other circuit damage caused if for instance the A and B leads are interchanged and 45 or more volts are applied to the tube filaments.

In the B circuit where two 45 volt batteries are replacing a unit which supplied a full 90 volts between positive and negative leads it will be necessary that a jumper wire be attached between the 45 volt positive terminal on one of the batteries and the negative terminal on the other.

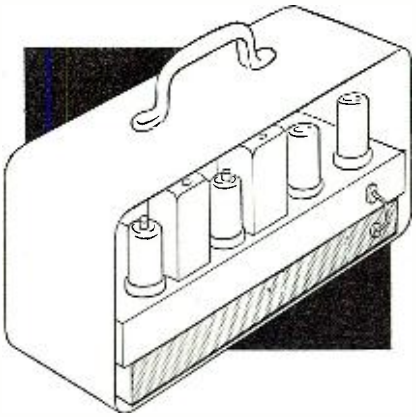

Fig. 3a. Portable with special pack.

On radio sets formerly operated with individual A and B batteries rather than a pack the procedure followed is very much the same as that just outlined.

If the batteries called for cannot be obtained their corresponding replacements will be found in the right-hand columns of Figure 1 and any plug change required indicated.

In some cases it may happen that only the A unit of a given set will have to be replaced while the specified B will still be available. Then it will simply be necessary to select the corresponding A replacement type in Figure 1. This will also apply in cases where the B unit only can't be obtained.

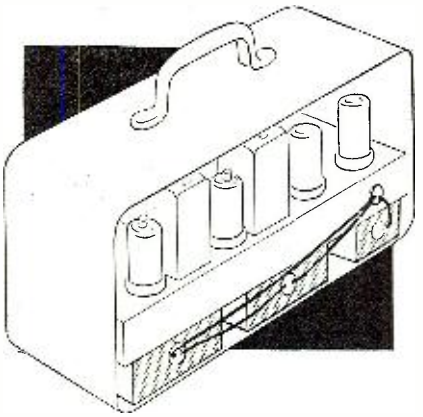

Fig. 3b. Revised pack installation.

Figure 1 should serve as a handy replacement guide for over 90 percent of the portable radios as the types and their replacements are widely used today. Of course certain types now listed as likely to be available may

have to be deleted later due to changing wartime conditions.

In Figure 2 will be found a quick reference chart by radio set model numbers of some of the more popular brands. The battery type numbers listed have been converted directly to the replacements units listed in the right-hand columns of Figure 1.

—30—

Practical Radio

(*Continued from page 26*)

This latter term, often abbreviated "R.M.S.", indicates the method followed in determining the effective value of an alternating current. This is accomplished by calculating the value of constant current that would be required to provide the same heating effect as the alternating current (or e.m.f.) under consideration. The heating effect of a direct current is proportional to the square of the current (I^2R). By selecting the *instantaneous* current values at various intervals during one cycle of a.c., squaring these, taking a mean (average), then extracting the square root of this mean, the heating effect of an alternating current may be arrived at—in terms of equivalent d.c. values. This will turn out in all cases of sine wave voltages to be 0.707 times the peak value of the alternating current or voltage.

A.C. Circuit Considerations

When an alternating voltage is applied to a circuit the values of current flow may be quite different from those of the same circuit with a constant voltage applied. If the circuit includes only pure resistance, such as a lamp, the conditions will be identical in either case. However, in a circuit containing capacity or inductance, conditions may be changed completely. A choke coil or other inductance may offer extremely high resistance to the passage of alternating current, yet present negligible resistance to direct current. Or a capacitor in series may completely prevent the flow of direct current, yet allow alternating current to flow freely. Because of these facts, the Ohm's Law of direct-current circuits do not apply in a.c. circuits containing either inductance or capacity.

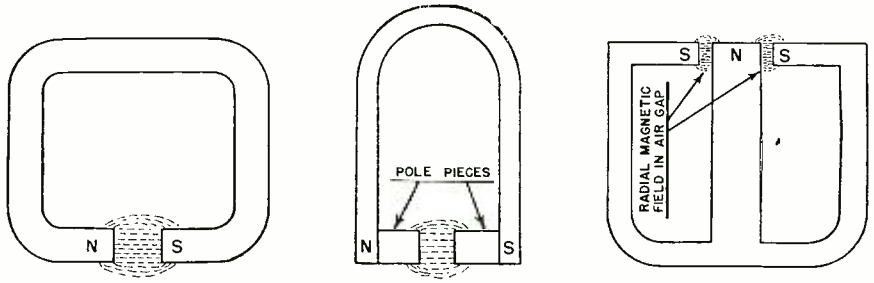

Fig. 4.

To understand clearly the reasons for this involves consideration of factors which have not as yet been touched on in these lessons. For this reason further specific consideration of a.c. circuits will be dropped for the moment but will be taken up again at frequent intervals as other related subjects are discussed. In fact mention and discussion of alternating current circuits will be almost continuously recurring because of the extremely important and fundamental part that a.c. plays in radio.

Magnetism

Magnetism and magnetic effects play such an extremely important role in radio and in electricity that neither of these arts would be the useful servant of mankind that it is today were it not for our ability to harness and apply magnetic principles.

The most fundamental form of magnet is a mineral known as magnetite and earlier more commonly known as lodestone. Centuries ago it was discovered that if a piece of lodestone were suspended or balanced

DON'T MISS
SERVICEMAN'S
Q and A
on page 27

in such a way as to leave it free to rotate, it would always come to rest in the same position—with one certain portion pointing approximately north. Mariners and travelers in ancient days took advantage of this to serve as the forerunner of the modern compass. Just as the north star and the sun provided guiding beacons in the past, the lodestone now served a guide that was not subject to the whims of daylight and darkness, of cloudiness and storm.

Later it was discovered that if a piece of hard iron or steel were rubbed with lodestone, it too would partake of the magnetic properties of this mineral and would become a magnet. Thereafter it would serve as a compass needle, and would also attract other objects of iron or steel. Thus was the artificial magnet born.

When a bar of steel is magnetized there is established around it a magnetic field capable of influencing any magnetically susceptible material or

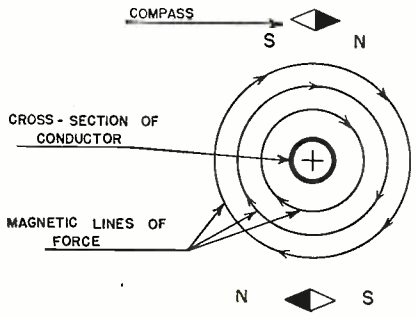

Fig. 5.

object that is brought in close proximity. This field exists in the form of magnetic lines of force as indicated in Figure 2. If this magnet is placed on a flat surface, a sheet of paper is laid over it and fine iron filings sprinkled on this paper, the filings will arrange themselves in a definite order or pattern, approximately as shown in Figure 3. The lines of magnetic force which cause this pattern to be formed extend externally from one end of the magnet to the other and back through the magnet to form closed loops. Actually there are no lines. They are simply imagined because they are convenient in that they serve to indicate the direction of the magnetic force existing at every point around the magnet.

If the bar magnet is suspended at its center in such a manner that it is free to rotate in a horizontal plane, one end will always assume a position pointing north. This end of a magnet is known as its "north-seeking" pole, commonly abbreviated into simply "north" pole. Investigation will disclose that the lines of force surrounding any magnet "extend" through the bar from its south to its north poles, then externally from the north back to the south poles thus forming the external field to which reference has been made.

If two magnets are brought together, end to end, they will repel each other if the adjacent ends are of

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similar polarity, as north-to-north or south-to-south. If the adjacent poles are dissimilar they will attract one another. In this respect magnets follow the same law as electrical charges which we learned follow the rule that "like" charges repel while "unlike" charges attract one another.

The fact that a north pole of a magnet is attracted to the north magnetic pole of the earth may seem to contradict this rule. Actually they are unlike poles. Earlier one was called "north" because it always points toward north, the other because it is located in the vicinity of the earth's north pole. These terms are still continued in use. Technically we consider the earth's north-magnetic pole as a south-magnetic pole; nominally we call it the north pole.

In the case of a magnet comprised of a straight bar the lines of force have to travel a considerable distance in air, and air has high *reluctance.* (Reluctance is to a magnetic circuit what resistance is to an electric circuit.) The result is that the external field of the straight magnet is diffused over a comparatively wide area, and is therefore relatively weak. If a bar magnet is bent into the form of the letter "U", its external field is concentrated and greatly strengthened. The field of a given magnet can be still more concentrated and strengthened if the magnet is bent into the shape of Figure 4A, or if "pole pieces" of iron are added as in Figure 4B.

All good magnetic materials do not make good permanent magnets. Soft iron, for instance, can be magnetized readily but will not retain its magnetism for any appreciable length of time, in fact may lose it instantly upon removal of the source of magnetizing energy. Hard steel on the other hand will retain magnetism almost indefinitely. Some alloys (like the one called Alnico) not only make extremely powerful magnets but magnets that will retain their power to an amazing degree.

An example of the use of such materials is found in the present-day dynamic loudspeaker in which the field energy is supplied by a powerful permanent magnet, dispensing with the electric power consuming field supply units formerly used to provide the strong magnetic field necessary for the functioning of this type of loudspeaker. A cross-section view of the permanent magnet arrangement used in such a p.m. (permanent magnet) speaker is illustrated in Figure 4(c).

Electromagnetism

If an electric current is made to flow through a piece of wire, this wire demonstrates some magnetic effects while the current flows. If dipped in iron filings, for instance, some will cling to it but will drop off immediately when the current flow is interrupted. Further, if this wire is run up through a hole in a horizontal piece of cardboard, iron filings sprin-

kled on the cardboard will form a much thicker mass near the wire than at more distant points and, moreover, will form into such pattern as to indicate a circular formation of the magnetic lines of force surrounding the wire. A small compass moved at random around the wire will definitely indicate that a magnetic field exists so long as current is flowing through it, and that this field consists of lines of force distributed concentrically around the wire, as shown in Figure 5.

The field around a single wire is relatively weak, but if this wire is wound in the form of a helix or coil the field becomes much stronger. The reason for this is that in a straight piece of wire the field exists along the entire length of the wire and therefore is so widely distributed as to be almost negligible at any one point along the wire. When this wire is wound into the form of a coil the magnetic field is concentrated in a much smaller area. The "magnetic swirls" existing around the individual turns join forces to make up one combined field which extends through the center of the coil, then around outside, as shown in Figure 6. It will be noted that this field is identical with that which exists within and around the permanent bar magnet of Figure 2. Actually the magnetic characteristics of a coil of wire and a bar magnet are identical—so long as current is flowing through the wire of the coil. Stop the current and the coil immediately loses all its magnetic qualities.

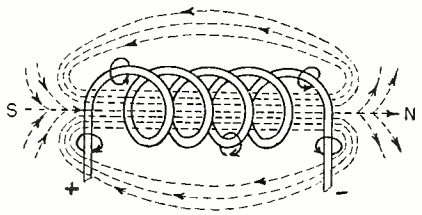

Fig. 6.

If a piece of iron is placed within the coil to form a core, this provides a path of low reluctance (magnetic resistance) for the magnetic lines of force and the magnetic effects become very much stronger. This is the common *electro-magnet* which finds wide application in electrodynamic loud speakers, relays, door bells and many other types of electrical apparatus. If a piece of hard steel is inserted as a core it will become permanently magnetized. In fact, it is this method that is often used in the making of permanent magnets. In most electro magnets the core is of soft iron (which will remain magnetized only while current flows in the coil) so that the magnetic effect can be turned off and on by turning the current off and on.

The windings and cores of electromagnets take various forms and shapes, depending upon the purpose for which intended.

(To be continued)

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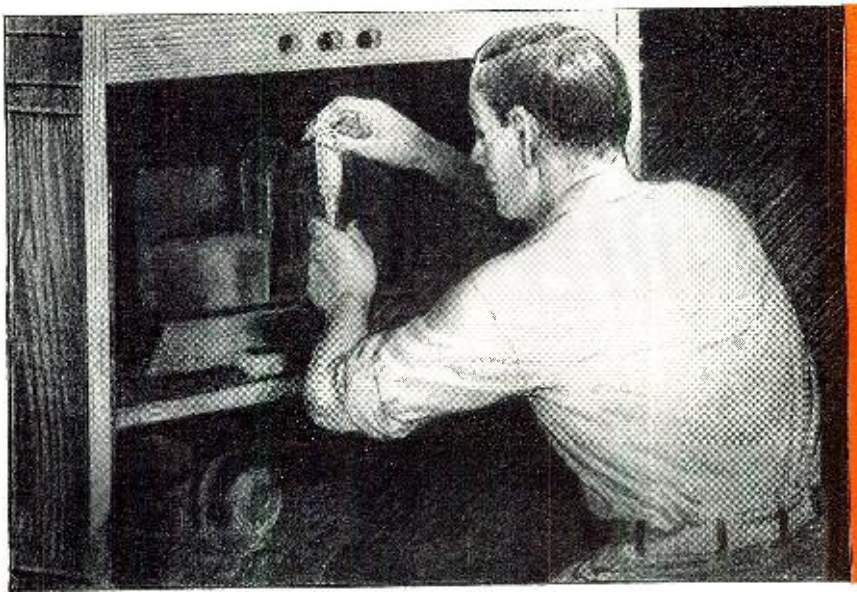


Even today, P.R. MALLORY & CO. Inc. MALLORY helps you say "All Sets, Ready to Go!"

● A completed repair job rings the cash register. But a half-finished job, held up for a repair part, is double trouble. It ties up your cash and may exhaust your customer's patience, since he's only interested in when he can get his set.

That's why Mallory's standardization program means more than ever to you right now . . . now we're all on a war basis.

Special duplicate parts are easy to manufacture. The original designer did the engineering. But a duplicate replacement is made for one model . . . and more than 20,000 models of radio receivers have been produced since radio began. No wonder a "duplicate" may be hard to secure!

Years ago Mallory started a standardization program to lick this problem . . . And from persistent research by Mallory engineers have come the benefits of standardization in vibrators, condensers and volume controls.

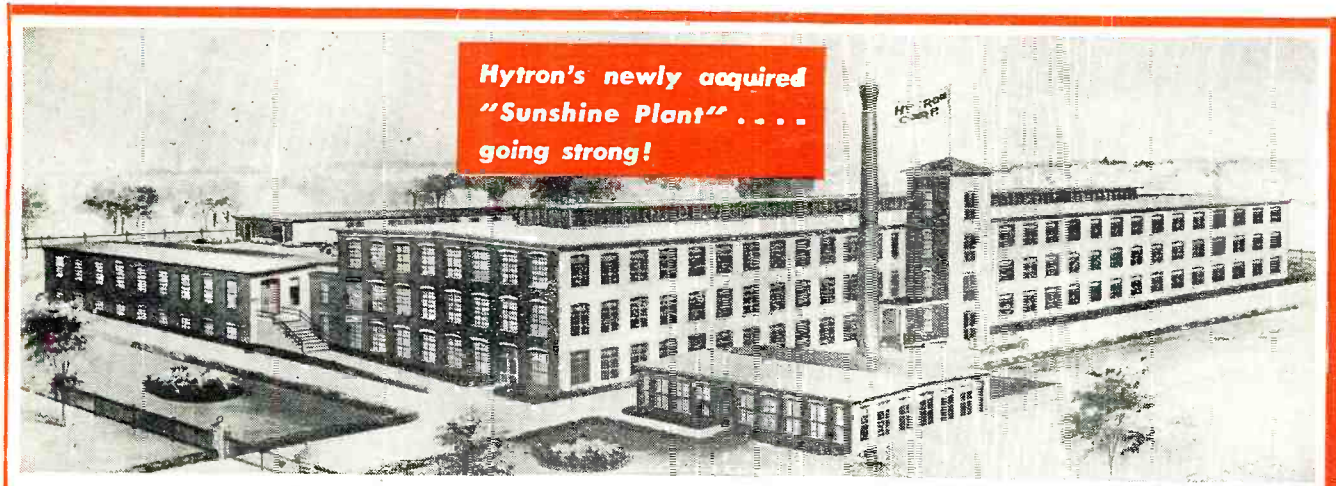
Take, for instance, the plug-in shaft type of volume control, first developed by Mallory. With this system, two controls and two shafts provide four combinations. Likewise, ten controls and ten shafts offer 100 combinations. It's simple arithmetic. Thus Mallory's complete line of shafts and controls provides enough combinations for past, present and future models of radio receivers.

You can count on five direct benefits in your business from Mallory standardization:

1. *Availability of repair parts.*
2. *Minimum inventory.*
3. *No slow-moving items.*
4. *Ability to handle more business.*
5. *Replacement parts of top performance—Mallory precision.*

See your Mallory Distributor, or write for technical help today to our Application Engineering Section, Wholesale Division.

P. R. MALLORY & CO., Inc.
INDIANAPOLIS INDIANA
Cable Address—PELMALLO



HYTRON now has QUADRUPLED space for war production

Hytron REMEMBERS PEARL HARBOR—Wake Island—Bataan—Corregidor. As its contribution to the swelling tide of production which will equip the nation with an overwhelming flood of war materials to avenge these temporary setbacks, Hytron is developing at top speed the productive capacity of its new plant. The new factory is so large that it could easily accommodate on one floor the entire Salem plant. In this appropriately-named radio war, Hytron's quadrupled facilities will play an important part in the production of vital electronic tubes to be used in making the enemy remember with regret his mistake in attacking the United States.

HYTRON CORPORATION

Manufacturers of electronic tubes since 1921

SALEM,
MASSACHUSETTS

MORE TUBES FOR VICTORY

RECEIVING — "GT", "G", or "acorns", R.M.A. or Government types, — twenty-two years of experience give you time-tested quality.

TRANSMITTING — Nationally famous u-h-f designs, popular instant-heating tubes for mobile use, standard Hytron triodes and rectifiers, all perform efficiently—dependably.

SPECIAL PURPOSE — From medium power tubes to tiny miniature types, Hytron welcomes the opportunity to manufacture in production quantities the specialized tubes you may need for your war production.