RADIO NEWS

JUNE 1944 25c
In Canada 30c

"...So Many Owe So Much To So Few..."

IN peace, the Nation's debt to the radio amateur was great. During hurricanes, floods, and other disasters, he sprang forward with emergency communications. His endless hours of patient experimentation—particularly on the high and ultrahigh frequencies—helped open up, as if by magic, whole new segments of the radio spectrum. Traffic enthusiasts surprised the people with unselfish service; DX hounds fostered international good will.

In this "radio" war, the "ham," along with the professional, became the backbone around which the Services and war plants built the myriad, complex communications systems of war, and the secret electronic weapons. He has trained and inspired the new recruits—the tens of thousands of potential "hams."

Hytron, especially, owes much to the radio amateur. When he entered the Services and war plants, he took with him a knowledge of Hytron tubes—particularly v-h-f types—and an admiration for them. Through his enthusiasm, these tubes became vital parts of war equipment. When the time comes to speak out for the return of his precious frequencies, Hytron will not forget him.

OLDEST EXCLUSIVE MANUFACTURER OF RADIO RECEIVING TUBES

HYTRON

CORPORATION ELECTRONIC AND RADIO TUBES

SALEM AND NEWBURYPORT, MASS.

HYTRON RADIO TUBES

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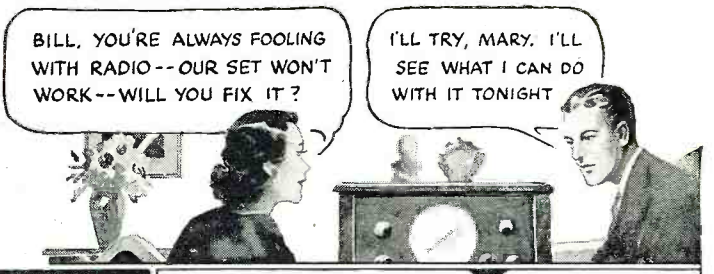
A FREE LESSON SHOWED BILL HOW HE COULD MAKE GOOD PAY IN RADIO!



I will send you a Lesson on Radio Servicing Tips FREE

TO SHOW HOW PRACTICAL IT IS TO TRAIN AT HOME FOR

GOOD JOBS IN RADIO

I want to give every man who's interested in Radio, either professionally or as a hobby, a copy of my Sample Lesson, "Radio Receiver Troubles—Their Cause and Remedy"—absolutely FREE! It's a valuable lesson. Study it—keep it—use it—without obligation! And with it I'll send my FREE 64-page, illustrated book, "How to Train at Home and Win Rich Rewards in Radio." It describes many fascinating jobs in Radio, tells how N.R.I. trains you at home in spare time, how you get *practical* experience with SIX KITS OF RADIO PARTS I send.

You'll see why my easy-to-grasp lessons have paved the way to good pay for hundreds of other men. But even if you never go any further, this Sample Lesson is worth having. I will send it to you without obligation. MAIL THE COUPON!

More Radio Technicians Now Make $50 a Week Than Ever Before

There's a shortage today of capable Radio Technicians and Operators. Fixing Radios pays better now than for years. With new Radios out of production, fixing old sets, which were formerly traded in, adds greatly to the normal number of servicing jobs.

Broadcasting Stations, Aviation and Police Radio, and other Radio branches are searching for Operators and Technicians. Radio Manufacturers employ many trained men. And think of the NEW jobs that Television, Electronics, and Frequency Modulation will open up after the war!

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As soon as you enroll for my Course I start sending you EXTRA MONEY JOB SHEETS that show you how to earn $5 to $10 a week EXTRA in spare time while still learning.

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The opportunity the war has given beginners to get started in Radio may never be repeated. So take the first step at once. Get my FREE Lesson and 64-page, illustrated book. No obligation. Just mail coupon in an envelope or paste it on a penny postal.—**J. E. SMITH, President, Dept. 4FR, National Radio Institute, Washington 9, D. C.**

My Radio Course Includes Training in
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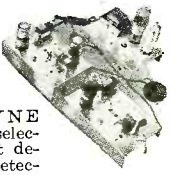
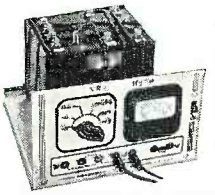
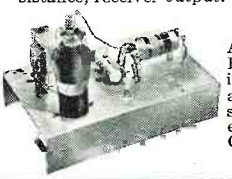
By the time you've conducted 60 sets of Experiments with Radio Parts I supply, made hundreds of measurements and adjustments, you'll have valuable PRACTICAL Radio experience for a good full or part-time Radio job!





SUPERHETERODYNE CIRCUIT (right) Preselector, oscillator-mixer-first detector, i.f. stage, diode detector—a.v.c. stage, audio stage. Bring in local and distant stations on this circuit you build yourself!

MEASURING INSTRUMENT (above) you build early in Course. Use it in practical Radio work to make EXTRA money. Vacuum tube multimeter, measures A.C., D.C., and R.F. volts, D.C. currents, resistance, receiver output.



A. M. SIGNAL-GENERATOR (left) build it yourself! Provides amplitude - modulated signals for test and experimental purposes. Gives valuable practice!

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RADIO NEWS

"Reg. U. S. Pat. Off."

JUNE • 1944

VOLUME 31, NUMBER 6

CONTENTS

FEATURES

DEPARTMENTS

COVER PHOTO
By AAFTTC

Communications equipment such as that illustrated on the cover requires tremendous expenditures for its purchase. We Americans are again privileged to take part in the Fifth War Loan Drive in order that our troops be supplied with the world's finest radio-electronic military gear.

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NEW LETTER CONTEST for SERVICEMEN

ELEVEN 1st PRIZE WINNERS IN 5 MONTHS IN CONTEST No. 1!

Yes, sir, guys, the hundreds of letters received were so swell that *double* first prize winners had to be awarded each of the first four months and there were *triple* first prize winners the fifth and last month . . .

SO—HERE WE GO AGAIN!

Get in on this NEW letter contest—write and tell us your *first hand* experiences with *all* types of Radio Communications equipment built by Hallicrafters including the famous SCR-299!

RULES FOR THE CONTEST

Hallicrafters will give $100.00 for the best letter received during each of the five months of April, May, June, July and August. (Deadline: Your letter must be received by midnight, the last day of each month.)

For every serious letter received Hallicrafters will send $1.00 so even if you do not win a big prize your time will not be in vain.

Your letter will become the property of Hallicrafters and they will have the right to reproduce it in a Hallicrafters advertisement. Write as many letters as you wish. V-mail letters will do.

Military regulations prohibit the publication of winners' names and photos at present . . . monthly winners will be notified immediately upon judging.

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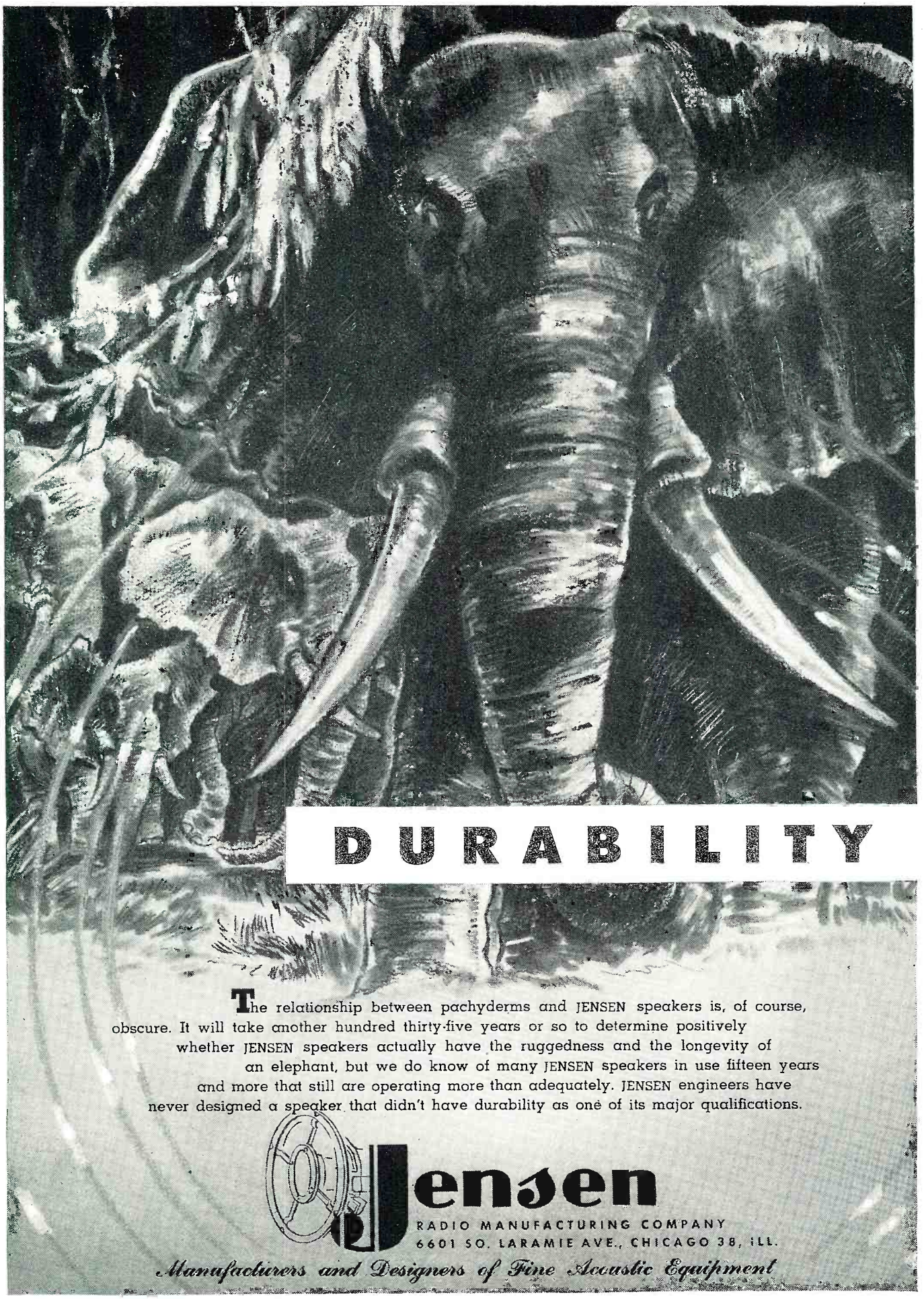
THE HALLICRAFTERS CO. MANUFACTURERS OF RADIO AND ELECTRONIC EQUIPMENT, CHICAGO 16, U. S. A.



The relationship between pachyderms and JENSEN speakers is, of course, obscure. It will take another hundred thirty-five years or so to determine positively whether JENSEN speakers actually have the ruggedness and the longevity of an elephant, but we do know of many JENSEN speakers in use fifteen years and more that still are operating more than adequately. JENSEN engineers have never designed a speaker that didn't have durability as one of its major qualifications.

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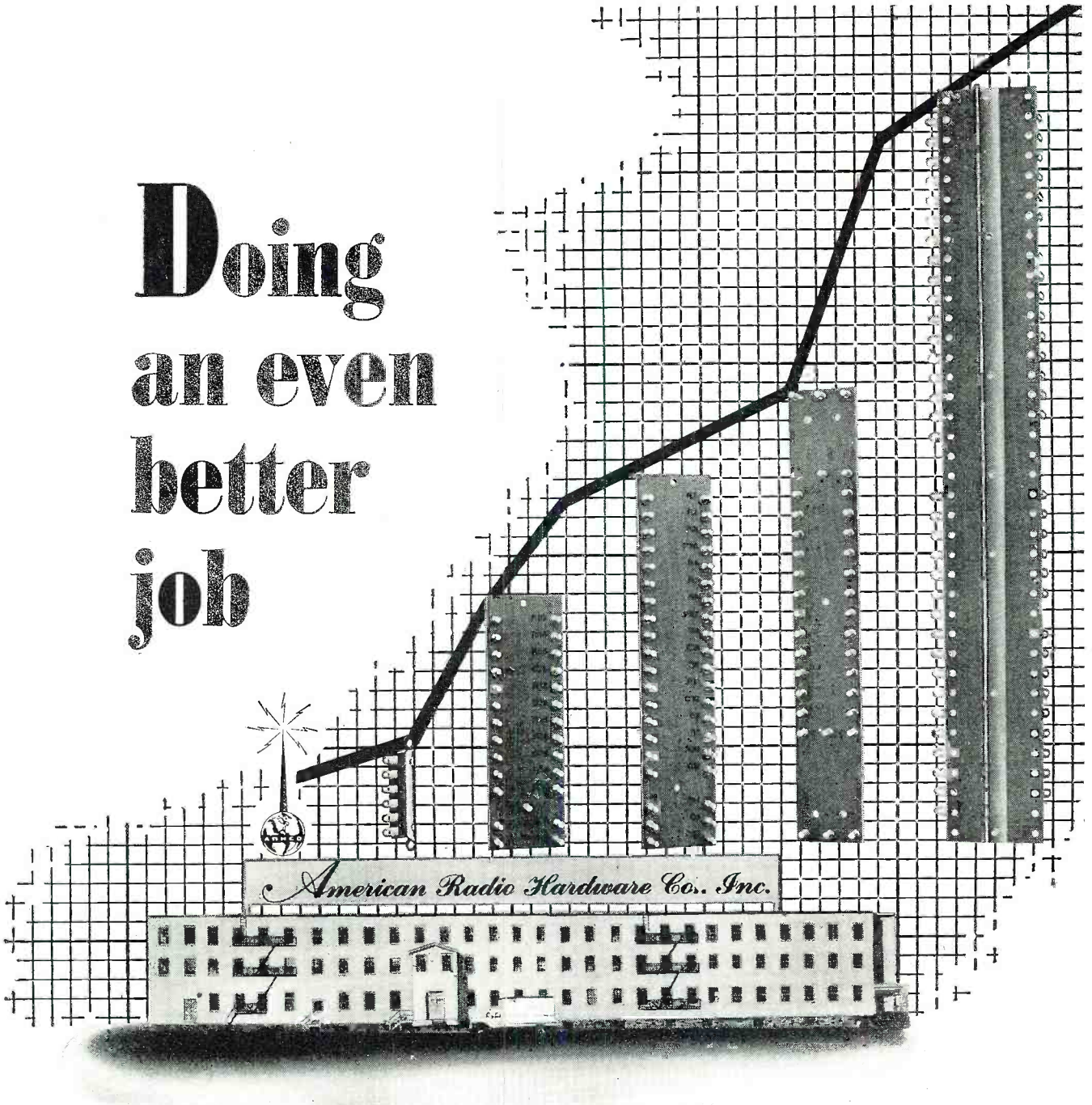
Manufacturers and Designers of Fine Acoustic Equipment

Doing an even better job



We were doing a splendid job of war production before the opening of our new plant. Today we're doing an even better job. Increased ARHCO facilities comprise the most modern manufacturing equipment . . . especially designed and developed for us. Every inch of space has been planned to yield the utmost capacity. Each worker utilizes his highest skill.

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Don't burn wastepaper . . . It's a vital war material

For the Record

BY THE EDITOR

MODERN mechanized warfare presents an ever increasing number of problems of materiel. Not only must the procurement of hundreds of thousands of items be expedited, but sufficient leeway must also be provided so that every plane, every ship and every radio set reaches the battle front with a full complement of repair parts which may be needed at a moment's notice to keep them in operation. It is axiomatic that somewhere between the production line and the combat area there should arise a fluctuation in requirements which very often results in a surplus of certain materials, and in other cases, a shortage of important items.

The immediate problem now confronting the radio and electronic industry is the disposal of surplus parts and other equipment resulting from cancellation of war contracts. In fact, many thousands of dollars worth of brand new parts are now crowding the shelves of many manufacturers and are taking up valuable storage space in warehouses scattered throughout the country. The radio industry is not the only one faced with this problem. It is happening in many others. Naturally we are concerned primarily with those problems faced by our own industry. The cost of this war is many times greater than World War I, therefore the problem of the disposal of surplus material becomes even more complicated. It seems that *now* is the time to find intelligent solutions whereby at least a large part of the material can be absorbed and put to use in other equipment whether or not it comes under the classification of radio-electronic items. Many executives are becoming alarmed and feel that no time should be lost in bringing the matter to the attention of proper governmental agencies together with the suggestions for a workable plan which would expedite the disposal of parts which are now occupying much needed space. Officers in the Armed Forces who have come from our own industry, and many who will return to their pre-war vocations, are becoming more and more concerned. They realize the seriousness of the situation and are doing everything that they can to arrive at a solution.

The residue of surplus parts has resulted chiefly from the cancelling of contracts. A definite policy for the disposal of this surplus—a policy that will protect the radio-electronic industry—has not as yet been formulated. During the past several months industrial leaders have sensed that sooner or later they would be faced with such a situation, but up to the present time no one has evolved a workable plan which could be put into effect on short notice and one which would not require long range planning in order to become a reality. It is fortunate that this entire problem will not be dumped in the laps of the industry in one sudden avalanche. This happened at the end of World War I and if allowed to happen again, the problem will at once become a thousand times more serious.

It is a "today's" problem—yes, a very serious problem that must be licked soon. It cannot wait for V-Day. American industrial leaders known for their sound judgment and intelligent planning certainly are capable of presenting a plan which can be put into effect with little delay. It cannot be solved by any one industrial specialist. Individual problems must be analyzed and tackled by men of each individual industry concerned. Each have their own problems, unique in their own fields. The radio-electronic industry is no exception. While it is true that every effort has been and is being made to consume every manufactured unit, there will always be a small percentage of goods found in the "surplus" pile. When one considers the millions of dollars worth of equipment produced by the industry every month and compares the total figure with the cost of surplus material, we find that the actual percentage of items on hand is very small. Even so, it does amount to a goodly sum of money.

Credit must be given the procurement and design officers and engineers for the efficient technique they have employed in purchasing and expediting the vast amount of materiel needed by our Armed Forces. They are doing a bang-up job and are in sympathy with the many problems faced by the industrialist.

Our primary concern at the moment is the winning of the war in the shortest possible time, but certain problems do arise—and this certainly is one that must be solved *now* so that we do not leave the industry in a chaotic condition at the conclusion of hostilities.

From such an unstable condition arises problems of surplus dumping and instability within the industry. The reconversion to peacetime operation of the radio-electronic industry depends on foresighted planning and orderly disposal of surpluses. This is something that must and can be done by the industry.

Arriving at a solution to a problem is not difficult—rather the difficulty lies in arriving at a solution that does not in itself present a greater problem.

O. R.

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Newark 1, N. J.

Spot Radio News

By RADIO NEWS Washington Correspondent

Presenting latest information on the Radio Industry.

ANOTHER MEDAL OF HONOR has been awarded to radio . . . this time in the European theater of operations. According to a War Department report covering Fifth Army operations in Italy, radio played a most active role in a variety of landing and internal operations. On the beachhead landings at Salerno and across highways and rivers, portable equipment afforded communications contact, even in the face of enemy fire.

Amphibious truck-mounted transmitters and receivers provided a continuous means of contact between land and sea units. Many networks were also established. In some instances as many as sixteen to twenty units were employed in such a net.

Although the equipment received a thorough drenching in many of the landing operations, it operated perfectly. And on land, during the rockiest journeys, transmission and reception were excellent, the report stated.

Lieutenant General Mark Clark, who directed the spearhead operations on the Italian shores, was radio equipped when he made his journey from North Africa. Contacting him during this trip was the Deputy Signal Officer with his operating team, who went ashore from a ship that was used as an alternate command ship.

Many of the boys in charge of radio equipment, who underwent severe artillery barrages to provide unbroken links of communications, received military awards. Corporal Leonard Mancuso, one of such a group, was awarded the Silver Star for his bravery in the heat of battle.

In another theater of operations radio was also recently honored. For, the first anniversary of the radio network of the six American Expeditionary Stations distributing programs to Africa, Sicily and Italy was celebrated. The idea for the network was established thirty-seven days after the first shell was fired at Casablanca. The first station was made of materials that were found on the beaches at Fedala and Casablanca, and from old parts of a French transmitter. Oddly enough, the first recording transmitted was "What Is This Thing Called Love?" The record album at the beginning consisted of seventeen records. Today there are hundreds.

General Dwight D. Eisenhower spoke during this first anniversary celebration. Founders of the network, Captains Andre Baruch and Houston A. Brown, also appeared on the anniversary program. Captain Baruch is a former announcer of CBS and NBC.

The network now furnishes ninety hours of entertainment every week, with the stations' crews and equipment moving as fast as the troops, when the battleground shifts. Congratulations to the AES!

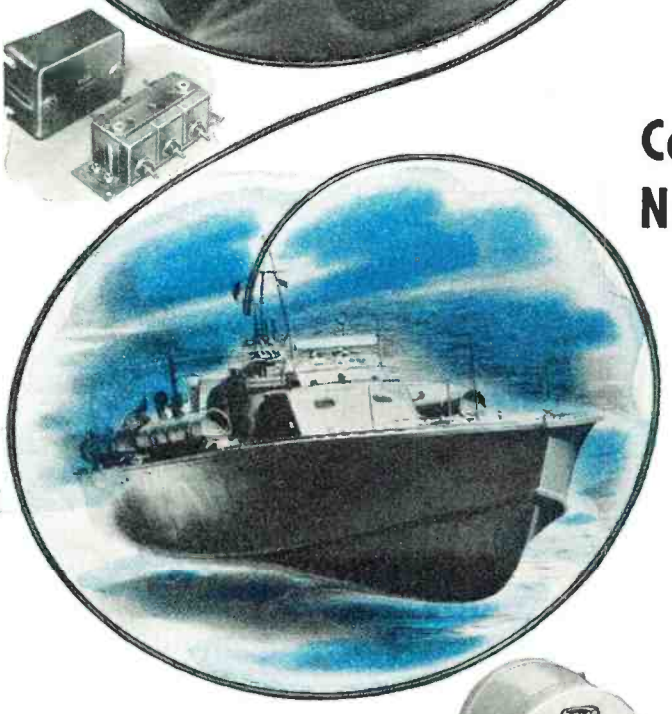
ACTION ON THE WHITE-WHEELER radio bill, delayed for many weeks by rewriting, may not only be delayed further by other Congressional activities, but buffeted around until election time. Then the delay may become indefinite since many of the members of the Interstate Commerce Committee, under whose jurisdiction this bill falls, will retire because of either term expirations or election changes.

Every effort, of course, is being made to secure enactment of some form of a revised Communications Act. Senator Burton K. Wheeler, co-author of the White-Wheeler Bill and chairman of the Interstate Commerce Committee, implied recently that it may be possible to secure necessary action on the revised bill before Congress goes home for the summer. The rewritten bill is about ready now, and according to reports, a five-man commission with a rotating chairmanship has been included in the new version.

A letter written by FCC chairman Fly to Congress, indicating the vital need of radio for railroad operation, will probably result in the introduction of a special radio bill during the current session. The Senate Interstate Commerce Committee has this matter under consideration. Mr. Fly's communication cited that flags, lanterns, flares, fuses and torpedoes, which are now in use on railroads, are antiquated and dangerous, and should be replaced by radio equipment. He cited that although the Interstate Commerce Commission recommended the use of block systems over ten years ago, there are fifty-thousand miles of passenger track that are still unprotected. Radio should not only be used here, but in all block system operations, he emphasized. Radio for head-end and rear-end communications on trains was also recommended by Mr. Fly.

Incidentally, radio for railroads is receiving the closest of study by many railroads. Recently, the Chicago, Rock Island and Pacific Railway announced that tests are under way for the development of equipment affording communication between front and rear ends of trains, office and switch

HERE ONE MUST HEAR!



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Upon reception and transmission of radio commands . . . upon freedom from local static's message-mangling crashes . . . may depend the timing which makes combined operations successful.

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Severe seasoning under combat conditions gives Solar engineers war-proved products to study, helps prepare for industry's "combined operations" when world skyways, seaways and railways again are routes of neighbor-to-neighbor trade. Let Solar advise you on radio-noise suppression. Solar Manufacturing Corporation, 285 Madison Ave., New York 17, N. Y.

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crews, and dispatchers and crews enroute. Ernest A. Dahl, former Western Electric engineer and now an instructor in the Army's communications and signal unit, has been appointed to study this project.

AN EFFECTIVE ANALYSIS OF THE SHORT-WAVE ACTIVITIES of the OWI and CIAA (Coordinator of Inter-American Affairs) was presented by Charles R. Denny, general counsel of the FCC, in his recent testimony before the Select Committee, which is investigating the FCC.

Acting General Counsel to the Select Committee, Harry S. Barger, had asked Mr. Denny about the frequencies assigned to the OWI. Mr. Denny replied that frequencies had not been assigned to the OWI or to the CIAA. He pointed out that the FCC assigns frequencies to commercial broadcast companies with stations licensed to operate as international short-wave units. The OWI and the CIAA have purchased time on these stations, and not the stations, explained Mr. Denny.

Mr. Denny was then asked as to whether or not the short-wave stations of the large networks and other independent operators were under lease by the government. He stated that these stations were not under lease.

"Instead," he said, "OWI and CIAA have entered into contracts for the purchase of all of the stations' time. A written contract is employed, similar to the contract used by any commercial sponsor. In other words," explained Mr. Denny, "the OWI and the CIAA have bought time on these short-wave stations."

Mr. Barger asked Mr. Denny if the OWI and CIAA could have applied to the IRAC (Interdepartment Radio Advisory Committee) for frequencies. The answer was, "Yes."

Representatives Clarence F. Lea, Richard B. Wigglesworth, and Louis E. Miller were present during this testimony, which was heard in the new House Office Building.

ANEPA, OR THE ARMY-NAVY ELECTRONICS PRODUCTION AGENCY, is being dissolved. Its functions will be absorbed by the Signal Corps Procurement Division, the Navy Bureau of Ships, and the WPB Radio and Radar Division. F. D. Tellright, ANEPA director, will probably return to private industry, while Captain C. A. Rumble, USN, deputy-director, probably will be assigned to similar activities in the Navy.

TELEVISION RECEIVED A HEALTHY PAT ON THE BACK from James Lawrence Fly, FCC Chairman, in an address before members of the press, motion picture, broadcast and television industries at a dinner in New York City which followed the première television presentation of the MGM picture "Patrolling the Ether." The picture featured the activities of the RID (Radio Intelligence Division) of the FCC. Mr. Fly said that television is not around the corner.

"It is at hand, and all we have to do is exploit it properly," he explained. He pointed out that the results in television are nothing short of a certainty, with only the details to be worked out.

The film which was preceded by a personal television appearance of Mr. Fly, presenting an explanation of RID activities, was relayed from WNBT, the NBC television station in New York, to WRGB, Schenectady, and WPTZ, Philadelphia. The film was also televised over video stations in Chicago and Los Angeles during the same evening. This was the first time that television has had a première performance under network conditions.

ALTHOUGH THE PRESENT 525-LINE AND 6-MC width television standards will be retained in the immediate postwar period, 1,000 to 1,500-line pictures on 20-mc. bandwidths may become standard several years after World War II is over. So stated engineers who presided at a round-table discussion in New York recently.

Experimental telecasting in the frequency spectrum between 600 and 2,000 mc., with provision for thirty channels of 20-mc. bandwidth, were recommended by television engineering groups. Television panel six of the RTPB is believed to have the latter recommendation under study.

While frequencies and many technical standards of prewar acceptance will be retained in the first postwar years, television studios and their allied equipment may have a new postwar dress. Evidence of this appeared in a special General Electric exhibit unveiled at the Waldorf Astoria in New York recently. A television studio building with Hollywood lines of design was shown. In this building were provisions for separate audience seating areas, each accommodating several hundred people so that one group might view a program, while another group is filing in or out, thus avoiding program disturbances. Another feature of the functional building was a welded steel frame structure supporting several cantilevered television cameras, as well as the circular roof in the stage area. According to the designing engineers, with one of these cameras mounted on the pivotal column in the center of the revolving stage, and the others on the sides, it will be possible to cover all parts of the stage at any distance and from any angle. Visual broadcasts of audience participation will also be possible for the same cameras will be capable of direction towards the audience. To provide for room-sized displays and even small aircraft, spacious backstage areas and receiving doors are included.

Some of the new equipment shown included a portable pickup mobile unit with portable sight and sound transmitters, and a camera unit. A para-

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My training will give you the broad, fundamental principles so necessary as a background no matter which branch of Radio you wish to specialize in. I make it easy for you to learn Radio Set Repair and Installation Work. I teach you how to install and repair Electronic Equipment. If you enter the Army, Navy or Marines, my training will help you win higher rating and better pay.

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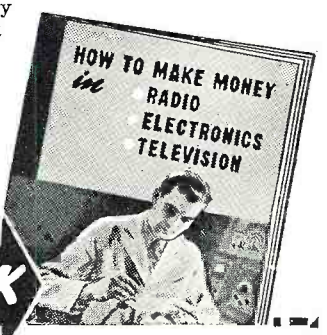

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Tear off this coupon, mail in envelope or paste on penny postcard.

bolic antenna reflector, which would beam the picture and sound to the main transmitter providing spot programs, was also a feature of this car.

Newspapers appear to have taken a liking to television. Recently, the Chicago Tribune and the New York Daily News placed orders with General Electric for forty kilowatt television transmitters and studio equipment. This equipment is similar to that used by General Electric for their station, WRGB, in Schenectady.

Department stores also appear to be quite interested in television. In Atlanta, Georgia, Rich's have appointed Irwin A. Shane, a New York television producer, as its television consultant. And from Boston comes a report that the Jordan Marsh department store is negotiating for the installation of television equipment.

In the New York Paramount building, Paramount Pictures are expected to install, shortly, television-receiving equipment for reception of televised signals, for theater projection.

Some thirty-seven advertising agencies have already appointed television directors to supervise sporting event, dramatic, variety, quiz, puppet show, religious, fashion, cooking school, beauty and news programs. This commercial interest is most unusual for, when radio was at a stage comparable to television today, there were just a few advertising agencies who were slightly interested, but with no definite plans.

THE SECOND WAR PRODUCTION CONFERENCE OF RMA, in connection with the Association's twentieth annual membership meeting, has been planned for June 6 and 7 at the Stevens Hotel in Chicago. War production will be the keynote of the industry meeting, including all RMA Divisions and committees, but streamlined to meet war conditions. There will be no exhibits or meetings for jobbers or dealers, and no banquet or other social features.

President Paul V. Galvin of RMA will preside at the Association membership luncheon on June 7, under the program arranged by Chairman A. S. Wells of the Convention Committee. A prominent government official is being invited as the guest speaker.

New officers and directors of RMA will be elected at meetings of the Association's Board of Directors and its Set, Tube, Transmitter, Parts, Amplifier and Sound Equipment Divisions. Committee meetings will be held on the first day of the conference, with an informal luncheon for committee members in attendance, with the annual industry luncheon being held the following day, June 7.

The tentative RMA program follows:

TUESDAY, JUNE 6

10:00 a.m.—RMA Advertising Committee
Chairman, John S. Garceau

10:00 a.m.—RMA Contract Terminations Committee
Chairman, John Ballantyne
Vice Chairman, Ray F. Sparrow

10:00 a.m.—RMA Distribution Costs Committee
Chairman, Ben Abrams

10:00 a.m.—RMA Employment and Personnel Committee
Chairman, A. H. Gardner
Vice Chairman, Glenn W. Thompson

10:00 a.m.—RMA Engineering Conference
Director, Dr. W. R. G. Baker
Associate Director, Virgil M. Graham
Manager RMA Data Bureau, L. C. F. Horle

10:00 a.m.—RMA Industry Reconversion Committee
Chairman, A. S. Wells
Vice Chairman, E. A. Nicholas

10:00 a.m.—RMA Industry Statistics Committee
Chairman, Fred D. Williams

10:00 a.m.—RMA Sales Financing Committee
Chairman, J. P. Rogers

12:30 p.m.—LUNCHEON (informal)
RMA Committee Members, Officers and Directors

2:00 p.m.—RMA Board of Directors
Presiding: President Paul V. Galvin

2:00 p.m.—RMA Export Committee
Chairman, Walter A. Coogan

4:30 p.m.—RMA Postwar Planning Committee
Chairman, R. C. Cosgrove

WEDNESDAY, JUNE 7

10:00 a.m.—RMA Set Division, Annual Meeting
Chairman, R. C. Cosgrove

10:00 a.m.—RMA Tube Division, Annual Meeting
Chairman, M. F. Balcom

10:00 a.m.—RMA Transmitting Division, Annual Meeting
Chairman, G. W. Henyan

10:00 a.m.—RMA Parts Division, Annual Meeting
Chairman, Ray F. Sparrow

10:00 a.m.—RMA Amplifier and Sound Equipment Division, annual Meeting
Chairman, T. A. White

12:00 Noon—RMA Board of Directors' Reception for Official Guests
Presiding: President Paul V. Galvin

12:30 p.m.—RMA MEMBERSHIP LUNCHEON — ANNUAL MEMBERSHIP MEETING
Presiding: President Paul V. Galvin
Amendments to RMA By-Laws
Address and Annual Report
President Paul V. Galvin
Annual Financial Report
Treasurer Leslie F. Muter
Address: Official Guest

2:00 p.m.—RMA Board of Directors
Election of President and other Officers

2:00 p.m.—RMA Credit Committee
Chairman, T. A. White

(*Continued on page* 130)

"triple Six S"

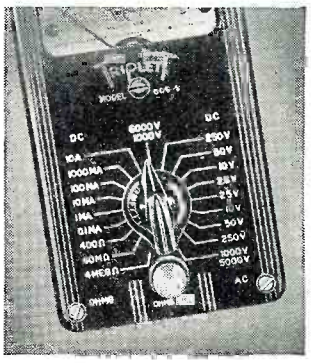
All-Purpose Pocket Size Volt-Ohm-Milliammeter

A new modernistic styled, compact unit that provides an answer to all Volt-Ohm-Milliammeter requirements. Incorporates all the testing facilities of larger, more costly equipment. A.C. and D.C. Volts 0–2.5–10–50–250–1000–5000 (D.C. at 10,000 ohms per volt; A.C. 1000 ohms per volt); 0–.1–1–10–100–1000 D.C. Milliamperes, at 100 millivolts; 0–10 D.C. amperes at 100 millivolts; Resistance 0–400 Ohms (10 ohm center scale); 0–40,000 ohms (500 ohms center scale) 0–4 Megohms (50,000 ohm center scale). Self contained batteries. Selector switch control for all ranges.

Completely insulated black molded case and panel, attractive streamlined design. (Leather carrying case also available to hold tester and accessories.)

The Triplett Line—more comprehensive than ever—goes today for war needs but its exacting services in war assure you the final answer for post-war equipment requirements.

Battery slides into place. Easily inserted or removed.



Twenty position selector switch control for all ranges.

Triplett

ELECTRICAL INSTRUMENT CO.

BLUFFTON OHIO ★ ★ ★

STANDARDS ARE SET BY TRIPLETT

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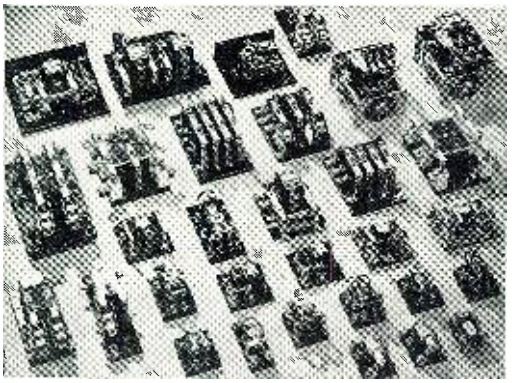
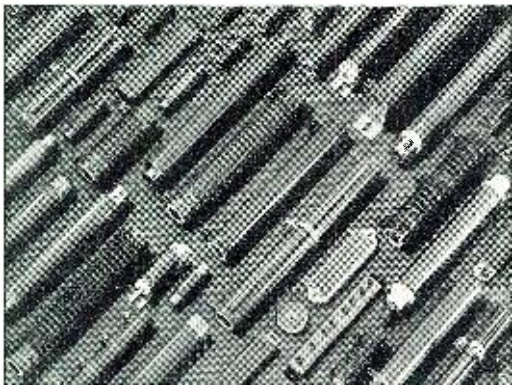


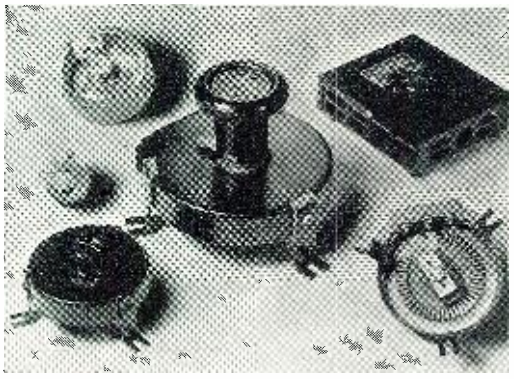
RELAYS

The Ward Leonard Line of Relays comprises light, intermediate and heavy duty types for sensitive, transfer, time delay, antenna change-over, break-in, and latch-in operation. They all have crisp action, are dependable and durable. Ward Leonard Relays use but little power.



RESISTORS

Ward Leonard Resistors are built to withstand heat, moisture, vibration and other adverse operating conditions. The regular line covers a wide range of types, sizes, ratings, terminals, mountings and enclosures. You can find exactly the resistors you need in the Ward Leonard line.



RHEOSTATS

Ward Leonard Rheostats include the widest range of sizes, tapers and current ratings from the tiny ring types for radio to huge multiple assemblies for the heaviest industrial use. Smooth operation, durable contacts and extreme dependability characterize all Ward Leonard Rheostats.

Ward Leonard Relays, Resistors and Rheostats are carefully designed and conscientiously made. They are conservatively rated to insure dependability and long life. They meet all the rigid requirements of service. Complete data Bulletins on the various products are available. Send for bulletins of interest to you.

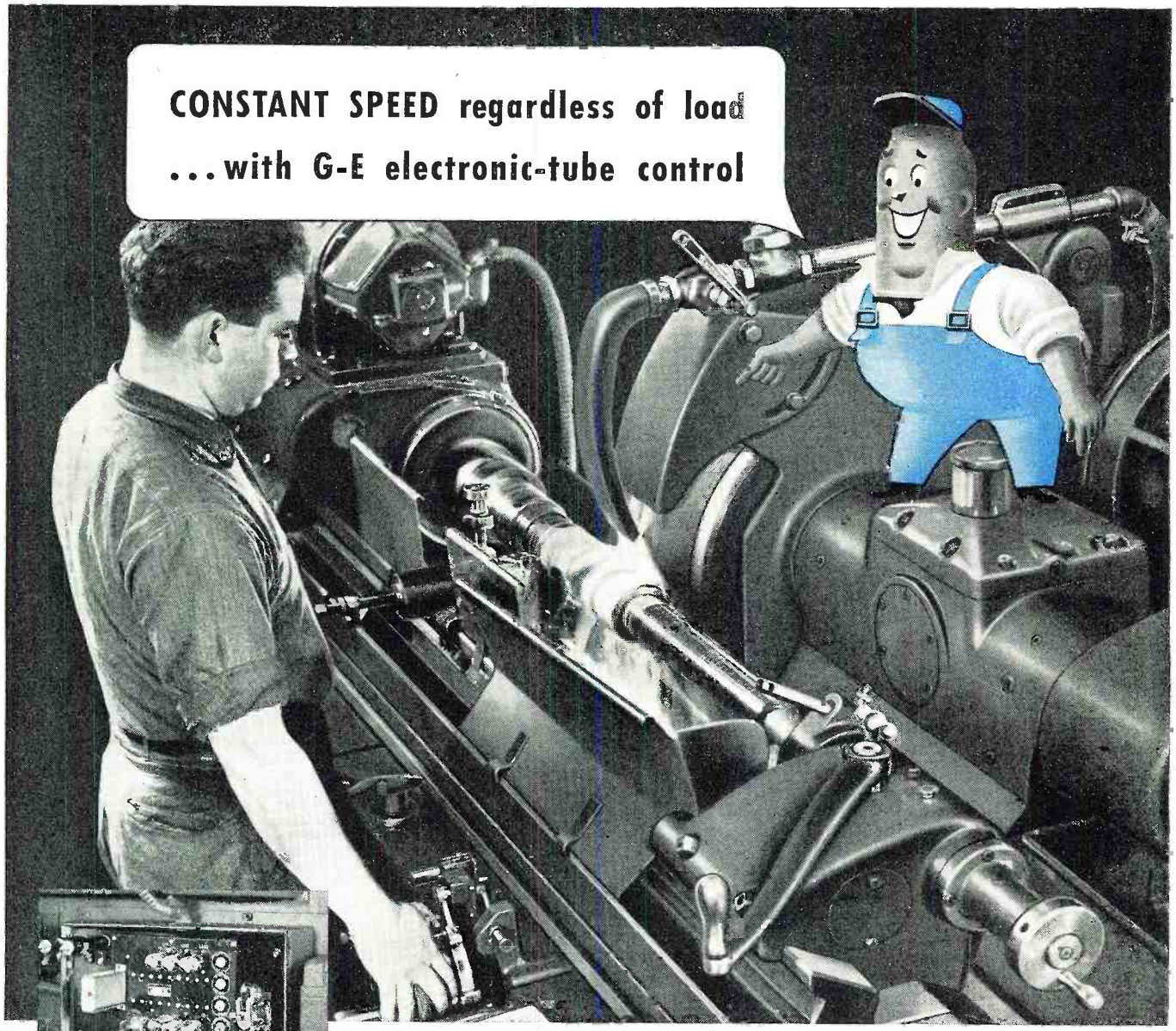
ARMY E NAVY

WARD LEONARD

Electric control (WL) *devices since 1892.*

WARD LEONARD ELECTRIC COMPANY, 47 SOUTH ST., MOUNT VERNON, NEW YORK

CONSTANT SPEED regardless of load ...with G-E electronic-tube control



The G-E thyratron tube is the "heart" of the G-E Thy-mo-trol unit which keeps the grinder going at uniform speed.

WHAT happens when a "hard spot"—or a "soft spot"—is encountered in a grinding machine operation? Nothing to upset the machine's stride when the Thy-mo-trol, the G-E electronic-tube motor control, is used for supplying power to the head-stock. Increased load causes no slowing; reduced load, no over-speeding . . . G-E tubes act as either a spur or a check to the power applied as may be needed to maintain the speed at which the operator has set the machine.

G-E electronic-tube control of motors provides smooth, stepless control of an extremely wide range of speeds. It helps to insure continuous smooth-surface grinding; improve tolerances; reduce rejects — and it provides the *right* speed for each type of grinding operation.

G-E electronic-tube control is similarly applicable to lathes, drill presses, milling machines and other motor-driven machinery subjected to varying loads. The thyratron is but one of a complete line of G-E electronic tubes that are enabling many kinds of industrial machines to do their work better, faster, more economically.

Through its nation-wide distributing system, General Electric is prepared to supply users of electronic devices with replacement tubes.

"HOW ELECTRONIC TUBES WORK"

This booklet will be mailed to you *without charge*. Its 24 pages are interestingly illustrated and written in easily understood language. Shows typical electronic tubes and their applications. Address *Electronics Department, General Electric, Schenectady, N. Y.*

• *Tune in* "The World Today" *and hear the news direct from the men who see it happen, every evening except Sunday at 6:45 E.W.T. over CBS. On Sunday listen to the G-E* "All Girl Orchestra" *at 10 P.M. E.W.T. over NBC.*

G.E. HAS MADE MORE BASIC ELECTRONIC TUBE DEVELOPMENTS THAN ANY OTHER MANUFACTURER

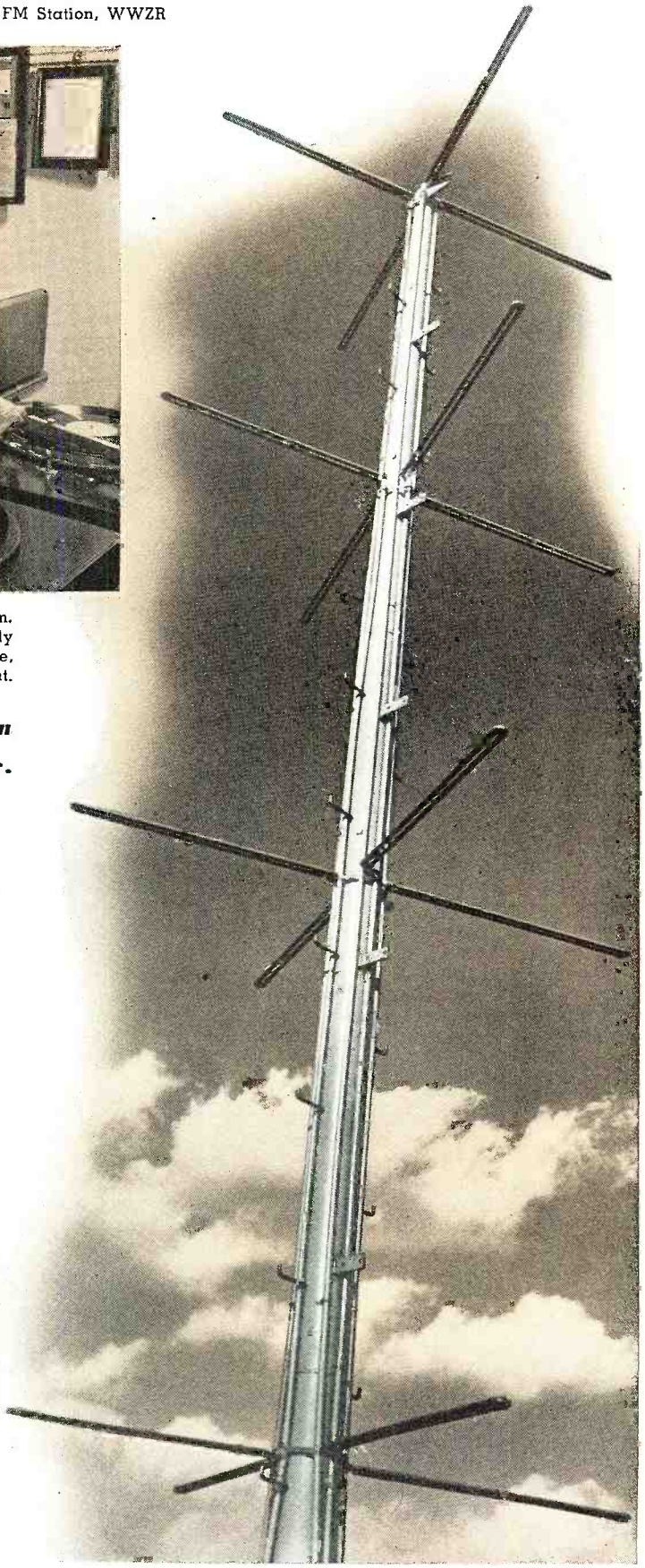
GENERAL ELECTRIC

162-C5

FM Station, WWZR

By ROSS UTTER

Chief Eng., FM Station, WWZR



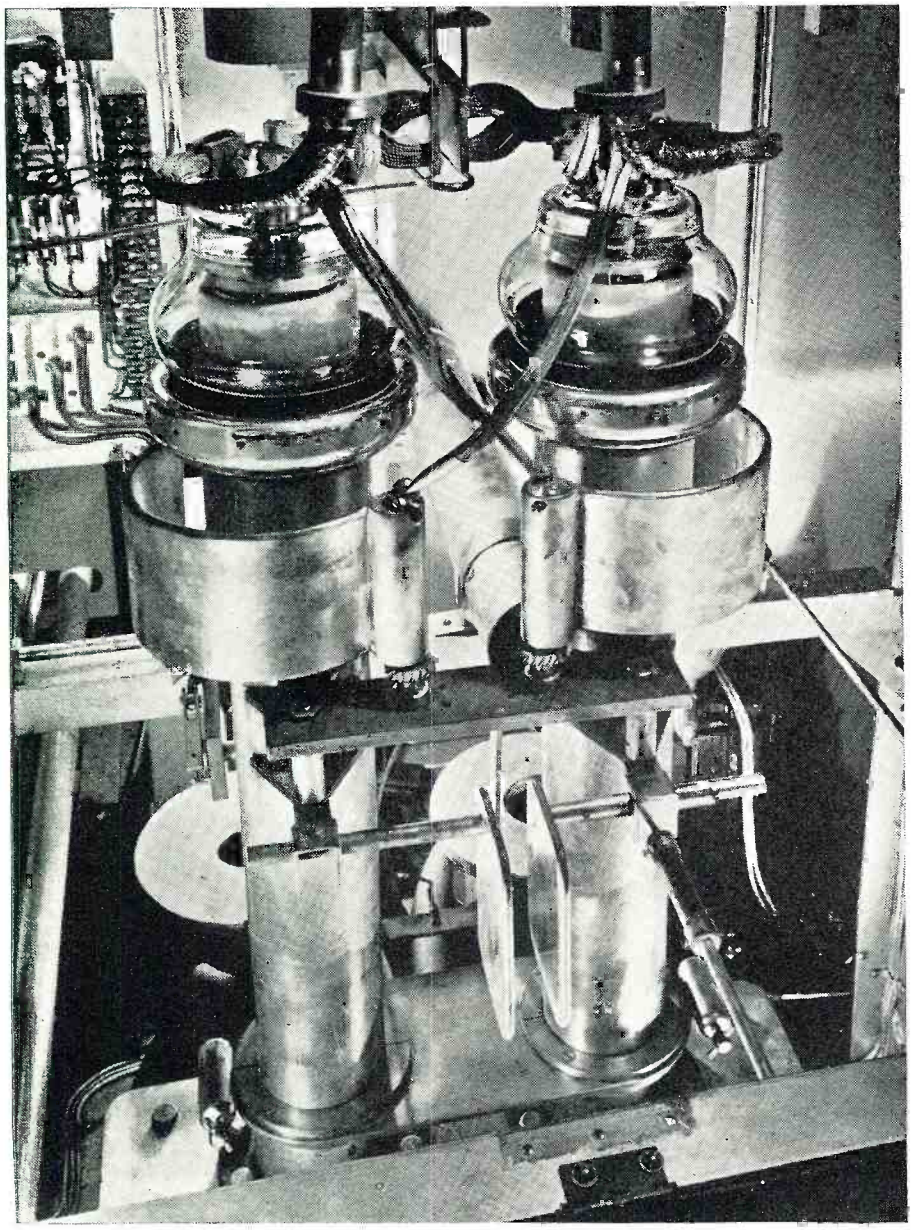
(Top) General view of station WWZR transmitter room. (Right) Four-bay turnstile antenna, providing horizontally polarized radiation. Antenna provides power gain of three, giving an effective field strength of 50 kw. with 18-kw. input.

Problems encountered in the construction and development of a 50-kw. transmitter.

FOR over two years, the greater metropolitan area of Chicago has been consistently served by the *Zenith* high-fidelity fifty-kilowatt commercial FM station, located atop one of the finest and most modern buildings in the Midwest. This building is also one of the tallest and serves admirably as the site for the broadcast station and antenna. It should be of interest to know that this effective fifty-kilowatt power output is obtained by using only eighteen kilowatts developed in the power amplifier stage, which requires only thirty kilowatts plate power input.

W51C, known as WWZR since November 1, 1943, is one of the pioneer FM broadcast stations in the United States, the first FM station in the Midwest to operate commercially with an effective power of fifty kilowatts. The course of development and expansion of WWZR led to the accomplishment of much that has been of value and interest in the field of FM broadcasting.

The construction and development of a fifty-kilowatt transmitter cannot be said to be an easy task. With the rapid and continually changing methods of improvement, practically every new station incorporates certain features that have probably never been used before or features that may be used in an improved manner. Quite frequently, improved equipment performance is effected by the application of a well-known basic principle. It is sheer invention that carves out a new step in the uphill road of progress and advancement. These factors, found in the broadcast field, in general, with its more than twenty years of background to draw upon, are even more pronounced in FM.



View of power amplifier showing details of grid and plate tuning circuits and water insulation coils.

Each time a new field is pioneered, as in the case of FM broadcasting, obstacles must be overcome, new methods discovered and fresh applications of governing laws put to use. It is interesting to note that less than four years ago the listening public, which is, after all, the judge and jury as well as the customer of all broadcasting, knew nothing about FM, and what it had to offer. Since then, however, FM has become an accepted fact and with it has come an increasing public demand for what FM broadcasting provides.

Development and Expansion

Realizing that the trend in the near future would be toward the high-frequency field, the station in 1937 inaugurated a staff of engineers whose work was not only to analyze the early developments in the high-frequency field, but also to make an effort to thoroughly prepare to take advantage of future opportunities. One of the first steps in this direction was the development and construction of a television station of advanced design, for experimental work in the high-frequency field. This first transmitter consisted of a one-kilowatt video and a one-kilowatt audio transmitter and antenna transmission line system of advanced design. This work was valuable from a standpoint of background, construction and operational experience and provided contributions to a new field, both in the television and high-frequency phases.

When FM emerged from the laboratory and was presented to the engineering world in a practical form, through the efforts of Major Armstrong, plans for the construction and operation of a fifty-kilowatt high-fidelity FM broadcasting station were made. In line with this program, the time that intervened basic research and development work made it possible for an application and permit for the construction of an experimental FM station in Chicago. Authorization was granted in 1939.

Working closely with Major Armstrong, engineers undertook a series of tests and experiments which contributed greatly to the advancement of FM in its formative stages. An experimental transmitter was built and the first FM test transmission with a power of one kilowatt was conducted on February 2, 1940 under the experimental call letters W9XEN, using Major Armstrong's Wide Band Frequency Modulation System. The location from which experimental operations were to be carried on had been selected, and accordingly, the transmitter and associated equipment were installed at that site. This was the Chicago Towers Club. The transmitter equipment was located on the thirty-seventh floor; the antenna, a vertical half-wave length coaxial type was mounted on the mosque-like dome of the building four hundred and ninety feet from the ground level. Many requirements for FM broadcasting were determined as a result of these tests, much that was new was encountered, and things already known subjected to tests and examination.

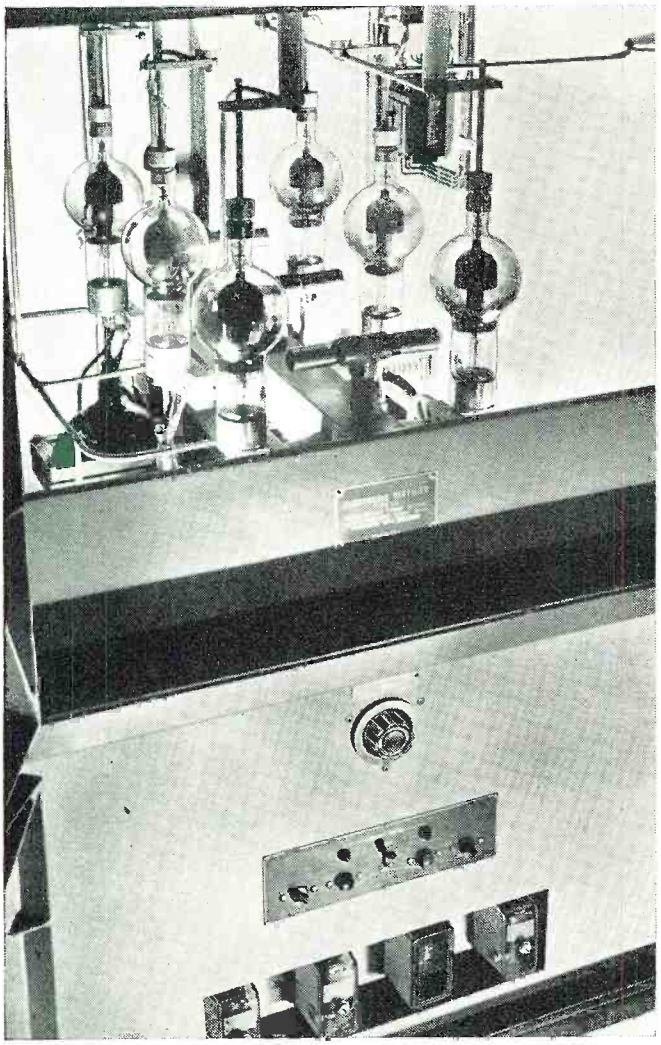
By February 17, 1940, this installation was completed and the testing program undertaken, using the one-kilowatt power amplifier, the Armstrong System Modulation unit manufactured by R. E. L., and Associated speech input and transcription equipment along with the necessary monitoring and measuring units.

Since this building was in the d.c. district of downtown Chicago, the three phase, sixty cycle, 220 volt a.c. primary power necessary to operate this transmitter was obtained by pressing into service a suitable motor generator unit of rather ancient vintage. This was installed in the elevator penthouse room of the thirty-ninth floor, with duplicate controls for operation from the transmitter room. The coaxial vertical antenna was connected to the transmitter output terminals by a length of 7/8" coaxial transmission line. This was run into the elevator shaft and up to the antenna. Some programs were supplied from the Columbia Broadcasting Studios over a specially balanced program line, whose characteristics were flat within two db. from fifty to fifteen thousand cycles. This line service was provided by A. T. & T.

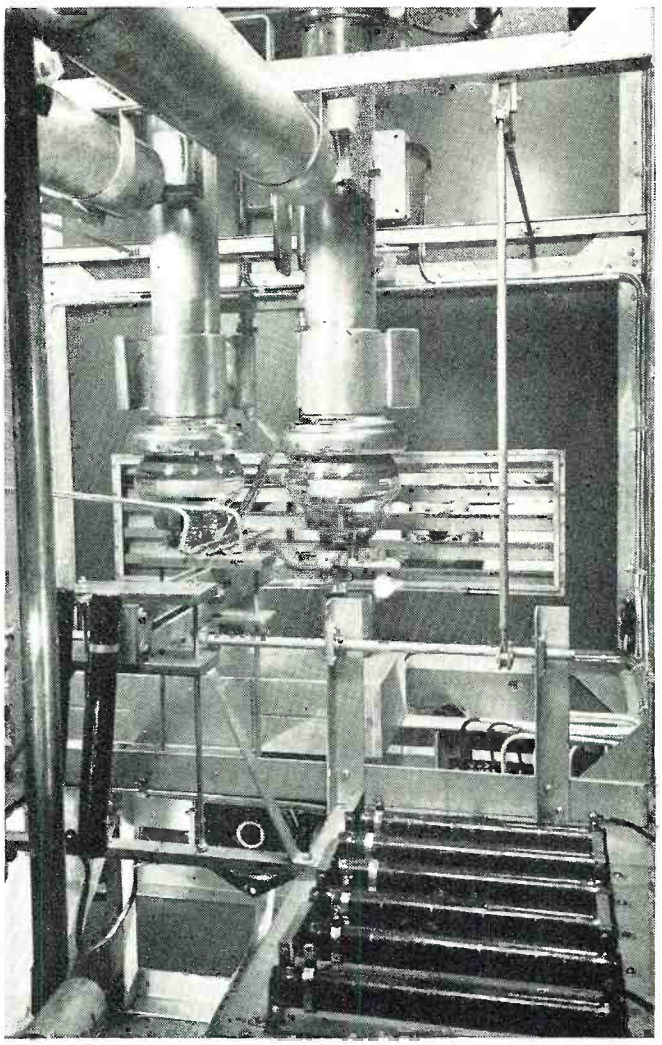
A difficulty encountered in the reproduction of transcriptions, due to the fact that the sixty-cycle a.c. current developed by the generator was not governed sufficiently well to prevent "wows" when used to operate the turntables. By using a pair of power amplifiers driven by a sixty-cycle electromagnetic drive tuning fork, sufficient regulated voltage was supplied to operate the turntables. This proved to be very satisfactory.

During 1940 several changes had been made on the one-kilowatt power amplifier that have proved worthy

(*Continued on page* 102)

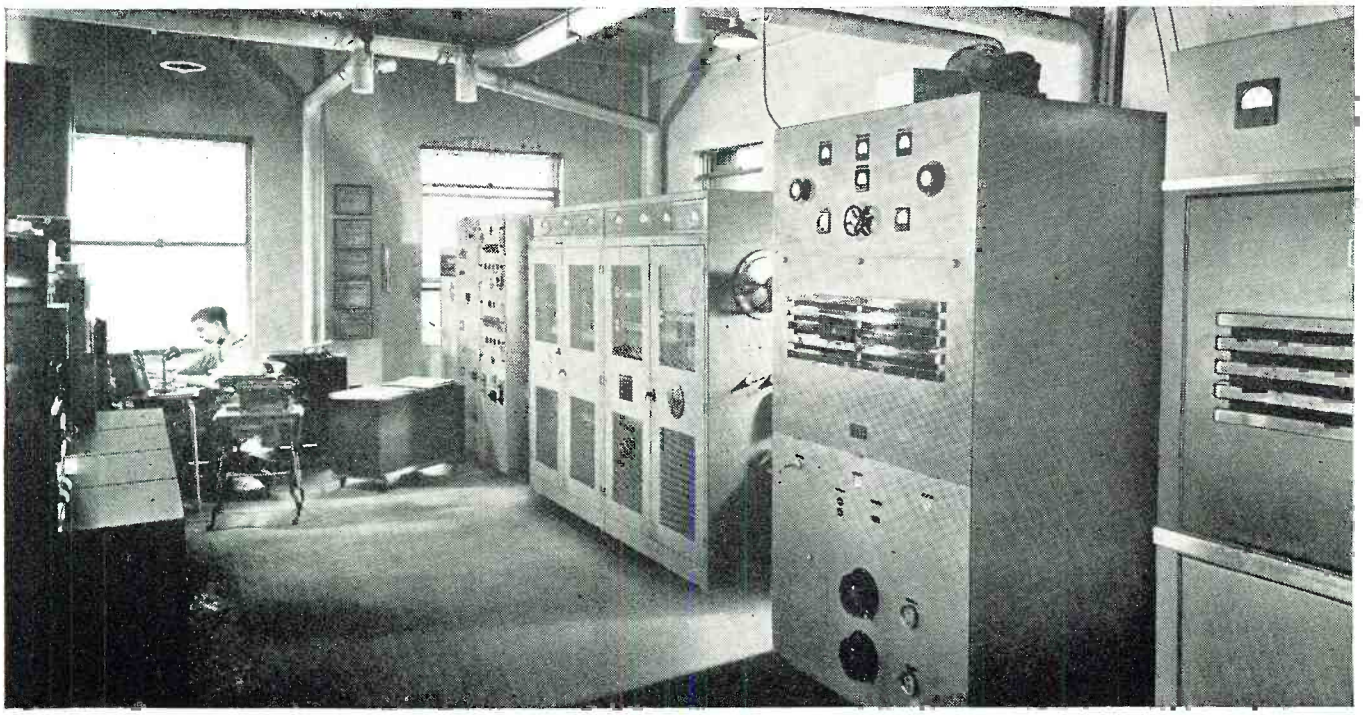


High-voltage rectifier cubicle and control panel. Note the simplicity in mounting the bank of tubes.



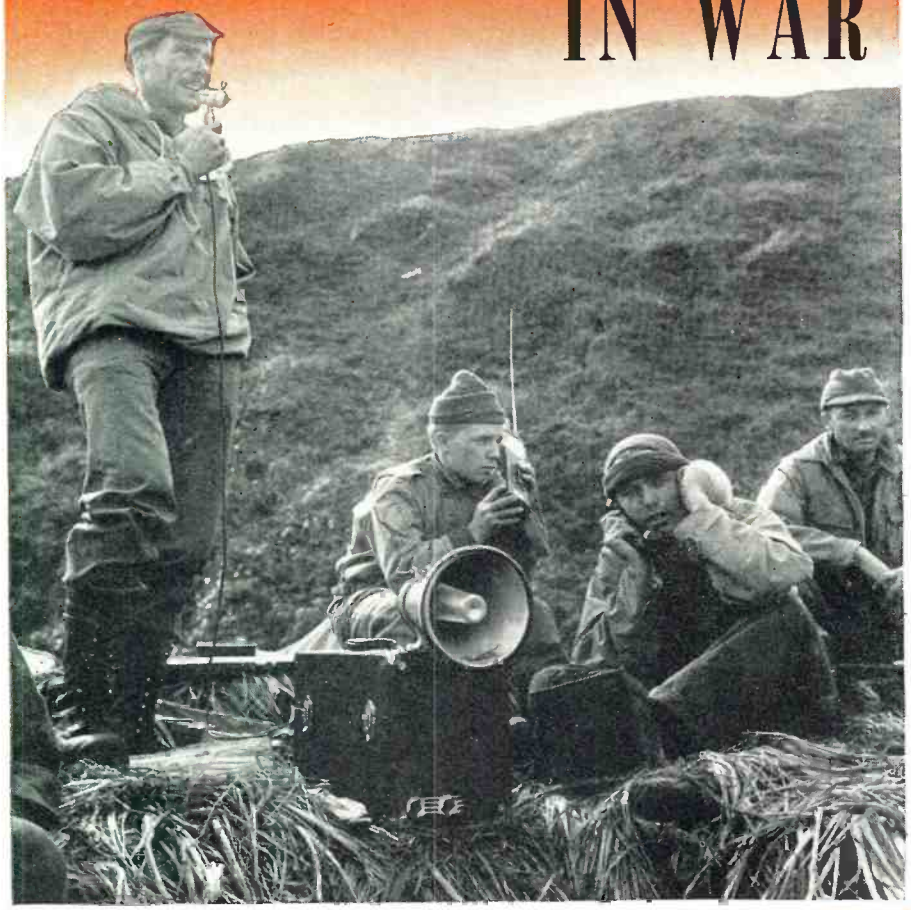
Details of final amplifier. Circuits are tuned directly from front panel. Water jacket serves as plate-tuning circuit.

Interior view of the transmitter room showing the various control panels and racks.



RADIO AMATEURS— IN WAR AND PEACE

By
GEORGE W. SHUART.
W2AMN



Former radio amateurs advancing inland during the occupation of Kiska with the vanguard of the joint American-Canadian invading forces.

The Author

A prominent "Ham" discusses the amateur of today and tomorrow—his part in the war and his plans for postwar broadcasting.

THERE are amateur photographers, amateur aviators and amateurs in many other fields, all of whom are doing a splendid job in the fight to preserve the finer things on this good earth of ours—but *we* are concerned mainly with amateur radio operators.

Somewhere on this great planet, not many weeks back, an invasion took place. There were hundreds of ships—battleships, carriers, cruisers, destroyers, PT boats and amphibious landing barges of every description. From every direction these dark, shadowy creatures moved slowly toward a tiny island which was to become a new strong-point in the rapidly shortening road to Tokyo. Heavy guns, from larger ships in the rear, hurled shells onto the beaches, and planes dropped their eggs in a sort of giant plowing and scraping process to make way for the thousands of boys who were to make that God-forsaken place their new home.

Among the endless chain of men struggling to haul heavy equipment ashore was a group of boys beaching radio gear to be used for the first communications base on that island. Within a couple of hours they were to have ready a complete radio station to provide weather reports, directions for airplanes, and to handle the hundreds of other messages that are so vital for successful occupation of strange territory.

Cases of radio equipment were floated ashore, striking jagged reefs which damaged the protective casings. With such rough treatment and with water soaking through to the delicate apparatus—would it work?—could they depend on the equipment after all that effort and after traveling many thousands of miles? A far cry this, standing there in water up to their knees on the shore of a strange island, compared with their last civilian experience where one sat in an easy chair and talked to some fellow "Ham" across the continent.

This was the final test . . . What were radio amateurs really contributing to the war effort? Those boys, going through an experience they'll never forget, knew that hundreds of their "Ham" friends were working in factories and laboratories back home, turning out this same kind of equipment which was soon to go on the air under most unusual circumstances.

Next, they had to decide where to place the station—and not much choice in the matter either with heavy shells falling just ahead of them—with men, tanks and other heavy equipment moving up so rapidly—they couldn't stand there holding up progress while they argued the point. Suddenly a crash near by caused the earth to split under their feet. That was it!! There was a hole, big enough to house *all* of their equipment—and somebody said: "Lightning never strikes twice in the same place."

And there it started! The master sergeant, formerly a radio amateur, and his eight assistants set up and began operating a modern radio sta-

(*Continued on page* 62)

COLORIMETRY

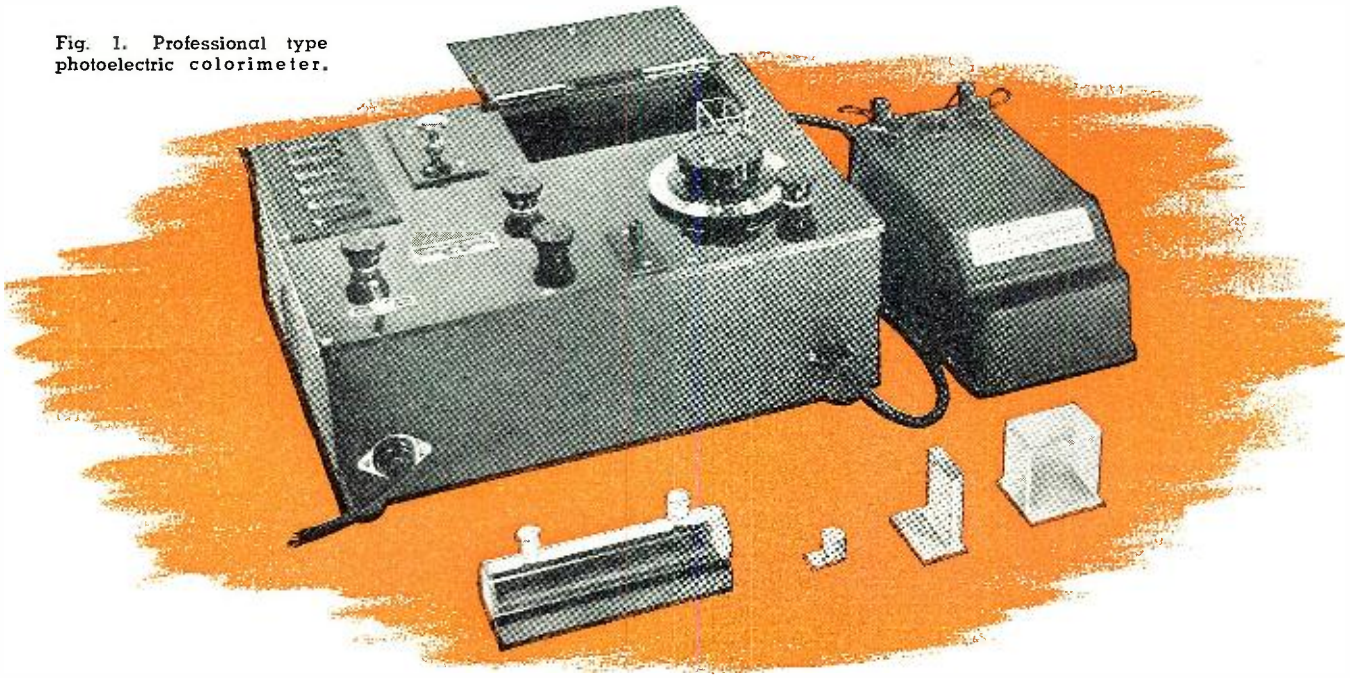


Fig. 1. Professional type photoelectric colorimeter.

By ALBERT A. SHURKUS

A review of the basic principles involved in the design of visual and photoelectric type colorimeters, used extensively in industrial measurements.

COLOR, when present, is an attribute of chemical solutions that enables their rapid and accurate analysis, for according to Beer's law the relative absorption or transmission of a solution is proportional to the concentration of the solute present. This law stated mathematically can be written:

$$\log_{10}\left(\frac{I_0}{I}\right) = kcl$$

where I_0/I is the ratio of the intensity of the incident light to the transmitted light that passes through a thickness l of a solution whose concentration c of colored solute is expressed in grams per liter. The constant k is called the specific extinction and is characteristic of the solute. The ratio I_0/I is the transmission of the solution. It must be remembered that this law is true only when monochromatic light is used and when the solution exhibits no scattering.

The science of performing this analysis is called colorimetry, and the instruments used for this purpose are known as colorimeters. These instruments may be either visual or photoelectric in operation. Photoelectric colorimeters have been developed to such an extent, however, and their acceptance has been so widespread, that they seem destined to replace visual type instruments almost completely.

Visual colorimeters, exemplified by the Duboscq type (Fig. 12), should in actuality be called color comparators since they are used to determine when two solutions have the same color. One of these solutions is of a known concentration of the compound being investigated, the other being of unknown concentration. One or the other of these solutions is adjusted in depth until a color match is obtained. When the solutions are so matched, then

$$\frac{\text{Concentration of unknown sample}}{\text{Concentration of standard}} = \frac{\text{Depth of sample}}{\text{Depth of standard}}$$

The accuracy of the color match

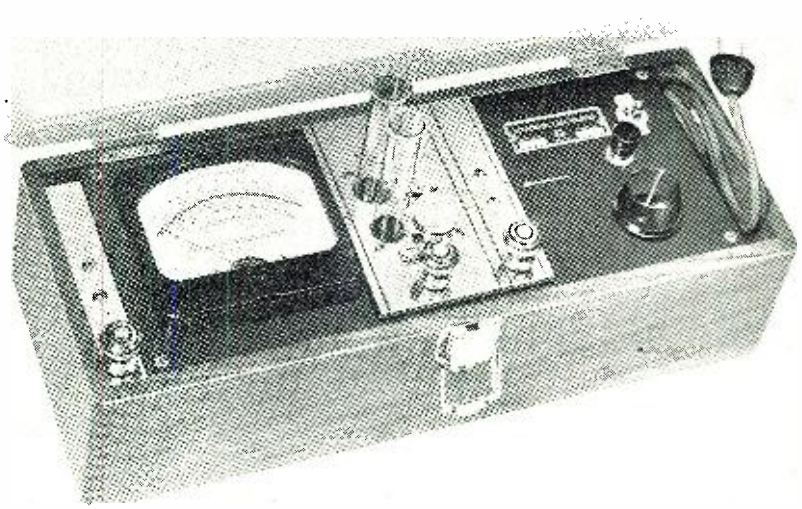


Fig. 2. Photoelectric colorimeter. Meter is used to accurately determine color measurements.

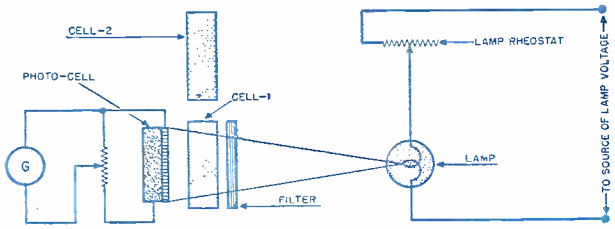


Fig. 3. Photocell colorimeter. The sample cells are mounted upon a cross slide for rapid interchangeability.

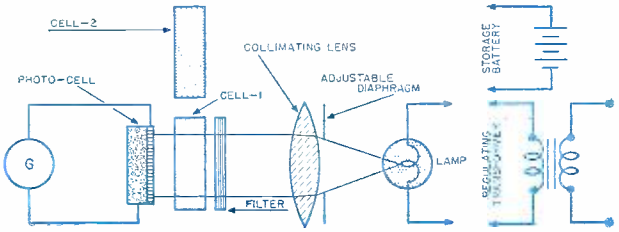


Fig. 4. A more elaborate form of photocell colorimeter, using lens for collimating light beam through sample cells.

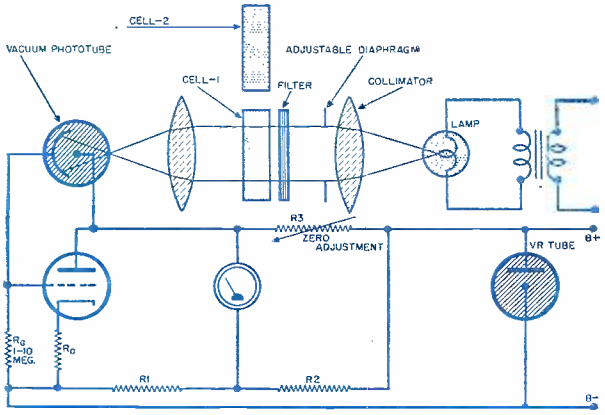


Fig. 5. Colorimeter employing thermionic amplification of a vacuum phototube with voltage regulation.

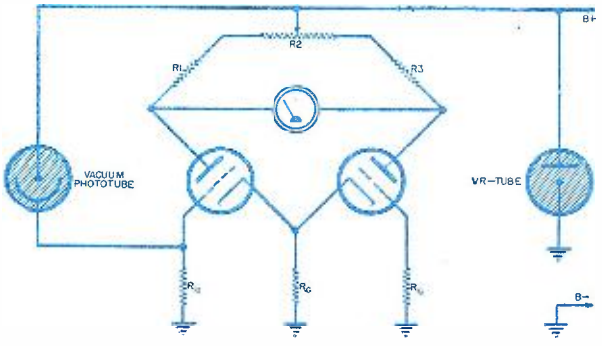


Fig. 6. Balanced-circuit amplifier employing single phototube and requiring no phototube battery.

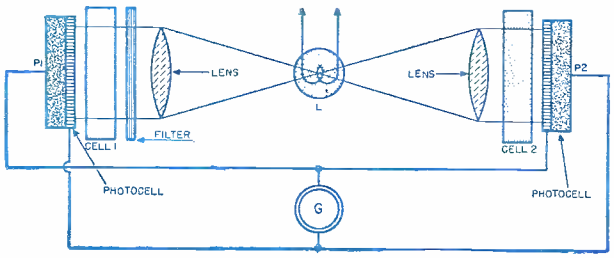


Fig. 7. The "differential" photocell circuit.

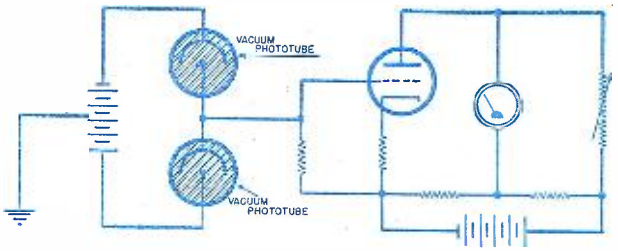


Fig. 8. The "differential" phototube circuit.

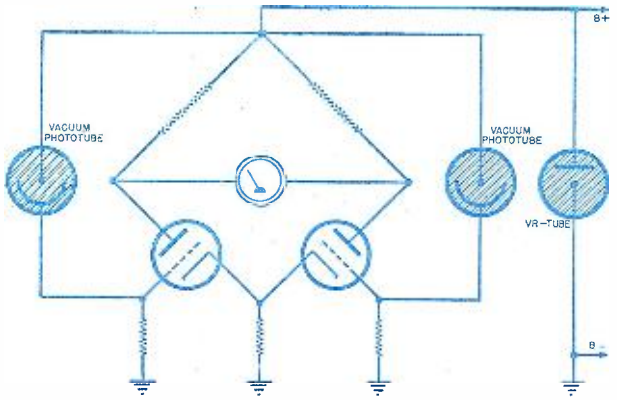


Fig. 9. The "differential" phototube circuit with a balanced amplifier arrangement.

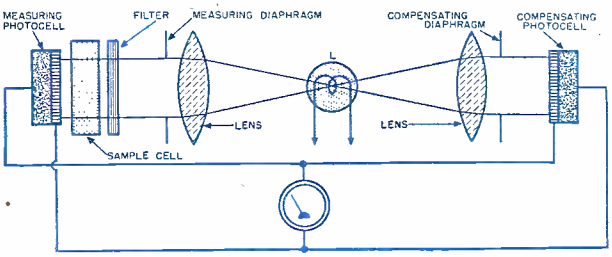


Fig. 10. "Differential" photocell circuit employing optical compensation.

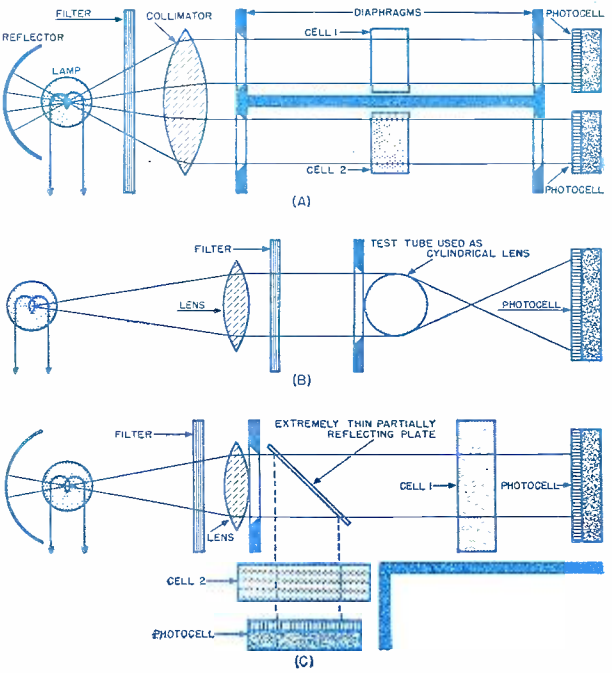


Fig. 11. Optical methods employed in various colorimeters.

obtained is dependent upon the monochromaticity of the light used and upon the personal equation; that is, inexperience, fatigue, and color vision anomalies on the part of the observer will give results which are in error. Nevertheless, visual colorimeters, when properly used, are capable of giving surprisingly accurate results.

Photoelectric colorimeters possess the chief advantage that the personal equation is eliminated. Causes for error are usually present in the instrument, yet they can be, theoretically, minimized by proper design and careful use.

Direct Reading Photoelectric Colorimeters

The direct reading photoelectric colorimeter is pictured in its simplest form in Fig. 3. Because of its simplicity many causes for error are present, making it all the better for purposes of discussion.

First of all, as shown, the lamp voltage is unregulated. It can be shown by theory and experimentation that the luminous intensity of a tungsten lamp will vary approximately as the fourth power of the lamp supply voltage fluctuations. The photoelectric current, being approximately proportional to illumination, will, therefore, also vary as the fourth power of the lamp voltage fluctuations. Since it is not unusual for the mains voltage to fluctuate rapidly by as much as ± 10%, it is evident that the photoelectric current will be anything but steady during the course of a measurement. For this reason, the use of this circuit makes mandatory the use of a lamp voltage regulator. The tuned resonant circuit type is commonly used. These regulators will "iron out" supply voltage fluctuations to such an extent that only about 1% variation in lamp voltage will occur. Yet, in many instances, even this amount of fluctuation in lamp voltage is objectionable. Then, either a large capacity battery must be used or a different circuit chosen.

In operation of this device, one of the two cells shown contains clear solvent, while the other contains the solution being measured. At the start of a measurement, the cell containing the clear solvent is introduced into the light path and through use of either a lamp rheostat or a meter shunt, both of which are shown upon the diagram, the meter is adjusted to read 100. Now, when the unknown solution is introduced, the meter deflection will be directly in percent transmission.

The use of a lamp rheostat is undesirable because the color temperature of the lamp is varied through use of it, making comparative readings subject to error. The variable meter shunt is better but it, too, can introduce unknown errors since the photocell is presented with different loads in the course of a series of readings, resulting in different proportionality factors between current and illumination. Better means of adjusting this full scale deflection would be through use of a variable lamp distance, a variable aperture, or adjustable neutral densities.

The use of uncollimated light, too, is objectionable for the refractive indices of the two liquids may be different, resulting in different areas of the photocell being illuminated. This condition can introduce noticeable errors since no photocell has uniform sensitivity over all of its surface.

In consideration of these things, the arrangement shown in Fig. 4 is much more satisfactory. But even this system must be calibrated for every type of solution to be measured. In this calibration it is customary to plot the logarithms of the transmissions of a series of specially prepared samples against their concentration, in which case the working curve is

(Continued on page 56)

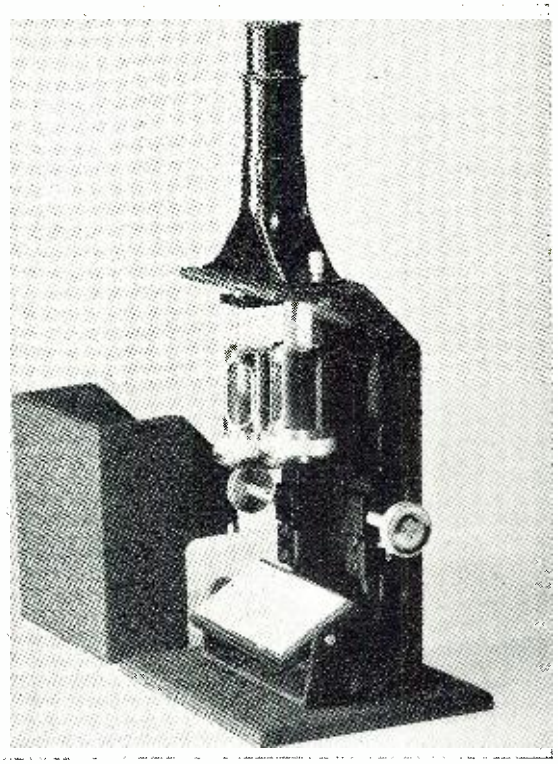
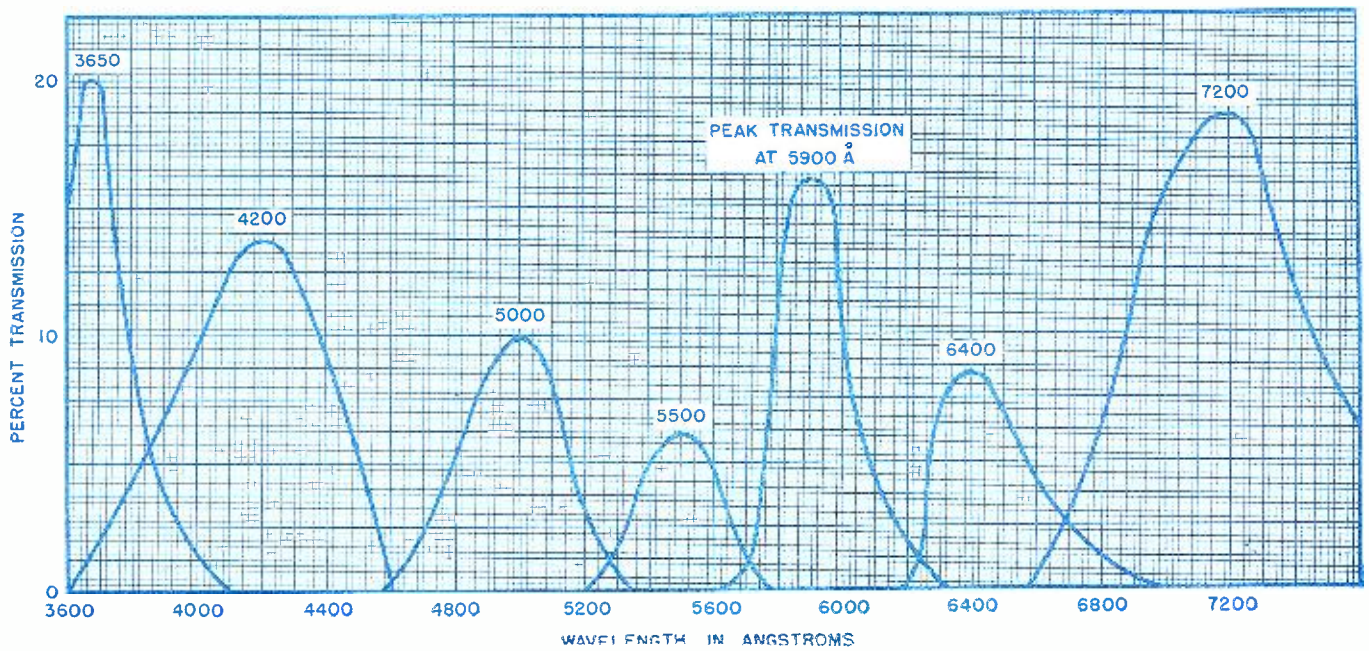


Fig. 12. Visual colorimeter. Shield fits over sample cells excluding stray light.

Fig. 13. Transmission curves of several commonly used colorimeter filters.



Postwar Opportunities For Servicemen and Technicians

By SAMUEL FREEDMAN
Lt. Commander, USNR

THERE is hardly a radio or electronic enterprise able to undertake all the things it would like or do them as well as it would like to do. The reason is the lack of sufficient development and engineering personnel. Because their number is limited by the prewar size of the industry they cannot be found quickly or developed from unskilled personnel. Even the termination of war contracts and the return to civilian life of many persons now in the Armed Forces or in defense plants will not be able to produce a surplus of capable engineering personnel.

It is not a question of finding jobs for displaced personnel postwar. It is a question of finding personnel for jobs that did not exist prewar. Many of those in the service will be suitable for this work, particularly those who have had experience before they entered the service. It must be recognized that in addition to the prewar radio industry employing approximately 300,000 persons, who will start up after the war with a tremendous backlog of business to fill for civilian needs, there are the many needs of electronics. It will require perhaps a 500% increase in employment postwar to handle new developments in electronics, television, railroad radio, radio-frequency heating, industrial applications, electron microscopy, medicine, microwave communication facilities and the conversion and extension of frequency modulation. Not a single one of these developments is stablized nor has its zenith in sight.

In Table I, 100 developments or opportunities for engineering personnel are enumerated. Any one of these developments can be made important enough to completely occupy hundreds and in some cases, many thousands of qualified radio people. This would be in connection with development, design, manufacture, installation, maintenance, training or sales.

Prewar radio and electronic equipment were of relatively few types and contained little in the way of tubes or parts. A radio receiver usually had less than ten tubes in it. Radio technicians and servicemen could maintain such equipment. Postwar we must definitely expect equipment that will contain over 25 tubes and in many cases up to 100 tubes. The maximum number can be expected in the case of television, particularly if it includes color and sound. It will also hold true for other apparatus such as the electron microscope, radio medicine, industrial electronics and aids to land, air and water transportation.

Let us analyze what 100 tubes in a piece of radio or electronic equipment really means when it comes to design or maintenance of such apparatus. Although future tubes may contain additional elements, let us think of it on the simpler prewar basis. Assume it had an average of 5 elements per tube (filament, cathode, control grid, screen grid and anode). In a 100-tube apparatus there might be 1000 resistor, condenser, inductance and terminal connections. Then the number of details and possible sources of trouble becomes not 5 elements $\times$ 100 tubes $\times$ 1000 connections or a total of 500,000. Actually the tube angle is not 100 times 5 but 100 to the fifth power. Therefore in reality it is 100 $\times$ 100 $\times$ 100 $\times$ 100 $\times$ 100 $\times$ 1000 or a total of 10,000,000,000,000 or ten trillion.

Even if there are not ten trillion points that might cause inoperation, there could conceivably be situations comparable with that number to be responsible for sub-standard performance. That is why postwar there will be a need for engineers rather than ordinary technicians and servicemen. Men and women with extensive education in physics and mathematics will be required as physicists and development engineers where they will specialize to a great degree.

Outside the laboratory, personnel will be required that can work with the equipment as a complete system. To keep this equipment functioning and in the hands of the consumer will require large numbers of sales and maintenance engineers. These engineers will be unsuitable if their training has been entirely academic. The field engineer must have an over-all knowledge of equipment from the highest practical standpoint . . . namely selling it and keeping it sold by having the equipment continue to function satisfactorily in the customer's hands. This article is largely directed towards such men—both actual and potential engineers.

There must be a shortage of such men now and postwar regardless of the displacement and changeover after the termination of hostilities and resumption of peace. The engineers required must have a good practical experience extending over a period of a few years. In addition, they should have specific theoretical understanding of vacuum tubes, use and application of the cathode-ray oscilloscope, time-base circuits, very-high-frequency techniques, phasing phenomena and a knowledge of mathematics sufficient to appreciate the algebraic and vectorial analyses of radio-electrical circuits.

It is not necessary that this theoretical training be obtained in residence school or at college with complete separation from one's trade or earning power during that time. It is feasible and perhaps desirable that men continue at their present radio tasks while acquiring the additional knowledge required by university extension, correspondence school course or simple self-study. Their normal radio work is a splendid substitute for laboratory experience. If opportunity affords, some resident instruction or visits to laboratories or factories are desirable, but not absolutely necessary. What is really necessary and very important is that the individual have an innate aptitude and desire for the work as well as an appreciation of what the future in radio and electronics holds forth. That cannot be better demonstrated than by one who has been employed in the field several years and who, by his own efforts, undertakes theoretical spare-time study to further improve himself. For such men minor disqualifications of age, physical disability or lack of a full formal education will not be a handicap towards making good.

While the equipment development may be the combined efforts of many minds, the job of making it a working system narrows down to the individual engineer. The fact that there are many engineers is due to the fact that there are many types of equipment since it is tied in with production and sales. The best engineer will be the one who came up the hard way from a junior category but obtained sufficient education formally or informally. If he started the intellectual or academic way, then it is important that he start at the

(*Continued on page* 100)

TABLE I. POSTWAR FIELDS OF OPPORTUNITY

Frequency Modulation. Replacement of Amplitude Modulation.
Facsimile systems.
Television.
Television in color with accompanying sound.
Diathermy equipment.
Radio alarm transmitters.
Radio alarm receivers.
Microwave automatic relay stations.
Transducers.
Sound detectors.
Magnetic detection.
Radio detection.
Navigational aids.
Aeronautical aids.
Vibration analyzers.
Electron optics.
Induction transmission.
Carrier channels of transmission on metallic circuits.
Carrier and sub-carrier channels on radio circuits.
Panoramic receivers.
Cathode-ray oscilloscopes.
Electron microscope.
Supersonic communication.
Electrical recording and transcription.
Magnetic recording and transcription.
Light recording and transcription.
X-ray techniques in medicine and industry.
Microphone equipment.
Loudspeakers.
Velocity modulation.
Phototube applications.
Talking movies.
Radio beacons.
Acoustics.
Radio plastics.
Public address systems.
Inter-office communication systems.
Wired Wireless systems.
Centralized radio receivers.
Automatic remote controls.
Component parts manufacturing.
Broadcast receiver manufacturing.
Vacuum tube manufacturing.
Cyclotron and atom smashing equipment.
Fluorescent lighting and adaptations.
Convulsion or shock machines to cure mental conditions.
Radio hardware.
Radio tools.
Radio transformers, chokes and inductances.
Resistor parts—fixed and variable.
Capacitors—fixed and variable.
High-frequency insulation materials.
Low-impedance components at microwave frequencies.
Police radio.
Railroad radio.
Radio nails.
Radio-frequency heating.
Public utility radio systems.
Taxicab radio.
Radio communication for trucks and busses.
2-way radio in automobiles.
Analysis of motional conditions too fast for the eye to see or body to feel.
Stroboscopic applications.
Radio altimeters.
Pressure indicators.
Humidity indicators.
Wind indicators.
Speed indicators.
Magnetic prospecting and metal locators.
Phasing equipment.
Electro-surgery equipment.
High-frequency baking, heating and roasting.
Medical research.
Crime detection.
Tissue growth, destruction and removal.
Traffic control aids.
Electronic clocks and timing devices.
Synchronizing equipment.
Color control and color matching.
Quality control and matching.
Density control and matching.
Electronic counting equipment.
Automatic warning and signalling.
Automatic control of lights depending on visibility.
Fire warning and fire control.
Geophysical exploration below earth's surface.
Atomic, molecular and even electronic control.
General microwave development.
Miscellaneous medical research and development.
Multivibrators and electronic switches functioning as fast as millionths of a second or as slow as hours in their action.
Power supply equipment using vacuum tubes for rectification.
Radio test equipment.
Antenna and transmission line techniques.
Radiosonde and meteorology.
Hearing aids.
Interference elimination.
Schools, textbooks and publications.
Amplidyne and selsyn systems.
Recording meters actuated by electronic circuits.
Measuring mass, motion, quality, flaws, quantity, rate of change and their control.

Each of these can furnish employment in research, design, manufacture, sales and distribution, installation, maintenance, training and utilization.

MAST SUPPORT for V.H.F.

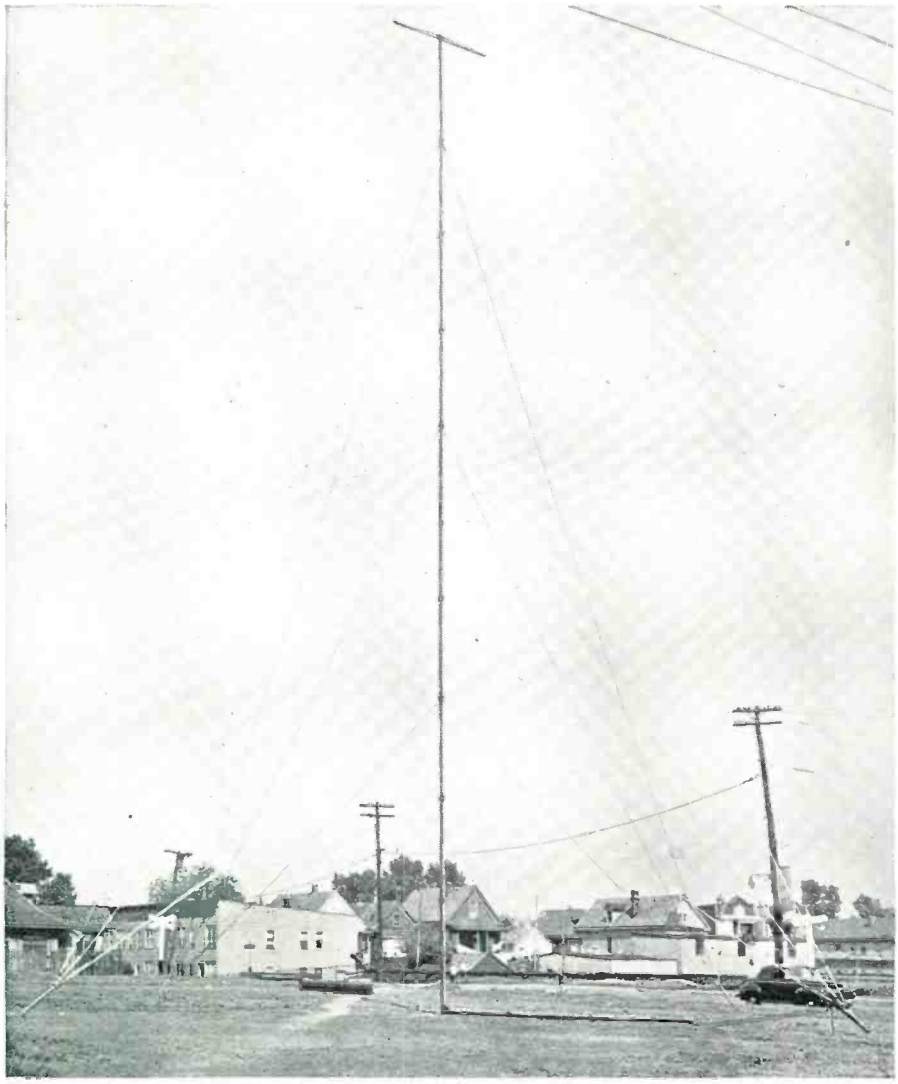


Fig. 2. Ninety-foot telescopic radio mast completely assembled and in position.

Fig. 1. Wedged bars are used to connect steel pipe sections of radio mast.

Fig. 3. Attaching hinged sections of base.

Fig. 4. Winch cable being attached to boom which, in final operation, is used to raise complete assembly into position.

and U.H.F. Antennas

By
HAROLD COHEN
Pres., Harco Steel Const. Co.

A readily-constructed portable antenna tower, ideally suitable for FM and television for use by amateurs and technicians.

IT HAS long been known that for radio waves above 40 megacycles in frequency, a clear path through the atmosphere is necessary for the transmission and reception of signals. Neither sky wave nor strong ground wave are normally existent at these frequencies. This is due to the fact that waves of these characteristics are not bent back to the earth by the ionosphere and are rapidly attenuated in the ground, with the result that they can be propagated only through the air in a path approximating the optical path. Although it is true that at times atmospheric refraction will increase the distance over which these waves can be transmitted, it is essential that both the transmitting and receiving antennas be elevated to the greatest practical height, in order to insure reliable communications at all times. In addition to increasing the length of the optical path, antenna elevation is also necessary in order to clear surrounding obstructions, which are particularly undesirable at these frequencies. A supplementary advantage of elevating the transmitting antenna will manifest itself in the reinforcement of the radiation at low angle resulting from the reflection of waves from the ground. Inasmuch as only waves emitted at low vertical angles are effective for v.h.f. and u.h.f. transmission, the skyward waves not being bent back and therefore being lost, this factor assumes considerable importance. Added antenna height becomes the equivalent of increased transmitter output.

With the present and anticipated increase in the applications of v.h.f. and u.h.f. techniques, including FM and television, the need for a simple, tall, portable, and easily erectible antenna support has become urgent. A mast completely fulfilling these requirements has recently been developed by *Harco Steel Construction Company* of Elizabeth, New Jersey. Called the "Speed King," it is furnished in heights of 50, 90, 110, 150 and 200 feet. The mast comes complete with all accessories, and can be erected by an inexperienced crew from instructions supplied with the equipment. If necessary, the mast can be disassembled and moved to a new location with all parts reusable. The development of this mast has obviated the use of complex, custom built structures, the cost and bulkiness of which limit their employment to only a very small percentage of installations.

Although this type of mast can be supplied in many convenient heights up to 200 feet, all masts are structurally similar, and by way of example the 90-foot mast will be described. Fig. 2 shows an erected 90-foot mast complete with a 12-foot crossarm and 27-foot boom.

The 90-foot mast consists of 10 sections of lightweight steel tubing, each approximately 10 feet long and 4 inches in diameter. Three similar sections comprise the boom, which is the device used to provide leverage for raising and lowering the mast. Sections of mast and boom are joined by an ingenious double wedge device which requires no bolts (see Fig. 1). A winch is supplied to provide a mechanical advantage so that two men can raise the mast to a vertical position.

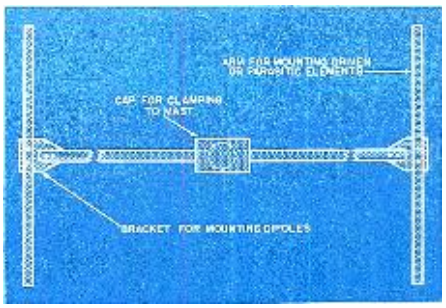


Fig. 5. Modified crossarm for mounting arrays of vertical elements.

Method of Erection

The mast is designed so that it is assembled on the ground in a horizontal position and then raised vertically after antennas, directive elements, and transmission lines have been attached. Raising and lowering of the mast can be accomplished in approximately 5 minutes, making possible frequent changes of antennas without long shutdowns.

Details of Erection

The first step is to set the mast base in place (see Fig. 3) and clear the adjoining area to allow sufficient space for assembly of the mast. Anchor positions are then located by means of a supplied template. Anchors are of the auger type, and are screwed into the earth until only the eye at the top of the anchor rod is exposed.

After the mast base and anchors are in place, the winch is installed on the rear anchor. The boom sections are then ready for assembly and attached to the winch (see Fig. 4). Using two sections of the mast as a lever, the boom is then raised vertically, and the remainder of the mast sections are assembled horizontally on the ground. After guy lines, crossarms, antennas and transmission lines are set in place, the mast is raised vertically by rotating in 90 degrees, as shown in Fig. 7.

Mounting of Antennas

The 12-foot crossarm is provided for mounting of antennas. This crossarm may be rotated around 360 degrees and made fast in any position, this feature being very desirable with directive arrays. Although a crossarm is supplied with each mast, it will sometimes be advantageous to mount a special array directly to the top of the mast, and this may be done without affecting the method of erection the least bit. There being so many different types of arrays, a universal mounting for them is impossible. However, the crossarm can be used directly for mounting vertical dipoles, and can be modified simply for mounting vertical arrays.

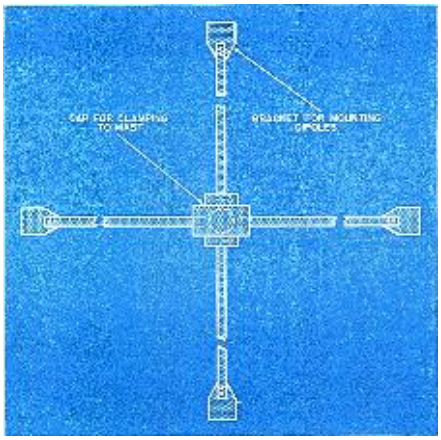
Mounting of Single-Element Vertical Dipoles

Neglecting the effect of the ground, the radiation from a single-element vertical dipole is uniform in a horizontal plane. Vertically, the radiation is greatest in the plane perpendicular to the center of the dipole and zero at the ends of the dipole, with a uniform gradient for angles between 0 degrees and 90 degrees. Where a pattern of this type is desirable, the single-element dipole can be mounted directly on the end of the crossarm.

For purposes of communication it is usually desirable to have separate antennas for receiver and transmitter to permit "cut-ins." These separate an-

(*Continued on page* 116)

Fig. 6. Double crossarm for mounting four vertical dipoles.



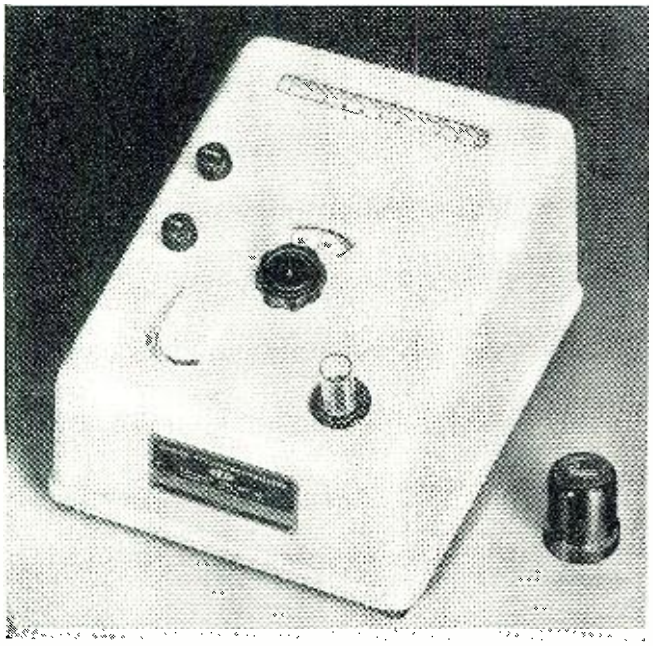


Fig. 1. Clinical type junior spectrophotometer.

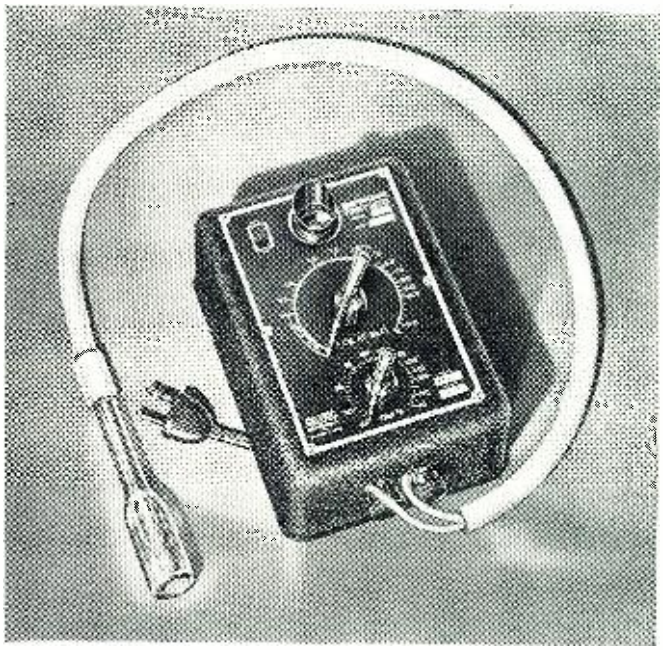


Fig. 2. Professionally constructed purity meter.

ELECTRONICS in Medical Science

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

Electronic equipment in use today by biologists and physicians to help maintain an increasingly higher standard of health.

STUDENTS of radio and elementary electronics have first-hand acquaintance with the common applications of electronics to biology, bacteriology, biochemistry, and medicine. Diathermy, short-wave therapy, the "radio knife," X-ray, and the microphonic stethescope have received widespread publicity. But for each of the widely-known systems, there are numerous invaluable applications not as familiar to the layman. The science of electronics is helping to safeguard our national health in more ways than "are dreamt of in our philosophy."

The history of electronic applications to biology is illustrious. Attempts to associate electricity and magnetism with life date back very nearly to the Middle Ages. It will be recalled that Galvani, experimenting in 1786, discovered muscular contraction in frog's legs touched with unlike metals. Benjamin Franklin found that he could kill a Thanksgiving turkey by the discharge of a Leyden jar. Still earlier, Mesmer asserted that stroking an afflicted limb with a lodestone relieved the pangs of rheumatism. Throughout the formative years of electricity there were repeated instances of the exposure of human beings to electricity or magnetism in one form or another in the earnest hope of curing ailments or at least diagnosing them accurately. Not until 1895, however, when Roentgen discovered X-rays, did electronics come forward with a device recognized at once as a great diagnostic tool for medicine.

In the forty-nine years which have followed the discovery of X-rays, electronic aids to biology, biochemistry, and medicine have been frequent and noteworthy. The largest number have been developed in comparatively recent years, since the introduction of the vacuum tube. While discovering new techniques and developing new equipment, we have at the same time improved the old and increased its scope. X-rays, as an instance, have therapeutic as well as diagnostic value in modern medicine.

It is reasonable to expect that biological applications of electronics will increase in number with the return of peace. Numerous technicians will be engaged in the production of equipment, and engineers and biologists will collaborate on new instrument design. An understanding of the less common present-day applications will enhance the experimenter's view of the current scope of applications, as well as furnishing support for future study. It is with that fact in mind that we present the following description of certain electronic devices and systems applicable to biology, biochemistry, and medicine.

Scope

Among the tasks which may be performed quickly and precisely by means of electronic instruments are (1) Determination of vitamins in food chemistry; (2) Examination of the blood; (3) Determination of mineral content in food chemistry; (4) Measurement of potentials in living bodies; (5) Measurement of percent oxygen saturation in the blood (an important test

performed on prospective airplane pilots); (6) Testing water purity; (7) Encephalography (brain investigations); and (8) Sterilization and irradiation.

Some of the instruments employed are general spectrophotometers elcctronic photofluorometers, anoxia photometers, purity meters, high-gain a.c. and d.c. amplifiers, vacuum-tube voltmeters and millivoltmeters, ultraviolet light sources, supersonic generators, and recording oscillographs. These instruments are rapidly becoming standard equipment in the laboratories of biological research organizations, hospitals, Government testing agencies, and manufacturers of medicinals and pharmaceuticals. Several of the instruments employ the photoelectric principle in one form or another and are capable of giving accurate indications quickly, continuously and without fatigue and error formerly experienced with "eye methods."

The Spectrophotometer

The *spectrophotometer* is one of the most modern of electronic instruments. Through it, light is enlisted as a laboratory tool. With it, *spectrochemistry* is precisely applied.

Before describing the spectrophotometer, let us consider the various factors and principles behind its operation and application. Color has long been a valuable tool to the chemist. (Color is simply a name for light wavelength). By means of color, the chemist is able to identify materials in solution and to measure their concentration. Formerly, this was done by comparing (by eye) the color and density of a solution with several standard solutions.

The spectrophotometer outstrips the eye in color matching and determining density. By means of an ingenious photoelectric system, it enables both qualitative identifications and quantitative measurements. In this instrument, light is directed through a test tube or *cuvette* of the test solution. A self-generating photocell replaces the eye, and a potentiometer bridge circuit measures the photocell voltage, giving direct readings of transmittance or optical density. A spectrum grating, placed between the light source and the photocell, enables the operator to select the color band of light to which the substance under examination has highest response.

The schematic for a popular clinical spectrophotometer is given in Fig. 4 Fig. 1 is a photograph of the corresponding instrument. From Fig. 4, it may be seen that light reaching the photocell must pass not only through the cuvette of test solution, but also through a system of quartz lenses, a monochromator grating, a spectrum slit, and a filter. The wavelength of this light is controllable by the wavelength cam, to the shaft of which is attached the wavelength dial direct-reading in millimicrons. (A micron is one thousandth of a millimeter and is equivalent to 300-million megacycles. The visible spectrum extends from 400 to 700 millimicrons.)

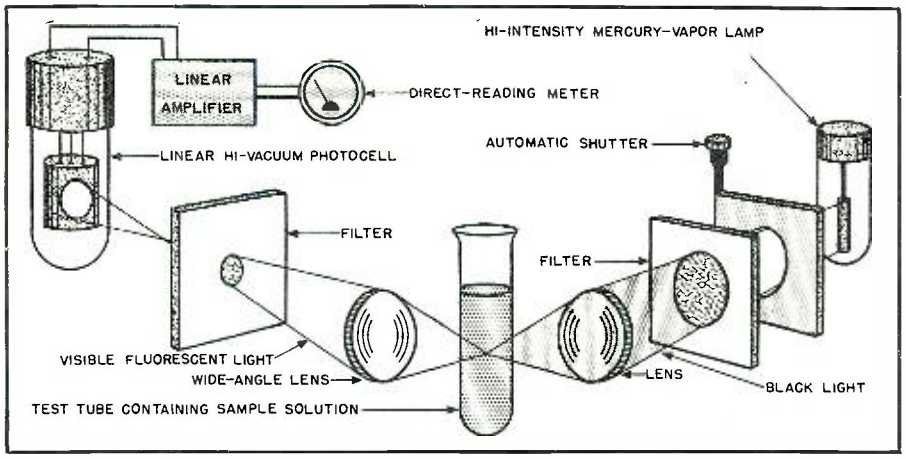


Fig. 3. Arrangement of a practical photofluorometer using black light from a mercury vapor lamp. The light beam is focused within a cuvette of test solution.

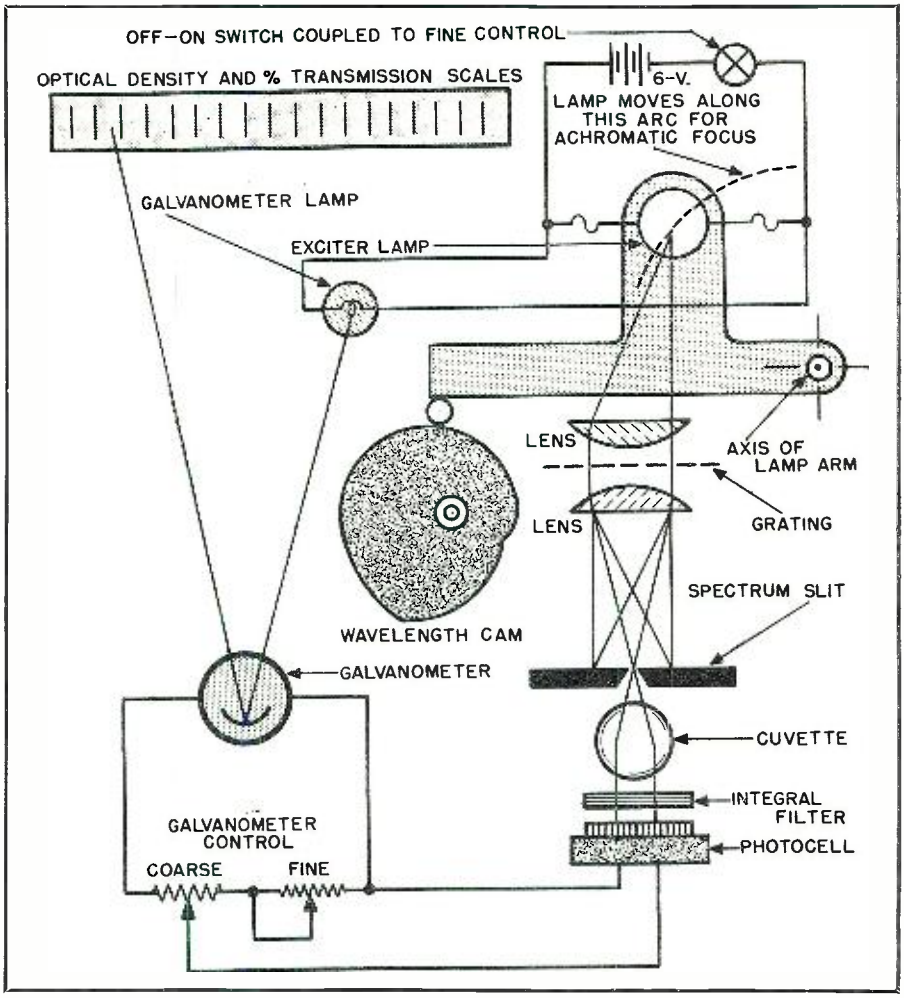


Fig. 4. Diagram of a clinical spectrophotometer. A beam-deflection galvanometer is used, giving direct readings of the optical density and percent transmission.

The photocell feeds into the potentiometer, and the latter in turn operates the beam-deflection galvanometer which gives direct reading of the optical density and percent transmission

The first measurement with the spectrophotometer is to determine which light band is most appropriate for the test and in this operation a series of readings at various wavelengths are taken for the test solution.

A spectral transmittance curve (such as Fig. 6) is then plotted. The lowest reading (maximum absorption) indicates the wavelength to which the substance is most responsive. From this data, the wave band is selected.

Using this band, several standard solutions of the material are examined and a concentration curve (such

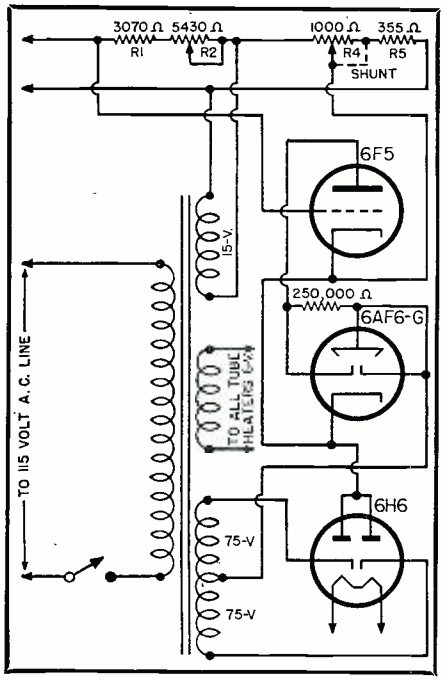


Fig. 5. Diagram of purity meter (Fig. 2).

as Fig. 7) is prepared from the readings obtained.

After these two operations, the instrument is then ready for testing unknown samples. Cuvettes of the latter are placed in the spectrophotometer and the readings obtained are referred to the concentration curve (Fig. 7) to determine concentration.

In vitamin A determinations, an absorption band of 350 millimicrons is employed. For vitamin B_1 and riboflavin, a mercury illuminator is used. Vitamin K is measured at 325 mu and Beta Carotene at 450 mu. Still other materials are examined by means of the photofluorometer (also called a fluorimeter).

Photofluorometer

Operation of the photofluorometer differs somewhat from that of the spectrophotometer.

The turbidity of some test solutions can be measured with photometric determinations by its effect upon light transmission. The fluorimeter utilizes fluorescence of the considered material under action of certain illumination and thereby removes this limitation. Some spectrophotometers, like the one previously described, may be adapted readily, by means of accessories, to fluorimetric tests. Thiamin and riboflavin are two vitamins which are easily and precisely assayed by fluorimetric methods.

Fig. 3 illustrates the arrangement of a practical photofluorometer. In this system, black light from a high-intensity mercury vapor light and special lens group, having the proper wavelength for the test, is focused within a test tube or cuvette of test solution. The considered material accordingly fluoresces, and the visible fluorescent light is picked up perpendicular to the black light beam and focused by a wide-angle lens through a filter upon a linear high-vacuum photocell. The cell output voltage is then presented to a linear amplifier which actuates an indicating meter.

The instrument is standardized by checking the meter zero. A test tube or cuvette of quinine sulphate is then placed into the sample cavity and the circuit adjusted for a convenient meter deflection (such as 100). The test sample is then inserted and its concentration indicated directly upon the meter scale. Between adjustments and insertions of cuvettes, the shutter between the mercury lamp and the cuvette is closed to protect the system.

Filters, for insertion between the shutter and the black-light lens, are available in several types for passing the different wavelengths required by certain tests. It is thus possible to select the wavelength of light which will give best fluorescence of the considered material.

The Anoxia Photometer

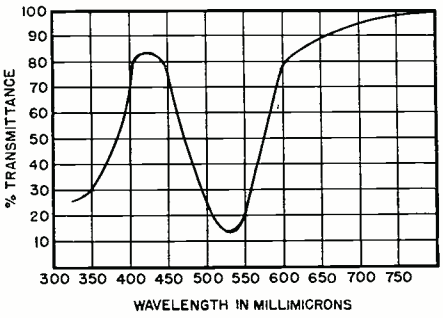
Anoxemia (insufficient oxygen in the blood) is an important factor in determination of the progress of anesthesia. It is particularly significant also to the Army and Navy, at this time, in tests made on prospective airmen.

The anoxia photometer, employed for anoxemia measurements, consists of a photoelectric colorimeter, similar to the instruments just described, an indicating galvanometer with direct-reading *percent oxygen saturation* scale, and a specially-developed "earpiece."

The earpiece consists of a miniature lamp house and photocell. It is clamped to the upper part of the subject's ear. Light from the lamp house passes through the thin scapha membrane of the ear, becomes "blood colored," and actuates the photocell. Currents generated by the cell are delivered to the instrument proper to enable measurements of spectral characteristics of the blood-colored beam. The galvanometer deflection then indicates directly the degree of anoxemia.

These measurements are made without taking blood samples. The subject accordingly is tested under dynamic living conditions. Aviation candidates may thus be tested within a decompression chamber, and continuous observations be made during decompression cycles.

Fig. 6. Spectral trasmittance curve.



The anoxia photometer is finding increased clinical application in anesthesia, oxygen therapy, and aviation.

Testing Water Purity

Large amounts of pure water are used in test operations and therapeutic techniques in the biological sciences. This water is distilled and must be as free as practicable of all mineral and organic contamination. Tests must be made quickly and accurately to determine the state of purity of each quantity.

Conventional chemical laboratory methods of water testing are relatively slow and depend upon eye examinations. Trained technicians are required.

The electronic purity meter, on the other hand, requires no skilled operator, gives precise retraceable indications directly, and will detect minute traces of impurity.

The Barnstead purity meter is shown in Fig. 2, and its circuit diagram in Fig. 5. This unit measures the conductivity of the water sample by means of a compact a.c. Wheatstone bridge.

The "pickup" device of the instrument is a glass *dip cell,* seen at the end of the cord in the photograph, which is immersed in the water sample. The active element of this cell consists of platinum electrodes, coated with platinum black, which when immersed become the unknown resistance of the bridge circuit. The cell is connected to the two upper left-hand input terminals in Fig. 5.

The resistance of the cell will vary in accordance with the contamination of the water sample, and the single-dial bridge control, R_4, may be made direct-reading in units to express this condition. The scale, readily visible in the center of the panel in the photograph, is marked off between 0.1 and 15 parts per million (as common salt—sodium chloride).

The circuit is a.c.-operated through a power transformer which delivers, in addition to tube heater voltages, 75 v. to each cathode of the 6H6 full-wave rectifier and 15 v. to the bridge circuit. The bridge balance indicator is the 6AF6-G magic-eye tube.

The amplifier and indicator tubes operate at twice the line frequency (in absence of filtration). This prevents the eye from opening if the bridge is unbalanced in one direction and closing if unbalanced in the opposite direction, a condition which would result if the 6F5 and 6AF6-G were operated at the line frequency. When the bridge is balanced, the indicator is at its maximum shadow angle (wide open).

Resistor R_2 is the temperature compensation control, to which is attached the lower pointer knob in the photograph. The scale of this potentiometer is graduated in Fahrenheit temperature units between 64 and 190 degrees, and enables the operator to

(*Continued on page* 96)

Adaptors for VoltOhmyst Junior

Design and construction of several simple attachments used to convert the Volt-Ohmyst Junior into an r.f. voltmeter, high-voltage voltmeter, and milliammeter.

By
GUY DEXTER

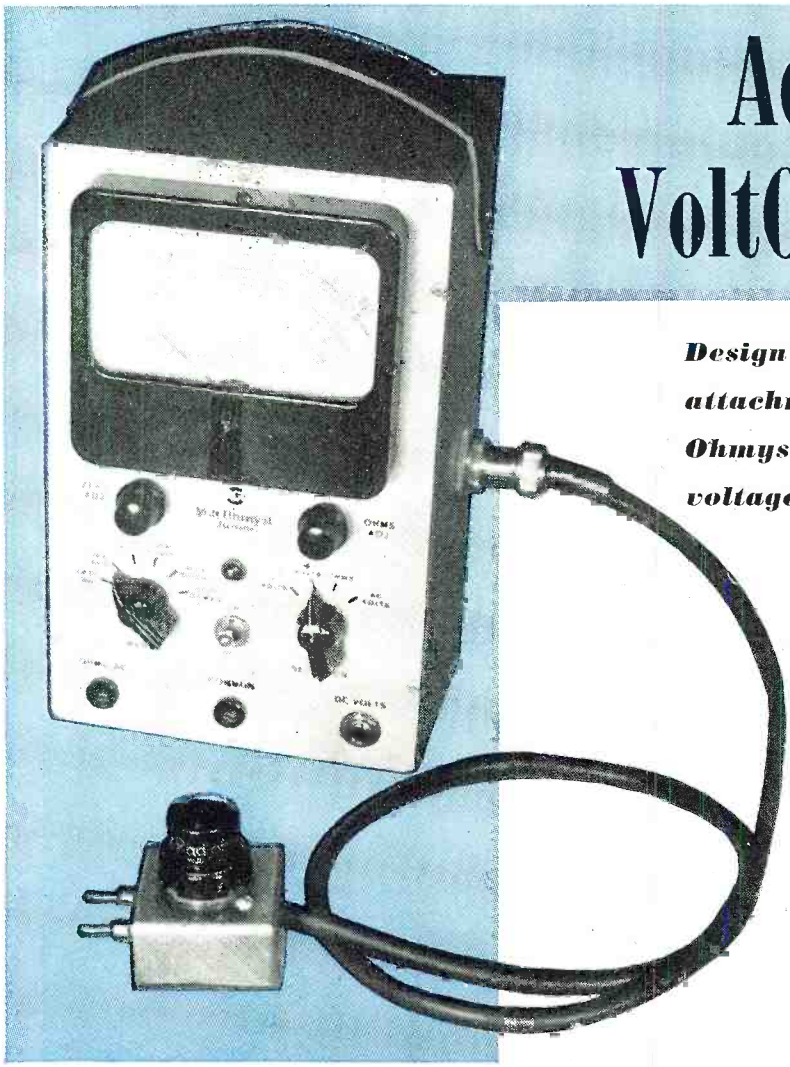


Fig. 1. VoltOhmyst shown converted for r.f. measurements.

ALTHOUGH the VoltOhmyst Junior is an instrument of wide utility, its usefulness may be increased still further by means of several small, easily-built attachments described in this article. These devices make possible the following additional functions:

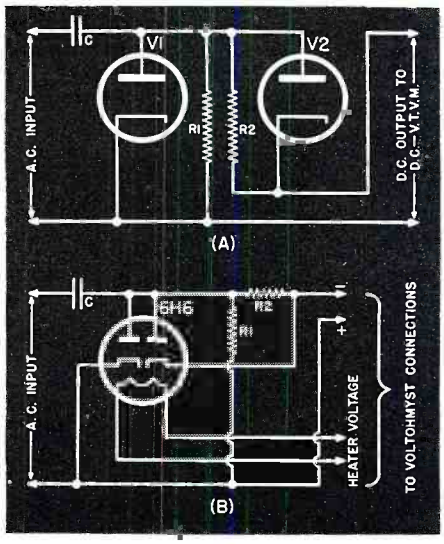
(1) Measurement of r.f. and high-frequency a.f. voltages;
(2) Measurement of higher voltages than the scale-limit value of 1,000; and
(3) Measurement of direct currents.

The first function is enabled by a diode-type voltmeter probe, two types of which will be described; the second by a compact ten-to-one voltage multiplier of the plug-in type; and the third by a four-step shunt. The regular meter scales are employed in each case. By means of these simple accessories, the VoltOhmyst is converted into a radio-frequency v.t. voltmeter, high-range electronic voltmeter, and milliammeter, these being in addition to its normal instrument functions.

The need for a special attachment for making voltage measurements at radio frequencies and high audio frequencies will be evident to most experimenters, for these reasons: The a.c. portion of the VoltOhmyst is based upon an oxide rectifier circuit. This limits the accuracy of voltage reading as the frequency is increased in the audio-frequency range, and the a.c. meter is by nature unsuited to r.f. application.

Any electronic d.c. voltmeter, of the VoltOhmyst type, is easily converted into an r.f. instrument by addition of a suitable diode-type probe. By this arrangement, the radio-frequency voltage is rectified at the point of its generation and the resultant direct voltage presented to the highly-efficient electronic d.c. circuit of the VoltOhmyst. The diode tube may draw current for operation of its heater, direct from the VoltOhmyst through the same cable sheath employed to carry rectified pulses to the input circuit. For extreme isolation, when it is undesirable to employ a.c. heater voltage, a diode probe may be assembled around a battery-type tube. Both types are described in this article, the a.c. probe employing a 6H6 tube and the battery-type a 1A3 high-frequency diode.

Fig. 2. Diagram of r.f. measuring probe shown in Figs. 1 and 3.



6H6 Probe

The a.c.-operated probe is shown in photographs in Figs. 1 and 3, its circuit diagram in Fig. 2. Fig. 3 shows the external aspect of the 6H6 probe with its cable and connector. In Fig. 1, this probe is shown plugged into the VoltOhmyst by means of cable connectors mounted on the instrument case (male) and probe cable (female). Fig. 5 shows the connector mounted through the VoltOhmyst case, and the cable disconnected.

Referring to the schematic in Fig. 2, it will be seen that the circuit of the probe is entirely conventional. A shunt-type diode circuit is used to rectify high- or radio-frequency voltages, and these are delivered directly to the voltage input terminals of the VoltOhmyst. As is well known, however, the diode tube has an appreciable contact potential, and the resultant flow of current in the absence of a signal will produce an initial voltmeter deflection and introduce an error in all readings within low ranges. It has been customary to

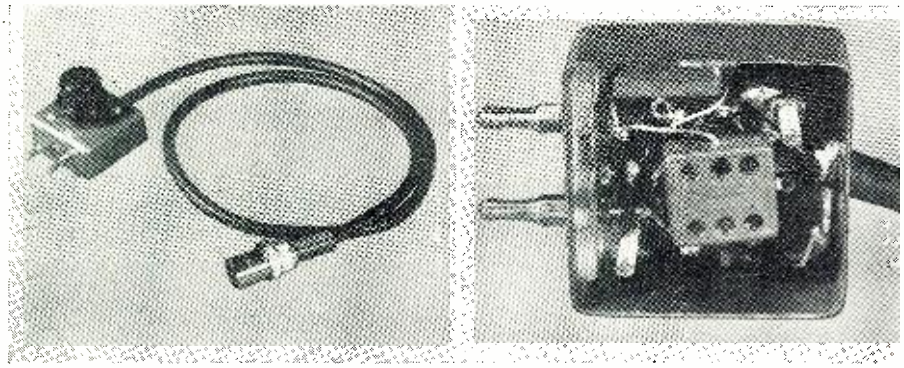


Fig. 3. Completely shielded a.c. probe, utilizing a 6H6 to rectify high-frequency voltages.

introduce a small voltage (usually from a dry cell) to buck out effects of the contact potential. In line with suggestions made recently by McMurdo Silver,[1] however, we have resorted to a novel and convenient means of bucking out the initial current flow without a battery: The first section of the 6H6 is employed as the active r.f. rectifier, but the second section is so wired into the circuit that its contact potential bucks out the electron current of the first. In Fig. 2, V1 is the rectifier while V2 is the bucking section. Bucking voltage is developed across desistor R2 and acts in opposition to rectified d.c. voltage produced across resistor R1. (See Fig. 2A.)

Actual wiring of the 6H6 probe is shown in Fig. 2B. The input capacitor (C) is .02 μfd. in capacitance and must be a miniature mica type. Since small mica units are not manufactured up to this value, it will be necessary to wire two .01-μfd. capacitors in parallel, mounting them as close together as physically practicable in order to obtain short leads. The rectifier load resistor, R1, is 20 megohms and may be a miniature ½- or ¼-watt unit. R2, across which the bucking voltage is developed, is somewhat critical in value, its actual ohmage being determined by the strength of the electron current flowing through it. The latter will vary with each tube and must be adjusted individually for the particular 6H6 chosen for the probe. The best practice will be to hook the probe up, attach it to the VoltOhmyst (as will be described later), and adjust R2 until the meter reading is zero. The value will lie between 1,000 and 50,000 ohms for most 6H6 tubes.

The 6H6 probe is built into a 2" x 2" x 1" can, which may be made of any convenient metal, and is entirely self-contained. The tube socket, which should be made of low-loss bakelite, polystyrene, or ceramic material, is mounted in the center of the can top, its long mounting screws being used to hold the bottom in place. The input terminals are banana plugs, mounted through clearance holes and secured to a polystyrene strip held to the can by a single screw seen between the plugs in the external-view photographs.

The probe is connected to the VoltOhmyst by means of a four-lead shielded cable, the wires at one end of which are connected directly to appropriate circuit points within the probe can and those at the other end to the four lugs in an Amphenol 91-MC4M1 four-contact microphone connector. This connector is seen plainly on the end of the cable in Fig. 3.

The female connector described above is presented to a matching Amphenol 91-PC4M four-prong male chassis connector which is seen on the side of the VoltOhmyst case in Fig. 5. When the probe is not in use, the cable may be detached from the VoltOhmyst simply and quickly by means of these connectors.

The male connector may be mounted through the VoltOhmyst case with no trouble. For this purpose, a ¾-inch-diameter clearance hole is cut on the right-hand side of the case (viewed from the front of the instrument), four inches from the bottom and 2½ inches from the front of the instrument. The entire instrument should be removed from the cabinet before cutting this hole; but in the position indicated, the chassis connector will clear amply all wiring, circuit components, and chassis. Nor is the instrument case disfigured by presence of the connector. Its smart plating furnishes a pleasing contrast with the gray wrinkle finish of the VoltOhmyst case, as may be seen by inspection of Figs. 1 and 5.

Insulated leads of flexible hookup wire are run from the "active leads" of the chassis connector to the two poles of the VoltOhmyst "DC VOLTS" input jack; also from the remaining two terminals of the connector to the low-voltage terminals of the VoltOhmyst power transformer. It is suggested that the No. 1 and No. 2 pins be connected to the heater-voltage winding; No. 3 and No. 4 to the d.c. jack. Wiring within the probe at the other end of the cable will be arranged in the corresponding manner.

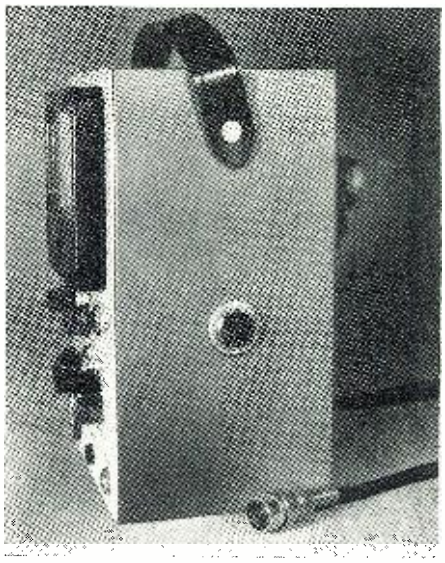


Fig. 5. Four-prong male connector shown mounted on the case, for use with a.c. probe.

After wiring has been completed and checked for correctness, and the VoltOhmyst is replaced in its case, adjustments may be made. With the probe disconnected from the instrument, the VoltOhmyst is switched on and allowed a reasonable period to come up to normal operating temperature. Its meter is then set accurately to zero, employing the electrical zero adjustment, and the probe is plugged-in. The operator must be careful at this point that there are no stray a.c. fields near the probe, otherwise the two banana plugs will have to be shorted by a stout jumper connected between them.

As the probe tube comes up to operating temperature, the meter will be deflected off zero, above or below, depending upon the setting of the VoltOhmyst switch. The value of R2 (Fig. 2) is then adjusted to bring the meter reading back exactly to zero. This set-

[1] *Laboratory Type V. T. V. M. McMurdo Silver.* RADIO NEWS, Sept., 1943, p. 32.

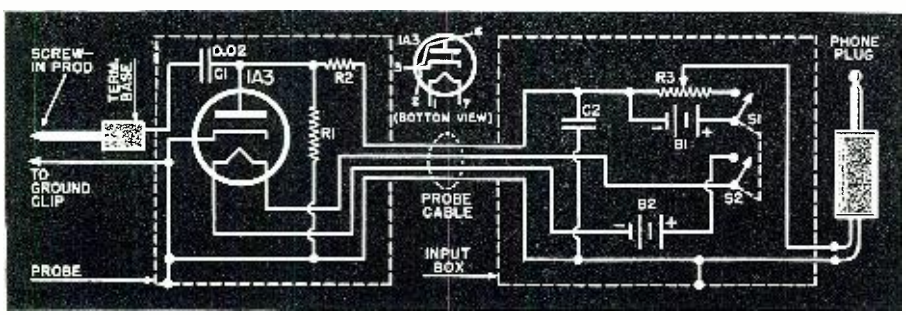


Fig. 4. Battery-operated probe, utilizing a 1A3 tube.

C_1—0.02-μfd. mica cond. (2-0.01-μfd. units in parallel)—Aerovox 1467
C_2—0.1-μfd., 200-volt tub. cond.—Aerovox 284
B_1, B_2—1½-volt flashlight cells—Eveready
R_1—20-megohm, ½-watt res.—Aerovox 1097
R_2—1-megohm, ½-watt res.—Aerovox 1097
S_1-S_2—Sections of a d.p.s.t. toggle switch—Arrow

ting is now permanent and the probe-can bottom may be screwed in place. The probe will be ready for operation, after R2 has been adjusted.

High-frequency a.c. voltages which are to be measured are then presented to the two input terminals of the probe and the meter deflection noted. The meter deflection should be up-scale; if not, the polarity switch must be reversed. The VoltOhmyst is set on appropriate d.c. voltage ranges for probe operation. The readings, given directly by the meter, will be a.c. peak values above about ten volts. Below ten volts, the indication is somewhat less than peak, although not r.m.s., due to the low-voltage characteristic of the rectifier tube. A special curve may be plotted for an individual 6H6 tube to show exact peak a.c. values against the low-range d.c. indications of the Volt-Ohmyst. In order that the reader may rapidly compare peak and r.m.s. values of input voltages, the graph of Fig. 6 has been prepared. Abscissas, in this case, show r.m.s. values, ordinates, and peak values. Thus, the common line-voltage value of 115 volts r.m.s. is found to be equal to 162.6 volts peak. The 6H6 probe is not recommended for the direct measurement of voltages higher than 117 r.m.s. (165.4 peak). An external voltage divider may be used for higher values and may be connected directly to the probe input terminals.

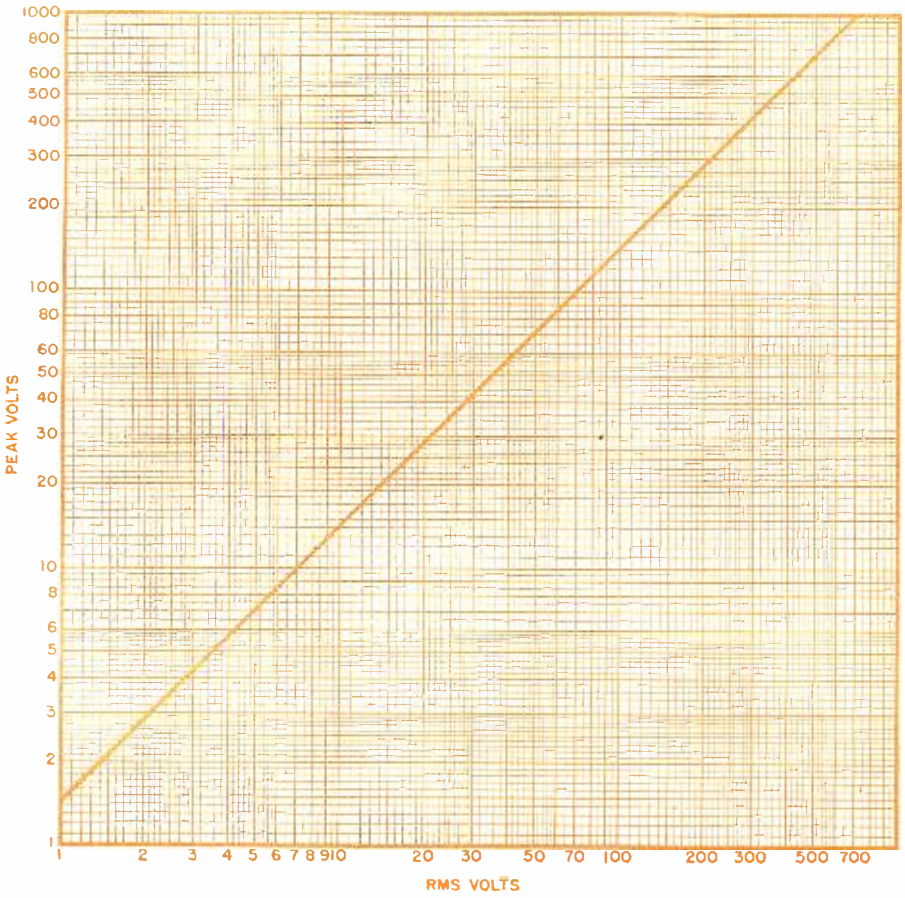


Fig. 6. Graph used with the a.c. and battery-operated probes to convert peak voltages measured to r.m.s. values.

Battery-Type Probe

In many varieties of high-radio-frequency measurements, it is desirable to isolate as much of the measuring equipment as possible from the voltage source and the power line. In such cases, a battery-operated diode probe will be necessary when an instrument of the VoltOhmyst type is converted for high-frequency voltage measurements. A satisfactory battery-type probe is shown in the circuit diagram of Fig. 4 and in the photographs of Fig. 7 showing internal and external views.

This probe employs a single-flashlight cell-operated high-frequency diode—type 1A3. This tube has been designed specifically for ultra-high-frequency service and has an input resonant frequency of 1,000 megacycles, far beyond the frequencies commonly handled by experimenters. Unlike other dry cell operated tubes, the 1A3 is an indirectly-heated cathode type.

Other advantages of this miniature button-base tube are its low values of interelectrode capacitance. For example, average values are plate-cathode, 0.4 $\mu\mu$fd.; plate-heater, 0.6 $\mu\mu$fd.; and heater-cathode, 0.6 $\mu\mu$fd. Like the 6H6, this rectifier will handle up to 117 volts r.m.s. (165.4 volts peak).

It will be seen from Fig. 4 that the circuit of the 1A3 probe is similar to that of the 6H6 accessory just described, except that the loss of the second diode makes it necessary to employ a bucking battery. C1 is 0.02 μfd. and is comprised by two 0.01-μfd. mica capacitors connected in parallel and mounted as close together as practicable. Rectifier load resistor, R1, is 20 megohms and may be either ¼ or ½ watt in size. R2 is a 1-megohm filter resistor, which with C2, a .1-μfd. filter capacitor, serves to remove the a.c. component from the rectifier output. The bucking circuit consists of the single cell, B1, and the potentiometer, R3. A switch, S1, opens this circuit to prevent cell drain when the probe is not in use, and is ganged with the switch S2 in the heater circuit. All of the circuit components within the dashed line are mounted within a small metal box (the "input box") placed near the Volt-Ohmyst. The output leads terminate in a standard phone plug which is inserted into the VoltOhmyst "DC VOLTS" jack when the probe is in use.

Physical characteristics of the battery-type probe may be ascertained from the external and internal views, clearly shown in Fig. 7. This is a simple assembly made with a minimum of parts. The probe container is an electrolytic capacitor can—1½ inch in diameter and 4½ inches long. The end plate is turned from high-grade bakelite (although better high-frequency operation might be expected if polystyrene or a ceramic material is used) and is a quarter-inch thick and approximately 1 31/64" in diameter. This disc was simply turned down to give a reasonably snug fit. For mounting the end plate in the enclosing can, two

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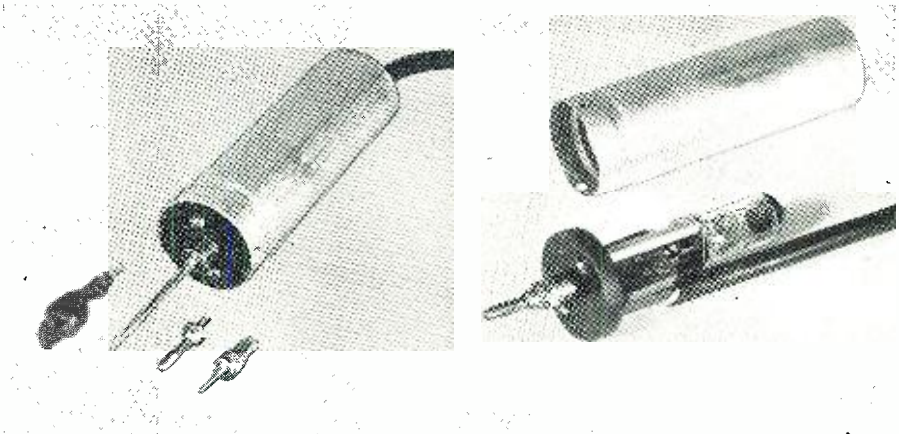
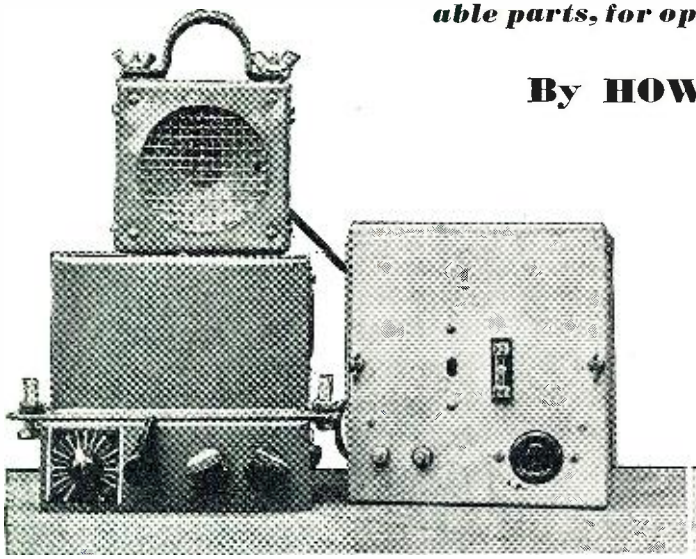
Fig. 7. External and internal views of the battery-operated r.f. measuring probe.



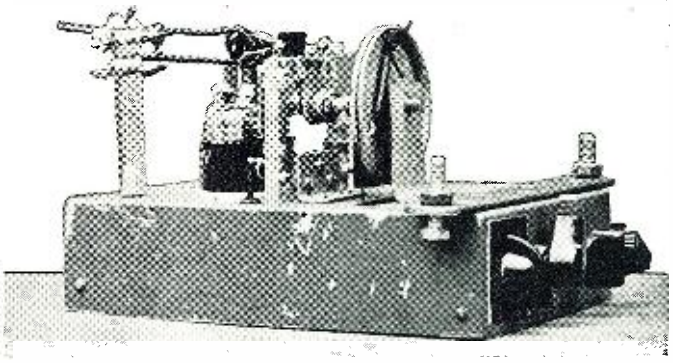
MOBILE TRANSCEIVER FOR 2½ METERS

Easily-operated mobile transceiver, constructed from available parts, for operation in the WERS 2½-meter wave band.

By HOWARD A. BOWMAN, W6QIR



Transceiver, power supply, and speaker case, constructed in three separate units. Transceiver controls are, from left to right, frequency adjustment, send-receive switch, regeneration, and audio gain.



Front three-quarter view of the chassis. The condenser-mounting plate and dial drive are visible, together with the method of mounting the condenser shaft extension.

AFTER reading a good many articles regarding mobile WERS operation, the writer came to the conclusion that none of the existing designs provided exactly the sort of apparatus which met his demands.

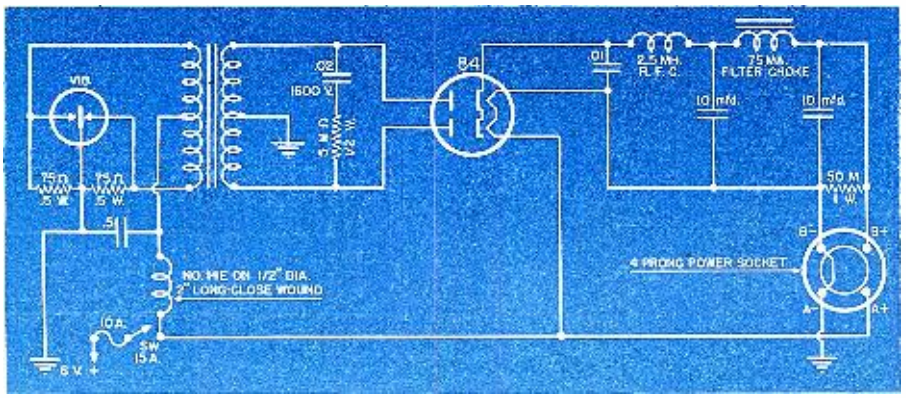
Most transmitters were made to fit inside the glove compartment. This does not seem to be a particularly good idea, for it precludes the possibility of using the glove compartment for other purposes, and makes difficult the attachment of power cables and antenna leads.

Too, most jobs call for a 300-volt 100-milliampere plate power supply. Now, it is readily possible to convert an old power transformer to such service, but it seems almost impossible to secure a heavy-duty vibrator which will handle the necessary primary current.

Smaller power transformers are available, however, or can be made by converting standard power transformers. Smaller vibrators are numerous, and most "Hams" can beg, borrow, or buy a suitable rectifier tube—an 84 or 6X5, preferably the former.

EDITOR'S NOTE: This article presents a mobile version of a studio unit which was described in the April, 1944 issue of RADIO NEWS under the title of "2½ Meter Transceiver for WERS." Reference may be made to this article for additional information.

Power supply schematic diagram, utilizing an 84 rectifier tube and standard vibrator.



Lastly, the usual mobile job uses a more powerful oscillator than seems necessary, considering the limited range over which most mobile units are called upon to work.

The writer eliminated these objections to his satisfaction by means of the following devices:

1. The transceiver is so constructed as to be mounted beneath the dashboard just left of the steering column. It extends but two inches below the dashboard, and in no way interferes with the operation of the car. It is installed just as is the usual under-dash auto radio and is perfectly rigid. The speaker is bracketed to the steering column itself, as will be shown later.

2. The power supply is mounted on the bulkhead between the motor compartment and the inside of the car. It is actually inside the car, with the switch readily accessible, yet it is not in the way of either driver or passenger. It employs a transformer good for about 65 milliamperes, an 84 rectifier, and an inexpensive vibrator.

3. The chassis and shield can for the receiver and the speaker housing are homemade of galvanized sheet iron obtained as scrap at a local shop. Anyone with a ruler, vise, hammer, and some patience can duplicate the job easily.

4. The oscillator tube is an HY 615. This is a baby brother of the justly famous HY 75. It is as smooth in its

operation as one could wish. The antenna coupling may be advanced to the point where the desired plate current is drawn on transmit, yet the tube will still regenerate perfectly on receive.

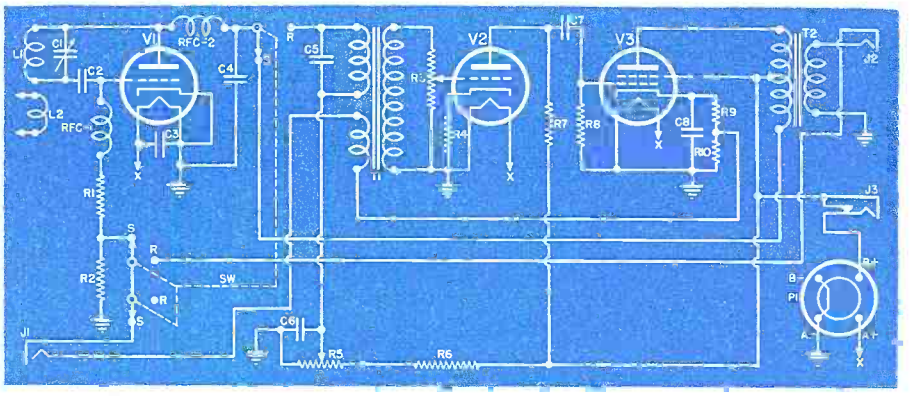
No sooner had construction plans begun when an unforseen difficulty presented itself. This arose from the fact that two items desired in the transmitter seemed to be in conflict. The writer wanted a rig which would mount beneath the dashboard. The HY 615, however, has grid and plate leads brought out to top caps on the tube envelope. This meant that the tuning assembly had to be on top of the chassis so as to permit short grid and plate leads.

The difficulty eventually was put to good account by designing an indirect tuning system for the unit.

The tube and its associated frequency-determining components were mounted on top of the chassis. The condenser is mounted on a 4" x 4" piece of ¼" plastic which has been bracket mounted to the chassis top. Most details of this are clear from the photographs. The coil L_1 is soldered directly to the condenser lugs. The grid condenser C_2 runs from the rotor lug to a soldering lug fastened to the plastic just to one side of the variable condenser by a 6-32 screw for which the plastic has been drilled and tapped. To this lug also goes the top end of the grid RFC-1 choke as well as a short piece of stranded wire terminating in a clip which fits the grid cap on the tube.

The other end of the grid choke goes to another lug similarly fastened near the bottom of the plastic plate. Just below this point is a ¼" grommet-insulated hole in the chassis, through which passes a lead from the grid-leak, R_1. The other end of the grid-leak is anchored to a tie-point below the chassis.

The top end of the plate choke RFC-2 fastens to the tuning condenser,



Schematic diagram of the transceiver, utilizing an HY 615 oscillator tube.

C_1—10 μμfd. variable cond.
C_2—.0001 μfd. mica cond.
C_3, C_7—.01 μfd., 600 v. cond.
C_4, C_5—.005 μfd. mica cond.
C_6—.1 μfd., 600 v. cond.
C_8—10 μfd., 25 v. elec. cond.
R_1—15,000 ohm, ½ w. res.
R_2—150,000 ohm, ½ w. res.
R_3—500,000 ohm pot.
R_4—4,000 ohm, ½ w. res.
R_5—50,000 ohm. pot.
R_7, R_8—250,000 ohm, ½ w. res.
R_9, R_{10}—250 ohm, 1 w. res.
RFC-1, RFC-2—RF chokes
J_1—Open circuit mike jack
J_2—Open circuit spkr. jack
J_3—Closed circuit jack
Sw.—3P2T rotary switch
P_1—4-prong male chassis power connector
L_1, L_2—See text
T_1—See text
T_2—Push-pull pentode to voice coil transformer
V_1—HY615
V_2—6C5, 6J5, or 7A4
V_3—6V6, 6F6, or 6K6

and the bottom end is held firmly by a lug screwed to the plastic mount, just as is the grid choke. The lead to the plate choke also comes up through a grommet-insulated hole in the chassis. From the top connection on the choke is run a short length of flexible wire to the appropriate top cap of the tube.

The tuning condenser shaft terminates in a flexible insulated coupling. From this coupling a short length of ¼" brass rod extends through a ¼" hole in a bracket screwed to the chassis. On this piece of shafting is mounted a three-inch dial drive wheel of the kind commonly used on broadcast receivers.

Under the chassis, just below the dial drive wheel, there is mounted a piece of ¼" iron shafting. This runs through a bushing in the front drop of the chassis, and is supported at the other end by a bracket in which has been mounted a 'phone jack. The spring of the jack puts tension on the rod and prevents easy motion.

A small hole is drilled through the under chassis rod. The dial cable—a good grade which does not stretch—comes down from the drive wheel, around the rod once, through the hole in the rod, around the rod again, and back up to the drive wheel. It is secured at the wheel by the conventional spring-tension method.

Having once used this arrangement, the writer does not see how he ever got along without it for WERS work. Most stations the mobile unit will contact are on a spot frequency, except for some small deviations. The usual

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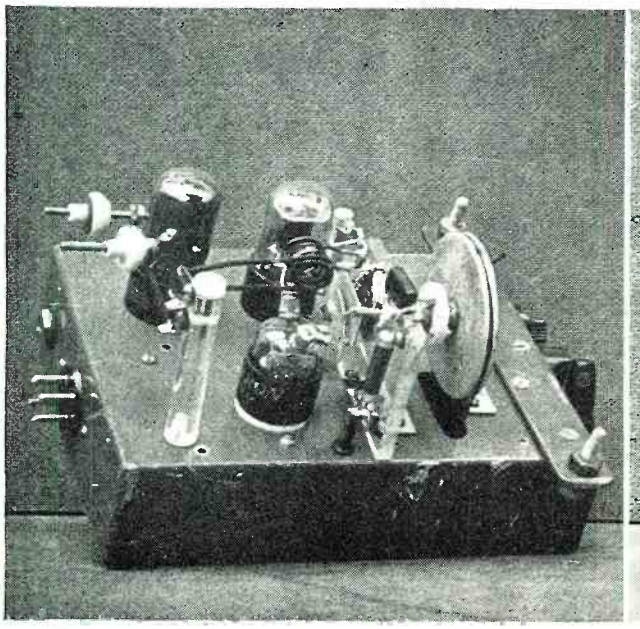
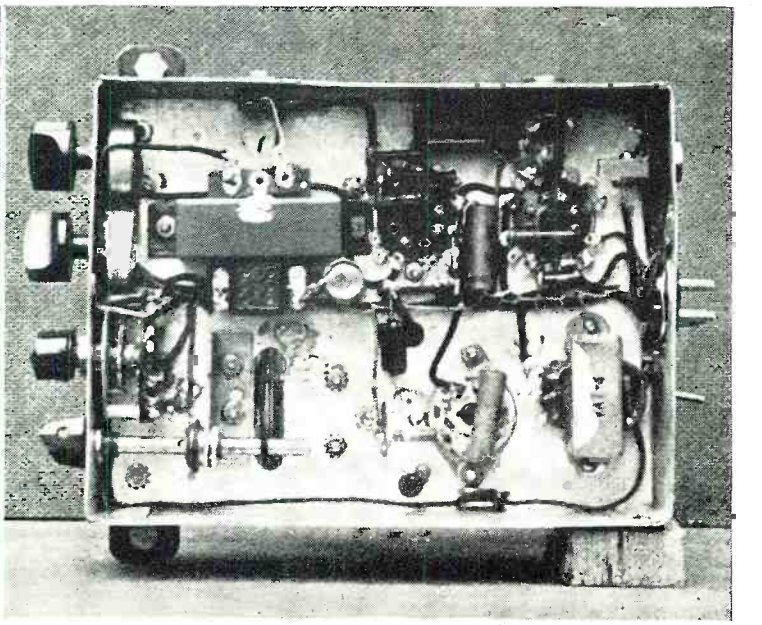
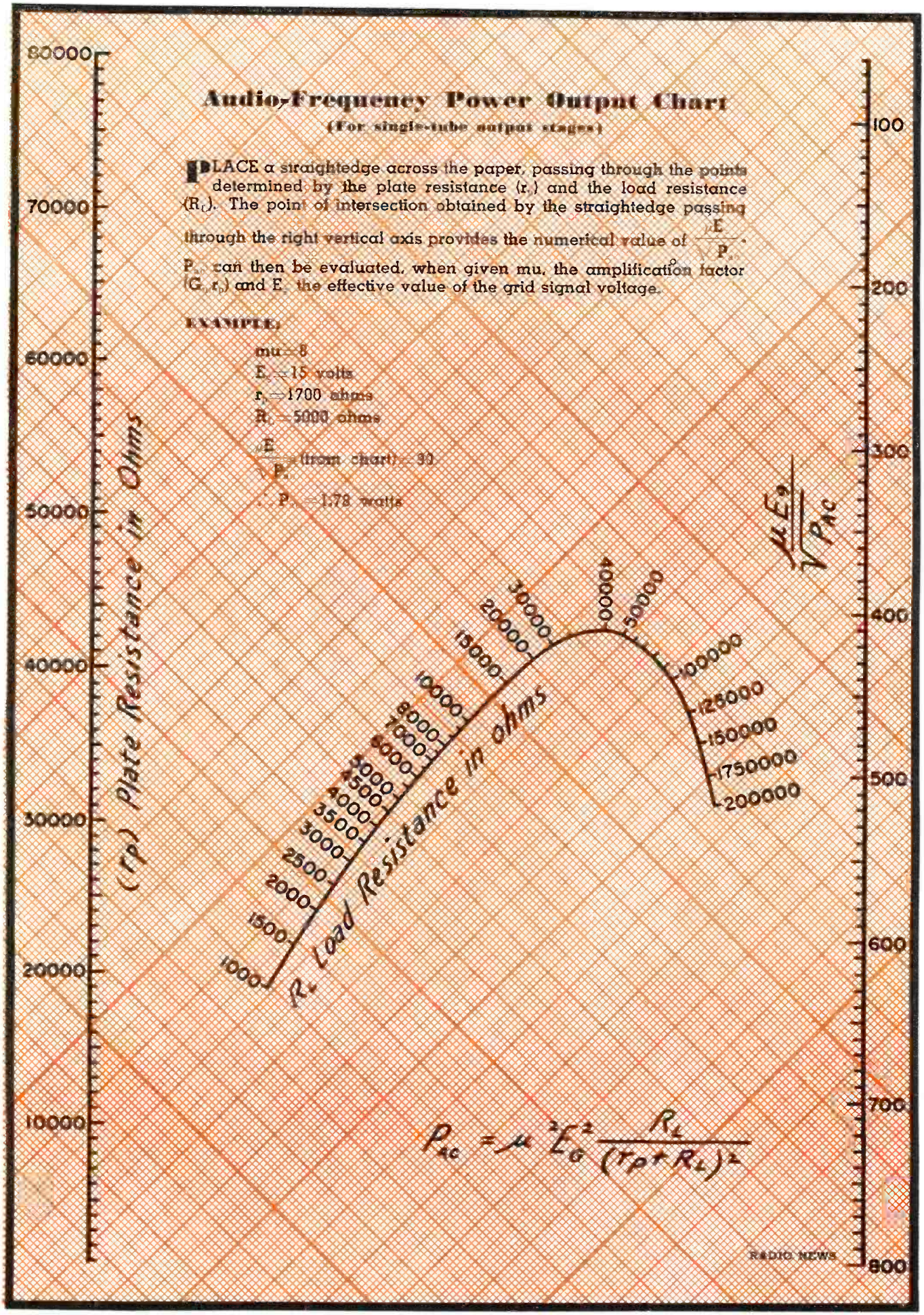


Tilted side view of chassis showing soldering lug and r. f. chokes mounted to condenser mounting plate.



Bottom view showing component arrangement. The mike transformer is shown at upper left, with the output transformer at lower right.



PRACTICAL RADIO COURSE

By ALFRED A. GHIRARDI

Part 24. Practical circuit arrangements for applying inverse feedback to audio amplifiers and its effect upon gain and power sensitivity.

OFFHAND, it would appear that the easiest way to introduce degeneration into a circuit would be to eliminate the by-pass condenser that is normally connected across the self-bias cathode resistor. Constant-current degeneration would then occur, but constant-current degeneration alone is generally unsatisfactory where the load is a loudspeaker, for the reasons explained previously. Consequently, special circuit arrangements must be used to correctly introduce a *controlled* amount of constant-voltage degeneration into the circuit. Since there are so many different satisfactory methods, it is only possible to indicate here some of the most widely used and most easily handled arrangements.

Various Circuit Arrangements for Applying Inverse Feedback Over a Single Stage

In Fig. 2 several circuits are shown for applying constant-voltage degeneration to a single stage of amplification when a single tube is employed. For a single power tube with transformer coupling to its grid, the circuit of (A) may be used. In this circuit a portion (E_f) of the output signal voltage appears across R_2. Since R_2 is in series with the secondary winding of the transformer across which the signal voltage (E_x) is developed, this out-of-phase feedback voltage is superimposed upon the input signal voltage, and degeneration occurs. The purpose of the condenser C in the feedback circuit is to prevent the d.c. plate voltage from being applied to the grid of the tube. Actually, it serves as a d.c. blocking condenser. Since R_1 and R_2 form a voltage divider, then the relative ohmic values determine the percentage of the output signal voltage that will be fed back. The feedback factor may be determined from the expression: $\beta = R_2/(R_1 + R_2)$. This formula applies to all the circuit arrangements shown in (A) to (C), inclusive.

The degenerative circuit shown at (B) operates in a similar manner except that the feedback voltage is introduced into the grid circuit in series with the cathode. In this arrangement R_1 and R_2 form, in effect, a voltage divider for the feedback voltage. The total voltage drop across R_2 and R_K is the grid bias applied to the tube. Since R_2 cannot be by-passed, it must be very small compared with R_K; otherwise an appreciable amount of constant-current degeneration also will take place because of it. This automatically limits the value of R_2 to comparatively few ohms which, in turn, fixes R_1 at a small value (since $\beta = R_2/(R_1 + R_2)$. Hence, less degeneration takes place with this circuit arrangement than with that shown at (A). Also, the series circuit C-R_1-R_2 represents a shunt of comparatively low resistance across the plate circuit load impedance, which naturally has an adverse effect upon the operation of the amplifier.

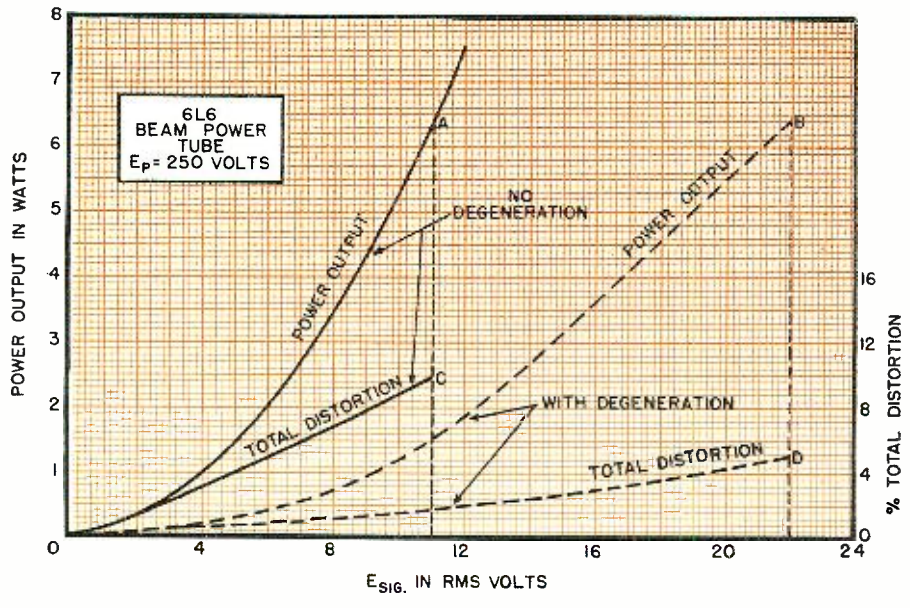
It is important to notice that in the degenerative circuits shown at (A) and (B), the blocking condenser C may introduce frequency distortion because its reactance varies with the signal-voltage frequency. If the reactance of the condenser is negligible at all frequencies that are to be reproduced, this effect will not be serious. However, it is quite possible that due to the improper choice of capacitance with respect to the values of the associated circuit constants, its high impedance at the lower audio frequencies will reduce the low-frequency feedback voltage. Obviously, less low-frequency input signal voltage is cancelled out then and excessive low-frequency amplification results. This action is the basis of operation of degenerative *tone controls* and *equalizers*, as has previously been explained.

In order to eliminate the blocking condenser with the possibility of its causing frequency distortion and, at the same time, to include the output transformer in the feedback circuit, thereby also reducing the distortion caused by it, the circuit shown at (C) is often used. There is obviously no need for a blocking condenser here because the feedback voltage is taken from the *secondary* winding of the output transformer which has no d.c. connection with the plate supply voltage. It is assumed, of course, that the correct polarity of the secondary is used so the feedback voltage is out of phase with the input signal. This may be found by trial and error.

A conventional resistance-coupled input circuit cannot be used with this type of regenerative circuit, because the input-signal voltage must be *in series* with the feedback voltage for proper operation. Hence, transformer input, as shown, must be employed. Because the winding capacity of the input transformer is in shunt with R_2 and some phase shift will be added by the output transformer, the amount of feedback which can be used is limited to a greater extent than in the circuit of (B).

A disadvantage of this system is that

Fig. 1. The effect of degeneration (to 50% of no-degeneration sensitivity) upon signal input volts required to produce full power output, and upon total distortion of a 6L6 beam power tube.



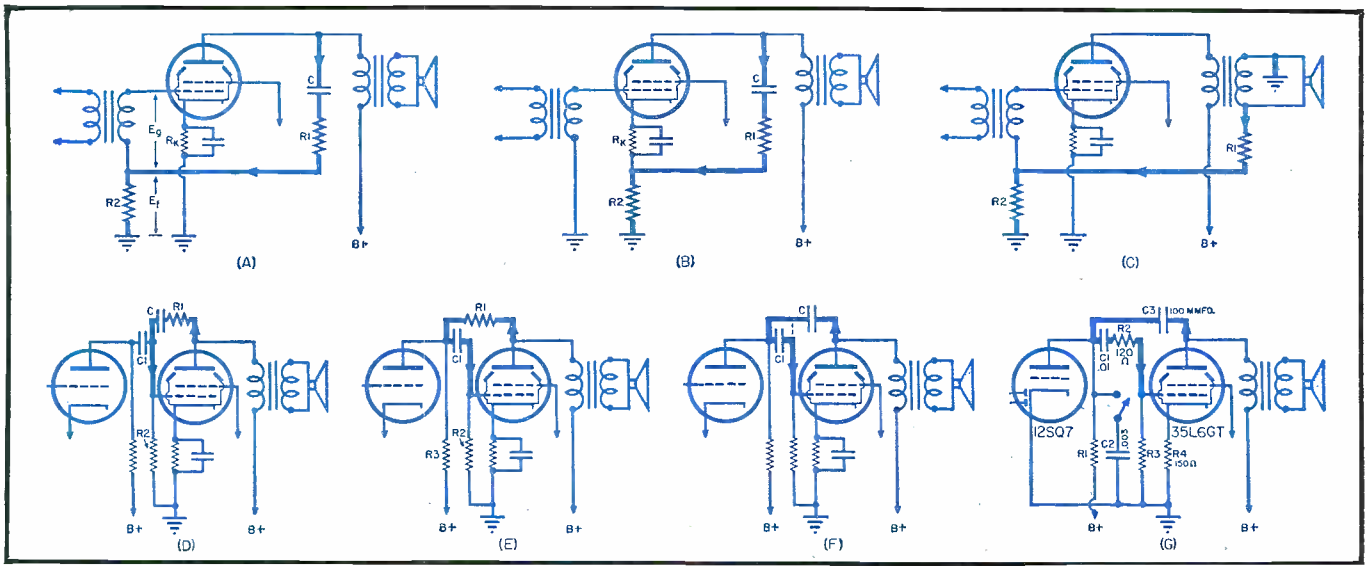


Fig. 2. Typical circuit arrangements employed for constant-voltage feedback over a single stage.

in some cases the very low impedance secondary winding does not have enough signal voltage developed across it to supply the amount of feedback voltage desired. To overcome this, an additional secondary winding is often placed on the output transformer, and its sole function is to supply ample feedback voltage, as in (B) of Fig. 3.

All three of the feedback circuits just described employ constant-voltage feedback introduced in *series* with the input circuit. When the input to the stage employs resistance-coupling, the feedback may be applied either in *series* or in *parallel* with the input circuit. Parallel-feed circuits similar to those shown in (D), (E), and (F) of Fig. 2 are frequently used.

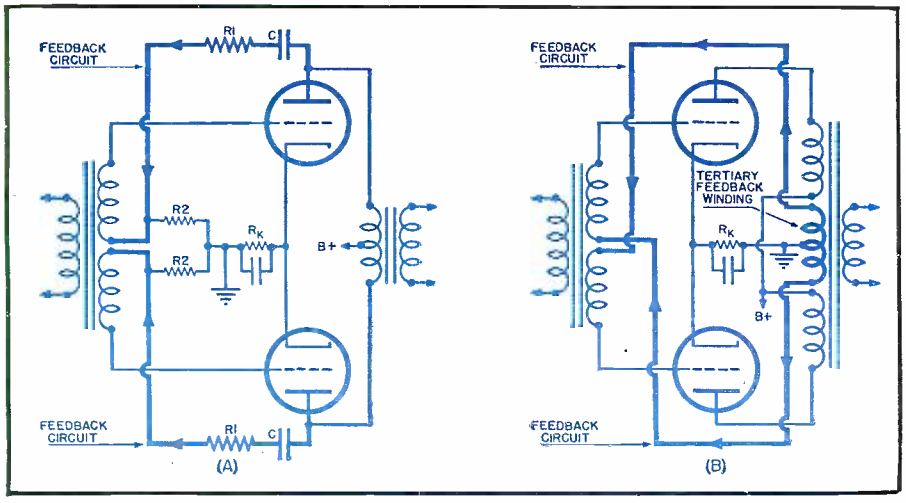
A simple type of constant-voltage parallel-feed feedback circuit is shown at (D). The feedback factor is approximately $\beta = R/(R + R_1)$ where R is the resultant impedance of R_2 in parallel with the plate resistance and load resistance of the preceding tube. A serious disadvantage of this arrangement is that the input impedance of the power tube is made comparatively low by the shunting effect of C and R_1. Consequently, the capacitance of C_1 must be made larger than normally is used for this position, in order to provide adequate bass response. Condenser C is merely a blocking condenser to keep the plate voltage of the power tube off the grid. It is important that this condenser be connected at the grid end of R_1. Stray capacitance between this condenser and the chassis must be minimized.

The feedback circuit of (D) is frequency-selective, and the degree of feedback at any frequency will depend upon the values of C and R_1. In the parallel-feed feedback circuit shown at (E) the necessity for the use of the blocking condenser is eliminated (together with the frequency discrimination of the condenser) by connecting a resistor R_1 between the plate of the tube and the plate of the preceding tube. This introduces a portion of the output voltage into the input circuit of the output tube via condenser C_1. Since the output signal voltage is *positive* at each instant when the signal at the plate of the preceding tube is *negative,* the feedback voltage is in opposite phase, as required. Since the feedback is not directly between the plate and grid of the output tube (condenser C_1 lies in the feedback path) this condenser has an influence on the response unless it is of a rather high capacitance value. The impedance of C_1 should be kept low, and R_2 reasonably high so that the feedback will be effective down to the low frequencies. Reduction of R_1 to very low values should be avoided, because of its shunting effect on the plate circuit of the preceding tube. (This works out satisfactorily if the preceding tube is a pentode or high-mu triode, with high plate resistance.) A minimum resistance for R_1 should be not less than five times the value of R_2. This limits the useful amount of feedback which can be employed in this manner to about 10 db.

Circuit (F) shows a parallel-feed feedback arrangement which provides capacity feedback, either from the plate of the power tube to the plate of the preceding tube (solid line), or from the plate to the grid of the power tube, as indicated by the dotted line. Since the reactance of condenser C is less at the higher than at the lower frequencies, a greater inverse feedback voltage is fed back at the higher frequencies and therefore the response is attenuated at these frequencies. Consequently, this arrangement is not satisfactory unless feedback is desired at the higher frequencies only so that the treble range will be attenuated, in which case condenser C must have a small value (50 $\mu\mu$fd or so).

The circuit shown in (G) (employed in the Stromberg Carlson No. 600 a.c.-d.c. receivers) is interesting because it employs dual inverse feedback in the power stage. Constant-current degeneration is obtained by omitting the bypass condenser which normally would be connected across the cathode-bias resistor R_1. Constant-voltage degeneration is obtained by feeding a portion of the beam power tube's a.f. output voltage back to the grid via the 100-$\mu\mu$fd. condenser C_3. This feedback

Fig. 3. Two methods of applying constant-voltage inverse feedback to an amplifier employing push-pull output stages.



attenuates the treble range and, hence, favors the low-frequency reproduction. For the sake of stability a 120-ohm suppressor resistor, R_3, is connected in series with the 35L6GT power tube grid to damp out transients.

The use of inverse feedback circuits to provide adjustable tone control (as well as the other benefits normally obtained) has already been discussed (see circuit in Fig. 4 in Part 22 of this series which appeared in the April issue).

Applying Inverse Feedback to a Single Push-Pull Stage

Naturally, any of the inverse-feedback circuits already described here can be applied to push-pull stages, but dual feedback loops must be employed unless a special circuit arrangement is used.

The series-feed constant-voltage feedback arrangement of (A) of Fig. 2 is shown at (A) in Fig. 3 applied to a push-pull amplifier stage. The amount of inverse feedback is equal to $\beta = R_2/(R_1 + R_2)$. It is evident that the usual frequency-discrimination disadvantages of this circuit arrangement also apply in this case. However, there is an additional disadvantage arising from its use in the push-pull stage if the push-pull tubes are operated as Class AB_2 or Class B amplifiers so that they draw grid current. (If the tubes are operated as Class AB_2 or Class B amplifiers, the self-bias arrangement (R_K) shown cannot be used. A source of *fixed* grid bias is essential.) The resistance of the grid circuit, due to the presence of R_2, will prove too high, and a considerable amount of *amplitude*, or *harmonic*, distortion will be introduced into the signal.

Therefore, a better arangement (particularly in amplifier circuits where grid current is drawn) is that shown at B of Fig. 3. In this arrangement, the feedback voltage is obtained from a tertiary winding on the output transformer. Now, the only additional d.c. resistance inserted in the grid circuit for the purpose of introducing the feedback voltage is that of this feedback winding, which is negligible. Consequently, since the resistance in the grid ciruit is negligible, a much better overload characteristic is obtained. Of course, this circuit also eliminates the blocking condensers and consequently, eliminates any frequency distortion they would cause. Notice that no resistors are used to control the amount of voltage fed back because it is assumed that the transformer is properly designed to provide the proper amount of feedback voltage. Commercial output transformers made in this way are available.

Additional circuit arrangements for applying inverse feedback to both the push-pull stage and the driver stage ahead of it will be described later.

Circuits for Inverse Feedback Over Two Stages

While single-stage feedback is probably the most widely used, there are several advantages to be gained from feedback over *two* stages, i.e., from the output circuit of one tube to the input of the next preceding tube. In two-stage feedback circuits, since there is more gain available between the feedback points, it is practicable to use higher values of feedback factor $A\beta$ (5 to 10 or more) and thereby to realize to a greater extent the potential advantages of the inverse feedback. The two-stage feedback may be made to take care of amplitude and frequency distortion in the driver stage as well as in the power stage. This makes it possible to operate a power tube with sufficient signal excitation to produce (under normal conditions) 25 per cent or even more distortion, and so greatly increase the power output, yet with low distortion in the actual output. Furthermore, distortion in the drive stage, such as occurs when the grid of the power tube is driven positive or when large exciting voltages are required, is likewise reduced. This makes it possible to redesign the driver to obtain more driver gain. Finally, with larger feedback the frequency response can be greatly improved.

Feedback across two stages may be introduced either in the cathode circuit as shown at (A) of Fig. 4, or in the grid circuit as shown at (B). If the input device is likely to be changed frequently, the circuit of (B) is less desirable because different input circuits will change the feedback ratio. The circuit shown at (A) is recommended for such conditions. Since R_2 usually can be quite small, it will not introduce any difficulty due to its own degeneration. The feedback ratio is again $\beta = R_2/(R_1 + R_2)$. The feedback volt-

(*Continued on page* 90)

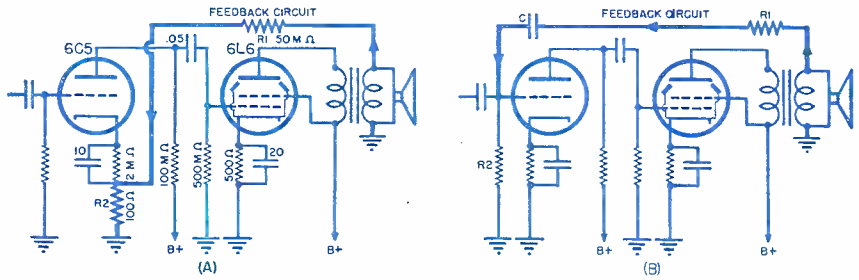


Fig. 4. The application of inverse feedback over two separate stages.

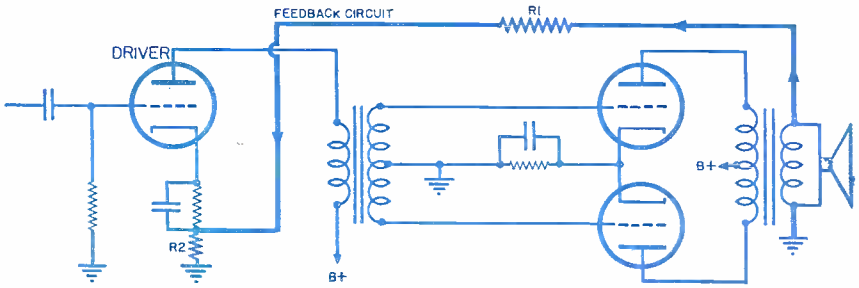


Fig. 5. Inverse feedback applied over push-pull output and driver stages.

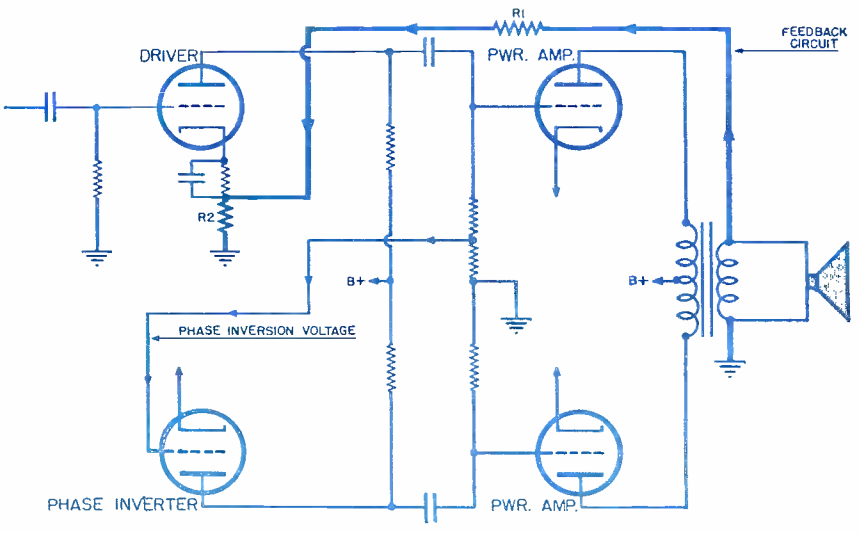
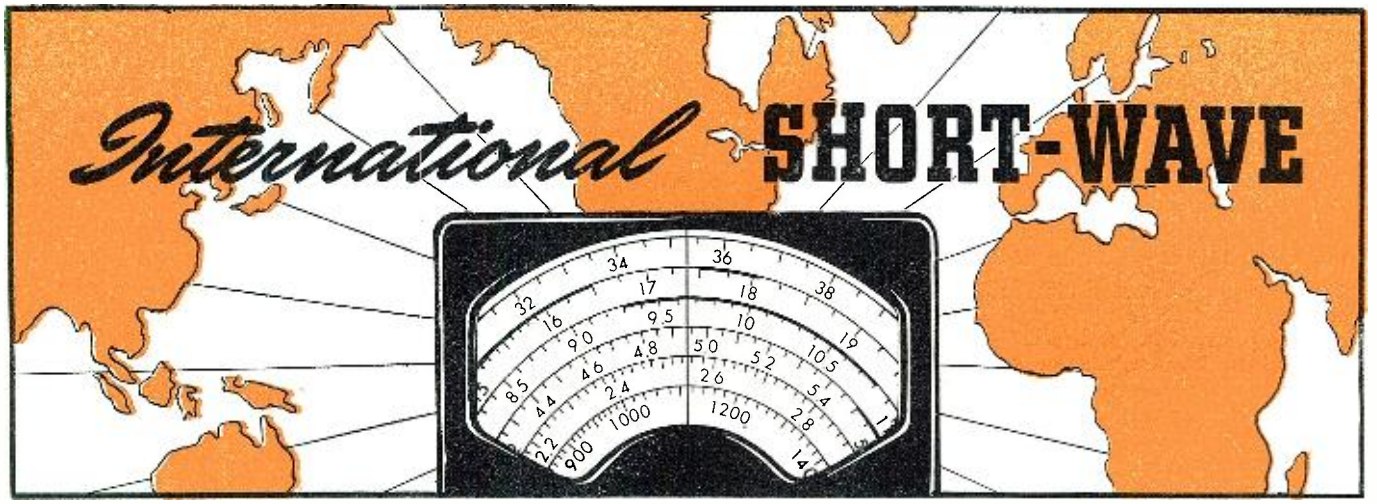


Fig. 6. The application of inverse feedback to a phase-inverter circuit.



Edited by KENNETH R. BOORD

FOR efficient, reliable, daily reception of short-wave broadcasting stations the world around, expensive or special equipment is not necessary. The important thing is to *know when and how to tune.*

By tuning carefully at the right time, you can bring into your own home—on the average commercial type receiver—the thrill of listening to voices from all over the universe.

Short-wave listening is educational, broadening, fascinating. As Fannie Hurst so aptly put it: "Radio is one of the most effective means of implementing and bringing to life the Four Freedoms for which we now fight. Radio can and will reach into and open the Caucasian or Mongolian hearts of men, one to the other, and let them hear for themselves the identicalness of their heartbeats. It can and will level the ivory walls of all national towers for all time. It can and will make men more similar and less different. 'It is difficult to hate people once you know them.' That small truism lies at the root of the microphone's power."

The war, naturally enough, has brought about great changes in radio manufacture, in broadcasting activities, and in the very nature of the programs themselves. Great engineering achievements are now being made in short-wave broadcasting and reception throughout this country and abroad. And when peace becomes a reality, you will hear more and more of the merits of this great medium of bringing the peoples of the world more closely together.

Thus far, all too little has been known by the general public concerning the almost unlimited possibilities of higher frequency broadcasting, but even already short-wave radio is at long last truly coming into its own.

True, no longer are the amateurs —known to professionals as "Hams"— on the air, but when the present world conflict terminates, these same "Hams" will be back for a fresh, new start—and with not only increased enthusiasm, but with better equipment which is coming into being almost daily as a result of the many improvements and inventions that are being produced of necessity during this war era.

And those who learn to operate the short-wave bands of their home receivers successfully now, in their efforts to listen direct to the news of the world, or to some of the world's finest musical treats, will be in a better position than their fellows to enjoy to the full the benefits of short-wave radio reception when it finally makes the grade as a peace-promoting force, as it is most certain to do—and soon.

EDITOR'S NOTE: In view of the many requests received from our readers, RADIO NEWS presents this new department on International Short-Wave, which includes latest information for DX fans, both in this country and abroad. News of happenings in the field of short-wave broadcasting, tips for listeners, latest program information and other interesting material will be presented monthly in this column.

Basically, short-wave radio listening is not an expensive enjoyment. In fact, the beginner would do well to confine his efforts solely to learning to efficiently operate the family radio. Practically all home radios are now equipped for adequate short-wave operation. While a doublet-antenna system can be installed at little cost and will probably add to signal strength in reception over great distances, the conventional "L" type aerial will be quite satisfactory for general purposes.

To anyone who might object to short-wave listening on the grounds that languages other than English are employed, may I point out that ever-increasingly, the foreign stations are using English as a medium of broadcast. There are few stations in any country of the globe today that do not radiate English programs at some time of the day or night.

It is admitted that a great deal of foreign broadcasting *is* of a propaganda nature, but one is still able to segregate the good from the bad by a mere twist of the controls, while sundry wholesome entertainment continues to be provided by most of the major short-wave stations both at home and abroad. For example, take the excellent native Marimba music that is broadcast daily over the short-wave station located in the capital of Guatemala; it can be heard like a local each afternoon and evening. And for your news first-hand from the fighting fronts, from the world capitals, and from stations in the most remote corners of the earth—for your news *when and as it happens*—short-wave radio continues to be "tops."

For best reception, you will need a good log of short-wave broadcasting stations, and that will be the purpose of this column—to provide you with the latest program tips, up-to-the-minute station schedules, and other pertinent data which will aid you in building up and maintaining a first-class, reliable short-wave log. Why not clip this column each time it appears and keep it for ready reference?

* * *

TIPS FOR WEST COAST LISTENERS

August Balbi, of Los Angeles, veteran West Coast monitor, reports as follows concerning programs heard in that region (PWT):

Suva, Fiji Islands, VPD (6.135), 10:55 p.m.-3:00 a.m.; BBC news, 11:00 p.m.; ABC news, 1:00 a.m.

Caledonia, not heard here. The same for Iran, Iraq.

Taiwan, not heard lately.

India, Ceylon (4.90), weak, 8:00-8:45 a.m.; BBC news, 8:00 a.m.

Bangkok, Thailand (6.06), 4:00-7:30 a.m. (no English).

Moscow, U.S.S.R. (15.11 and 15.23), 2:15-2:40 p.m., 6:15-6:40 p.m., 8-15-8:40 p.m.; news in English at beginning of each transmission.

Tokyo, JVW2 (9.675), heard 6:15-11:00 a.m.; news, 10:00 a.m.; JLG2 (9.505), news at 8:40 p.m., 10:00 p.m.,

(*Continued on page* 126)

AROUND THE CLOCK WITH THE WAR NEWSCASTS IN ENGLISH

MORNING

EWT	LOCATION	CALL	FREQ.*
7:00 a.m.	London	GSP	15.31
7:00 a.m.	Perth	VLW3	11.83
		VLW6	9.68
7:00 a.m.	Melbourne	VLR	9.58
		VLI4	7.22
7:30 a.m.	Berlin	DJB	15.20
7:50 a.m.	Tokyo	JLG2	9.505
8:00 a.m.	Melbourne	VLG2	9.54
8:30 a.m.	Tokyo	JLG2	9.505
9:00 a.m.	Manila	PIAM	9.64
			6.14
9:00 a.m.	Hongkong	JZHA	9.47
9:00 a.m.	Tokyo	JZI	9.535
		JZH4	6.13
9:30 a.m.	Berlin	DJB	15.20
9:30 a.m.	Hsingking	MTCY	6.12
10:00 a.m.	Saigon	R.S.	11.775
10:00 a.m.	Tokyo	JZI	9.535
		JZH4	6.13
10:00 a.m.	Chungking	XGOA	5.98
		XGOY	6.05
10:15 a.m.	Melbourne	VLG	9.58
10:45 a.m.	Saigon	R.S.	11.775
11:00 a.m.	Ceylon		4.90
11:00 a.m.	London	GSP	15.31
		GRG	11.68
11:00 a.m.	Stockholm	SBT	15.155
11:00 a.m.	Tokyo	JZI	9.535
		JZH4	6.13
11:00 a.m.	New Delhi	VUD2	6.19
11:00 a.m.	Melbourne	VLG	9.58

* * * * * *

AFTERNOON

EWT	LOCATION	CALL	FREQ.*
12:00 noon	London	GSP	15.31
		GRW	11.70
		GRU	9.445
12:00 noon	Tokyo	JZI	9.535
		JZH4	6.13
12:50 p.m.	Vichy	TPC5	15.24
1:00 p.m.	Tokyo	JZI	9.535
		JVW2	9.675
		JZH4	6.13
1:15 p.m.	Shonan-Singapore		9.555
2:00 p.m.	London	GSP	15.31
2:00 p.m.	Tokyo	JZI	9.535
		JZH4	6.13
2:45 p.m.	Brazzaville	FZI	11.97
3:45 p.m.	London	GRG	11.68
4:45 p.m.	London	GSP	15.31
		GSC	9.58
5:15 p.m.	Moscow		15.11
			15.23
5:45 p.m.	London	GRG	11.68
		GSC	9.58

* * * * * *

EVENING

EWT	LOCATION	CALL	FREQ.*
6:15 p.m.	Tokyo	JZJ	11.80
		JLG2	9.505
6:45 p.m.	London	GRG	11.68
		GSC	9.58
		GSL	6.11
6:47 p.m.	Moscow		15.11
			15.23
7:00 p.m.	Berlin	DJD	11.77
		DXJ	7.24
		DXP	6.03
7:45 p.m.	Brazzaville	FZI	11.97
8:00 p.m.	Berlin	DXL25	7.28
		DXJ	7.24
		DXP	6.03
8:15 p.m.	Leopoldville	OPL	9.785
9:00 p.m.	London	GSC	9.58
		GRJ	7.32
		GSU	7.26
		GRW	6.15
		GSL	6.11
9:00 p.m.	Djarkarta		18.13
9:00 p.m.	Tokyo	JZJ	7.24
		JLG2	9.505
9:00 p.m.	Berlin	DXL25	7.28
		DXJ	7.24
		DXP	6.03
9:15 p.m.	Moscow		15.11
			15.23
9:20 p.m.	Tokyo	JLG4	15.105
9:30 p.m.	Bern	HER4	9.54
10:00 p.m.	Bern	HEI3	7.205
10:00 p.m.	Berlin	DXL25	7.28
		DXJ	7.24
		DXP	6.03
10:00 p.m.	Rio de Janeiro	PRL8	11.72
10:15 p.m.	Djarkarta		18.13
10:45 p.m.	London	GSC	9.58
		GSB	9.51
		GRW	6.15
		GSL	6.11
11:00 p.m.	Berlin	DXJ	7.24
		DXP	6.03
11:15 p.m.	Moscow		15.11
			15.23
11:40 p.m.	Tokyo	JZJ	11.80
		JLG2	9.505
12:00 midnight	Berlin	DXJ	7.24
		DXP	6.03
12:00 midnight	Durban (So. Africa)	ZRD	5.945

* * * * * *

AFTER MIDNIGHT

EWT	LOCATION	CALL	FREQ.*
12:30 a.m.	Durban (So. Africa)	ZRD	5.945
12:30 a.m.	Johannesburg	ZRH	6.007
12:30 a.m.	Capetown		5.882
12:30 a.m.	London	GSL	6.11
1:00 a.m.	Tokyo	JZJ	11.80
		JLG2	9.505
1:00 a.m.	Berlin	DXJ	7.24
		DXP	6.03
1:00 a.m.	London	GRW	6.15
1:15 a.m.	Melbourne	VLG4	11.84
1:30 a.m.	Hsinking	MTCY	11.775
2:00 a.m.	Tokyo	JZJ	11.80
		JLG2	9.505
2:00 a.m.	Suva (Fiji Island)	VPD2	6.135
2:00 a.m.	London	GRM	7.12
		GRW	6.15
2:30 a.m.	Hsinking	MTCY	11.775
3:00 a.m.	Tokyo	JZJ	11.80
		JLG2	9.505
3:45 a.m.	London	GRG	11.68
4:00 a.m.	Suva (Fiji Island)	VPD2	6.135
4:00 a.m.	Melbourne	VLG4	11.84
		VLR	9.58
		VLI4	7.22
4:00 a.m.	Perth	VLW3	11.83
4:45 a.m.	London	GSC	9.58
5:30 a.m.	Tokyo	JLG2	9.505
5:45 a.m.	London	GSC	9.58
6:30 a.m.	Shonan-Singapore		9.555
6:45 a.m.	London	GSC	9.58

*Frequencies shown are in megacycles. To convert to meters divide 300,000,000 by the frequency.

Functional Analysis of RADIO and ELECTRONIC THEORY

By NICHOLAS B. COOK
Instructor, ESMWT, Rutgers University

An effective method of teaching students, by emphasizing the functional analysis of each component part within the circuit.

ONE of the marks of an "expert" is the ease, speed, and directness with which he finds the cause of trouble in a machine or in an electrical device. He can do this for several reasons: (1) he has wide experience; (2) he has an analytical mind; (3) he knows the function of each part and its relation to every other part.

In the past two years large numbers of young men have been taught the principles of radio and electronics. Certainly it is hoped that many of these students have become experts and have acquired an expert's facility and sureness in analyzing trouble.

But even in two years, not every graduate has obtained "wide experience," in the Armed Forces or elsewhere. This qualification requires more time, together with continuous application and diversified practice.

Not every student has an "analytical mind" either; at least the ordinary mind is not analytical to the superlative degree exhibited by the expert. But the average student *can be taught to analyze,* and thus make the best use of his average mind. He can be taught, providing he is eager to be taught, "the function of each part and its relation to every other part."

As an illustration of the technique, the "block diagram" of Fig. 1 is a familiar example. The emphasis here is entirely upon *function.* With a diagram of this kind firmly fixed in his mind, the student cannot go far wrong in his approach to the ordinary superheterodyne receiver.

However, the emphasis upon *function* can be carried over into every detail of the circuit and this can be done by means of effective illustrations. Take as an example the vacuum tube in the first block of Fig. 1, very likely a pentode. This may be represented as shown in Fig. 2.

The function of the cathode is to emit electrons. These are "boiled off" when the cathode is heated by the heater, just as steam is given off when a pan of water is heated over a gas flame. If we turn the gas flame up higher the water boils more violently and the steam output increases, up to a certain limit. In a vacuum tube, if we raise the temperature of the cathode the electron output is increased until a limit is reached.

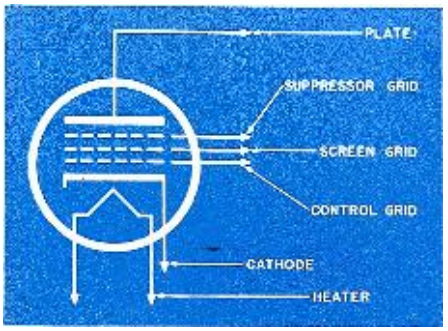
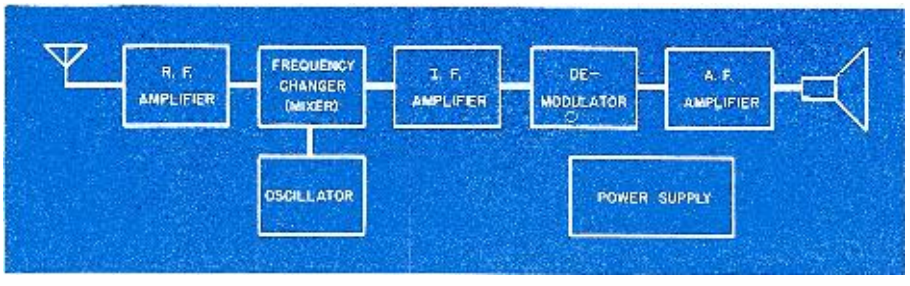


Fig. 2. The functional operation of each electrode of a vacuum tube must be learned.

In a poorly ventilated kitchen the steam and the fumes can not escape and sometimes form a visible "cloud" over the gas range. This condition may be remedied by the use of an exhaust fan set into the wall above the range. The strong current of air pulls the steam away from the range and out of the building. To reduce its pull we may run the motor at lower speed. The exhaust may also be controlled by interposing louvers between the fan and the room.

Fig. 1. Block diagram used to illustrate simply the functional operation of each stage in an ordinary superheterodyne receiver.



In a vacuum tube, if only the heater is energized, the electrons given off by the cathode can not escape since they quickly lose their velocity. Thus, a cloud of electrons is formed which hangs about the cathode and keeps other electrons from moving away. This electron cloud is known as the "space charge."

If now we apply a positive potential to the plate, the electrons are pulled toward the plate and away from the cathode. The higher the voltage the greater the pull, until all the electrons are drawn to the plate as fast as they are liberated. Thus, the "space charge," which prevented the electrons from reaching the plate, is now completely neutralized. The electrons drawn to the plate continue their motion, pass into the external circuit, and constitute the "plate current" of the tube.

It is possible to control the movement of the electron cloud by another means; namely, by electrostatic louvers known collectively as the "grid." This element is interposed between the cathode and the plate. A positive potential on the grid mesh tends to neutralize the space charge and urges the electrons on toward the plate. The grid itself, being of coarse, open structure, is not intended as a collector of electrons. Since it is very close to the cathode, its control over the electrons is more effective than that of the plate. The electrostatic louvers may be opened or shut simply by changing the voltage applied to the grid.

Since the grid can so easily control the flow of plate current, it is very sensitive to disturbing influences. A change of voltage on the plate may be felt by the grid because of the nearness of the two elements. In an ordinary amplifier the grid should be affected only by the input signal. If the output signal is allowed to be picked up by the input grid it is amplified again and again, and the result is a squeal.

To prevent this interaction, a shield may be placed between the grid and plate. A shield is usually at ground potential. In the ordinary vacuum-tube circuit the cathode is at ground potential or somewhat above while the plate must be at high positive voltage to attract electrons. The "screen grid" must be at ground potential (to a.c.

voltages) in order to function as a shield while at the same time it must be supplied with a high positive d.c. voltage so that it will not repel the electrons that are trying to get to the plate. This looks like a dilemma until we realize that the positive voltage is a steady d.c. voltage while the disturbing voltages are a.c. So the screen is supplied with a positive d.c. voltage and is grounded to a.c. through a condenser.

Every country boy has thrown sticks or stones into an apple tree to knock down apples. If he could find nothing else handy he picked up a bruised apple from the ground and threw that to dislodge the red, ripe fruit.

In a radio tube, when the electrons impinge at a high speed upon the plate they dislodge other electrons. This is called "secondary emission." It causes no trouble in a triode since the electrons are simply drawn back to the plate, which is the only positive electrode. In a screen-grid tube, however, the screen-grid is positive at a fixed potential. When the tube is working, the downward swing of the plate voltage may reduce the voltage of the plate below that of the screen. In such a case, some of the electrons that rightfully belong to the plate are captured by the screen.

By way of illustration we may picture a small boy swinging a ball at the end of a long rubber band. No matter how far he throws the ball, it always comes back to him. It always comes back until a mean big boy snags the ball, breaks the rubber string, and runs off with the booty.

When the plate thus loses electrons to the screen there is a marked lack of correspondence between change in plate current and change in plate voltage. At one part of the curve of a 24A, for example, it is seen that the plate current decreases when the plate voltage rises. In fact, at this voltage in earlier types the electrons were knocked off the plate in such numbers that the plate became a *supplier* rather than a *collector* of electrons.

To make sure that the plate's footloose electrons return to the plate where they belong, the designers have added a fifth electrode, a sort of electrostatic fence known as a *suppressor*. It is placed between the plate and the screen and is usually tied to the cathode. Thus, the suppressor is at ground or a very low potential and, therefore, it repels the random electrons that proceed from the plate. These are moving at low speed and are easily persuaded to turn back. The suppressor has little effect upon the electrons that are moving at high velocity from cathode to plate.

Now in this five-element tube, known as a pentode, we have the story of an astonishing evolution. It embraces not eons or ages but considerably less time than the normal "three score and ten" years of human life.

First we have the diode, virtually discovered by Edison in 1883 and left neglected until put to work as a rectifier by Fleming in 1905. In nearly every modern radio receiver the diode performs the tremendously important tasks of rectification and detection. Within the diode is the groundwork of all the extraordinary developments in electronics.

The writer occasionally exhibits a control-grid assembly taken from a radio receiving tube. Held between thumb and finger it is scarcely visible from the front seats in the classroom. It is introduced with the remark, "Here is the greatest invention of the twentieth century."

The triode made possible some of the most notable achievements of the age. Long-distance telephone, radio broadcast and reception, picture transmission, public-address systems, remote control of machinery, television, and a seemingly endless list of other developments have followed the invention and development of the three-electrode vacuum tube.

The tetrode was born of necessity and soon showed itself to be a well-favored child. It was endowed with advantages possibly not dreamed of by those who fathered it. For the reduction of feed-back it gave a plate-grid capacitance only a few thousandths of

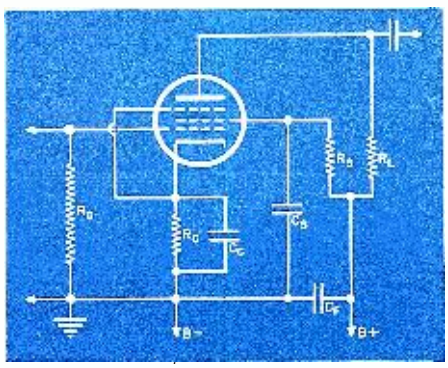


Fig. 3. Conventional diagram of a familiar voltage amplifier stage.

that of a triode. For the control of plate current it provided a plate-grid transconductance of the same order of magnitude as that of a triode. And for purposes of voltage amplification it made available an amplification factor about ten or one hundred times that of a triode.

But though the designers were justly proud of their offspring, they were disturbed by the fact that the tetrode was not able to handle large signals without introducing excessive distortion. Wide swings of the amplified voltage caused the plate voltage to dip into the region where secondary emission upset the proportionality between plate voltage and plate current.

This condition was corrected in the pentode, which contains an electrostatic "fence" to restrain the secondary electrons and urge them back to their starting point.

The same result has been achieved in the beam power tube and again the designers (and the public) have received a bonus in the form of much better performance.

The phenomenon of "secondary emission" has been accepted both as a necessary evil and as a desirable good. Some amplifying tubes make use of the fact that one flying electron can knock off a dozen more that will fly along. One falling apple will knock off others that knock off others, as may be demonstrated in any orchard. In this manner, by repeated impacts of electrons against plates or targets, an "electron multiplier" tube is able to produce a greatly amplified current from a very small input.

When the functions of an amplifier are discussed it is helpful to represent the tube and its circuit as a combination of generator and prime mover, similar to a turbo-generator. A turbine must be supplied with energy by means of "steam lines"; the energy is not in the turbine but in the steam pressure. A vacuum tube must be supplied with energy by means of d.c. lines. The student should be able to trace the entire network of d.c. lines which establish the conditions necessary for operation. Measurement of d.c. voltages shows whether or not the "steam lines" are under proper operating pressure.

The function of the steam boiler is to supply energy; it is not part of the rotating machinery. The function of the amplifier's power supply is simply to provide the energy for operation. The operating circuits usually do not include the energy source.

Fig. 3 is the conventional diagram of a familiar voltage amplifier.

Static or *d.c. supply lines:*

Grid-cathode circuit: Grid, cathode, R_c, R_g (IR drop in R_c is grid bias source).

Screen circuit: From +B through R_s, screen, cathode, R_c, to −B.

Plate circuit: From +B through R_L, plate, cathode, R_c, to −B.

Dynamic or *a.c. lines:*

Grid: Grid, cathode, C_c, R_g (The input circuit is R_g in parallel with a series circuit consisting

(*Continued on page 73*)

COMPONENT	TROUBLE	AURAL EFFECT	EFFECT ON VOLTAGES	OTHER EFFECTS	EXPLANATION
Power transformer	Blown fuse	Heated transformer	Low	No "B" voltage	Shorted secondary winding

Fig. 4. Type of chart recommended as an aid to clear understanding.

TECHNICAL BOOK & BULLETIN REVIEW

ELECTRONICS, by The Technical Staff of Coyne Electrical School. Published by *Coyne Electrical School,* Chicago, Illinois. 402 pages. Price $4.95.

This is a practical handbook for radiomen and electricians who are called upon to service and repair various types of electronic equipment. The subject is treated from the standpoint of industrial applications and may serve as a reference text both on and off of the job.

The authors have introduced material on many pieces of industrial electronic equipment about which there is little in print. New electronic controls, which have been developed recently for war industries, are described and analyzed as to operation and function to enable the electrician to bring his knowledge up-to-date.

Various manufacturers have contributed generously of their photographs with the result that actual applications and installations of much of the equipment discussed may be seen by the reader.

A condensed chart of trouble-shooting techniques is included in the book and should prove extremely helpful to the serviceman called upon to repair various pieces of equipment.

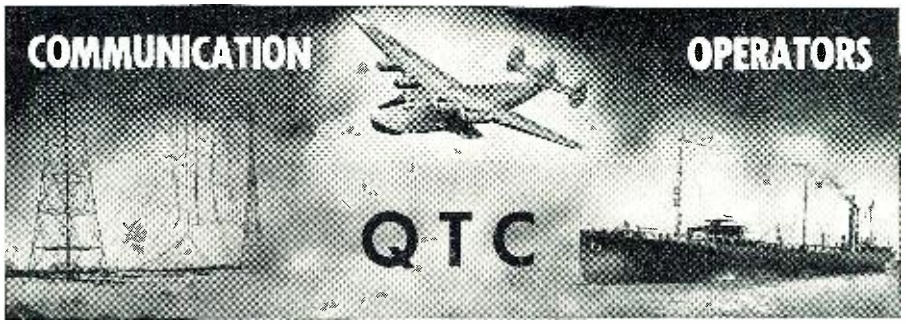
Although the publishers have described this book as being of value to the student and beginner, this text does not present the basic and fundamental theories necessary to acquire a groundwork in electronics. The instructions included for the repair and handling of various problems arising are clear and concise, and could, undoubtedly be followed by rote by the beginner, yet the "whys" of the job being done would escape him unless a workable knowledge of the fundamentals had already been acquired.

BASIC RADIO, by C. L. Boltz. Published by the *Ronald Press Company,* New York. 269 pages. Price $2.25.

This book is an informally written text on the subject of elementary radio, suitable for home-study and beginning radio courses. Persons lacking a sufficient background in electricity to enter the more advanced study of electricity and radio, will find this book helpful.

The author has not assumed any familiarity on the part of the student with the subject and begins his text with the most basic of concepts. The terminology may prove to be somewhat unfamiliar to the American student, as Mr. Boltz has used the common English terms for radio components, however this does not detract from the fact that this is a text for which there should be great demand. Many of the so-called elementary books on radio presuppose a thorough knowledge of electricity and magnetism, with the re-

(*Continued on page* 114)



By CARL COLEMAN

A FEW men are still between the devil and the deep blue sea, it seems, regarding the draft board situation and trying to get started as merchant marine radio officers. The first thing you must do after getting your "ticket" is to get in touch with your local draft board and explain that you wish to join the merchant marine — no one is allowed to depart from the United States without permission of his local board. Obtain this permission in black and white if possible. As this goes to press details of new selective service regulations have not been fully completed, but it appears as if men between 18 and 26 will not be given any type of deferment, including those in the merchant marine. The Army really wants men in that age bracket. Do not be lead into believing that if you are a member of the merchant marine you are exempt from service with the Armed Forces, as such is not the case. Men who have had considerable sea experience, that is, legitimate seamen, are deferred but those who are joining the merchant marine for the first time are subject to draft call. We suggest that you contact your local marine radio union for further details on latest information regarding the draft situation as it affects radio officers. If you are engaged in a "frozen" job you will require a release from your present employer before you can transfer to the merchant marine. Men classified in 1-A have been permitted to join and under the new set-up will most likely be able to continue to do so.

EDITOR'S NOTE: The American Merchant Marine needs at least 500 first and second class commercial radio telegraphers, who are licensed by the Federal Communications Commission, within the next three months, the War Shipping Administration has announced.

Men who possess these qualifications should wire, collect, at once to U. S. Merchant Marine, Washington, D. C. Qualified men can also apply in person or by letter to any U. S. Employment Service Office, or any post office of Recruitment and Manning Organization, War Shipping Administration. As soon as a qualified man registers he will be placed on active pay status. All qualified registrants must attend a Navy school on wartime procedure, which will require from one to three weeks. Registrants will be paid while attending school.

WSA officials said qualified radio operators are urgently needed because most vessels will henceforth carry three civilian licensed operators instead of one, as previously mentioned in QTC.

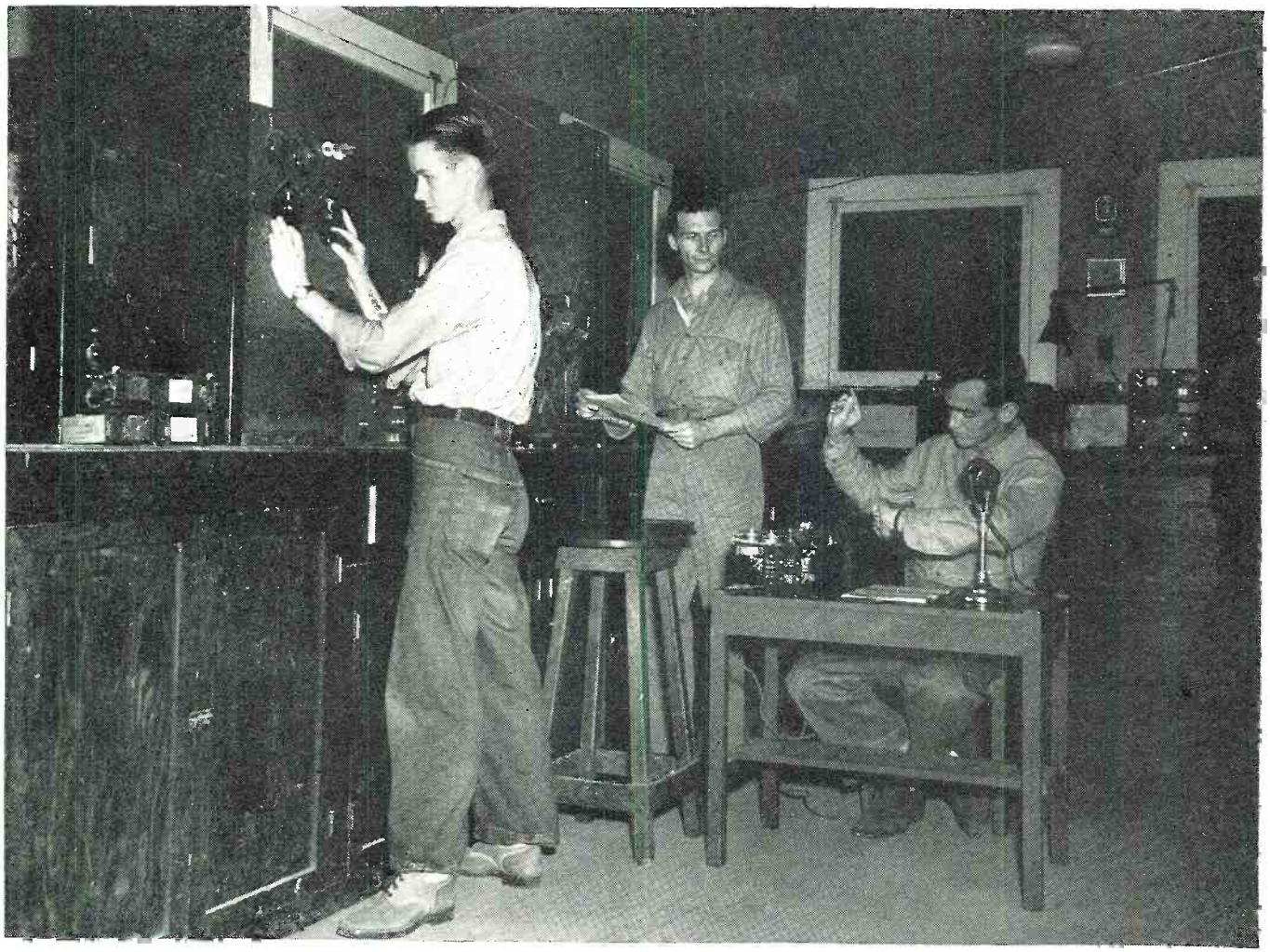
AN interesting letter has been received from W. V. Trevethen, Chief Operator on the *SS United Victory.* Mr. Trevethen wrote:

"In your March issue of RADIO NEWS in the column QTC, I notice that you mention that the first Victory ship had been launched and expressed the hope that it is an improvement over the Liberty type.

"As Chief Operator on the *United Victory,* I can assure you that from the standpoint of the radio equipment it is far ahead of the Liberty, all the various units being in one continuous panel with a typewriter well in the center and a key on either side of it, which keys either the h.f. transmitter or the main transmitter. There is still another key over to the right which keys the emergency transmitter. This is as it should be and is a great improvement over the Liberty.

(*Continued on page* 80)

"I'll bet this blows out all our condensers!"



Broadcasting with a "homemade" transmitter constructed of discarded parts and makeshift substitutions.

"ROCK RADIO"

By S/Sgt. GARTH P. JAMES
Marine Corps Combat Correspondent

An unusual radio station operating in a combat area for the entertainment of fighting men.

PERHAPS the world's most informal radio station, powered by two and one-half watts' worth of tired tubes, broken bed springs, and stripped Jeep gears, is owned and operated by three enterprising Navy men, to the everlasting delight of Marines and sailors on the South Pacific island of American Samoa.

This casual broadcasting system, called "Rock Radio" after the Marines' predilection for calling this island paradise "The Rock," is the brain-child of Radio Technician First Class Kenneth D. McCoy, of Salem, Oregon; Radioman First Class Stanley T. Dixon, of San Francisco, and Radioman Third Class Charles H. Wilson, of Steubenville, Ohio.

The station, literally, is hung together with spare and out-moded radio and mechanical parts. Its microphone first saw life as the receiver of a Marine field telephone; its record player is the turntable of an antiquated victrola, bought from a native for $3. Where its batteries and tubes came from is a closely guarded trade, or military secret. But "Rock Radio" works, every night. It even gets fan mail.

Operated by whichever of the three owners is not on duty at the time, the station broadcasts on just enough power to be heard over the entire island. On holidays, it stays open until midnight. Programs begin and end with "The Star Spangled Banner" and anything can, and usually does, happen in between. Usually a half-hour "variety" program opens the evening's entertainment. This is a program of recordings, chosen at random by the announcer from a pile at his elbow, and is interspersed with wise cracks, jokes or whatever the man at the "mike" has on his mind at the time.

Then follows a 15-minute news broadcast by the "Rock Radio Reporter." After that, comes an hour of request recordings, and how the requests flow in! Every night there are enough left over to get the next night's offering away to a flying start.

Being an informal show, the "studio," located in a repair shop, is apt to find any number of guests who have just wandered in to see what was going on. When program time comes, the announcer on duty throws a switch and casually opens up with: "Good evening, everybody; this is 'Rock Radio' on the air again for your entertain-

(*Continued on page* 64)

CONQUERING THE BOGEY MIXED CODE

By FRANK L. VELTEN

Chief Code Instructor, RCA Institutes, Inc.

Practice tests to help the student attain the accuracy necessary for receiving mixed code.

THE average student who takes the code test for Radiotelegraph - - 2nd Class without previous "mixed code" coaching stands about the same chance as had the celluloid dog who was chasing the asbestos feline through Hades. In former years a "plain language" test was given at 20 words per minute, which the examinee usually passed with no great difficulty. It afforded him a "warm-up period" in preparation for the "mixed code" which was to follow. Today there is no "plain test" to provide a mental running start for the examinee; he starts "cold" on his rocky road of converting scrambled sounds to legibly written characters. In a few minutes the ordeal will be over, and he will hear the verdict of the Radio Inspector, "O.K. You passed. You can start your theory," or, the fatal and dreaded, "You failed. Try it again in 60 days."

Let us conjure up the scene of what happens when a nervous and not too excellent code man sits for his first mixed code test. He sits jittery at the desk, watching the Radio Inspector check the speed of the auto and listening to the irritating tick-tick-tick of the machine before the tape is inserted. Finally the tick-tick stops and the Radio Inspector says "O.K." A code group sings into the earphones, five letters to the word, scrambled characters having no meaning. The examinee makes frenzied hieroglyphics on his paper and copies five or six groups in a row which he knows he is getting correctly. Then a group comes along that starts with a number and it seems to the examinee, mentally, as if some one had slugged him with a blackjack, physically. He is tripped up for a split second, puzzled by the number and the change in cadence. He hesitates as he gropes for the group that is passed, the next group arrives before he has puzzled out the former one. Utter mental confusion results and a ragged series of letters or numbers appear on the lad's paper. His fingers and wrist tighten up, seem incapable of rapid movement, his fingers sweat from gripping the pencil too tightly. He recognizes the characters but is unable to put them on the paper coherently. He knows he is slipping and savagely tries to pull himself together, gets a solid group, another group, and then comes a group with a number in the middle, followed by a group with a number at the end. A sense of panic overcomes him, his control slips completely and at the end of the test he is still struggling gamely but futilely. He bites his nails and hopes miserably that the Radio Inspector will pass him, yet knowing all the while that the R.I. could not and would not pass him if he did not rate it.

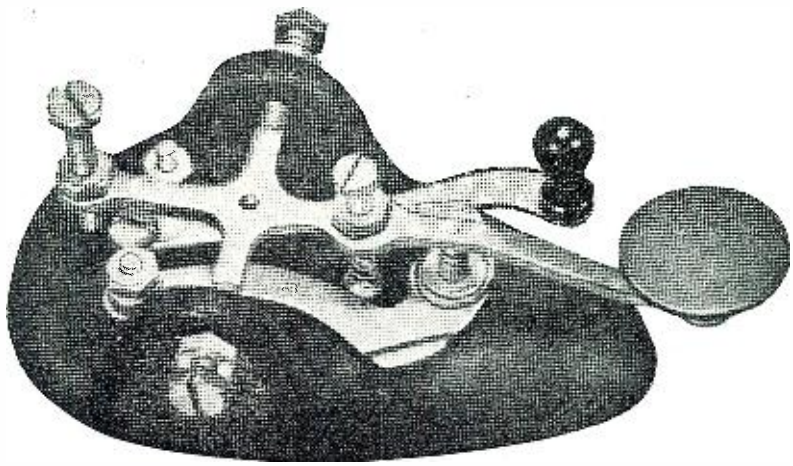
If the picture painted here appears too exaggerated, ask a few of the men who have failed their code test the first time and you will find their story will be amazingly similar to the above portrayal. What is the answer? What are the reasons for so many potentially good code men going "haywire" during a mixed code test? In the writer's opinion, the answer is lack of proper preparation, plus lack of reserve speed. The old cliché "Familiarity breeds contempt" is as true as it ever was and applies especially to the conquering of that bogey "mixed code."

Let us now break down the mixed code test. A group may be one of three categories, 5 letters, 3 letters and 1 number, or 2 numbers and 1 letter may constitute a group. A number or mark of punctuation counts or is equal to 2 letters. The five letter groups are not particularly difficult to receive for there is a definite cadence or rhythm to them. Insertion of a number into a group of letters breaks up all semblance of the "count of five" rhythm, concentration slips, and accuracy suffers.

If the code student is accurate at any given speed in plain language, it should be no great mental feat to copy five letter code at a lesser speed, let us say, about four words or groups slower than his normal plain language speed. Practice should begin with five letter plain language words, mainly to get used to the "rhythm of five," sent at the student's top "accurate-receiving speed." Then the plain language words should be gradually changed into code words, at first including a code word every fifth word and then including a code word every fourth or third word. If this be done the student will have a "breathing space" between code and plain words and will not be under the mental strain that ensues when straight code is used for the first time. Below is a practice test:

APPLE BOXES COSEY DROLL
QWERT EAGLE FOXEY GRAIN
HYENA YUIOP INPUT JOKER
KLINK LOUSY ASDFG MOUSE
NOISY ORDER PUSSY ZXCVB
QUOTE ROTOR SNOUT TRACK
MNBVC UNDER VIPER WATCH
XRAYS VAQWS YODEL ZEBRA
APRIL BRAID KOZEJ ADDER
BRUNT CATCH DRILL XCVBN

The above test should not prove too difficult when sent at the student's normal "accurate receiving" speed. An occasional code word can be received without noticeable mental stress on the very first run, whereas, when solid code material is used, the student often gets discouraged easily and tires quickly. When the first test is copied solidly it will be advisable



Inexpensive code key used by many amateurs for code practice.

to shift to another one in which every third word is a code word. Code speed should not be increased in transmission of this test, accuracy must still be stressed. Let us try this test now.

AZORE BUXOM YTREW CRUSH
DRUNK PLKUI EMPTY FINAL
ZXFGH GRASP HOVEL YHGBN
IDEAL JUNKS OYGFD KITTY
LEVEL WKLFD MOIST NODAL
FRWZQ OPALS PROUD LKUXB
QUICK RAPID LJFCM STEAK
TIMID ZDFSA UNION VALID
JYHGR WHALE XMTRS QWKDG
YEARN ZOROS MNBVC ARDOR

It is to be expected that the initial copy of the second test will not be as solid as was that of the previous test. If the copy is nearly a total failure, more work on the previous test should be done, occasionally using a new series of plain five letter words instead of the present ones. If the copy of this second test is reasonably good, more work must be done along these lines, changing words occasionally but keeping the same order, every third word as a code word. Speed must remain constant as before.

Next, is the third test, composed of alternate plain and code words. Do not expect too much on the first run.

ARBOR CVBTR BLAST YOPHG
CAPON DEKQP DRUID PLGFY
ENDED DFCVO FRAUD FGREQ
GLOBE WJHLA HOTEL POUYQ
INNER JAZQW JOIST WJGZM
KINGS ZGHLP LOPED XCTYW
MUSIC PURFJ NIECE PQWJD
OTTER XTRYK PIPER TYGSN
QUEER RQETC RATIO OLUAV
SNIPE VUBHS TRUNK LZAEQ
UNTIL LKJDY VELDT XTYIU
WHERE AFJKI XPIRE ETHYQ
YOKEL ZANDY

After a couple of runs on the third test, the average student feels instinctively that he is getting his mental "second wind" and the running is not nearly as difficult as when he started the grind. Much practice should be put on this type of test until a five letter code group possesses no great hazard to receiving accuracy and no longer trips up the concentration. By the time a solid copy is attained the student will be conscious of the fact that he is copying mechanically and no longer relying on the assistance of contex. When this condition is obtained, it is time to go after the horrible number groups.

Before the more difficult combinations of letters and numbers are discussed, let us try to receive groups that are made up in very simple form. Begin with a number followed by three letters, the letters forming easy plain words. Reception will not be too difficult, and each group mastered will be a step forward. Furthermore, you can check your own copy more easily using this method and get an honest idea of your progress and accuracy. After you have copied a few groups in consecutive order, you will find that your mental engine does not stall any more and there is very much less gear clashing. Let us try this fourth test.

1ANT 2BUD 3CAN 4DAM 5EAT
6FAT 7GAL 8HOG 9IMP 0JIG
1KID 2LEE 3MUD 4NOW 5OAR
PUP6 OUQ7 NUR8 WAS9 XAT0
ETU1 XOV2 YHW3 TIX3 NEY5
EOZ6 EPA7 GOB8 YRC9 PID0
RAE1 EOF2 SAG3 MIH4 ECZ5
GOJ6 YEK7 TOL8 DAM9

If you have made a perfect copy of this test, you can reverse the order of each group and it should be exactly the same as the previous test. It will be quite some time before you memorize it; when you do, we can move on to other combinations.

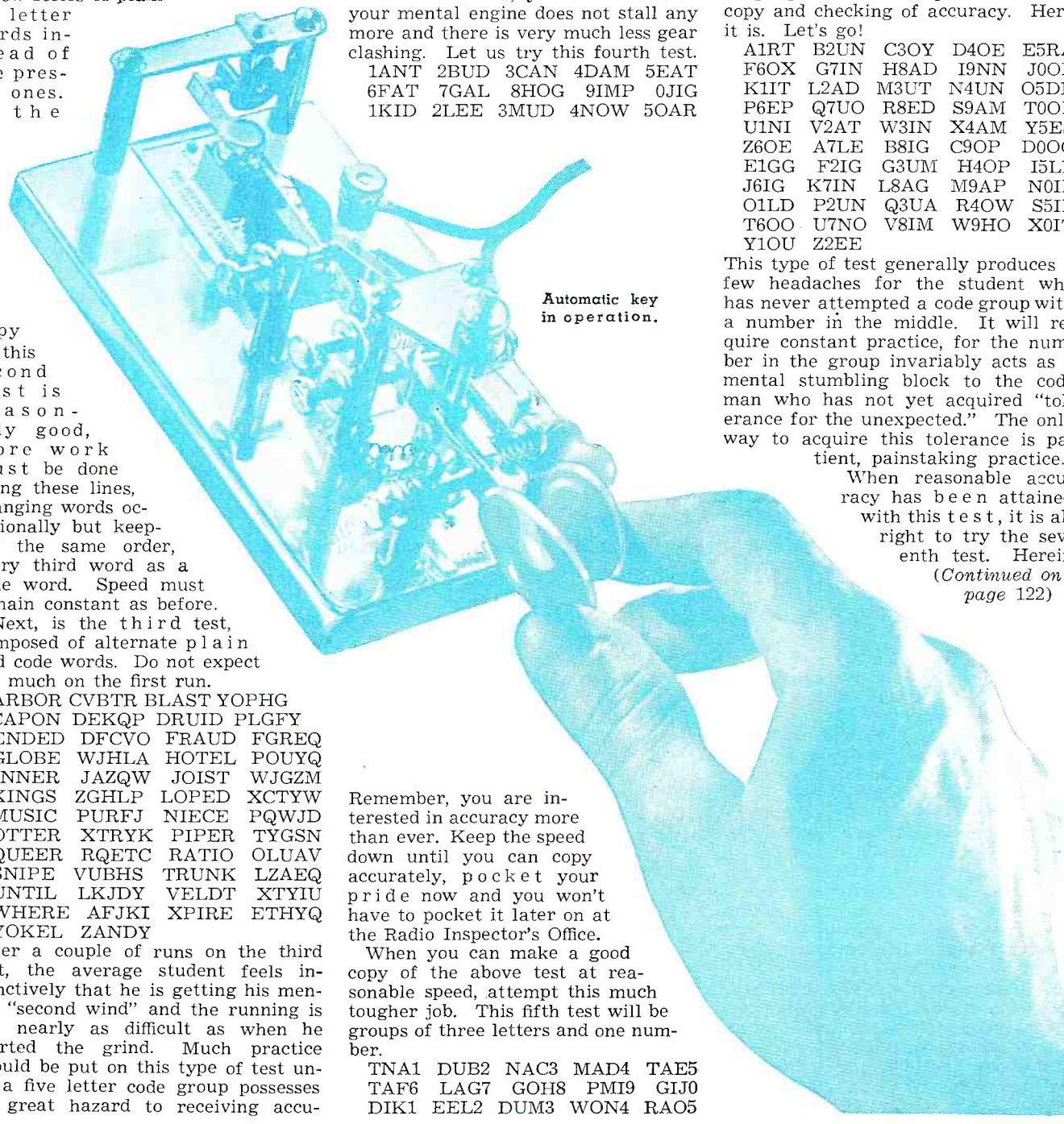
Numbers between the letters of a group make for very difficult copy and you may now attack such combinations with the material of the sixth test. Herein we have difficult groups, running in alphabetical and numerical order. The test employs a number as the second character of a group; the letters, insofar as possible, spell plain language words. This permits ease of copy and checking of accuracy. Here it is. Let's go!

A1RT B2UN C3OY D4OE E5RA
F6OX G7IN H8AD I9NN J0OB
K1IT L2AD M3UT N4UN O5DE
P6EP Q7UO R8ED S9AM T0OP
U1NI V2AT W3IN X4AM Y5ES
Z6OE A7LE B8IG C9OP D0OG
E1GG F2IG G3UM H4OP I5LL
J6IG K7IN L8AG M9AP N0IP
O1LD P2UN Q3UA R4OW S5IP
T6OO U7NO V8IM W9HO X0IT
Y1OU Z2EE

This type of test generally produces a few headaches for the student who has never attempted a code group with a number in the middle. It will require constant practice, for the number in the group invariably acts as a mental stumbling block to the code man who has not yet acquired "tolerance for the unexpected." The only way to acquire this tolerance is patient, painstaking practice.

When reasonable accuracy has been attained with this test, it is all right to try the seventh test. Herein

(*Continued on page* 122)



Automatic key in operation.

Remember, you are interested in accuracy more than ever. Keep the speed down until you can copy accurately, pocket your pride now and you won't have to pocket it later on at the Radio Inspector's Office.

When you can make a good copy of the above test at reasonable speed, attempt this much tougher job. This fifth test will be groups of three letters and one number.

TNA1 DUB2 NAC3 MAD4 TAE5
TAF6 LAG7 GOH8 PMI9 GIJ0
DIK1 EEL2 DUM3 WON4 RAO5

Fig. 135

Fig. 136

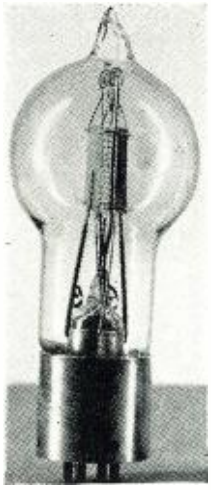


Fig. 137

THE SAGA OF THE VACUUM TUBE

By GERALD F. J. TYNE
Research Engineer, N. Y.

Part 12. The period of increased activity in the wireless industry with Lee de Forest's development of suitable oscillator and detector tubes.

WITH the money received from the sale of the telephone repeater rights on the Audion to the Telephone Company, de Forest went back to his old laboratory in the High Bridge section of New York City and resumed his investigations as of old. Before long, the laboratory was again in operation and things were progressing as before. In the discovery of the ability of the Audion to produce oscillations, little had been learned concerning its operating characteristics as an oscillator, or generator of alternating currents. De Forest, once more free from want, at least temporarily, began work on the problem of making the Audion give high-frequency output in useful quantities.

His peace of mind was not for long, however. One of the by-products of the wireless boom of 1906-1907 and the stock-jobbing schemes previously mentioned was the indictment of de Forest and some of his associates early in 1912. They were charged with using the mails to defraud, in connection with the sale of Radio Telephone Company stock. At the time de Forest demonstrated the Audion before the officials of the Telephone Company, he was free on bail of $10,000 which had been furnished by Beech Thompson, president of the Federal Telegraph Company. De Forest and his associates were brought to trial in late November of 1913. The trial ran for six weeks. So little were the potentialities of the Audion realized at that time that the indictment charged them with using the mails to defraud the public by selling stock "in a company incorporated for $2,000,000, whose only assets were de Forest's patents chiefly directed to a strange device like an incandescent lamp, which he called an Audion, and which device had proven to be worthless." This in 1912!

The Federal District Attorney, Robert Stephenson, in summing up his case said that de Forest had said[168] ". . . in many newspapers and over his signature that it would be possible to transmit the human voice across the Atlantic before many years. Based on these absurd and deliberately misleading statements of de Forest, the misguided public, Your Honor, had been persuaded to purchase stock in his company—" And yet, only two years later this feat was accomplished by the A. T. & T. Company engineers, using improved electronic tubes, based on the Audion which the overzealous District Attorney held up to such ridicule! Truly Mr. Stephenson's face must have been red!

The jury rendered its decision on New Year's Eve, December 31, 1913, seven years to the day after the grid was first inserted in the Audion. De Forest and his friend and patent attorney, Samuel Darby, were acquitted. Two of their associates were found guilty.

De Forest went back to his work. Later in 1914 the Telephone Company purchased additional rights to the use

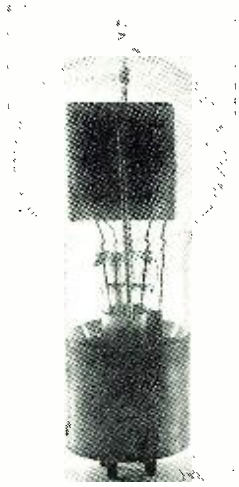


Fig. 138.

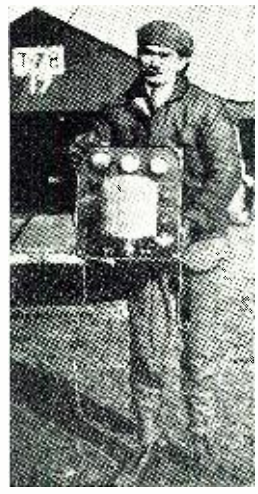


Fig. 139.

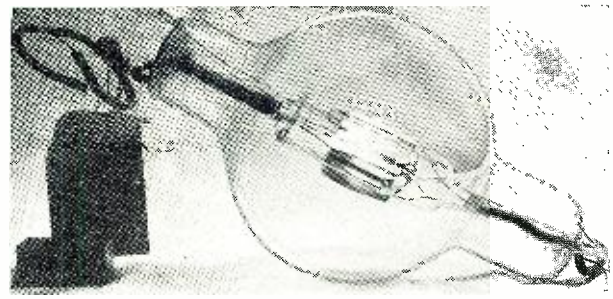


Fig. 140.

of the Audion, this time in the field of radiotelephony, for $90,000. With this additional capital de Forest's work proceeded more rapidly. The High Bridge factory was equipped with newer and better machinery, particularly with the latest and best vacuum pumping equipment. The manufacture of "Oscillions," the name given to Audions intended for use as oscillators, first of the smaller sizes and later of the larger ones, was begun.

One of the smaller types developed was the so-called "Singer" type Audion, which obtained its name from one of its uses—that of producing audio-frequency oscillations, or "singing."

The earliest models of this type had candelabra bases and the grid structure was supported by glass rods. One of the oscillators, denoted as the "Type S Oscillion" incorporating this early model is shown in Fig. 135 and the Oscillion itself is shown in Fig. 136. These Oscillions were used by de Forest in a "musical" instrument, the predecessor of such present-day devices as the Novachord and Solovox.

De Forest demonstrated this musical instrument before the New York Electrical Society in December 1915. While the Proceedings of this Society contain no record of this demonstration, there appeared in one of the popular electrical magazines of that time an article [169] by de Forest on this application of the Audion.

A later variant of the "Singer" type Audion, equipped with the "Shaw Standard" base, and with radically different internal construction is shown in Fig. 137. A rectifier version of this same tube, later used in some of the low-powered de Forest transmitters, appears in Fig. 138.

Other sizes of Oscillions began to come into being. De Forest realized the growing importance of aircraft in

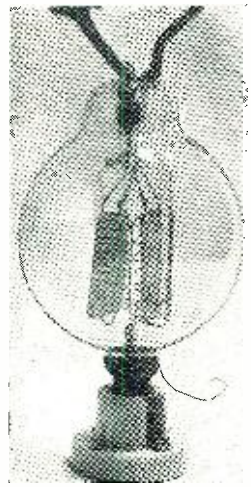


Fig. 141.

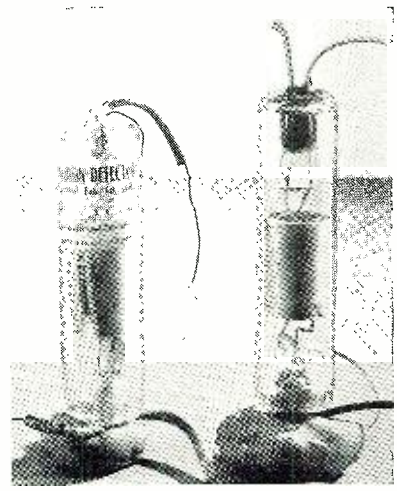


Fig. 142.

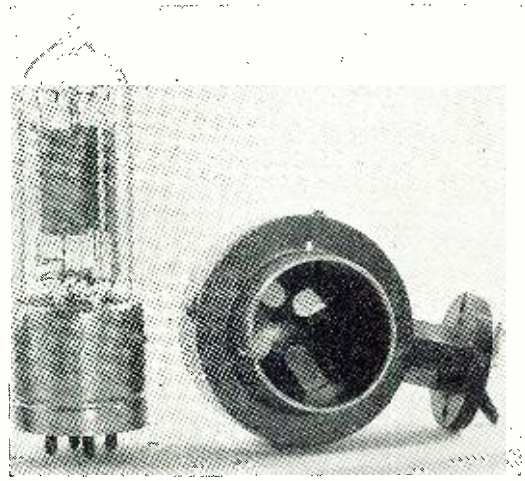


Fig. 143.

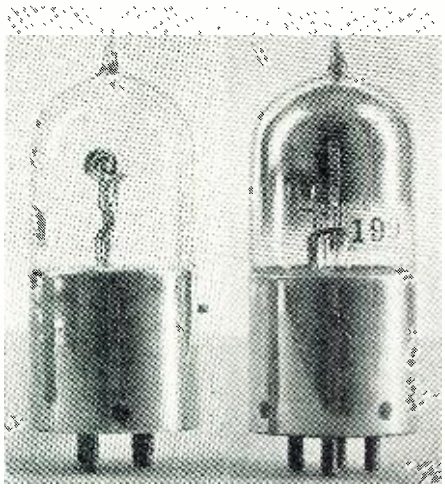


Fig. 144.

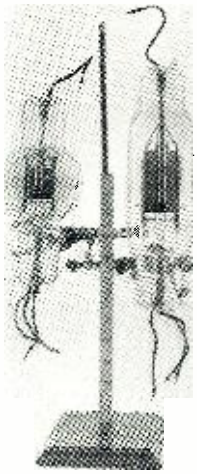


Fig. 145.

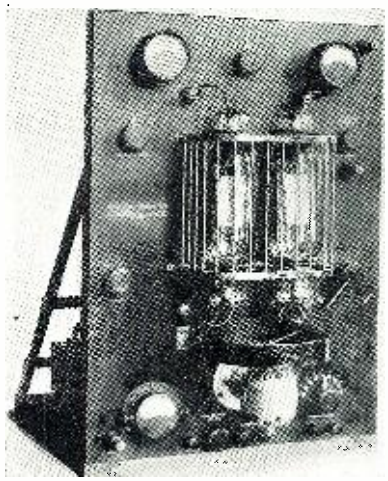


Fig. 146.

the modern way of life and felt that the necessity of plane-to-ground communications would soon become evident. Accordingly, he set about the development of an Oscillion aircraft transmitter. One of the earlier steps in that direction is the transmitter unit held by Dr. de Forest in Fig. 139.

A somewhat similar transmitter, using the same type of tube, but known as the "Type OJ3 Oscillion Telephone," was offered for sale to amateurs in 1917.

Other and higher power output Oscillions followed. This tube (Fig. 140) operated at a plate potential of 1500 volts and had an output of 250 watts. It was this type of tube which was used in the transmitter installed at High Bridge. Through this transmitter the returns of the Presidential election of 1916 were broadcast.

Late in 1915 de Forest engaged Robert F. Gowen as chief engineer. Gowen was not only a trained scientist but an enthusiastic amateur wireless operator of long standing. As a student at Harvard he had aided in organizing a wireless network for intramural communications. This organization was known as the "Weld Phonepterograph Company, Ltd." and was composed of a number of wireless enthusiasts, each of whom operated a wireless station in one of the buildings on the campus.

Under Gowen's supervision High Bridge turned out a number of sizes and types of tubes. In the way of detector tubes there was an improved spherical Audion, which is shown in Fig. 141. This, like the early Western Electric tubes, had a double glass arbor for supporting and stiffening the plate and grid assemblies, but unlike the Western Electric tube had two filaments.

Meantime, competition for the business of the radio amateur began to appear. A cylindrical three-electrode detector tube, known as the "Audio Tron" was put on the market by a West Coast concern. These tubes were good detectors, and what was most important to the amateur—whose ambitions always exceeded his financial resources —could be purchased alone. As will be recalled from a previous article the de Forest Audions could be legitimately obtained only by first buying a complete Detector, after which renewal bulbs could be purchased upon returning the old ones.

Probably to meet such competition the de Forest Company brought out a tubular Audion, designated as the "Type T," which was first offered for sale in April 1916. The "Type T" was a single filament tube, and sold for about the same price as the "Audio Tron," which was a double filament type. A photograph of two of the early "Type T" Audions is given in Fig. 142.

Not long after the appearance of the "Type T" the de Forest Company put on the market the "Type PJ Oscillion Telephone," using an Oscillion of about the same size as the "Type T" but with an internal structure resembling that of the older spherical bulbs.

With the entry of the United States into World War I all amateur activity was stopped, and the de Forest Company began to manufacture tubes for the U. S. Government. One of these, used by the Signal Corps, was designated as the "VT-21." This tube operated at a filament current of 1.1 amperes, and had an amplification factor of 10-12, with plate resistance of 60,000 ohms, at a plate voltage of 20 volts. The bulb shape of the VT-21 varied. De Forest also made tubes for the U. S. Navy, one of these being designated as the "CF-185." This tube was at first supplied to fit the Navy Standard

(*Continued on page* 118)

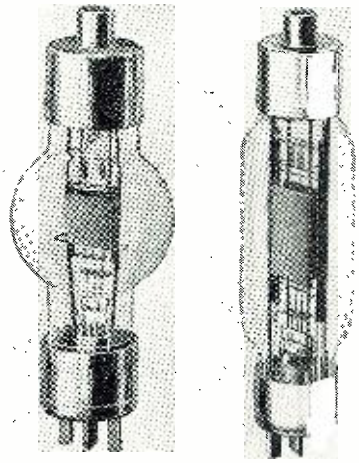


Fig. 147.

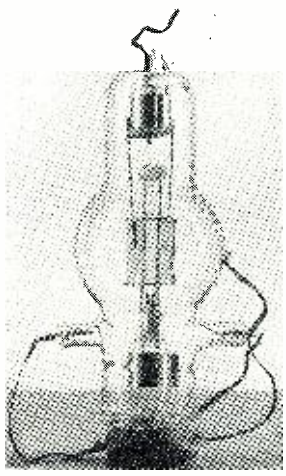


Fig. 148.

Colorimetry

(*Continued from page 27*)

found to be very nearly a straight line. This curve will depart from the straight line condition if the solution fails to obey Beer's law.

In place of the barrier layer cell and galvanometer, a phototube and amplifier can be used in the manner diagrammed in Fig. 5. In operation, the maximum meter deflection is adjusted

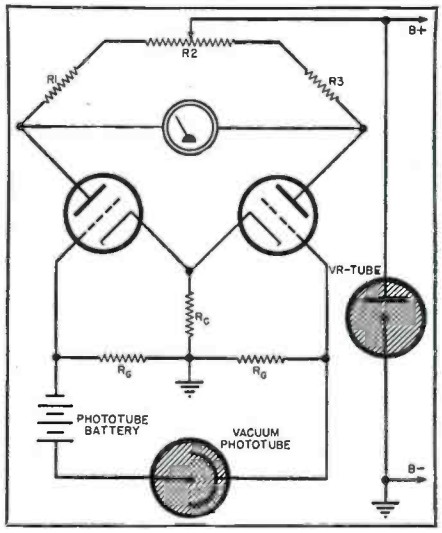


Fig. 14. Balanced circuit amplifier for use with a single phototube in an optical arrangement similar to that shown in Fig. 6.

by means of the diaphragm and the zero set, with the phototube dark, by the resistance R_3. The primary prerequisites for the successful operation of this circuit are operation along the straight line portion of the amplifier tube's characteristic curve and a stable plate voltage supply. Stability of plate voltage can be achieved

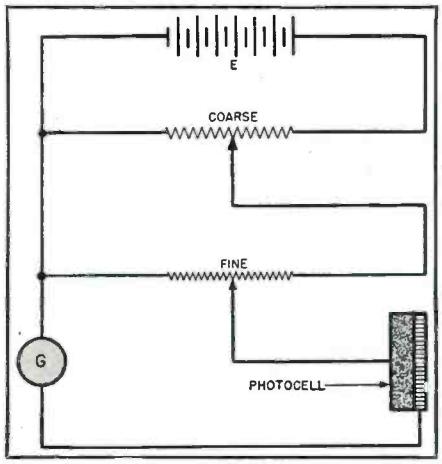
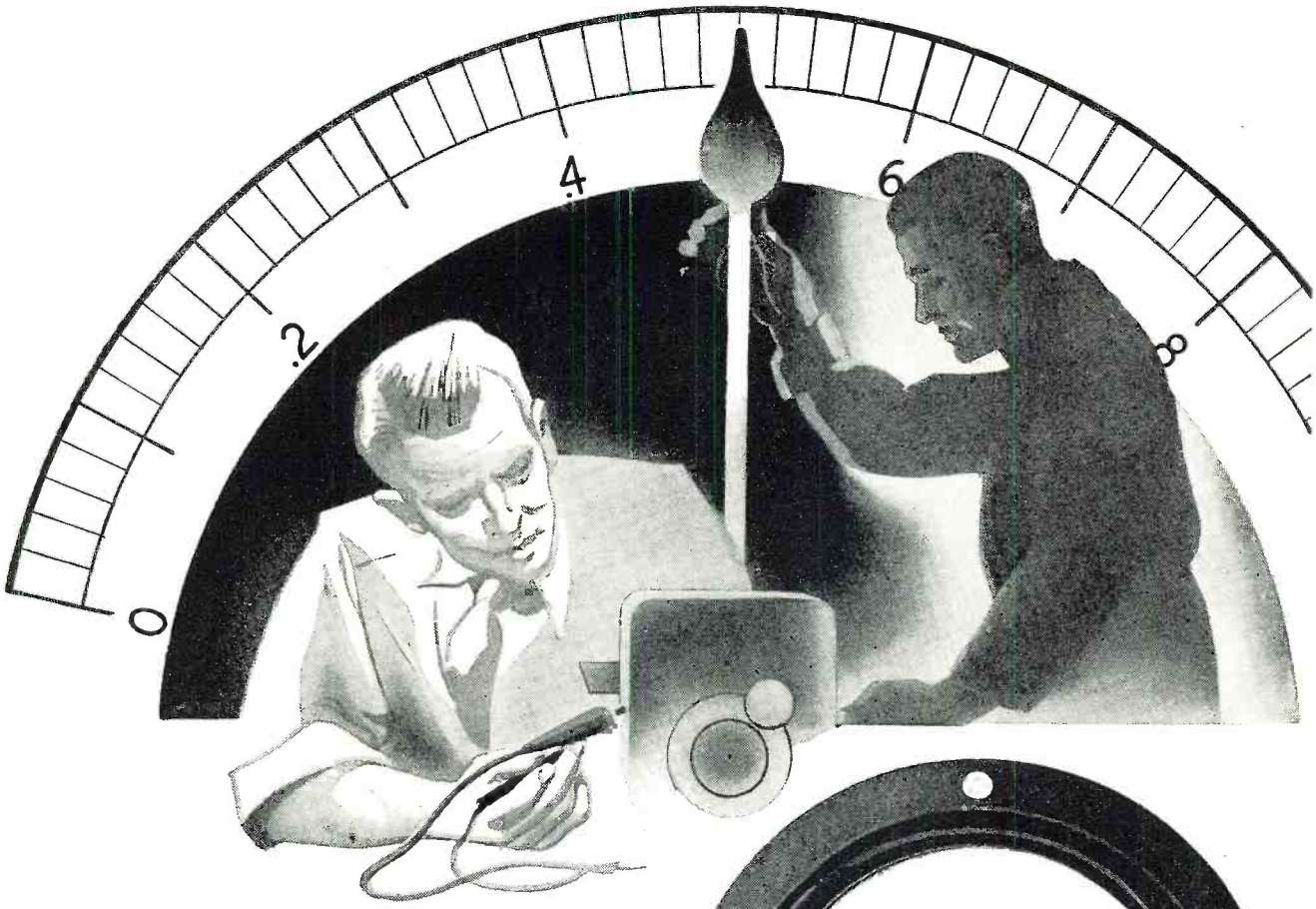
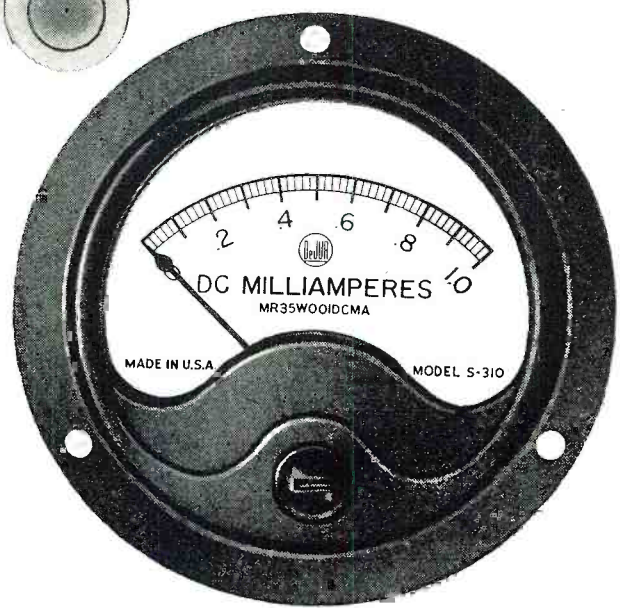


Fig. 15. "Slide-back" circuit employing single photocell.

through use of a battery, a glow discharge tube, or through use of an electronically-stabilized power supply.

A circuit placing less dependence upon plate voltage stability is the so-called balanced or bridge circuit of the type first advanced by Wold and later improved by Wynn-Williams. Two





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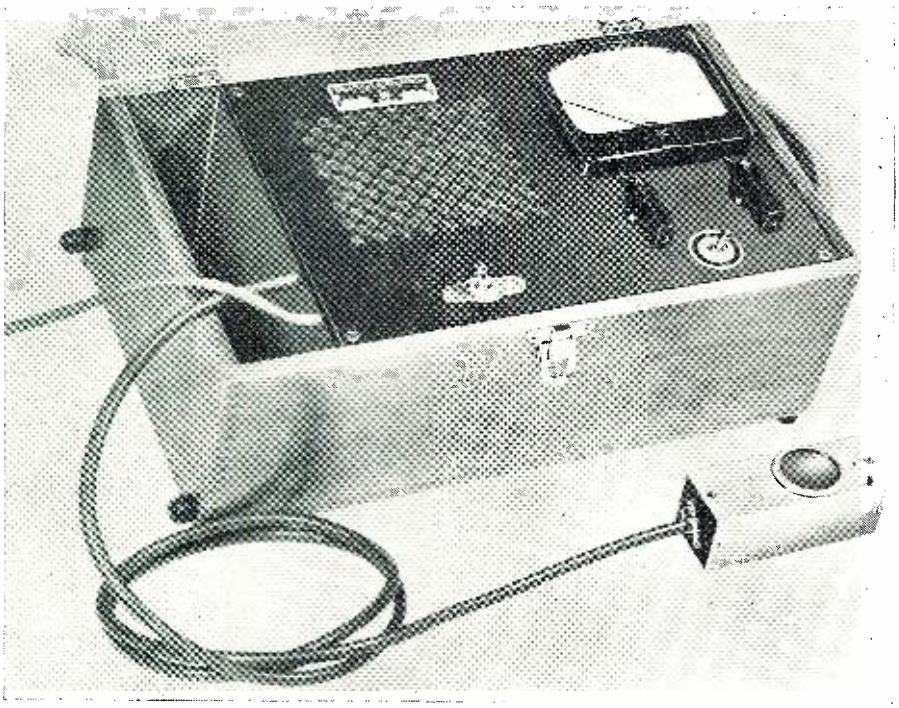


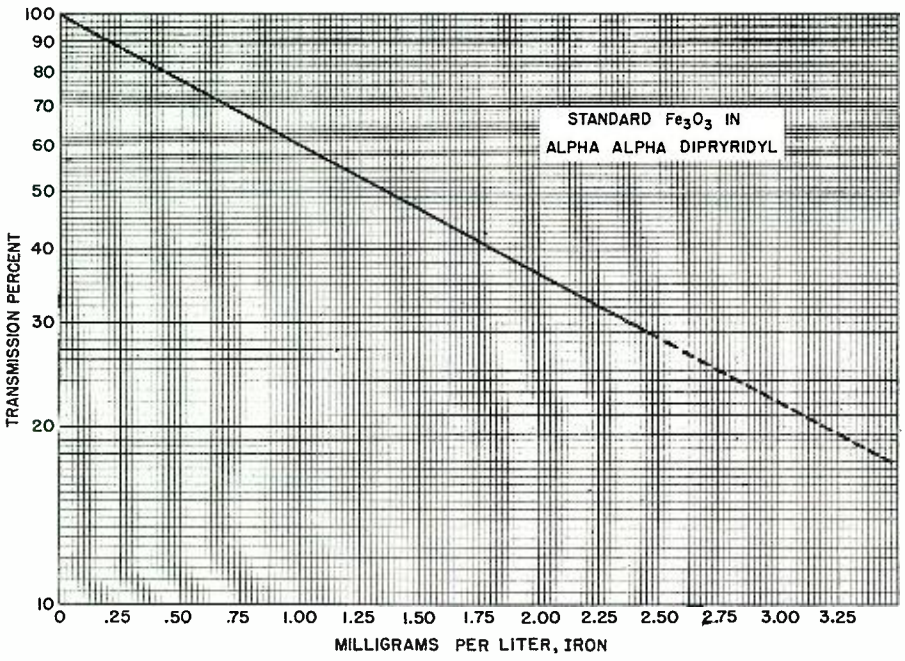
Fig. 16. Photovolt electronic photometer, operating with phototube and d.c. amplifier.

forms of this circuit are widely used, those shown in Figs. 6 and 14 can be shown that, theoretically, the circuit of Fig. 14 is twice as sensitive as that of Fig. 6. This alone is sufficient reason to tolerate the phototube battery necessary. It might be stated, too, that the use of this battery creates no problem from the maintenance standpoint, for its life in the circuit is not much less than its shelf-life since the current drain from it is negligible. Either of these circuits has the added good features that it is very sensitive (being able to detect current changes of the order of 10^{-10} amperes), is relatively insensitive to supply voltage fluctuations (especially when balanced), and reads linearly over a wide range of illumination. If desired, too, the meter can be replaced with another similar stage directly coupled to the first.

Application of the "differential" circuits has also found wide favor among the designs of direct reading photoelectric colorimeters because their use obviates the need for a stabilized lamp voltage supply. The reason becomes apparent from a study of Fig. 7. Light from the lamp L passes through two identical optical systems to fall upon the two photocells P_1 and P_2. Since the outputs of the two photocells are in opposition, a variation of the light intensity due to line voltage fluctuation produces equal and opposite currents through the meter, the net result being an insensitiveness to light intensity fluctuations. Introduction of the sample solution, however, affects the light beam of one photocell only and will cause a meter deflection. And, as in the other models, the meter deflections must be calibrated. Either photovoltaic or photoemissive photocells may be used in this arrangement. The photovoltaic arrangement has already been shown in Fig. 7; the two types of phototube arrangements that can be used are shown in Figs. 8 and 9.

The primary fault of the "differential" circuit is that its use necessitates, from the theoretical standpoint anyway, that the two photoelements be matched in spectral response, fatigue, and temperature effects. The writer, however, knows of instances where the photoelements were not matched; indeed they were two different makes, with no deteriorative effects, granted, of course, that the arrangement was not as precise as it might have been.

Fig. 17. Typical calibration curve for any type of colorimeter.



Electrically Compensated Photoelectric Colorimeters

So far the discussion has centered about the direct reading types of photoelectric colorimeters. Rather than operating in this manner, some designs employ the "slide-back" principle; that is, instead of calibrating meter deflections, the angular rotation of a resistance is calibrated instead. One such circuit, employing only one photocell, is shown in Fig. 15. In this arrangement the photo-current is balanced out by means of the potentiometric circuit shown. It is this potentiometer that is calibrated in terms of transmission.

There are strong reasons to doubt the usefuless of this circuit. First of all, the maintenance of the initial calibration is based upon the maintenance of the battery E at a steady potential. That this battery will decay with time goes without saying. In the second place, it is questionable whether the photocell, itself, will not change because of the "bucking" current passing through it.

A more sound design is that shown in Fig. 19, employing two photocells in a "differential" circuit. In this circuit, the potentiometer R_1 on the "measuring" side is used to set the null point at the start of a measurement and the potentiometer R_2 on the "compensating" side is used to bring the meter back to its null point after the sample has been introduced. R_2 is calibrated in terms of transmission.

Optically Compensated Photoelectric Colorimeters

An alternative method to electrical compensation is optical compensation. Here, too, it is best to use the "differential" circuit. The primary difference between the two methods is that an adjustable diaphragm is placed in the "measuring" light beam to set the null point and a calibrated diaphragm in the "compensating" light beam is used to return the meter to the null point

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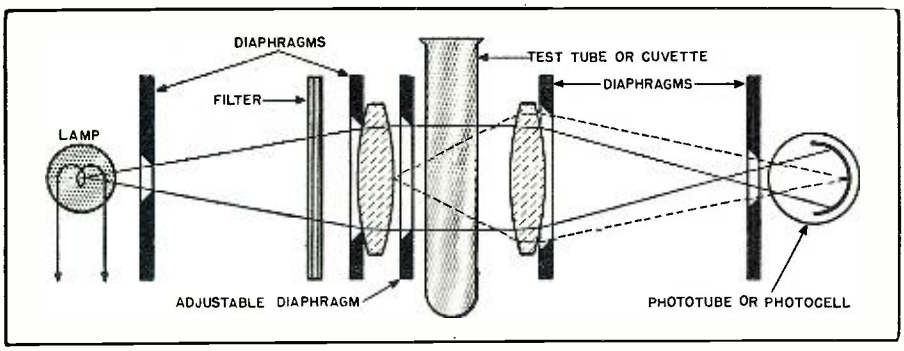


Fig. 18. The manner of employing diaphragms. As shown, the light between the two lenses is collimated and the second lens images the first upon the phototube cathode. This results in uniform illumination upon the phototube cathode. If made symmetrical, this optical arrangement is satisfactory for differential circuits.

following introduction of the sample. Its chief advantage over the electrical compensation method is that the photoelement characteristics are not changed as they are in electrical compensation with its variable photocell load resistances. Either photovoltaic or photoemissive photoelements may be employed.

Diaphragms, however, are not the only optical compensating devices that can be used. Polaroid discs, a variable lamp distance, or a calibrated neutral density wedge can be used to achieve the same results.

Filters

The reader has probably noted that filters have been shown in all diagrams. The use of filters is practically mandatory with all chemical solutions in order to make them obey Beer's law. Of course, filters can be omitted but then the plot of the logarithms of the transmissions against concentrations will not be a straight line function making interpolation and extrapolation of data subject to error. For this reason filters are invariably used.

Filters are chosen with respect to their ability to pass very narrow bands of wavelengths. The truly ideal filter would pass only a single wavelength, but then the instrument resulting would be a spectrophotometer. In colorimetry, filters passing bands as wide as 500 Å are completely satisfactory. The transmission curves of several filters commonly used are shown in Fig. 13. The filter to be used for any given measurement is dictated by the color of the solution. The transmission peak of the filter should be coincident with the absorption peak of the solution being measured.

Errors in Photoelectric Colorimetry

The reader must not assume that the application of electronics to colorimetry is a cure-all for all possible errors. Although the personal equation is removed by the photoelectric colorimeters, many other causes for error still remain. These can be largely eliminated by scrupulous care,

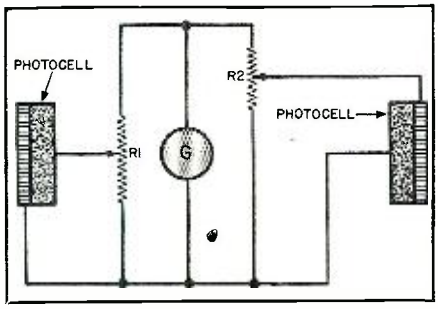


Fig. 19. "Differential" photocell circuit with electrical compensation.

both in the design and use, of the instruments.

Stray light is a common and frequently overlooked source of error. It can best be avoided through use of a dull black finish for the interior of the instrument and by use of baffles and diaphragms in the light path. Stray light may also enter the instrument through cracks and crevices in the cover which should be light-tight. The proper use of baffles and diaphragms is shown in Fig. 18.

Temperature effects are another commonly neglected source of error. Before any measurements are taken, the lamp should be turned on for a period of several minutes to allow not only the lamp filament to reach its operating state, but also to allow the mechanical, electrical, and optical parts to expand to their working dimensions. Unfortunately, the photocell is usually most affected by heat, so it is wise to remove it as far as is practicable from the light source. Even so, thermal effects are usually encountered.

All optical and electrical parts should be kept free from dust because its presence will, on the optical parts, create stray light and, on electrical parts, create contact difficulties.

The optical system should be such that the area of the photoelement illuminated is not substantially different whether the sample is in the light beam or not. This condition is most readily satisfied through use of collimated light. Whenever a measuring aperture is used, its use in parallel light is mandatory. The use of an iris diaphragm for a measuring aperture is not advisable because a setting upon them is never reproducible. Practical optical systems are shown in Fig. 11.

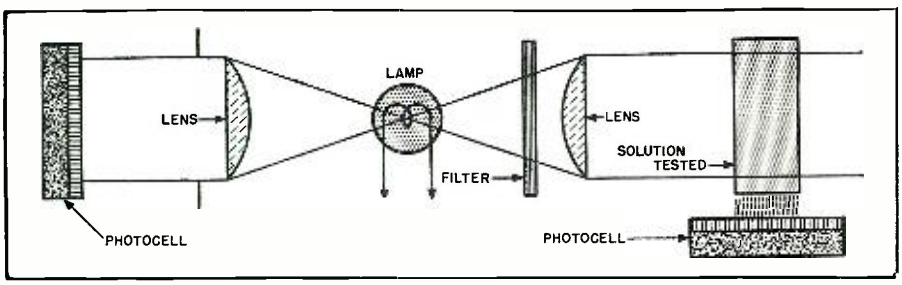
Turbidimeters, Nephelometers, and Fluorophotometers

The turbidimeter, the nephelometer, and the fluorophotometer are all instruments that involve essentially the same components electrically and optically, as do the colorimeters. One can usually be obtained from another by relatively simple changes.

The turbidimeter is an instrument employed for measuring the transmissions of turbid solutions that may or may not be classed as colloids. They may be of identical form to any of the colorimeters already discussed. Often, however, the liquid strata used must be thicker and, hence, they may differ only with respect to the solutions cells used. As in colorimetry, it is necessary to prepare a working curve or plot of concentration vs. scale reading for all solutions used. The relation of concentration to turbidity is usually complex and not linear.

The nephelometer and the fluorophotometer are two instruments similar in principle and design and differing from the colorimeter and the turbidimeter only in the respect that the light intensity measured is at right angles to the illuminating beam. In the case of the nephelometer, the light measured is produced by true scattering by tiny particles suspended in solution, while in the fluorophotometer the light is produced by the actual fluorescence of the solution. In nephelometry an intense white light beam is used; in fluorophotometry an intense beam of monochromatic ultra-violet light is used. The optical arrangement of either instrument is shown in Fig. 20. The electrical arrangement of both instruments can be of any of the types discussed for colorimetry.

Fig. 20. Optical arrangement used in both nephelometers and fluorophotometers.



Applications and Sensitivities

Colorimeters are applicable to the measurements of constituents that are

(*Continued on page* 71)

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WANTED — Hallicrafter S-20R, S-29, SX-25, or SX28. Will pay cash. Ensign C. C. Board, USN #6, Lowes Lane, Key West, Fla.

WANTED—Gernsback's radio ser. manuals #1, 4, 5, 6 in binder. Since 1937 if available. Cash. Franz E. Wells, Box 183, Massena, N. Y.

FOR SALE—4-prong Eby sockets #12, used, 8c ea.; Westinghouse used trickle charger, $2; 12" Zenith speaker, $3; also from 5" up to 11" @ $1 ea. Want power trans. and condensers, Superior channel-analyzer and sig. gen. for cash or trade. Jos. K. Peffer, Box 66, Mt. Holly Springs, Pa.

URGENTLY NEEDED—Audax microdyne pick-up #D-3811 in perfect cond. Will swap even a Seeburg phono amplifier compl. with 7 tubes but less speaker. Also need late model sig. gen. All letters answered. Jos. D. Copeland, 66 Clark St., Portland 4, Me.

WANTED—Superior channel analyzer in good condition compl. with inst. and test cables. Halstead Chrisman, Aflune, Wash.

WILL SWAP—Have Clough-Brengle OM oscillator with 2400 r.p.m. sweep motor, 5-bands. Need V-O-M or what have you? Supplies Radio Service, 210 E. Ferry St., Buffalo 8, N. Y.

WANTED—1F6 for cash. Bob Briggs, 7 Bigelow St., Cambridge 39, Mass.

WANTED—Any good used test eqpt. or S-W receiver. Have port. typewriter in A-1 shape; also Weston 0-100 MA and Weston 0-30 MA to swap or will pay cash. H. A. Thompson, P. O. Box 405, Monterey Park, Calif.

URGENTLY NEEDED — Sig. generator, also vac. tube volt meter such as Philco. M. E. Straub, 352 E. Liberty St., Girard, Ohio.

FOR SALE — Kadette KRC-2 remote control unit. Want F-M converter or receiver & recorder & heavy-duty phono motor. Alfred M. Stump, 311 Marathan Ave., Dayton 6, Ohio.

WANTED — Any make V-O-M in good condition or needing slight repair. Also tube checker. Cash. Columbus Henry, 909 E. 30th St., Houston, Texas.

FOR SALE—Postal S-W 9-tube receiver less tubes, $23.50; Esico 85-watt soldering iron, $3.35; Jackson 100-watt soldering iron, $4.25. All used but good. Dave's Radio, 1316—42nd St., Brooklyn 19, N. Y.

FOR SALE OR TRADE—Philco car dial plates models AR5, 9, 40, 45, 50, 55, 65, 75, new. Also Crowe & Star plates, '37 Buick custom radio, $27.50; '39 Chevrolet 8-tubes p-b, $32.50. Need meters, test eqpt., tubes, etc. Gregory Radio Co., 1009 Valencia St., San Francisco 10, Calif.

SWAP OR SELL—Kenyon filter choke, 400 mills, 80 ohms; Two power trans. 600-0600V. 200 mills. 6.3v., 7.5v., 2.5v.; 12" steel speaker projector with crows feet; 2-gang Bud var. cond.; and large variety of midget electrolytics, tubes, etc. Write for list. Need Hi-fi output trans. 5000 ohms pl. to pl., also good foundation meter 0-1 mill. Cpl. Jos. Ratkowski, Btry. H. 245th C.A., Fort Tilden, N. Y.

FOR SALE—18 hard-to-get s-w tubes; 15 metal, 3 glass. Good asst. little used, A-1 condition guaranteed. $18 cash for all. Also RCA Radiola #18 broadcast receiver with separate #103 speaker in metal cab. to match. Cheap. Herman Fischer, 626 Carlton Ave., Brooklyn 17, N. Y.

WANTED—RCA voltohmyst, Jr.; CB oscillograph for use with Clough Brengle OMA sig. generator. Knight Radio Service, 106 Wesleyan Ave., Providence, R. I.

WANTED—Rider's manuals 7 to 11 and modern tube tester. Cash. J. B. Mosley, 1426 N. 24th St., Birmingham, Ala.

TUBES TO SWAP—Have plenty of 1H5, 1N5, 1P5, 5U4, 5Y3, 6J5, 6J7, 6SK7, 6SR7, 12SK7, 12SR7, 12J5, 12K8, 80, 6L6, and others to swap for 6A8, 6SA7, 12SA7, 35A5, 35Z5, 35Z5, 35Y4, 50L6 or what have you? Military Radio, 448 Ontario St., Buffalo 7, N. Y.

WANTED FOR WARTIME RESEARCH—Supreme 561 or Hickok 180 service oscillator; Supreme 562 audolyzer or equivalent sig. tracer; Supreme 504 tube tester or equiv.; Solar condenser analyzer. Prefer 110V 25-cy. but can use 110V, 60 cy. Give details. Canadian Research Institute, 463 Spadina Ave., Toronto 4, Ont., Canada.

FOR SALE—500-watt phone or 800-watt C-W transmitter and other amateur eqpt. Incl. TZ40's, T40's, T55's, 866's, T20's, TZ20's, etc. Want late model test eqpt. also mobile amplifiers or A-C amplifiers, trumpets or other sound eqpt. Signal Sound Supply, P. O. Box 921, Wilmington, N. C.

YOUR OWN AD RUN FREE!

This is Sprague's special wartime advertising service to help radio men get needed parts and equipment, or dispose of radio materials they do not need. Send your ad today. Write PLAINLY—hold it to 40 words or less. Due to the large number received, ads may be delayed a month or two, but will be published as rapidly as possible. We'll do everything we can to help you—and the fact that thousands of pieces of Radio-Electronic equipment are in operation today as a result of sales or "swaps" made through The Trading Post offer convincing proof of the far-reaching effectiveness of this service. Ads offering equipment for sale bring best results, and will be given priority.

Different Trading Post ads appear monthly in Radio Retailing-Today, Radio Service-Dealer, Service, Radio News, and Radio Craft. Sprague reserves the right to reject ads which do not fit in with the spirit of this service.

When buying Capacitors—please ask for Sprague's by name. We'll appreciate it!

HARRY KALKER
Sales Manager

SPRAGUE PRODUCTS CO., DEPT. RN-64, NORTH ADAMS, MASS.

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

Radio Amateurs

(*Continued from page 24*)

tion. Did the equipment work? You bet it did! The boys at home had done their job well. The water and rough treatment had not the slightest effect on the operation of the receivers and transmitters.

That crude radio station had to move *five times* during the first two days it was in operation. It has been operating twenty-four hours a day from the very beginning—has been rebuilt and improved many times—*and if it is still standing,* now looks like the modern tower at your local airport.

Such is the story of a handful of A.A.C.S. radio-men, one a former "Ham." We appreciate that amateurs form only a small part of our fighting forces, and we'd be the last to suggest that they are winning the war single-handed. We do want to point out, however, that in a great many instances "Hams" occupy positions of great importance, and in talking to prominent military men we have been told time and time again that the "Ham" is considered a distinct military asset. Amateurs are now serving as instructors, engineers, operators and executives in all the communications branches of the service. They were not essentially radio men—they were lawyers, doctors, clerks, mechanics and business men, and they took with them into service additional experience that made them ideal prospects for key positions.

Amateur radio has served in many other ways, too. Large quantities of equipment were purchased from "Hams" by the Armed Forces, helping to meet the urgent demands in the early part of the war while manufacturers were getting into mass production. In addition, the technological development of high-frequency communications has been aided considerably by the vast amount of experimenting done by "Hams" in the last ten years.

Up to this moment, of course, amateur radio is all history. Technically speaking, the status of the "Ham" remains the same as before the war, though his activities have been suspended for the duration. The future of amateur radio is rightly of great concern to many people—most of the boys who were "Hams" before the war will want to get back on the air when they come home. Also, many thousands of our boys who had no previous knowledge of radio are now saturated with communications as a result of their wartime training and they too will want to do something about it when they get back to the normal way of living. All this means that we are going to face a big problem when we come to allocate frequencies in the postwar era. Surely this is not the time to start a fuss about frequency allocations, but this *is* the time to start thinking and talking about it.

Many branches of the radio industry

THE *MOST* RADIO-ELECTRONIC TRAINING

★ in the shortest time ★ at the lowest cost

Let Alfred A. Ghirardi—Radio's best known technical author—start you on a fascinating, profitable **RADIO-ELECTRONIC** career!

FOR BEGINNERS . . . no previous training necessary

You can pay a big price for basic Radio-Electronic Training—but the amazing fact remains that Ghirardi's famous 972-page RADIO PHYSICS COURSE book will give you just the training you need, all you need—and easier, better, and faster—*at a total cost of only $5 complete!*

LEARN EASIER—BETTER—FASTER

With other types of training selling for as much as $150 that's a big statement to make—BUT HERE ARE THE FACTS: Ghirardi's big RADIO PHYSICS COURSE book has given more people their start in Radio than any other book or course. It is more universally employed in U. S. Army Signal Corps and Navy Schools than any other book of its kind.

It is more widely used for home study—and by civilian schools and colleges. Most important of all, it is more widely endorsed by thousands of radio men themselves as the finest, most complete, easiest-to-understand Radio-Electronic course on the market.

No previous knowledge of Radio-Electronics is necessary. Ghirardi's Radio Physics Course carries you rapidly along from the very basic fundamentals of Electricity to the latest, most modern Radio-Electronic developments. Nothing is omitted—nothing condensed. Every step is made crystal clear and understandable by thorough, simplified explanations, and by more than 500 special illustrations.

Each section is followed by self-testing review questions so that you can check your progress every step of the way. There are no monthly lessons to wait for. You go ahead as fast as you want to. All you need is a little spare reading time plus a desire to get started RIGHT for a worthwhile future in broadcasting, aviation radio, servicing, electronic manufacturing television—or any other of Radio-Electronics' fast growing branches.

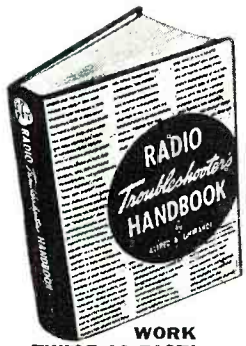
36 COURSES IN ONE!

Actually, RADIO PHYSICS COURSE gives you the scope of 36 complete courses in one big book. If it were broken into sections and sold as a course, you'd regard it as a bargain at $50 or more. It's yours, however, for only $5 complete ($5.50 foreign)—and you don't even take the slightest chance on that! Our 5-Day Money-Back Guarantee is your absolute protection. Send the coupon today!

SEE IT • STUDY IT • BEFORE YOU BUY IT

Here's how sure we are that you will like it:

Judge Ghirardi's RADIO PHYSICS COURSE for yourself. Compare it with any other Radio book or course at any price. Use it for 5 full days. Then, if you are not convinced that it will teach you basic Radio-Electronics EASIER, FASTER, and at LESS COST, return it and we will send your MONEY BACK!



WORK TWICE AS FAST!

"It has helped me fix twice as many radios in a day as I could fix before owning this book," writes Vernon Taylor of Elgin, Texas.

HERE'S HOW TO "TEST" A RADIO IN TWO MINUTES . . . or less!

Then fix it in half the time you'd normally expect to take

If you repair Radios for a living—or, even if you only tinker with sets occasionally, this big, new, completely revised edition of Ghirardi's famous RADIO TROUBLESHOOTER'S HANDBOOK is a book you cannot afford to miss! This big, 744-page, manual-size book is a complete guide to trouble diagnosing, locating, and fast repairing for practically EVERY type of Radio Receiver now in use. It eliminates extensive testing; helps you do two jobs in the time normally required for one; repair cheap sets at a profit; substitute available tubes and parts properly; train new helpers, etc.

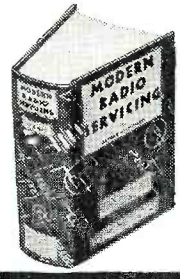
TELLS WHAT TO DO—EXACTLY HOW TO DO IT!

New, fully revised, the RADIO TROUBLESHOOTER'S HANDBOOK now contains 404-page Case-History compilations covering over 4,800 models of receivers and record changers—I.F. alignment peaks for over 20,000 superhets; big section on I.F. trans. troubles, and hundreds of tables, graphs, charts, and data sections, including a big new tube chart ESPECIALLY DESIGNED FOR WARTIME SERVICE NEEDS. It is yours complete for only $5 ($5.50 foreign) on an absolute 5-DAY MONEY-BACK GUARANTEE BASIS.

THIS GHIRARDI WINNER WILL TEACH YOU RADIO SERVICING!

How would you like to have Radio's most widely acclaimed servicing expert at your side to teach you everything you need to know to help make you an accomplished radio service man? Actually, ownership of Ghirardi's MODERN RADIO SERVICING means just about that! It is the only single, inexpensive book that gives a thorough and easily understandable explanation of test instruments; receiver trouble-shooting procedure; circuit analysis; parts testing and repair; maintenance, etc. 1300 pages with 706 illustrations, 720 self-testing review questions; 766 different topics! Only $5 complete ($5.50 foreign).

See *MONEY-SAVING COMBINATION in Coupon*



RADIO & TECHNICAL DIVISION OF MURRAY HILL BOOKS, INC.
Dept. RN-64, 232 Madison Ave., New York 16, N. Y.

Enclosed find $..... for books checked (send postpaid): or ☐ send C.O.D. (in U.S.A. only) for this amount plus postage. If I am not fully satisfied, I may return the books within 5 days and receive my money back.

- ☐ RADIO PHYSICS COURSE $5.00 ($5.50 foreign)
- ☐ 3rd Revised Ed. RADIO TROUBLESHOOTER'S HANDBOOK $5 ($5.50 foreign)
- ☐ MODERN RADIO SERVICING $5 ($5.50 foreign)
- ☐ Special **MONEY-SAVING COMBINATION:** MODERN RADIO SERVICING with the TROUBLESHOOTER'S HANDBOOK $9.50 for the two ($10.50 foreign)

Name .....

Address .....

City and Dist. No. ..... State .....

REPAIR ANY KIND OF RADIO EQUIPMENT

PREPARE YOURSELF FOR A BETTER JOB AT HIGHER PAY IN THE RADIO-ELECTRONIC FIELD

are now discussing *their own* future in the new world which is sure to come and much postwar planning has already been done in Washington to safeguard the future of amateur radio. Our objective here is to aid and assist those efforts by bringing to the attention of our readers some little known facts about "Hams" and their past and present activities.

We hope, in a forthcoming article, to bring you a story about the part the "Hams" are playing in the communications systems of the far North. In the meantime, we'd like to hear from any of our readers who are "Hams" or from those who have more than a passing interest in amateur radio.

—30—

Rock Radio

(*Continued from page* 49)

ment. Tonight . . ." And the show rollicks on.

Radio Technician First Class McCoy, the 27-year-old son of Mr. and Mrs. N. T. McCoy, of Salem, Oregon, was an announcer for Station KWIL, Albany, Oregon, before he joined the Navy. A graduate of Oregon State University, he enlisted in June, 1940, and has been in the South Pacific on shore duty since November, 1942. Radio Technician McCoy usually acts as newscaster and announcer for special events. On Christmas Eve he supervised the recording and rebroadcast of the President's message to the Armed Forces.

The owners of "Rock Radio" are never absolutely certain that they'll take to the air each night as scheduled.

"It's on account of saboteurs," says Radioman First Class Dixon, of 2425 Twenty-first Avenue, San Francisco, California. "Whenever someone needs a spare part or something, they get it out of our set. About five minutes before we open up, we usually find some lug has swiped a tube. Then we rush like mad to get another."

Radioman Third Class Wilson, 23, whose mother, Mrs. Jennie Wilson, lives at 138 South Third Street, Steubenville, Ohio, has been associated with radio since he was graduated from Steubenville High School, where he had his own orchestra. Before enlisting in September, 1942, Radioman Wilson was an announcer for Station WKST, New Castle, Pennsylvania, and a night club master of ceremonies. He hopes that some day "Rock Radio" can put on real shows and he is scouting for talent among his mates.

What the men want most is better equipment. They want a good, even reasonably new, microphone, a record-player and more records; those that they have are badly scratched and "The Star Spangled Banner" is virtually worn out.

"Rock Radio" may be whacky and haphazard, but to the Marines and sailors on that island it is an institution.

—30—

There's No Profit in This Kind OF REPEAT BUSINESS

WHEN you've spent a lot of time running down the trouble in a set and finally finishing the job, there's no profit in having the work to do over again because of replacement part failure.

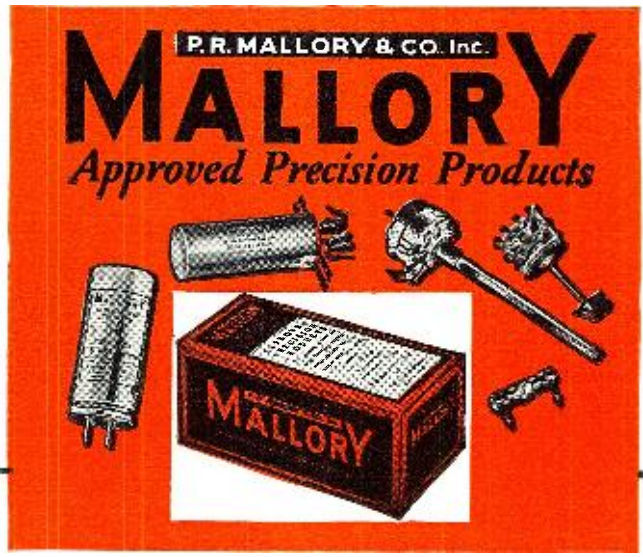
Manpower is scarce...your time is precious, and so is your reputation. So don't take chances—use Mallory parts and rest assured that your customers will be satisfied.

Standardize on Mallory volume controls, capacitors, vibrators, switches and resistors for replacement installations. Their dependability and reputation for proved performance is your assurance that when it leaves your shop, the job is right the first time . . . and every time.

P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

MYE TECHNICAL MANUAL —408 pages of complete data on capacitors, noise suppression, receiving tubes, loud speakers, vibrators, phono-radios, automatic tuning and other valuable information. Available from your Mallory distributor...Price, $2.00.

4TH EDITION RADIO SERVICE ENCYCLOPEDIA . . . Complete information on repairing any make or model of receiver. Circuit references, original part numbers and recommended replacements. Available from your Mallory distributor . . . Price, 95 cents.



Hasten Victory . . . Buy War Bonds

WHAT'S NEW IN RADIO

New products for military and civilian use.

NEW PILOT LIGHT

Known as the *Gothard* Series No. 1110 Pilot Light—this new unit is available in several variations. Primarily for ungrounded panels, all variations of this new light are equipped

with two solder terminals. Models No. 1110 (faceted jewel) and No. 1111 (plain jewel) take long bulbs—Models No. 1112 (faceted jewel) and No. 1113 (plain jewel) take round bulbs. The preceding models are available with bayonet sockets only.

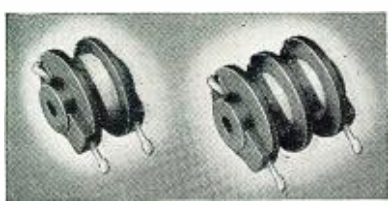
This new light is also available as a shutter type light, for such applications that require variable intensities. To satisfy varying conditions, 90° turn of the shutter provides gradation from bright light, through intermediate glows to a dim glow, *or total blackout.* In the shutter type—Models No. 1114 (faceted jewel) and No. 1115 (plain jewel) provide for round bulbs. They can also be furnished with polarized lens. All models mount in 11/16" holes and have ½" jewels.

Lamps are removed from front of panel. This new series of pilot lights is manufactured by the *Gothard Manufacturing Company* of Springfield, Illinois.

BOBBIN RESISTORS

One of the latest developments in the application of *Sprague* Koolohm ceramic-insulated wire construction to the solution of resistor problems is the new Koolohm-Bobbin type resistor. Instrument resistor stability, is assured for these resistors by means of a current and temperature aging process.

Standard resistance tolerance for these resistors is ± 5% for full wattage rating,while closer tolerances, as low as ± ½%, can be provided at



lower wattage ratings. Maximum power rating is 2.5 watts and maximum resistance 250,000 ohms in a section ⅝" wide and a diameter of 1 3/16". The maximum recommended operating temperature (ambient plus rise) is 150 degrees C.

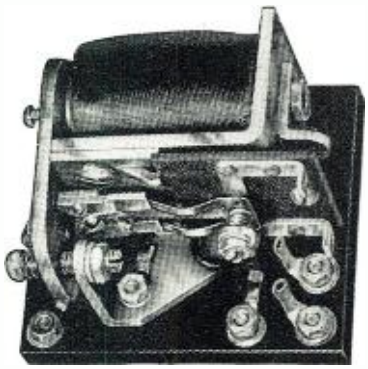
These resistors are recommended for use as meter multipliers, resistance standards in control instruments, resistance elements of RC oscillators and as power resistors of medium wattage ratings in values to ½ megohm.

Data sheets will be sent upon request to *Sprague Specialties Company,* Resistor Division, North Adams, Mass.

SNAP ACTION DELAY

The familiar *Struthers-Dunn* Type 79XAX relay has been redesigned to make it both practical and economical for use in a wide variety of applications calling for a specialized type relay.

This relay is designed so that its armature practically completes its travel before the contacts snap with a positive action to the corresponding position. This feature, plus the fact that contacts remain closed with full



pressure up to the instant of transfer to the other position, permit this unit to be used in a number of unusual ways. Such applications include overcurrent protection, particularly in the range of 1 to 100 milliamperes, overcurrent protection in connection with shunts furnishing potentials in the range of 1 to 100 microvolts, pulsing circuits where the relay must "pump" and numerous sensitive vacuum tube circuits.

An engineering data bulletin describing the redesigned relay in detail and giving circuit application diagrams is available from the manufacturer, *Struthers-Dunn, Inc.,* 1321 Arch Street, Philadelphia, 7, Pa.

VERNIER GAUGE BLOCKS

A vernier gauge, marketed under the trade name of DoAll is one of the newest items in a long line of measuring equipment made by *Continental Machines, Inc.*

An increased demand on the part of industry for close tolerances has created a need for a gauge capable of measuring a ten-millionth of an inch.

This DoAll gauge extends the range of combinations of sizes which can be made with any set of gauge blocks by permitting combinations to be made in steps of ten micro-inches and to the same degree of accuracy as provided by precision gauge blocks.

The gauge consists of two blocks having precision tapers on their mating faces. When the taper faces of two blocks are wrung together with their taper index marks coinciding, the blocks form a gauge block whose height is .700 inches. One block is graduated into ten equal parts between the index graduations. By sliding this block to the right, the height of the vernier gauge is increased ten-millionth for each graduation because of the taper. Similarly, movement of the block to the left, decreases the height by one ten-millionth.

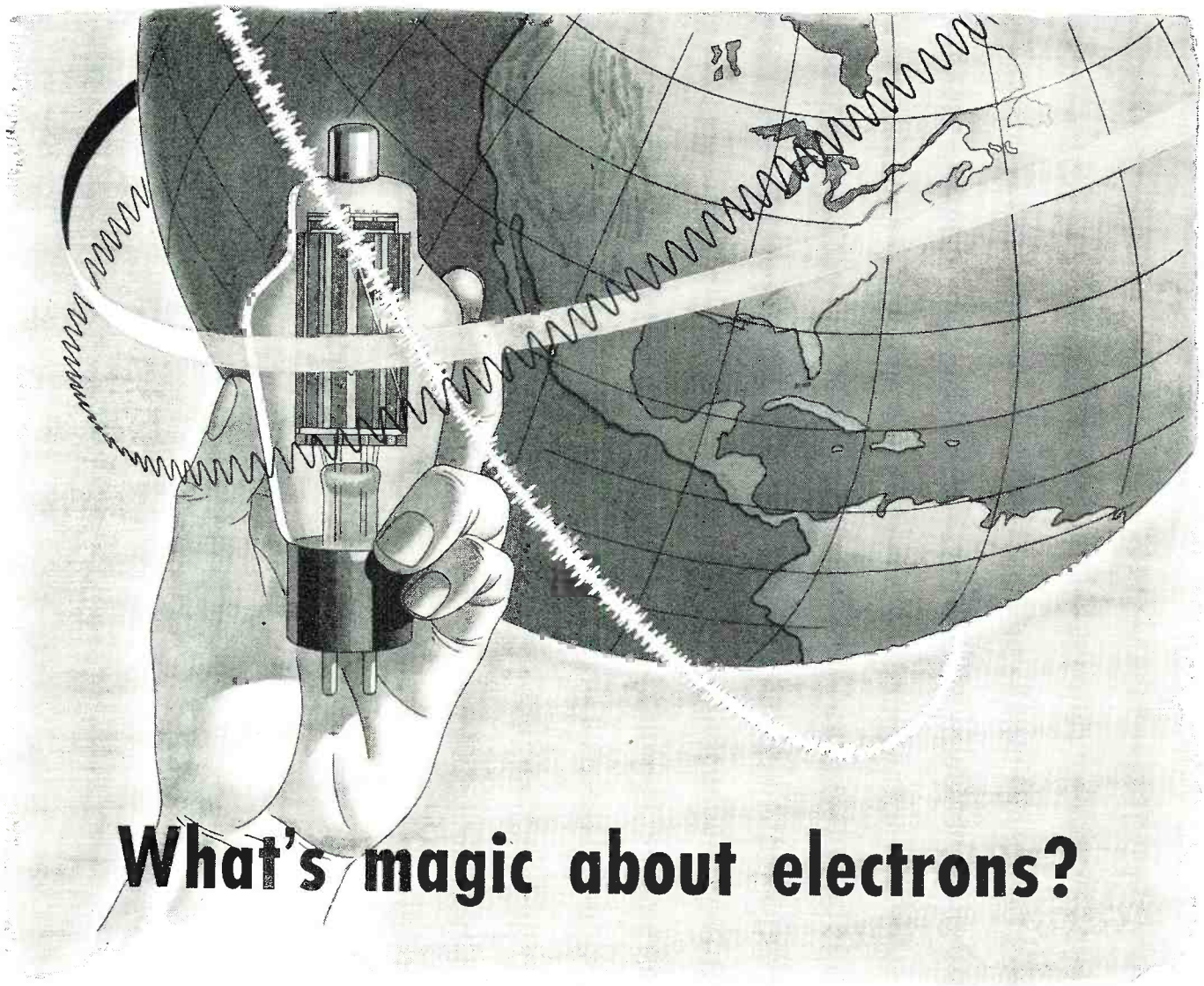
This gauge has a total range of one ten-thousanth of an inch plus or minus, thereby enabling dimensions to be made in increments of ten-millionths above or below any dimension which can now be made with a standard set of precision gauge blocks.

Information regarding this gauge will be forwarded by *Continental Machines, Inc.,* 1301 Washington Avenue, South, Minneapolis, Minnesota.

TRANSFORMER DESIGN

A significant reduction in the size of potential transformers has been effected by the *Westinghouse Electric and Mfg. Company,* by means of new design and the use of Hipersil steel.

The new line of transformers, rated from 25 to 138 kv. has been introduced. The 69 kv. unit in the new design is only two-thirds as tall as former models and requires less than one-third the ground space and one-fifth the volume of the former model. Reduction in size has made possible a



What's magic about electrons?

The magic about electrons is man's ingenuity in putting them to work. The magic about electrons is their promise of service in marvelous ways only hinted at in the last few years. Now harnessed for war, the science of electronics will later work to enrich the peace.

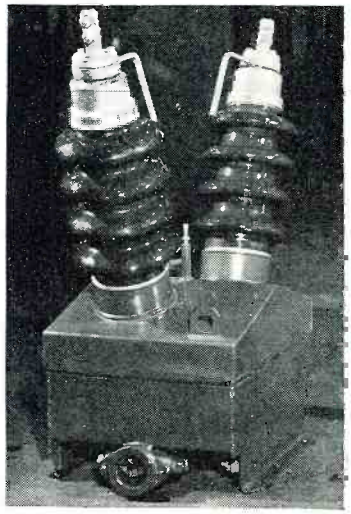
Working in close cooperation with Army and Navy engineers, Delco Radio has applied its knowledge and skill to putting electronics actively and effectively into the fight for Victory. In Delco's laboratories, principles are explored and exploited; in Delco's engineering department, designs are evolved to apply these principles; and on Delco's production lines, complete equipment is manufactured with the speed and skill that only a large manufacturer of precision radio instruments can bring to such work.

Put your dollars "in action"
BUY MORE WAR BONDS

Delco Radio
DIVISION OF
GENERAL MOTORS

substantial reduction in the amount of transformer oil required.

The introduction of non-metallic materials for structural and supporting members added to a redesign of the bushings is responsible for the size reduction.

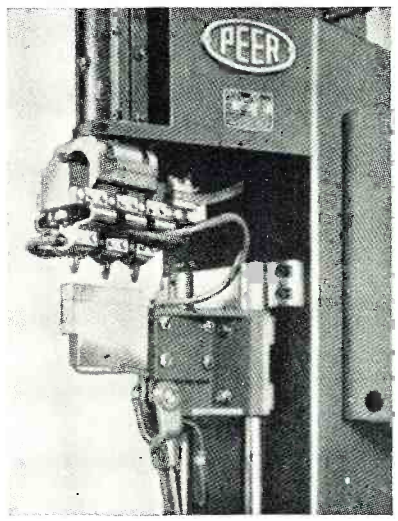


Information regarding the potential transformers for specific power applications is available from *Westinghouse Electric and Manufacturing Company,* East Pittsburgh, Pa.

MULTIPLE SPOT WELDER

Designed for the many applications requiring a number of spot welds within close proximity, the *Peer* Air-Operated Multiple Spot Welder is cutting welding time.

One of the multiple heads, a three-point unit, is shown employed on a Peer press type welder. This head made it possible to reduce the number of operations on a metal box, requiring 52 spot welds, to 14 operations.



Accuracy of spacing and uniform pressures is available with the unit.

For detailed information regarding this type of welding equipment, write the *Peer Equipment Mfg. Co.,* 2000 Milton Street, Benton Harbor, Michigan.

SILVER MICAS

A capacity range of 6 to 2000 μfd. measured at 1 megacycle is now avail-

U. S. Army Signal Corps Photo

DULAC FUNGUS RESISTANT LACQUER No. 86—

Protecting the Lifeline of Communications

U. S. Signal Corps Specification #71-2202-A covers the material and process to be used in rendering Signal Corps equipment resistant to moisture and fungus. Thousands of gallons of Dulac Fungus Resistant Lacquer No. 86—have been used for tropicalization of communication equipment.

Send for Bulletin.

MAAS & WALDSTEIN COMPANY, NEWARK, N. J.

PRODUCERS OF LACQUERS, ENAMELS, SYNTHETICS AND SPECIALTY FINISHES FOR ALL PURPOSES

Branch Offices & Warehouses: 1658 Carroll Ave., Chicago, Ill. • 1228 W. Pico Blvd., Los Angeles, Calif.

The Chosen

RADAR-RADIO QUEEN

YOUR PARTNER IN THIS WAR

Radar-Radio's Pin-Up Queen

More than ever before women have come to the front to play their part in this fight. Dorothy Crisp—since 1942 a worker in the factory at Amphenol—who smiles at you from these pages, typifies and symbolizes the radar-radio woman-power which is effectively taking over war plant jobs. Her skillful hands represent two out of 2500 pairs working daily to maintain the security, dependability and quality behind the name of "Amphenol".

Amphenol's products—connectors, cables, fittings, radio parts—prove their quality in meeting the exacting specifications and laboratory tests called for in AN requirements.

American Phenolic Corporation
1830 S. 54th Ave., Chicago 50, Illinois

I would like to have a photograph of Radar-Radio's Queen and Pin-Up Girl, Dorothy Crisp.

Name ..... *Position* .....

Company .....

Address .....

(Q)

able in silver mica capacitors manufactured by *Centralab.* Several new types with many terminal arrangements have also been added to the 830 and 831 types first manufactured.

The basic construction of the capacitor is stacked mica discs individually silvered and vacuum impregnated in transil oil after assembly. They are especially useful for high frequency applications.

Type 830 has a metal cup holding the mica capacitor and is assembled to a tapped brass mounting with or without ground terminal. Mounting terminal and shell are both electrically connected. The same type of capacitor without tapped mounting is available for applications where it is preferable to solder the cup directly to another component.

Literature on all types of silver mica capacitors is being prepared and will be available upon application to *Centralab,* 900 E. Keefe Avenue, Milwaukee, Wisconsin.

—30—

Colorimetry

(*Continued from page* 60)

colored of themselves or which combine with some reagent to form a colored compound. Colorimetric methods are used for analyses of solutions whose concentration is so low that the ordinary gravimetric or volumetric methods give results that are grossly in error. Using these methods, for example, as little as one-thousandth of a gram of inorganic phosphorus per 100 cubic centimeters of blood can be measured. And this is but one example.

Turbidimeters have as one of their principle uses the determination of free sulfur or sulfates present in foodstuffs and water by the conversion of it to barium sulfate. They are also used in the determination of particle size and particle size distribution. A suspension of one part per million is the customary sensitivity in water analysis.

Nephelometers are best used in the quantative analysis of reactions where a fine, colorless, insoluble precipitate is formed. Its sensitivity is demonstrated by the fact that phosphorus is detected in concentrations as low as 1 part in 330 million of water and acetone in concentrations of 1 in 100 million.

Fluorophotometers have, in recent years, come into their own in the measurement of certain vitamins like riboflavin (B_2) and thiamin (B_1) in biological extracts where the concentration may be in the vicinity of millionths of a gram per liter.

In these instruments we have another example where optics and electronics, "optical electronics," have combined to further the ultimate good of mankind. And these examples do not stand alone. Many more have already been added and infinitely more will be added in the future.

—30—

Program Unrehearsed

Photo Courtesy the Signal Corps

This is a bomber-riding radio man. With high-precision, Belmont-made equipment, he is tuned in on the greatest drama of our times . . . a drama in which he is one of the audience and one of the principal characters too.

It is a drama filled with periods of nerve-racking silence . . . the chilling sound-effects of machine-gun fire . . . moments of high exhilaration, deep anxiety, and painful suspense . . . *a drama in which many may pay with their lives if but one muffs a line or misses a cue.*

The responsibility of this radio man is great indeed. But willingly he accepts it, concentrates on it, and meets it with all his resourcefulness and skill. And as producers of much of the equipment he uses, Belmont accepts its own responsibility in this same spirit. Belmont Radio Corporation, 5929 West Dickens Avenue, Chicago 39, Illinois.

Belmont Radio

RADAR ★ TELEVISION ★ FM ★ ELECTRONICS

Functional Analysis

(*Continued from page 47*)

of C_c and the grid-cathode capacitance).

Screen: Screen, cathode, C_c, C_s.

Plate: Plate, cathode, C_c, C_p, R_L (The power supply should form no part of the dynamic circuit).

It is helpful to draw in these lines with different colors. The idea may be extended to show a.c. lines of various frequencies such as r.f., i.f., and a.f. In this manner the *functions* are visually emphasized.

One of the most effective teaching devices is the analysis, piece by piece, of an ordinary superheterodyne circuit, such as may be found in a tube manual. Beginning, for example, at C_1, have the students explain the function of every condenser. This may be done with all the resistors and all the coils and with every other component in the circuit. It may be done with one circuit in class for practice and with another circuit for homework.

Next, any number of troubles may be introduced one at a time. If the student now has learned the *function of each part,* he is in a position to know how the circuit will be affected by the failure of *any* part. All this can be learned on paper, with subsequent powerful reinforcement by means of experiment. Such experimental verification of predicted results gives the student a sense of mastery.

The chart in Fig. 4 is recommended for clearer thinking.

"Troubles" may be inserted by the instructor or suggested by the students. Under "Aural Effect" we might have "no signal," "hum," "distortion," etc. "Effect on Voltages" is usually predictable. "Other Effects" might include "heating" (of a particular component). Under "Explanation" the student gives briefly the reasons for his answers.

Passing on to the second unit in the block diagram of Fig. 1, we might illustrate one function of the mixer tube by recalling the story of Procrustes who fitted every guest, long or short, to his one bed, medium, either by amputation or by stretching.

In the mixer tube every signal, high frequency or low frequency, is "fitted" to be the right "size" for the i.f. channel. No matter what signal we select, within the range of the receiver, when it comes out at the mixer tube it is "just right" for the i.f. channel.

Again, any class will be intrigued by the statement that modulation was understood by the American Indians and is practised today by dark-skinned natives in impenetrable jungles.

Modulation might be defined as a *change* impressed upon an otherwise constant action for the purpose of conveying intelligence. A steady column of smoke rising from a campfire would mean only that there was a campfire. Of course, one of James Fenimore Cooper's Indians would be able to tell from the color of the smoke whether the campers were white men or red men. (A "pale-face" fire has too much smoke.) But when the Indian wanted to send a message, he *interrupted* the smoke-column with a blanket. The steadily rising column was *modulated,* changed to a series of puffs.

The radio engineer has available a continuous and unvarying flow of r.f. waves. To transmit intelligence he *modulates* this steady column by cutting it into little pieces (telegraphy) or by changing the width or frequency of the waves at a rate corresponding to the sound waves of speech (telephony).

The action upon which the change is impressed and which would otherwise be steady, is known as the *carrier.* Almost any medium may be used: the air of the jungle for tom-toms; the open spaces for heliography; the water of the great oceans for submarine signaling; the steam pipes in a prison; the unidentified medium that conveys radio programs. (It is interesting to designate the *carrier* in each case.)

In the classroom the air is used as a medium for the transmission of intelligence by means of the voice. In a well-ordered class this medium is available to only one person at a time. If several of such audible carriers are put on the air at once, the result is a confusion of sound. Only in the presentation of vocal music can more than a single vocal carrier be tolerated.

One great advantage of radio frequency carrier signaling is the fact that many carriers may use the same medium at the same time. Since these are vibrating at super-audible frequencies, the human ear is not aware of their existence.

It is the function of the radio receiver to select *one* of these carriers, detect the *changes* that have been impressed upon some characteristic of the carrier, and then (usually) convert these changes into sound.

When the postman delivers a letter we do not invite him in to have tea. His business is to act as *carrier* (in the ordinary sense) for the message. When the detector in a radio receiver has demodulated the message brought by the carrier wave, there is no further use for the carrier. It is dismissed by way of the r.f. filters.

The foregoing are but a few of the many illustrations that may be employed to enliven the lecture period and to lay heavy emphasis upon *function.*

In long experience with circuits the writer has observed several different approaches when trouble occurs. One man looks around hopefully in the expectation of finding a wire broken off, or he pokes around tentatively to see if he can jar the thing back into activity. In most cases this method will only result in further damage.

A second man comes along. He has had more experience and he knows what generally goes wrong. If this particular trouble is in the groove, our man finds it at once. If the trouble is something out of the ordinary he tries a number of remedies that should help but usually do not.

Now we call in the expert. He knows "the function of each part and its relation to every other part." He

SUGGESTS DEAD MAY BE REACHED BY RADIO WAVES

Australian's Theory Will Be Probed by Scientists If He Can Show "Life" Exists After Death.

When Sir Ernest Fisk, managing director of Amalgamated Wireless (Australasia) Ltd., and Australia's No. 1 radio scientific executive, said he was convinced of the possibility of radio communication with the dead, the Australian Association of Scientific Workers offered to investigate the theory, provided Sir Ernest produced evidence of "life" after death.

Said Prof. V. Bailey, head of the experimental physics department at Sydney University, and a member of the association: "It would be hard to get in touch with dead people unless they have radio receivers."

Addressing the Legacy Club at Sydney, Australia, recently, Sir Ernest said that he did not wish to be dogmatic, but evidence was accumulating, as a consequence of study by leading physicists, that the spirits of the dead inhabited the ionized ether beyond the earth's atmosphere, and that eventually there might be discovered a wave length which would make communication with them practicable.

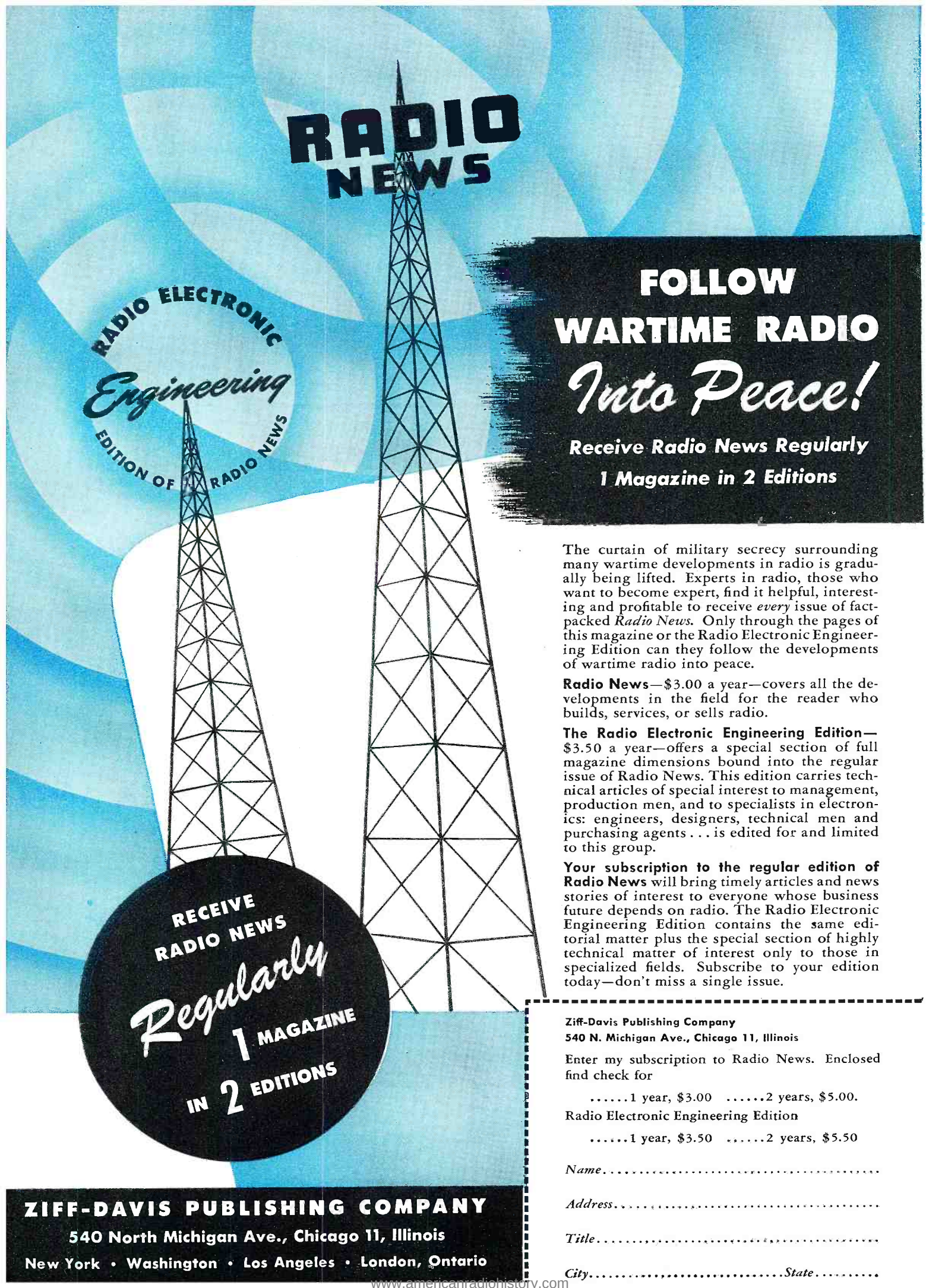
"Highly scientific people are now satisfied," he added, "that the whole universe is one unit, planned by one designer." He said he was not speaking either as a religious man or a church member, but he was convinced that friends and relatives of war prisoners could bring them some consolation by using their minds and spirits to reach those of the prisoners through earnest prayer.

Dr. S. L. MacIndoe, president of the Association of Scientific Workers, said:

"If Sir Ernest is able to produce genuine evidence of survival after death, my association, composed of more than 1,000 scientific workers, will be glad to investigate such evidence.

"The association will also examine any evidence if such exists, which would remotely suggest the possibility of communication with the departed. In the absence of such evidence, Sir Ernest is as entitled to a personal opinion as any other private individual. But his ideas cannot be associated with scientific knowledge which requires some factual basis or experimental evidence."

Well! Well! . . .—Ed.



The curtain of military secrecy surrounding many wartime developments in radio is gradually being lifted. Experts in radio, those who want to become expert, find it helpful, interesting and profitable to receive *every* issue of fact-packed *Radio News*. Only through the pages of this magazine or the Radio Electronic Engineering Edition can they follow the developments of wartime radio into peace.

Radio News—$3.00 a year—covers all the developments in the field for the reader who builds, services, or sells radio.

The Radio Electronic Engineering Edition—$3.50 a year—offers a special section of full magazine dimensions bound into the regular issue of Radio News. This edition carries technical articles of special interest to management, production men, and to specialists in electronics: engineers, designers, technical men and purchasing agents . . . is edited for and limited to this group.

Your subscription to the regular edition of Radio News will bring timely articles and news stories of interest to everyone whose business future depends on radio. The Radio Electronic Engineering Edition contains the same editorial matter plus the special section of highly technical matter of interest only to those in specialized fields. Subscribe to your edition today—don't miss a single issue.

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quickly analyzes the situation. He discovers which part is working and which is not and why.

To become an expert a man needs ability, knowledge, and experience. Ability is quite often only a potentiality until it is utilized. Experience may lie within the reach of many young men in these times. But *knowledge* is the one qualification that all students should obtain in full measure.

Knowledge can be made attractive by means of illustrations and familiar analogies. It can be made stimulating by the use of prediction and verification. It can be made effective and sufficient through *functional teaching.*

-30-

Adaptors for VoltOhmyst

(*Continued from page* 37)

holes are drilled through the can end and into the disc, being threaded in the disc for 6-32 screws:

The button-type socket is mounted atop two studs, each 1½" long and 3/16" in diameter. As will be seen by examination of Fig. 7, there is ample room between the bottom of the tube socket and the insulating end plate for mounting the two .01-μfd. input capacitors between the two studs. A small brass stud, ¾" high and ¼" in diameter, is drilled and tapped for 6-32 screws, and is secured to the center of the end plate by a 6-32 screw passed through a central hole in the latter. This supplies a terminal base into which various sorts of terminals and prods may be screwed. In Fig. 7, for example, a needle-type prod is shown screwed in place. This consists of a piece of eight-inch-diameter brass rod, ground to a point at one end and threaded (6-32) for approximately a quarter-inch at the other end. Other prods are shown close to the end of the probe in Fig. 7. From left to right, these are a pee-wee clip, banana plug, and small blunt-point prod tip. All are provided with short 6-32 screws which permit them to be screwed into the probe terminal base. The ingenious experimenter will doubtlessly think of other convenient prods for specific tests.

A soldering lug is attached to the screw holding the brass terminal base to the bakelite end plate, and this lug serves as both connection and support for one set of leads of the input capacitors. (See Fig. 7.) The capacitors thus are mounted by the shortest possible leads in a straight line between the test prod and tube socket terminal. This type of mounting keeps input capacitance at a minimum, as well as providing clean, straight-forward construction.

The "input box" which holds C2, the two cells (B1 and B2), the bucking-voltage potentiometer R3, and the d.p.s.t. toggle switch S1-S2, may be made of any convenient material, although obvious advantages will be obtained from metal construction. A standard radio shield box 4" x 4" x 2" in size (such as

Fig. 8. External view of current-measuring adaptor shown in Fig. 9.

Bud No. 883) will house all components, even when jumbo-size flashlight cells are used at B1 and B2. When pencil-size cells are employed, together with a midget potentiometer, a very small input box is possible. The input box may be dispensed with entirely if the builder is willing to mount the cells within the VoltOhmyst case. If the latter expedient is adopted, it will be necessary to mount the potentiometer, R3, on the instrument case and to provide a two-terminal plug. Both of the latter parts might be mounted in the position of the chassis connector in Fig. 5.

After wiring has been completed and checked, the battery-type probe and input box may be checked in the following fashion: (1) With the probe and input box disconnected, switch-on the VoltOhmyst and allow a reasonable time for the instrument to come up to normal operating temperature. (2) Set the meter to zero by adjustment of the electrical zero control. (3) Switch the instrument to the lowest d.c. volts

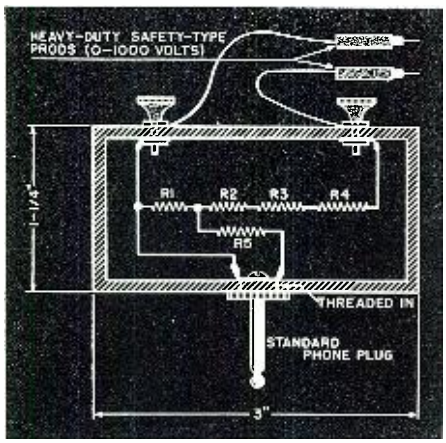


Fig. 10. Adaptor unit to convert Volt-Ohmyst Jr. for high-voltage measurements.

R_1, R_2—5-megohm, 1-watt res.—Aerovox 1098
R_3, R_4—20-megohm, 1-watt res.—Aerovox 1098
R_5—1-megohm, 1-watt res.—Aerovox 1098

range. (4) Connect the probe and input box by inserting the probe-box plug into the VoltOhmyst "DC VOLTS" jack. (5) It will now be observed that the meter reading has been displaced from zero because of diode contact potential. Zero is restored by adjusting potentiometer R3 in the input box. If stray a.c. fields are present in the vicinity of the probe, it will be necessary to short the probe terminals. This may generally be accomplished satisfactorily by clipping the flexible ground lead (see Fig. 4) to the "high" prod.

As in the case of the 6H6 probe, Volt-Ohmyst d.c. scale values will be approximately equal to the a.c. peak voltage above about ten volts. Below ten volts, a special calibration will have to be made for the 1A3 if actual values are to be known.

The use of diode probes with the VoltOhmyst Junior provides the experimenter with a high-grade rectifier-amplifier type of v.t. voltmeter. This arrangement corresponds to that employed at present in the most exacting laboratory work. The unusually high stability and low zero-drift afforded by the VoltOhmyst contribute an amplifier and indicator section such that only experienced experimenters might expect to duplicate. It thus is to the advantage of any VoltOhmyst owner, who needs a high-frequency instrument, to provide his instrument with a rectifier probe.

Attachment of probes in the manner just described will in no manner impair fundamental operation of the Volt-Ohmyst. By making the probe plug-in, as explained, it may be removed when not in use, and thus will not be in the way when the instrument is employed in regular d.c. and resistance tests. The worker must be careful, however, when drilling in the instrument case to remove the instrument and the ohmmeter battery to prevent damage. He must also be careful not to disturb any of the variable resistors serving as calibration controls. Many experimenters will prefer not to draw heater voltage from the VoltOhmyst nor to drill holes in its case. They will doubtlessly favor the battery-type probe which needs only to be plugged into the VoltOhmyst jack in lieu of the regular signal-tracing d.c. prod. Or if the experimenter desires, he may provide an input box for use with the 6H6 probe. This would house a small filament transformer to supply 6H6 heater voltage and might be kept trim in size and shape.

Shunt Box

Milliampere readings are made possible with the voltage section of the VoltOhmyst by means of an external shunt box. This unit, shown in schematic in Fig. 9 and in external view in Fig. 8, contains several shunt resistors across which the unknown current produces a voltage drop to be measured by the VoltOhmyst. While this scheme is not entirely satisfactory in all applications, it will be applicable to many operations, particularly emergency situations, when current readings must be made without delay.

The shunt box provides four ranges: 0-1, 0-10, and 0-100 milliamperes d.c., and 0-1 ampere d.c. From the resistor values in Fig. 9, it will be observed that the resistance presented by this arrangement is considerably higher than that of corresponding milliammeters of standard manufacture, and the shunt box-VoltOhmyst combination accordingly is recommended only to those applications wherein these high resistance values are of no consequence. It must not be forgotten, however, in this connection that certain circuit alterations may be made (in the measured circuit) to enable satisfactory inclusion of this combination. For example: in a circuit including 100,000 ohms resistance and in which the 0-1 ma. range might be desired, 10,000 ohms might be cut out of the measured circuit—that amount of resistance being included in the shunt box.

Resistances offered by the shunt box are 10,000 ohms for the 0-1 ma. range, 1000 ohms for 0-10, 100 ohms for 0-100, and 10 ohms for 0-1000. These resistors are 1-watt carbon units chosen carefully for exact calibration and preferably imbedded in a high-grade wax, such as Cerese or Ceresin. (A mixture of equal parts of paraffin and

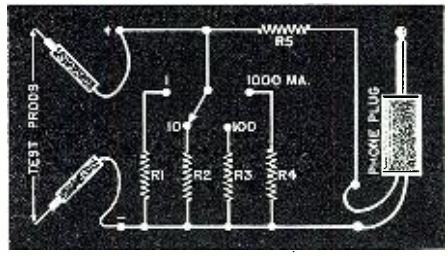


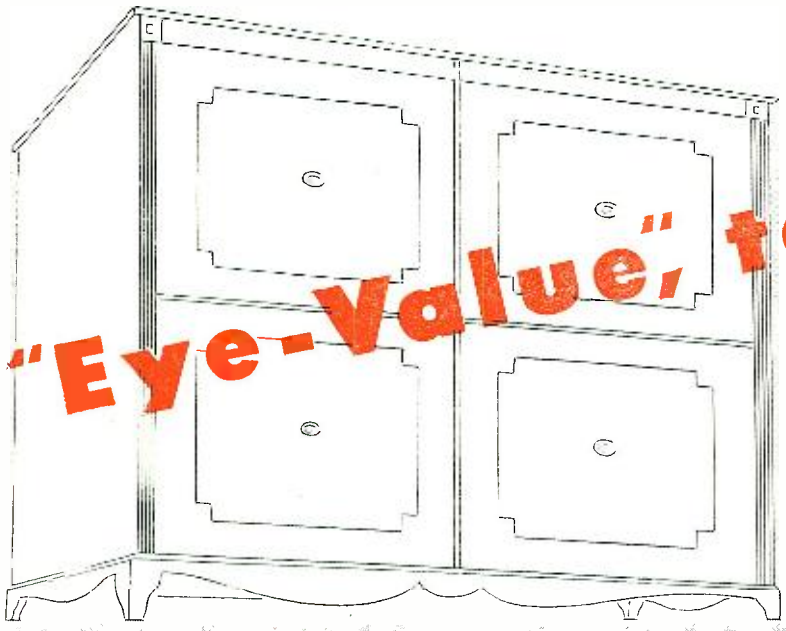
Fig. 9. Diagram of an adaptor used to measure milliampere currents.

R_1—10,000-ohm, 1-watt res.—Aerovox 1098
R_2—1000-ohm, 1-watt res.—Aerovox 1098
R_3—100-ohm, 1-watt res.—Aerovox 1098
R_4—10-ohm, 1-watt res.—Ohmite
R_5—1-megohm, 1-watt res.—Aerovox 1098
S—Single-pole, four-position, heavy-duty selector switch

beeswax has also been recommended.)

The shunt box is comprised of a metal container 4" x 4" x 2" in size; a heavy-duty, single-pole, four-position selector switch; five resistors; a set of input binding post terminals; and an output phone plug. The 1-megohm, 1-watt resistor, R5, replaces the isolating resistor of the same value which is contained in the signal-tracing type d.c. prod of the VoltOhmyst. The selector switch is controlled by any suitable finger-grip knob, and the indicator plate is made by lettering on stiff, white Bristol board with black India ink and mounting the completed plate under a protecting cover of heavy transparent celluloid.

The input current terminals are a pair of heavy test prods and test leads which plug into binding post terminals on the input shunt box. The output circuit of the shunt box terminates in a standard phone plug which is inserted in the VoltOhmyst "DC VOLTS" jack when current measurements are to be made.



In "Eye-Value," too

Yes, even the cabinets of Temple radios will be Temple-built — another important factor vital to postwar production, postwar deliveries, and postwar retailing. What's more, Temple radios will be as distinguished in outer beauty as in mechanical excellence — *real* furniture, expertly designed, acoustically perfect, *finest made!* Another selling *plus* that invites you to "team up with Temple".

TEMPLETONE RADIO COMPANY, MYSTIC, CONN.

FM . . . TELEVISION . . . RADIO-PHONO' COMBINATIONS

Buy U. S. War Bonds

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Yes, in Cabinets, too . . .

Here FM will also mean Finest Made!

Licensed under Armstrong & RCA Patents

The 0-10 volts d.c. scale of the Volt-Ohmyst is employed for all current measurements. On this scale the readings on the four shunt-box ranges are easily made—0-1, 0-10, 0-100, and 0-1000 ma.—without mental gymnastics. There are no special directions for current measurements, since these are straight-forward. Simply plug-in the shunt box into the VoltOhmyst actively operating on the 10-volt d.c. range, set the shunt-box selector switch to the desired current range, and clip the test leads into the current circuit. If the meter deflection is backward, simply the throw VoltOmyst selector switch to the position of opposite polarity.

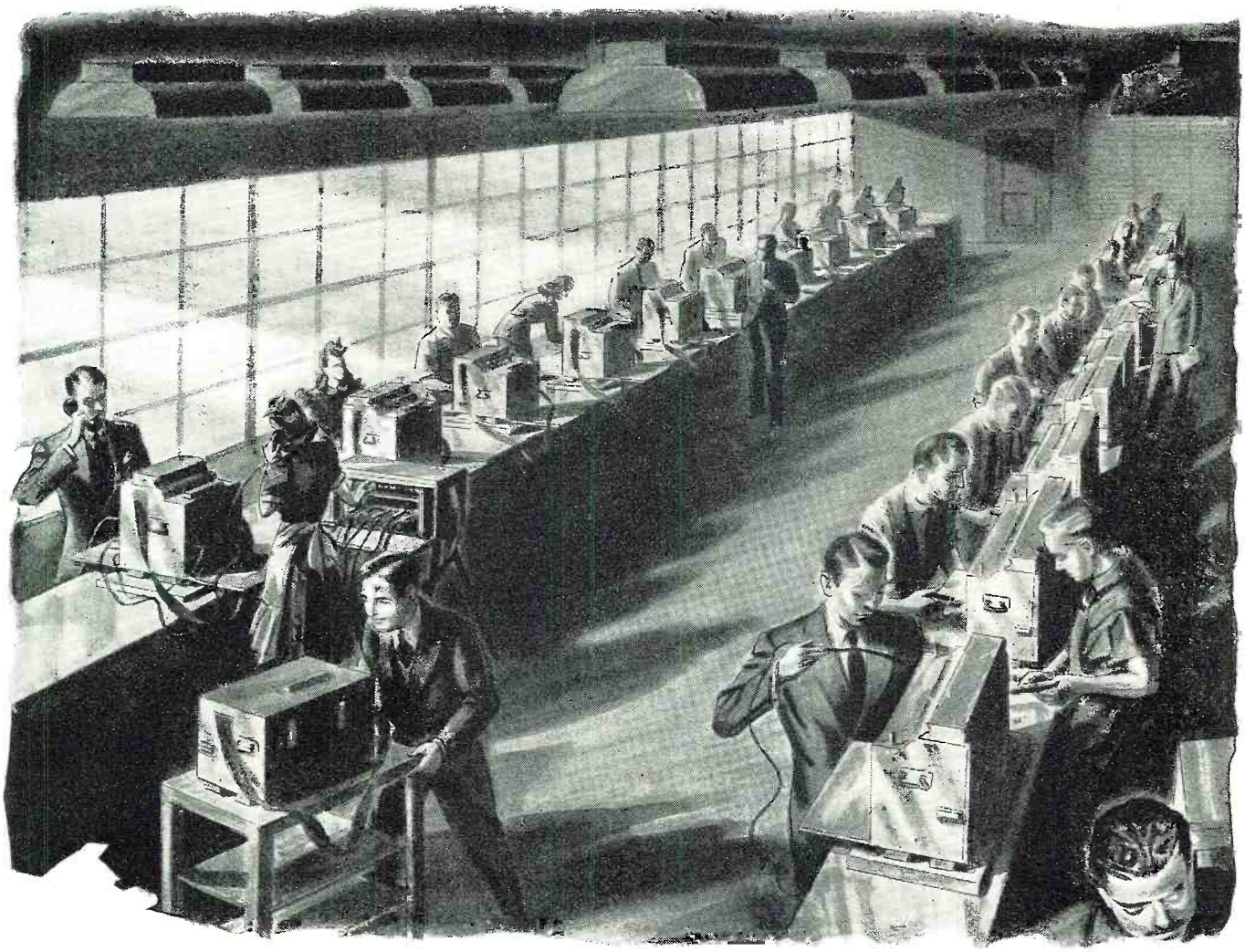
High-Voltage Adaptor

The high-voltage adaptor is a compact plug-in multiplier (voltage divider) which converts the VoltOmyst 1000-volt d.c. range to a 10,000-volt d.c. range. The multiplication thus is ten to one, and the meter readings need only be multiplied mentally by 10.

The high-voltage adaptor unit is shown in Fig. 10. The entire unit may be built into a case of insulating material (such as bakelite) 3" x 1" x 1¼" in size. A standard phone plug is threaded into one side of the case (this is accomplished very readily if the case material is at least 3/16" thick) and a pair of binding post terminals mounted as far apart as possible on the opposite side. The posts receive a pair of standard high-voltage safety-type test leads, and the plug is inserted directly into the VoltOhmyst "DC VOLTS" jack. Any good sheet insulating stock, such as bakelite, polystyrene, fiber, etc., may be employed in constructing the case. It is not recommended that wood be used, unless it is thoroughly dried in an oven and then given several coats of a good-grade shellac. Of the various kinds of wood, maple would be the most satisfactory.

The voltage-dividing network is comprised of four resistors (R1 to R4 in Fig. 10) which total 50 megohms. A tap is provided at 5 megohms, 1/10 of the total resistance. These resistors must be chosen carefully with respect to ohmic value. It is advisable to sort carefully from as large a stock as possible. The most satisfactory method of checking will be to measure current through the resistors individually. A battery and microammeter are recommended (100 volts, e.g., will force a current of 20 microamperes through a 5-megohm resistance). All of the resistance values may be off, provided they are *all* off by the same percentage and in the same direction. The 1-megohm resistor, R5, replaces the isolating resistor of the same value which is contained in the signal-tracing type d.c. probe of the VoltOhmyst. All resistors are 1 watt; carbon will be satisfactory. After wiring is completed and checked, the entire interior of the adaptor box is covered with a good-grade wax. Satisfactory waxes are Cerese or Ceresin, or a mixture of equal parts of paraffin and beeswax. The wax must be thoroughly melted, and then poured into

Meeting the CALL for MORE and still MORE



This year our armed forces need thirty-five per cent more communications equipment than in 1943. The men and women of this division are tackling their share of this biggest assignment yet, with the same enthusiasm they have shown from the start . . . and with three years' practical experience behind them.

They have good reason to be enthusiastic, for pictures, news stories, and soldiers returning from all over the world, tell of the heroic use that is being made of the equipment we turn out.

Here is a group of skilled engineers, designers and production people who are proving their ability to handle a big and difficult assignment. We tell about it here because we think that is the kind of organization you will want to have working on *your* postwar needs, such as:

COMMUNICATIONS SYSTEMS • SIGNALLING EQUIPMENT
PRODUCTION CONTROL EQUIPMENT AND INSTRUMENTS
HOSPITAL SYSTEMS • ELECTRONIC EQUIPMENT • PRECISION
ELECTRICAL MANUFACTURING • IGNITION SYSTEMS

CONNECTICUT TELEPHONE & ELECTRIC DIVISION
GREAT AMERICAN INDUSTRIES, INC.
Meriden, Connecticut

the box until all components are covered and the box completely filled. The box cover is then screwed or glued in place.

Use of the adaptor unit is extremely simple: The VoltOhmyst is set to 1000 volts d.c., the adaptor unit provided with its test leads and plugged into the VoltOhmyst "DC VOLTS" jack. Voltages between 0 and 10,000 volts may then be checked, simply adding mentally one cipher to each reading observed on the meter scale.

The simple adaptor is not suitable for high-voltage a.c. measurements, since the a.c. portion of the VoltOhmyst is a 1000 ohms per volt oxide rectifier circuit. The current drain in this circuit will not afford correct calibration when the a.c. meter connections are made to the adaptor output plug.

Conclusion

The attachments illustrated in this article are but a few which the ingenious mind may concoct for use with the VoltOhmyst. Where one instrument must perform as many tasks as possible in the small shop or laboratory, the VoltOhmyst is a star performer, and quite a few accessories may be designed to extend its usefulness into regions beyond those specified by its manufacturers.

The writer has been the possessor of a VoltOhmyst Junior for at least three years and would not part with this instrument. He certainly does not wish the manufacturers of the instrument to believe he thinks it is an incomplete device, because of this article. Quite the contrary! The VoltOhmyst does everything for which it was designed, and admirably. But it is characteristic of the gadgeteer to make every instrument do just one more job.

-30-

QTC

(*Continued from page 48*)

"The unit is rigged fore and aft as against the thwart ship arrangement of the Liberty, with the operator's room forward and the battery room aft of the radio shack.

"In regards to heating, ventilation, etc., it will take a trip into the tropics and also north to actually determine how it will work out. The radio room has one radiator on the outboard side, the same as the Liberty, and also one porthole. However, the porthole is forward of the radiator, if that would make any difference. The port is larger than the Liberty port; it is man-size for obvious reasons.

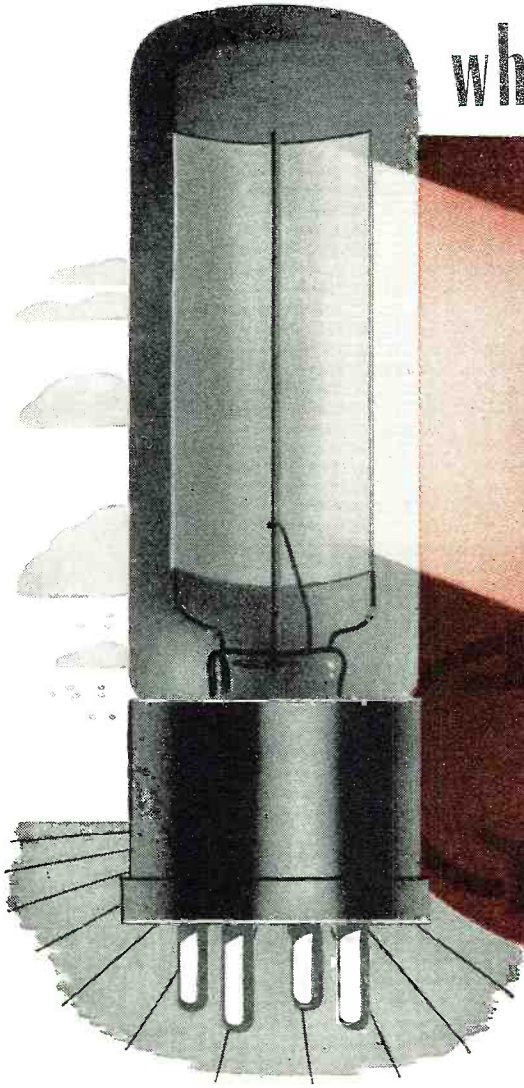
"There is one redeeming feature about the shack, however; the overhead or ceiling is paneled over and I understand has about 3 inches of spun glass insulation. This feature was lacking in the Liberty ships and was one of the reasons why it was so difficult to heat the Liberty radio room. Iwas north (Alaska) one winter and the thermometer stood at 46 degrees with the radiator going full blast. I don't believe this will happen on the Victory.

"This is a brief summary of the first Victory. Perhaps at some future date I may be able, or permitted to give a more detailed account. Until then 73's."

SOME of the gang in the airways are starting to come through with some information. Many of these men are ex-marine operators who have given up the wanderlust for a berth ashore during the times when the airline companies were on the upgrade and looking for good c.w. men.

T. G. Ferguson, Eastern Air Lines, sends along a good bit of information which may help some of those who are wondering how the situation in this branch will stand after the present war. "Substantial expansion is contemplated, pending release by the Army of equipment and the profession should absorb quite a few of the better c.w. operators when the operating equipment becomes available after the war. This airline has depended in the past for its main communications on the c.w. operator and we have no definite indication that things will be changed any after the fuss is over. We have experimented quite a bit with some recent female graduates of commercial schools, but I think it is safe to say that they have not proven entirely satisfactory. For some reason or another, they just don't seem to make

wherever a tube is used...



for example:
REGISTER CONTROL

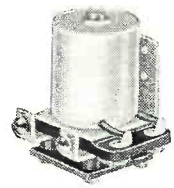
For hairline register in color printing . . . for accurate cutting or "chop-offs" . . . for watching the feed and side motion of a printed web . . . phototubes are used in several printing applications, usually in conjunction with relays and solenoids to bring about the desired end actions.

THERE'S A JOB FOR *Relays* BY GUARDIAN

In the electronic circuit there is usually a sensitive relay similar to Guardian Series 5, to control a heavier current in response to the weaker "signal" of the phototube. In some applications, however, the current to be handled may be greater than the contact capacity of the sensitive relay. In this case a power relay or solenoid contactor is controlled by the sensitive relay. Guardian series SC-5 is typical of this type of contactor.

Consult Guardian wherever a tube is used—*however*—Relays by Guardian are NOT limited to tube applications but may be used wherever automatic control is desired for making, breaking, or changing the characteristics of electrical circuits.

SERIES 5 D. C. RELAY. Maximum switch capacity—two normally open, two normally closed, or DPDT contacts. Resistance range .01 up to 15,000 ohms. Send for bulletin 14.



SERIES SC-5 SOLENOID CONTACTOR. Contacts rated at 75 amps. continuous, 300 amps. surge. Contact combination—single pole single or double throw. Coil operates on 18-28 volts D. C. and consumes 7 watts at 24 volts D.C. continuous. Send for bulletin SC-5.

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

good c.w. operators. I mention this so that the boys who are serving in the military fields might not be caused undue alarm over the trend. When the Military Transport Department took over a number of our planes they took over trained flight personnel also, each ship having a c.w. operator. In the advent of larger transport ships when the war is over, expect to see possibly a c.w. operator aboard every passenger plane."

"T. G." also said that he believes that things look pretty good for postwar expansion. Point-to-point branch has lost a few men to the Armed Services, but in the main, most of the men have been given occupational deferments.

ADOPTION of the War Shipping Administration's decision to require three radio officers to each merchant ship has resulted in the placement of about three hundred and fifty radio operators aboard ships within the last two weeks of March and early April. This demand has had the effect of exhausting the pool of radiomen that has been accumulating for the past year. Assignments on the Atlantic coast were running around thirty a day and operators became so scarce that the recruiting division of W. S. A. had to call for about a hundred men from the Gulf and Pacific coast ports to fill the demand. R.O.U. and A.C.A. were appealed to by W.S.A. to furnish lists of members who had drifted into shore jobs at times when they were unable to find a berth aboard ship. Due to an oversupply of operators the U. S. Maritime Service school at Gallups Island cut enrollment of students last winter and will be unable to furnish but few men to relieve the situation. C. S. Vincent, Atlantic Coast representative of the W.S.A.'s Recruitment and Manning Division said his organization is working with the U. S. Employment Service to recruit shore radio operators to meet the increased needs for the Merchant Marine.

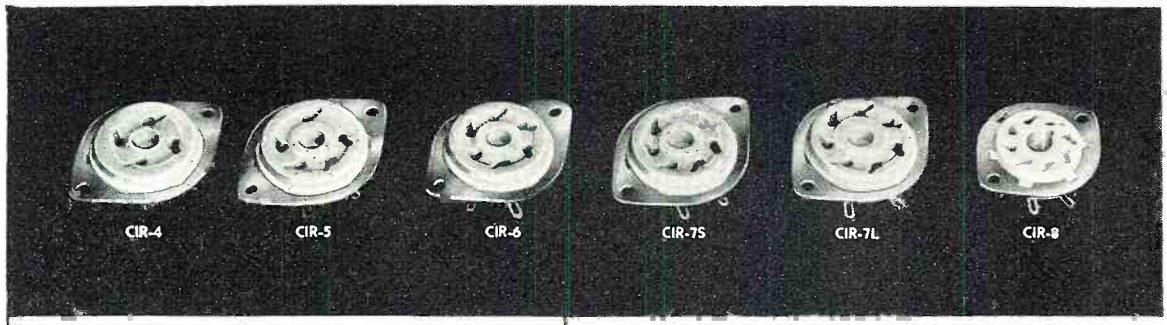
At one time it was reported that WSA had as many as one thousand men on the payroll—trainees from Gallups Island—at seven dollars per day. The school at Huntington, N. Y., was only in operation a few months and then closed up with the belief that Gallups' Island could supply the necessary men to man the ships.

Any of the old timers who have left the briny deep for shore berths and feel the urge to return to the sea life should get in touch with one of the local marine radio unions or with the War Shipping Administration.

FOR the assistance of newcomers to the marine field, the following suggestions by Fred Howe of the Radio Officers Union will give you an idea of how to get started and what you will need.

"Uniforms are not compulsory, but recommended. In cold weather the proper uniform for a radio officer is a heavy blue serge, double breasted suit

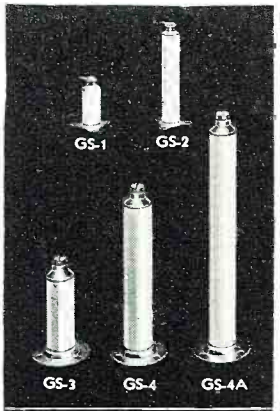
NATIONAL LOW-LOSS SOCKETS AND INSULATORS



CIR Series Sockets

Any Type **List $ .45**

Type CIR Sockets feature low-loss isolantite or steatite insulation, a contact that grips the tube prong for its entire length, and ring for six position mo... supplied with two meta...



GS...

GS-...

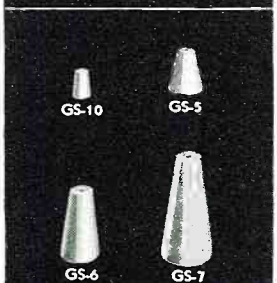
GS-3...

GS-4,...

GS-4A...

Cylindri... standoff i... plated cap...

GSJ, (not i... A special ... top threade... diameter insu... GS-4A.



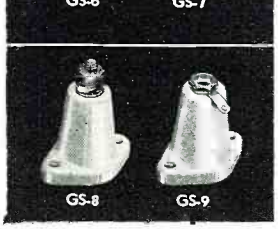
GS-5, 1¼" **List, each $ .40**

GS-6, 2" **List, each $ .70**

GS-7, 3" **List, each $ 1.25**

GS-10, ¾", package of 10 **List $ .12**

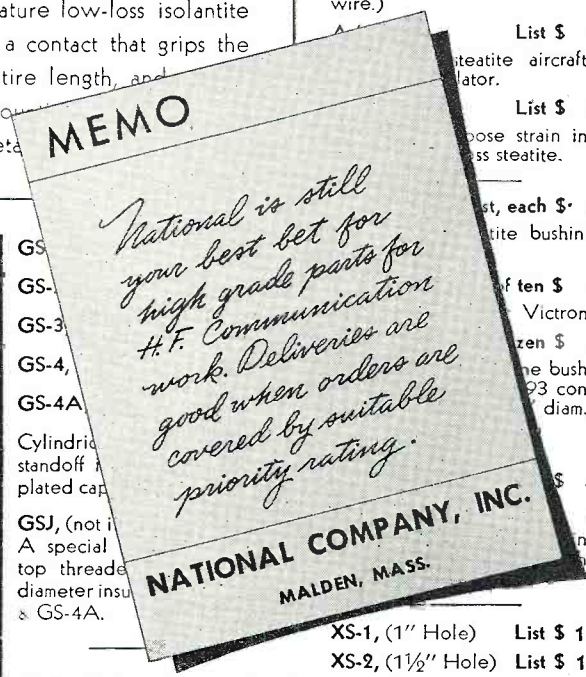
These cone type standoff insulators are of low-loss steatite. They have a tapped hole at each end for mounting.



GS-8, with terminal **List $ .90**

GS-9, with Jack **List $ 1.25**

These low-loss steatite stand-off insulators are also useful as lead-through bushings.



AA-3 **List $ .60**

A low-loss steatite spreader for 6 inch line spacing. (600 ohms impedance with No. 12 wire.)

List $ .50

...teatite aircraft-...lator.

List $ .90

...ose strain in-...ss steatite.

...st, each $ .20**

...tite bushing

...f ten $ .85**

Victron.

...zen $ .85**

...e bush-...93 con-... diam.,

$ .55

.75

...n-...n-

XS-1, (1" Hole) **List $ 1.20**

XS-2, (1½" Hole) **List $ 1.35**

Prices listed are per pair, including metal fittings. Insulation steatite.

XS-3, (2¾" Hole) **List $ 6.00**

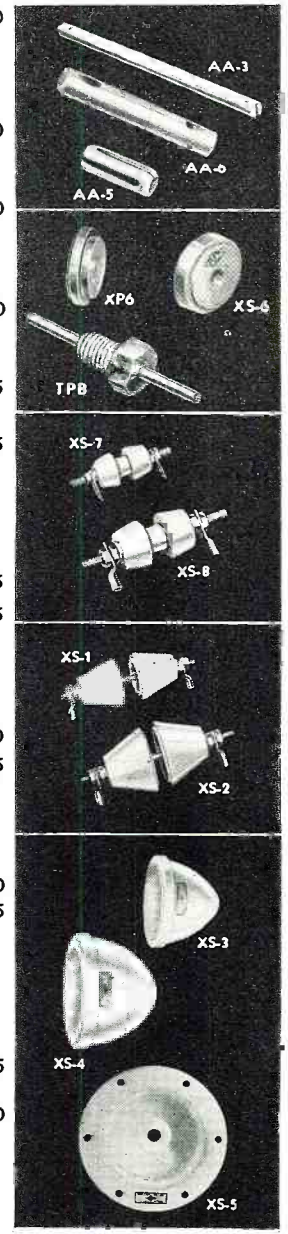
XS-4, (3¾" Hole) **List $ 7.25**

Prices are per pair, including metal fittings. These low-loss steatite bowls are ideal for lead-in purposes at high voltages.

XS-5, Without Fittings **List, each $ 8.25**

XS-5F, With Fittings **List, per pair $17.00**

These big low-loss bowls have an extremely long leakage path and a 5¼" flange for bolting in place. Insulation steatite.



with a double row of three brass buttons in front, one gold stripe around the sleeves, and some "sparks" just above the stripe. Be careful about the insignia. One is not allowed to wear military insignia or the official insignia of the U. S. Maritime Service. In warm weather, the radio officer wears a suit of khaki with the same insignia, but with epaulettes on the shoulders. One may accept a position as radio officer and wear civilian clothes, if he wishes, but in foreign ports there are many places where one may not enter unless in uniform. If your ship goes to a very cold part of the world the radio officer will be loaned warm clothing without charge. These are placed aboard by agencies which are assisting in the war effort. If your vessel goes to the tropics you will need khaki or whites. We do not recommend that one purchase anything special, such as uniforms, until he is ready to ship out. You may allot all of your base wages and forty per cent of your bonus to relatives while at sea. This is arranged when one signs ship's articles before the U. S. Shipping Commissioner when signing on."

LEGISLATION has been introduced in the House of Representatives to forestall a repetition of the ship market collapse which saw vessels of the U. S. Merchant Marine rot away and others practically given away to foreign competitors of American steamship companies for a very small fraction of their original cost after World War 1. Representative S. O. Bland introduced a bill which set out a formula under which ships may be sold by the Maritime Commission. In addition to fixing a cost percentage below which the ships could not be sold, the terms of payment for the ships sold to non-citizens would require spot cash payment.

WASHINGTON reports that the U. S. Navy will soon have about 1,500 combatant vessels. That is almost enough to make a bridge from the West Coast to Tokio.

THE men aboard Liberty ships complained, and justly so, about the placement of a second bunk in the Chief Radio Officer's room on that type of vessel. The ships were designed with an adjacent room to house the second and third, which has been occupied by cadets. It seems as though the experienced radiomen should be given their own quarters which are already provided and rightfully theirs instead of turning this room over to inexperienced seamen.

IN ORDER to keep within our alloted space and at the same time get in some of the latest "dope" we have omitted the "briefs" on assignments this month. Be back with them next issue. 73.

—30—

Manufacturers' Literature

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

WELDER CONTROL

A two-page folder, just issued by the *Weltronic Company,* gives features, specifications and functions of the company's resistance-welder control, Model 75-51-50. This particular model, which is fully automatic, all electronic, precisely synchronous and continuously adjustable, has been designed to permit complete control of operations on spot welders using air or hydraulically-actuated electrodes, with solenoid operated valves.

The four functions of sequence timing, synchronous timing, heat control and electronic contacting which are performed by this unit are described in detail. Photographs are included to illustrate the material covered.

Copies of this technical booklet are available from *Weltronic Company,* 20735 Grand River Avenue, Detroit 19, Michigan, by requesting Technical Bulletin No. 75-51-50.

CALLITE TECHNICAL BOOKLET

A new technical bulletin has been released by the *Callite Tungsten Corporation* on the subject of Calliflex Bi-Metal which is described as a reliable economical material for use as a temperature responsive element in automatic control.

This bi-metal is available in five types according to temperature requirements. These are low, medium, special medium, high and rust-resisting types.

Bulletin No. 155 on Calliflex gives technical data on the deflection and power of the various types in strip and coil form, also data on thicknesses, and sizes, all of which is of interest to the product designer and engineer.

Copies of this bulletin may be had by requesting Bulletin No. 155 from the *Callite Tungsten Corporation,* 540 Thirty-ninth Street, Union City, New Jersey.

TESTING INSTRUMENTS

Just off the press is the new *Radio City Products* Catalogue No. 128 describing a wide range of standard commercial testing instruments. Many of the models illustrated are now being used by the Armed Forces.

Included in this catalogue are various types of multitesters, vacuum tube testers, insulation testers, electronic voltmeters, limit bridges for precision resistance testing and other instruments comprising a comprehensive range of testing instruments to meet the requirements for all kinds of production testing, laboratory and shop purposes.

Interested persons may secure a copy of Catalogue 128 by addressing their request to *Radio City Products Co., Inc.,* 127 West 126th Street, New York 1, New York.

SCHOOL BULLETIN

In an elaborate 14-page booklet, entitled "Electronics, The Dawn of A New World," *National Schools* have presented the story of the part that electronics will play in the postwar world.

This booklet is lavishly illustrated with pictures showing the possibilities of electronics and the part to be played by trained personnel in an electronic world. The scope of the field is outlined showing that electronics will play a vital role in the home, industry and on the farm.

The course offered by the *National Schools* to prepare students for electronics is described briefly in this booklet.

This book is available for distribution to persons requesting it from *National Schools,* 4000 South Figueroa Street, Los Angeles 37, California.

SPOT WELDER CATALOGUE

The line of manual and automatic spot welders made by the *Peer Equipment Manufacturing Company* are described in a recently published catalogue No. 42. Details of important parts, regulator controls and automatic weld timer for controlling the timing periods are given.

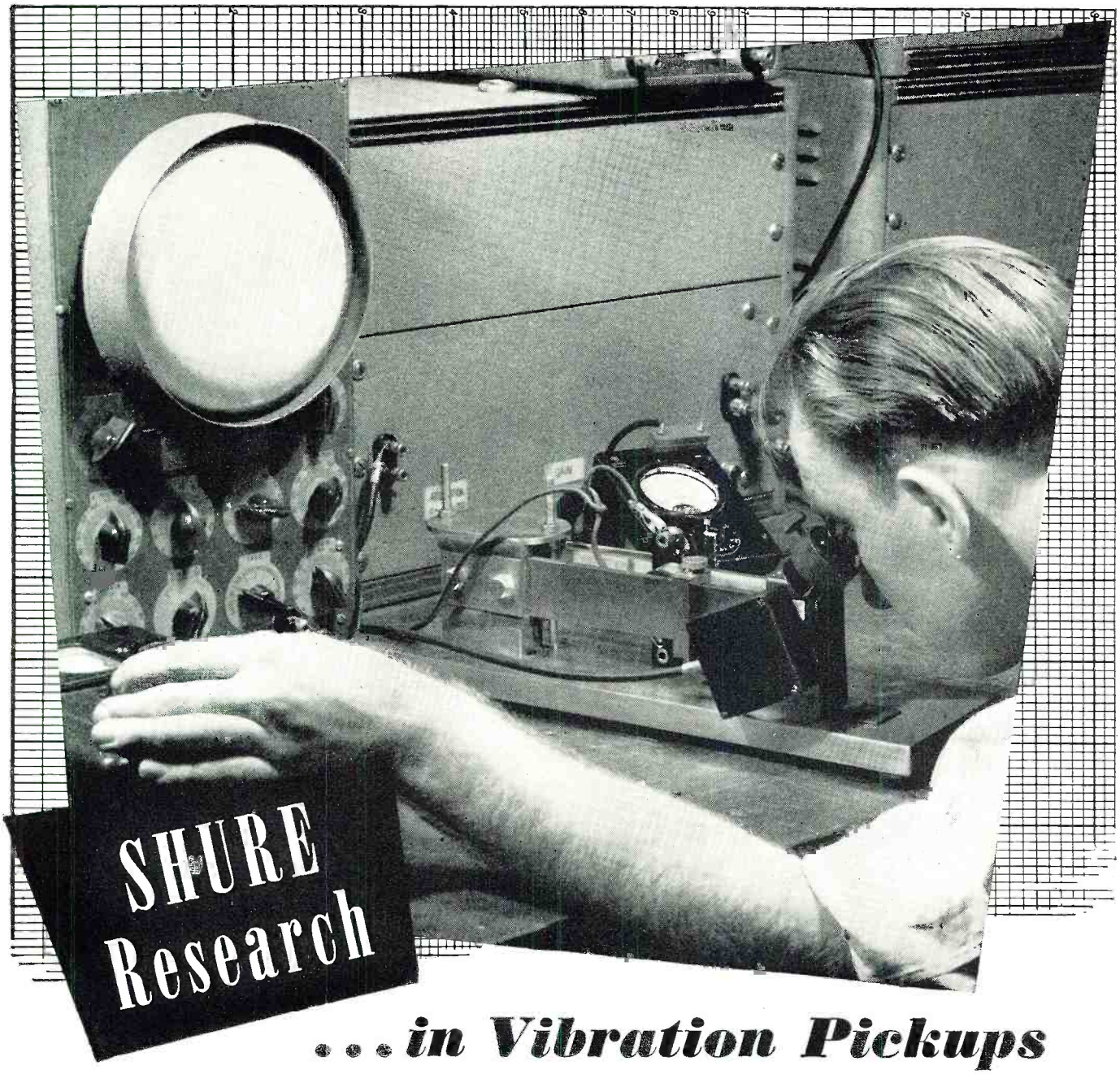
The foot-operated welders listed in the catalogue range from 5 to 50 kva. capacity. The air-operated press types include 20 to 30 kva. capacities, with high speed projection and spot welders of 30, 50, 75, 100 and 150 kva. capacities. Welding capacity charts for all welder sizes and for different throat depths are included.

Copies of the catalogue may be obtained by requesting Catalogue No. 42 directly from *Peer Equipment Manufacturing Company,* Benton Harbor, Michigan.

HOT-COILED SPRINGS

In an interesting manner, the *Muehlhausen Spring Corporation* has described the process of making precision springs in a new booklet now available for distribution.

The progress of the material through the plant and the various steps in the manufacturing process are described and illustrated. Special equipment which enables *Muelhausen Corporation* to produce precision springs up to 2½" bar diameter is shown along with the testing equipment through which

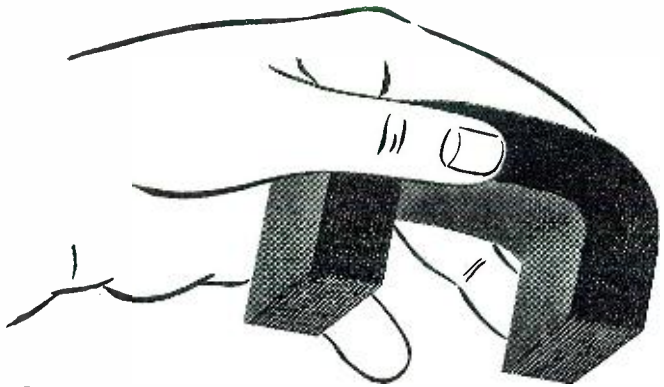


. . . in Vibration Pickups

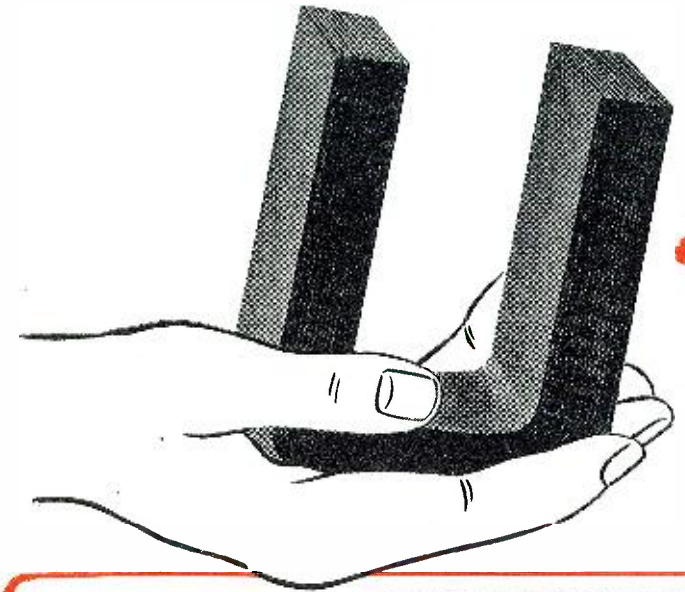
Shure research has pioneered in the development of vibration measuring instruments. These instruments are important in the determination of leakages in water pipes, the vibration of machinery, buildings, electrical appliances. Among its many uses, vibration pickups have been successfully used in locating termite infested wooden members. Shure engineers have devised special vibration actuators and special standard pickups capable of measuring vibration accurately throughout the greater part of the audio frequency range. Another significant contribution is the development of integrating networks which permit the measurement of either acceleration, velocity or displacement with a single Vibration Pickup.

SHURE BROTHERS, 225 West Huron Street, Chicago
Designers and Manufacturers of Microphones and Acoustic Devices

ARMY E NAVY
SHURE
MICROPHONES



CHECK THIS FASTER HF COIL ASSEMBLY METHOD . . .



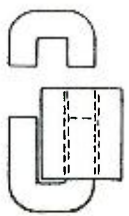
WITH PRE-ASSEMBLED

Two-piece

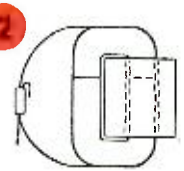
HIPERSIL* CORES

COMPARE THIS WITH YOUR PRESENT CORE ASSEMBLY METHODS

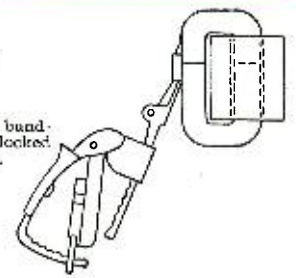
1 Core is placed around coil.



2 Core parts are butted together. Strap is threaded through seal and . . .



3 . . . tightened with banding tool. Band is locked in place with seal.



Banding Straps, Seals and Tools available from Westinghouse. See Page 9 of booklet B-3223-A.

Now you can eliminate the time-consuming operation of stacking hundreds of tissue-thin core laminations by hand for High-Frequency Communications Equipment. Pre-assembled Type C HIPERSIL cores are delivered to you in just TWO ready-to-assemble pieces per loop. Westinghouse winds a thin strip of HIPERSIL to form, bonds it, then cuts it in two.

These split-type cores of HIPERSIL are available in a complete range of standard sizes, or they can be furnished uncut in rectangular or circular shapes if desired.

GET THE FACTS ABOUT HIPERSIL TYPE C CORES . . . write for **HIPERSIL BOOK, B-3223-A.** It contains performance facts and application data that will help speed production of vital communications equipment to the fighting forces. Address: Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., Dept. 7-N. J-70423

**Registered Trade-Mark, Westinghouse Elec. & Mfg. Co., for High PERmeability SiLicon steel.*

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

HIPERSIL CORES

each spring must run before being released for production line use.

This booklet is available upon application to the *Muehlhausen Spring Corporation,* 1943 Michigan Avenue, Logansport, Indiana.

DOALL GAGE BLOCKS

In a new pamphlet issued by the *Continental Machines, Inc.,* the precision gauge blocks of this company marketed under the tradename of DoAll, are described in some detail.

Many pictures, taken from the company's training film "Precision Measurements in Industry" are included to illustrate the text material. Beside the booklet described, the training film is also available free of charge to industrial groups for training personnel.

Information on both the booklet and the film may be obtained by writing to *Continental Machines, Inc.,* 1301 Washington Avenue, South, Minneapolis 4, Minnesota.

-30-

Mobile Transceiver

(*Continued from page* 39)

superregenerative receiver, however, assigns but a few dial divisions to the entire band. This means that these small frequency deviations may mean frequent retuning. In a mobile unit, with the dial poorly lighted, frequent retuning is not easy, especially when tuning is critical. With the method described, however, tuning is so simple as to be a joy, and light is not needed since the general position of the dial pointer gives all the accuracy needed. Of course, it goes without saying that when the unit is in the transmit condition, the frequency should be spotted quite accurately.

The general layout of the rig is obvious from the photographs. A few words may be in order, however, as to the mechanical work involved. The chassis is 6" x 8" x 2". It was bent at a tinshop, from 20-gauge galvanized iron. The box covering the tuning unit and tubes is 6½" x 6" x 4" with a ½" lip on top to permit fastening the top plate. The box is made in five pieces: the front, the back, and two sides, and the top. This method was employed because the available pieces of metal were small, and because it is very much simpler than trying to make the box in one piece. All sections were assembled with self-tapping screws.

The box for the speaker was similarly made of a front piece, a rear piece, and a two-inch wide strip bent into box shape joining the two. The front and rear pieces are identical: 4⅛" square with a half inch lip all around. The front piece has a 3" diameter hole cut out and backed up with a piece of ¼" mesh hardware cloth spot-soldered in four places. The rear piece has a ⅜" grommet-insulated hole to pass the speaker cable.

Both of these boxes were brushed with gray enamel of the five-and-dime

store variety. Ordinarily, this enamel takes a day or so to dry thoroughly, but a hurry-up job was produced by suspending a 500-watt heating element in a reflector about a foot over the enameled surfaces. Drying is complete in half an hour or so, and a reasonably durable finish is produced.

To mount the transceiver, a piece of band iron, ⅛" x 1" x 8" is required. This is mounted to the chassis top at the front as shown in the photographs. It is fastened to the chassis by means of five 6-32 flat head screws and nuts, the heads countersunk into the band iron.

Right now might be a good time to say that *every* bolt and screw in the entire assembly, except the self-tapping screws, has a lock washer included. This is a mobile unit, and mobile units notoriously get jarred about.

The piece of band iron then has a ¼" hole drilled near each end, at about the center of the portion projecting over the side of the chassis. These holes take bolts which fasten the chassis to the lower lip of the dashboard in the car. For additional support, a brace may be run from the bottom plate to the bulkhead behind the motor.

The speaker housing is mounted on the steering column. Two pieces of the same size band iron are used to make the mounting bracket which is clearly visible in the photographs. Heavy felt pads prevent marring the enamel, and wing nuts provide easy installation and removal.

The power supply was built in a 6" x 6½" x 4" metal box because one happened to be available. The switch, fuse, power outlet socket, and six volt input binding posts are all mounted on the front of the box. The box itself fastens to the bulkhead by means of two ¼" bolts. The cables to the battery are No. 8 stranded and heavily insulated automobile cable. The lugs are homemade of short pieces of ¼" copper tubing flattened at one end and drilled to take the binding posts, which are 10-32 brass machine screws. Power is brought from the power supply to the transceiver by means of a four-wire cable. Two wires are paralleled for the negative lead.

Most of the foregoing has been about construction rather than about the circuit, wiring, and so forth. Actually, the business of wiring high frequency equipment has been well covered in innumerable articles. Radio-frequency leads should be short, and a common ground at the oscillator socket should be employed. In this unit everything grounds to the lead which joins the cathode and one filament pin of the HY 615, with the exception of the junction of R_1 and R_2. This grounds through the switch, which is several inches away, up at the front of the chassis. It seems to make no difference, however.

The only real difficulty was experienced with a very bad case of audio feedback found in an earlier model which employed choke-coupled modulation and audio output. It was discovered that the lead carrying modulated "B" plus from the modulator to the switch had inadvertantly been placed close to the lead from the junction of the two grid leaks to the switch. It took two days to run this down and separate the leads.

When unusual noises and difficulties appear in these units it is a good idea to experiment with by-passes and lead routing. Often howls may be cured by putting a resistor across the secondary of the input audio transformer, but this is a poor solution since it cuts audio gain.

No transceiver transformer T_1 was available, so an old audio transformer had to do. It was disassembled and a layer of No. 30 enamel was wound directly over the original windings. Leads were brought out and the winding protected by a coat of insulating varnish and a layer of masking tape. The leads go to a double tie point which is soldered to the frame holding the core together.

The microphone supply circuit is one which eliminates the need of batteries. It adds the cost of the one resistor to the rig, but does a grand job. It is simple and fool-proof, providing the cathode by-pass takes out all the audio.

The switch is a standard three-pole double-throw rotary affair. Thousands of these were made for skip-band BCL sets and many servicemen have a few lying around. It is a shorting type, but may be taken apart and filed to eliminate the shorting characteristic. Only three sections of the switch are employed. The lever type control knob provided is a real help in operation—a great improvement over the simple pointer.

Putting the transceiver into operation consists of two major steps. First, the receiver tuning must be adjusted to hit the band. The fact that the drive cord turns about the drive shaft but once each side of the hole precludes the possibility of getting out of the band once the band is found.

Secure a signal source of some nature, preferably a station of your own network. Loosen the dial drive wheel and rotate the flexible coupling until the signal is heard. When the signal is found, tighten the drive wheel again. The pointer may then be loosened and rotated to put the signal at any desired dial setting, then retightened.

The second major step is that of adjusting the coupling on transmit. Attach a 6-volt dial lamp across the output terminals as a dummy load and switch to transmit. The bulb should light up to some extent. Coupling may then be adjusted to increase the output. After each change in coupling, switch back to receive to see if the tube still regenerates. It will probably be found that the tube may be loaded amply on transmit without causing poor regeneration.

Installing the rig in the car brings up the subject of an antenna. Both

Armor for the Knights of the Skies

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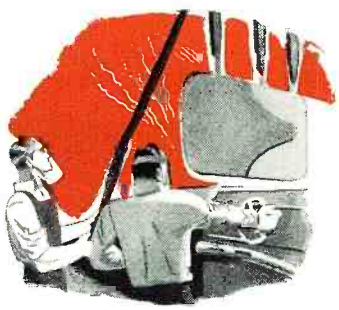
Breeze Armor Plate for America's fighting aircraft has brought home many a pilot and gunner, has saved not only valuable equipment, but priceless lives as well.

Manufactured by the Breeze Electric Heat Treating Process, this Armor is engineered in unusual shapes and sizes to designers' special requirements. The most severe tests, combined with actual use, have proved that Breeze Aircraft Armor Plate is unequaled in ballistic qualities and resistance to shatter. This is due not only to the special Breeze process of liquid carburization, but also to Breeze-developed methods of welding — quality workmanship which produces a joint as dependable as the Armor Plate itself.

In quantity manufacture today, Aircraft Armor Plate supplements the well-known Breeze line of accessories that are serving America on land, on the sea, and in the air.



Wartime experience in heat-treating, welding and plating tomorrow will enable Breeze to manufacture products of the highest quality for peace-time use.

Breeze BREEZE MARK

CORPORATIONS, INC. NEWARK, N. J.

PRODUCTION FOR VICTORY . PRODUCTS FOR PEACE

ends of the antenna link are brought out through feed-through insulators on the back of the box so that any type desired may be used. The writer has purposely avoided describing one because nearly every operator has his own particular favorite. Mounting the rig as described, however, will make possible a short antenna lead, so that maximum transfer of energy may be obtained.

No unusual claims are made for this transceiver or for its construction. It is merely an example. With current material shortages, WERS must worry along as best it may. Every installation will present new problems, but they can be licked. "Hams" have been licking radio problems of all kinds and descriptions for better than twenty-five years now. We just have to keep on doing it.

—30—

Practical Radio Course

(*Continued from page* 43)

age can be taken from the primary or the secondary of the output transformer for the circuit shown at A, but for the circuit at B it must be taken from the secondary. With such two-stage degeneration, it will generally not be difficult to obtain a reduction in gain of the order of 20 db. and a corresponding improvement in noise, hum and distortion.

A two-stage feedback circuit in which one of the stages is a push-pull output stage is illustrated in Fig. 5. Here again, the feedback loop includes the driver tube. If, in a circuit of the type shown in Fig. 5, regeneration and oscillation occur instead of degeneration, reversing the polarity of the feedback winding of the output transformer will usually be an effective cure.

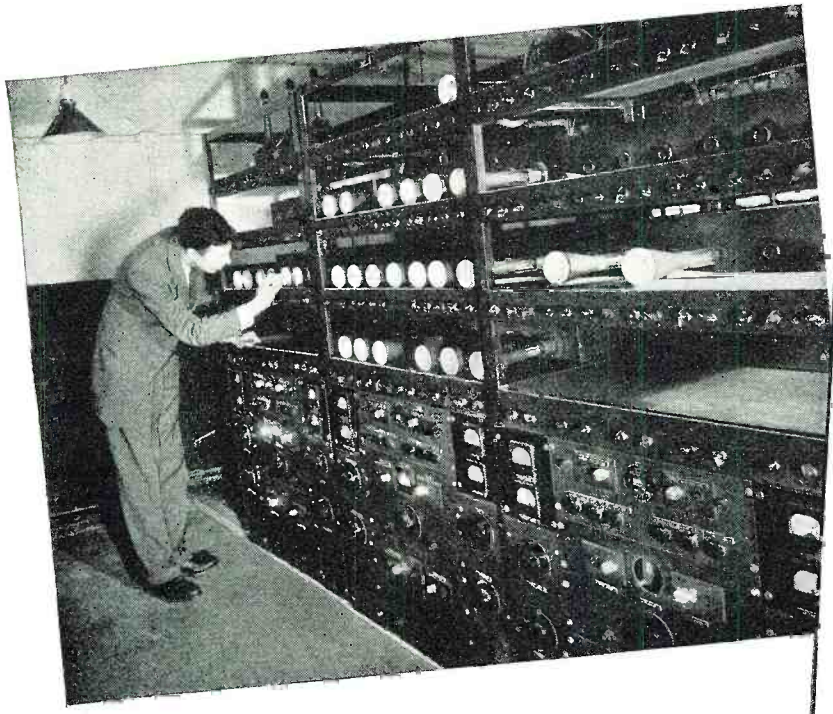
If the amplifier contains a push-pull output stage resistance-coupled to a driver tube and phase inverter, the feedback voltage may be fed into the cathode circuit of the driver tube (*not the phase-inverter tube),* as indicated in Fig. 6.

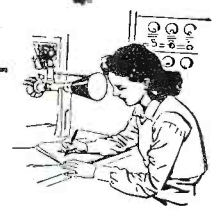
It will be noticed that the two-stage circuits are characteristically different from the single-stage circuits previously discussed because of the reversal of polarity resulting from the additional tube. It will be instructive at this point for the reader to review what was said earlier about oscillation in two-stage feedback circuits, and about oscillation preventatives.

Inverse Feedback Over Three or More Stages

When feedback is carried over *three* stages, the additional stage ordinarily should be placed between the input and output tubes. In 3-stage feedback circuits it also is possible to feed from the plate of the output tube to the grid circuit of the input stage. Difficulty is likely to be encountered unless the total phase shifts of the three stages can be kept down. By designing

Exhaustive DuMont quality control and life tests take all the guesswork out of CATHODE-RAY TUBE *Life*





DuMont Quality-Control Checkup

Percentage sample tests—some 100%—are made on production runs for the following:

Brilliance and screen condition—color, spots, burns, etc.

Examination of cathode by using tube as an electronic microscope. The few thousandths of an inch diameter gun aperture is magnified to ½ inch circle to check uniformity of emitting surface. Cathode emission current is measured.

Deflection sensitivity is tested to determine amplitude of signal required to deflect beam by given amount.

Maximum electrode current. Check for excess anode current (to avoid overloading power supply of equipment using tube.)

Determining grid cutoff (when too low, tube life is shortened; too high, might exceed range of intensity control of equipment using tube).

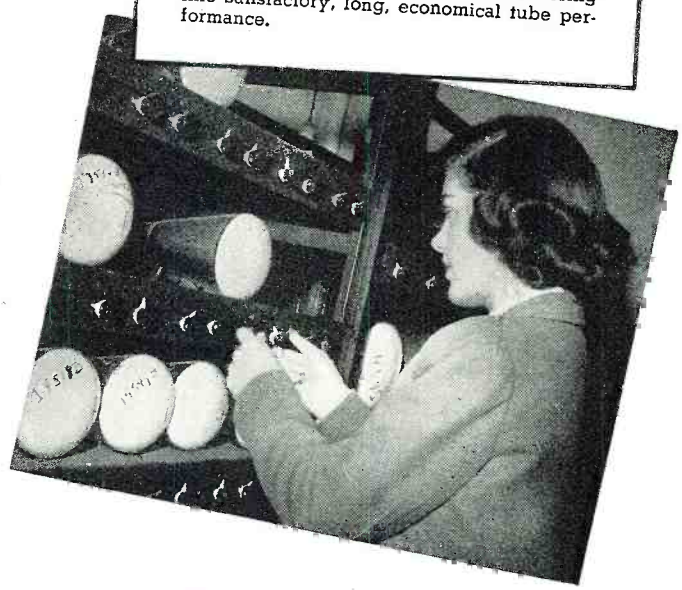
Leakage current of various electrodes.

And other critical and vital factors entering into satisfactory, long, economical tube performance.

DuMont never gambles. Thus each batch of fluorescent material is thoroughly tested in sample tubes. All new metals and other materials are likewise tested. New designs are thoroughly checked with sample production runs. The same with new processes—even to supposedly minor details such as washing and drying of glass envelopes.

DuMont life-test racks eliminate the greatest gamble of all—probable life. Percentage samples are operated in these life racks for 500 hours. A time totalizer keeps score. Tubes are tested weekly for brightness and cathode condition. And at the end of 500 hours the tubes are checked for all characteristics that might be affected by such intensive operation.

So again we repeat: there is no guesswork regarding performance and life with DuMont cathode-ray tubes.



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DUMONT *Precision Electronics & Television*

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the amplifier so that two of the stages have a frequency response no wider than necessary, while the remaining stage has a uniform gain and substantially negligible phase shift to much higher and lower frequencies than do the other stages, oscillation is not likely to occur.

It will be instructive at this point for the reader to review what was said earlier about oscillation in three-stage feedback circuits, and about oscillation preventatives.

When wiring amplifiers like that of Fig. 6 it will be found necessary to shield any long leads in the cathode circuit. It probably will be best to place the resistor R_1 near the input tube rather than at the output transformer.

Summary of Benefits Obtainable from Inverse Feedback

Some of the benefits obtainable from properly designed and applied inverse feedback applied to radio transmitters, the audio amplifiers of radio and television receivers, public address and sound picture amplifiers and electronic instruments are:

1. Reduction of *frequency* distortion (unequal amplification of all frequencies.)
2. Reduction of *harmonic* distortion (distortion of waveform.)
3. Reduction of *phase* distortion (phase angle not a linear function of frequency, important mainly in television amplifiers.)

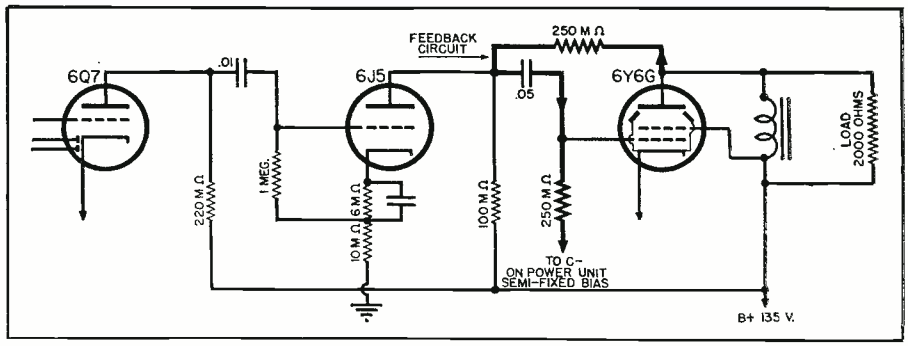

Fig. 7. Adding an extra driver stage is usually necessary to compensate for feedback.

4. Reduction of *sensitivity* or gain.
5. Reduction of *hum* or *noise* generated within the amplifier or from the power supply circuits.
6. Adjustment of frequency response of amplifier to almost any desired characteristic (tone control by selective feedback.)
7. Reduction of effective plate resistance of output tube (by constant-voltage feedback.)
8. Increase of effective plate resistance of output tube (by constant-current feedback.)
9. Reduction of loudspeaker transients, resonance and "hangover" effects through increased damping.
10. Increase of ability to deliver constant voltage or constant current to a varying load or output impedance.
11. Improved stability of amplifier gain and amplication reduction of variations in gain due to variations in input voltage, load impedance, tube characteristics (aging or change of tubes), supply voltages, (line, batteries, dynamotor, etc.), values of circuit constants included within the feedback loop, etc.
12. Practicability of using less precise and, hence, usually cheaper, circuit components because of these, without sacrifice of over-all performance or reliability.

This is a very imposing list! Lest the reader conclude that almost any desirable characteristic in an amplifier may be easily corrected by employing inverse feedback, let us hasten to add that great care usually must be exercised in choosing the proper type of feedback loop and the constants of the components of the electrical network if the benefits expected from inverse feedback are to be obtained in practice. Inverse feedback has its place and value for many applications. Its practical value lies in enabling cheaper apparatus to be used to meet the same requirements, or in meeting requirements that otherwise could not practically be met. However, since it does give rise to problems of its own, it makes careful design necessary if satisfactory operation is to be attained. Also, it has its limitations, and is not to be considered a magic cure-all for the poor performance of badly designed amplifiers or for all the ills that attend amplification. Furthermore, the use of inverse feedback does not absolutely *eliminate* the undesirable characteristics—it merely *reduces* them about in proportion to the amount that the gain of the amplifier is reduced by the degeneration. This characteristic also places a very definite limitation upon its use in many applications. Also, any distortion, hum, noise. etc., that is introduced into the amplifier as part of the input, or that originates in the amplifier but ahead of the feedback loop remains (with the exception of frequency distortion which may be compensated by a complimentary characteristic of the feedback amplifier).

Effect of Inverse Feedback on Gain and Power Sensitivity of Amplifier

There are three general types of tubes which can be used in the output stage: the power-amplifier triode. power pentode and beam power amplifier. As we have already learned, the power

Three attitudes that hamper the War Effort

IGNORING NATIONAL DESTINY

Many men are solving the problems of war as they would ordinary business difficulties. Having solved them, they ignore the most important phase. Their attitude toward the war's meaning and its effect on national destiny is apathetic and disinterested.

USING VITAL ISSUES TO PERSONAL ADVANTAGE

To further their own selfish aims, many men seize upon vital issues to confuse and confound the average citizen. When the times call for statesmanship, America is treated to a sorry spectacle of demagoguery, greed, blocs, distortion, shrewd manipulation of emotions.

PULLING IN DIFFERENT DIRECTIONS

While commands in various war theatres are being consolidated and strengthened, here at home there are men who have forgotten the unity after Pearl Harbor. Each is off on his own particular project, seldom remembering that thousands of other men will die before the conflict is over.

THERE IS NO PLACE IN THE COUNTRY FOR SUCH MEN

We of ECA are working not only to produce the materials of war but, like all good citizens, to help attain the objectives of the war. We know that we must be vigilant... especially so now. Men of evil intent have come out of hiding. In smoke-filled rooms attractive bargains are being arranged — with the "little people" included out. Energy which should be devoted to the support of the Commander-in-Chief, and those under him, is being used to stir up distrust and dissension. What appears to be overlooked is that the ultimate aim of victory is a decent world ... where men of good will live and work together with a full understanding of each other's needs and hopes and aspirations. We have already learned, the hard way, what isolationism and selfishness and disunity can mean. Must history again repeat itself?

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triode has many desirable characteristics from a distortion viewpoint, but it suffers from three important disadvantages. Its power sensitivity is low, that is, it requires a comparatively large signal input for its output; the grid bias it requires is often as high as 12-25 per cent of its plate voltage; its efficiency is fairly low, that is, only some 20-25 per cent of the d.c. plate power can be converted into useful a.c. power for operating the loudspeaker.

The power pentode and beam power tubes have the advantage of high sensitivity, a comparatively low grid bias and much higher efficiency—and it is because of these advantages that they are so widely used. However, they suffer from the disadvantages of having comparatively high plate resistance and third harmonic distortion (which cannot be eliminated by push-pull operation). But both of these disadvantages may be effectively reduced by applying inverse feedback—for the cost of either (or both) a single resistor and condenser for the feedback circuit. Actually, the addition of negative feedback makes it possible to operate a pentode or beam power output tube with an input signal excitation so large that under normal conditions (without feedback) 25 per cent or even more total distortion would be produced. Yet with the inverse feedback applied, the distortion that appears in the actual output under these conditions will be very much lower—within the limits for good fidelity. Hence, through its use, *reduced* distortion is obtained for the *same* output, or more *usable* (distortion within fixed limit) power is acually obtainable from the tube. The output of an amplifier may be increased approximately as the square of the gain reduction due to inverse feedback, for the same percentage distortion allowed without feedback. For example, if one per cent distortion is allowed without feedback, and feedback reduces the gain of the amplifier 5 times, then the driving signal voltage can be increased so as to increase the output *nine* times for the same one per cent distortion with feedback, provided the extreme capabilities of the amplifier are not exceeded thereby. This is especially advantageous in small a.c.-d.c. portable battery-operated receivers where tubes designed for low operating voltages must be used.

Unfortunately, the application of inverse feedback reduces the gain of the amplifier (the gain is reduced about the same number of db. as the distortion is reduced). Since the gain is reduced, the power sensitivity* decreases

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** Power sensitivity is defined as the ratio of the output power in watts to the square of the input audio signal in volts (rms), as in the equation below:*

$$\text{Power Sensitivity} = \frac{\text{Watts Output}}{(\text{Input Signal Volts})^2}$$

For example, if a 0.1 volt audio signal must be applied to the first audio grid of a two-stage audio amplifier to produce one watt output, the power sensitivity, expressed in mhos, is equal to 1/.1², or 1/0.01, which equals 100 mhos. Measurements on a number of receivers indicate that a good value of audio-frequency power sensitivity for a.c. operated receivers is about 200 mhos.

The War Is Selling Radio Like Nobody's Business
- by don herold

This war is the biggest ad for radio that anything ever was for anything.

130,000,000 Americans are using their radios constantly to keep up with war news — are finding out what radio really can do — are having their appetites whetted for better radio equipment — can't get what they want now — are going to start to better themselves, radio-ly speaking, the minute the war is over.

10,000,000 guys in the armed forces are learning what radio can do in battle and in training. They'll all come back radio nuts.

Television sets may be almost as common as electric toasters not too long after the war.

So, hang on, brother. If you can "take it" these days, you'll reap richly in them days to come.

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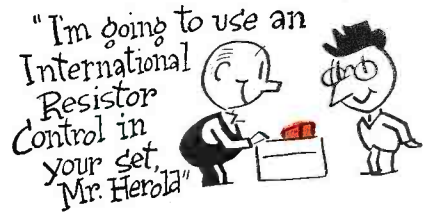

And remember that we radio-shop customers, for whom I speak, always get a glow out of knowing that you handle and use famous products in your shop. If you tell me, f'rinstance, that you use International Resistance Units, I know you know what's what.

No. 5 *in a series of special messages prepared by America's famous business writer, humorist and cartoonist, Don Herold . . . In sponsoring these Don Herold "broadcasts," IRC pays tribute to the thousands of Radio Service Men who, whenever possible, specify and use IRC resistance units in their work.*

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also, hence the distortion decrease is obtained at the expense of power sensitivity. However, even though the application of inverse feedback to pentode or beam power output tubes reduces their power sensitivity, they still provide very much higher power sensitivity than does a power triode tube operated to produce the same per cent distortion. Therefore a very real advantage is obtained through their use.

If the amplifier using pentode or beam power output tubes possesses sufficient gain and power sensitivity for its requirements, after the inverse feedback has been added to it, nothing further need be considered. However, if the application of the inverse feedback required reduces them to too low a value (as is the case in many small receiver designs, public address amplifiers, etc.), the lost gain can be compensated for by the addition of another voltage-amplifier stage (or, often the voltage amplifier tubes being used can be replaced with tubes providing higher gain). An important fact to bear in mind is that for anything less than 100 per cent feedback, where the gain-loss ratio becomes unity, *it requires a smaller increase in input signal voltage to make up for the lost gain due to degeneration than the actual gain lost.* For example, a 20 per cent increase in input voltage may make up for a 30 per cent loss in gain due to degeneration. Where gain is to be added by the installation of an additional stage, a good rule of thumb is to use as much feedback as will be compensated for by the additional gain added by the stage, so that the over-all gain is brought back to the original value.

Following this technique, one designs an amplifier for more amplification than is actually required; and then, by properly sacrificing some of this potential gain (by applying inverse feedback) one obtains certain beneficial characteristics in the amplifier. For example, in the amplifier shown in Fig. 7 the 6J5 stage was added to provide the additional gain and power sensitivity to offset the reduction caused by applying degeneration to the 6Y6-G beam power output tube. The power sensitivity of the amplifier if built with only the 6Q7 and 6Y6-G tubes without inverse feedback is 53 mhos. With inverse feedback and the 6J5 stage added, as shown in Fig 7, the power sensitivity is increased to 200 mhos at 2 watts output. Thus, for the cost of a 6J5 tube, a socket, five resistors and a condenser, the power sensitivity of this amplifier was increased nearly four-fold, the distortion at 2.5 watts was reduced to less than half its original value, and the frequency response characteristic was improved.

Since the application of inverse feedback to an amplifier requires that more driving voltage be applied to obtain full power output, in some cases the output of the driver will have to be excessive and the distortion produced in it because of this alone may offset the distortion-reducing benefits provided by the inverse feedback. This is one reason why inverse feedback is often more conveniently applicable to beam power than to pentode output tubes. When inverse feedback is used with a pentode, the total driving voltage required for full power output may be inconveniently large. Because a beam power tube gives full power output on a comparatively small driving voltage, inverse feedback is especially applicable to beam power tubes. By means of it, the high efficiency and high power output of beam power tubes can more easily be combined with freedom from the undesirable effects of varying speaker impedance already discussed.

Examinatilon of Fig. 1 will prove interesting regarding this point. Notice that *without* degeneration the 6L6 beam power tube produces its maximum signal power output of 6.5 watts (point A) when a signal voltage of approximately 11 volts r.m.s. is applied. When the tube is degenerated to 50 per cent of its no-degeneration sensitivity it requires 22 volts of input signal to produce the same power-output of 6.5 watts (point B). But, notice that when no degeneration is applied, approximately 10 per cent distortion results (point C) when the 6.5 watts power output is being delivered. With the degeneration, the distortion is reduced to only 5 per cent (point D).

(To be continued)

Electronics in Science

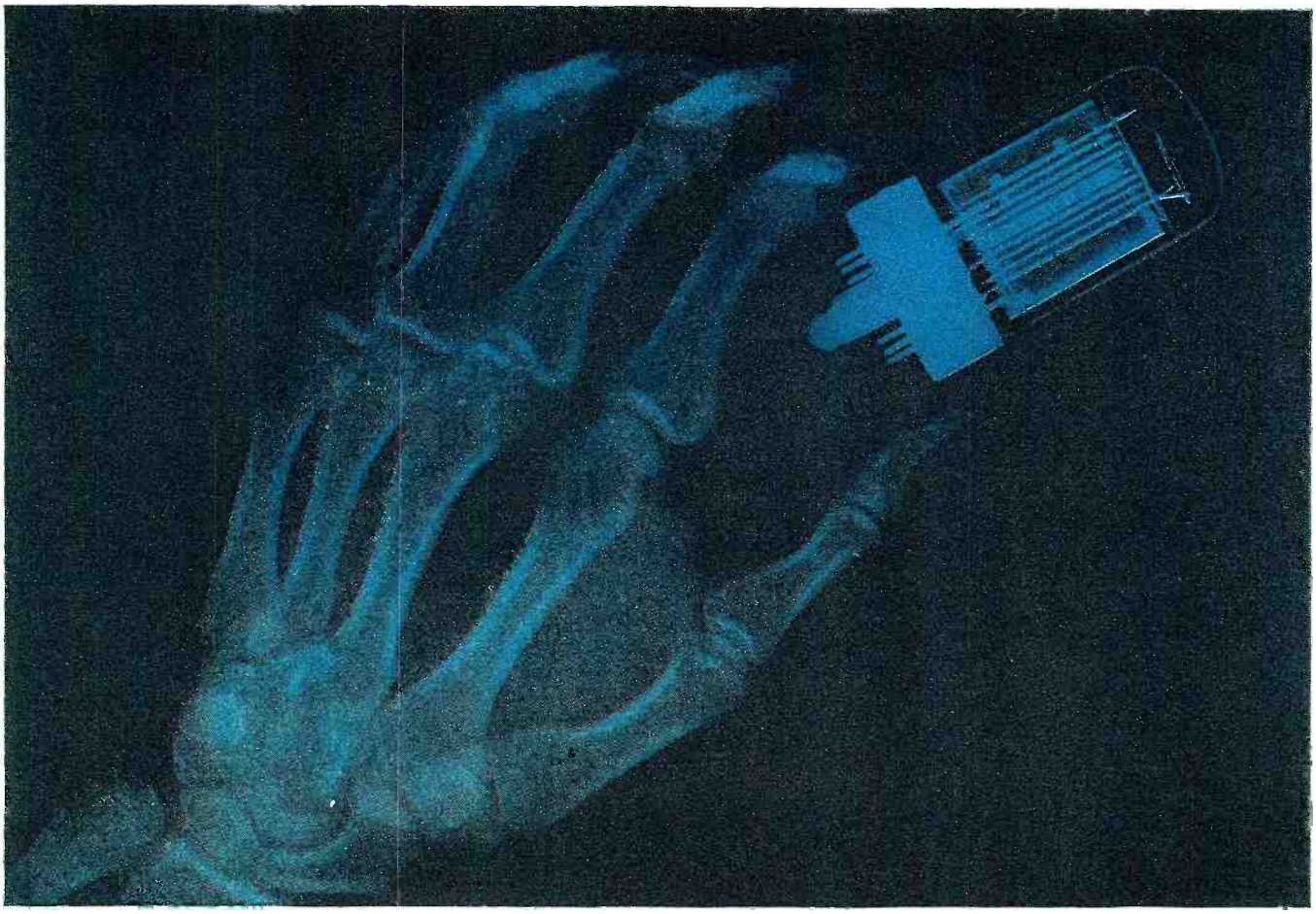
(*Continued from page* 34)

make adjustments for common water-temperature levels.

Electroencephalography

Encephalography is the "science of brain waves." It has been known for some time that potentials originating within the brain tissue may be picked up by electrodes in contact with the scalp, amplified, and recorded. Lately, it has been established that the shape of these wave patterns correlates with certain conditions of the central nervous system (brain and spinal cord). Waves of certain shapes, for example, are picked up over brain tumors and certain other ones are set up during epileptic attacks.

The task of the electronic engineer has been to develop special equipment for amplifying the low-potential brain waves and recording the patterns. Since the frequency of these voltages is always at the lowermost end of the audio spectrum, amplifier response must be flat between 1 and 45 cycles. The amplitude of brain-wave voltages is low, being of the order of several microvolts, hence considerable amplification is necessary in order to actuate recording devices. With such low signal-input levels and high-gain amplification, the noise level of the amplifying systems cannot exceed 2 microvolts. Working at such low frequencies, the amplifier rightly may be



Induction Ceremony

This is an X-ray photograph of the final step in the stiff pre-induction examination which National Union engineers are giving many of the N. U. Tubes now headed for combat duty.

Why X-ray? Because with great objectives and priceless lives at stake, it is a military necessity to know that critical-type N. U. Tubes are sound through and through—equal in every way to the ordeals they'll face in battle. Even tubes which have passed scores of operational tests with flying colors, are scrutinized by the searching eyes of the X-ray engineer. X-ray examination of the finished tubes—after all processing has been completed—helps our scientists to know that there is *no* hidden weakness *anywhere.*

This insistence upon leaving nothing to chance typifies the uncompromising scientific standards which prevail at National Union. It is assurance that every tube which carries the N. U. trademark can be counted on to do its duty, always. And for post-war industrial needs, it is a safe and sure guide to electronic tubes of known performance characteristics and dependability. *Count on* National Union.

NATIONAL UNION RADIO CORPORATION, NEWARK, N. J.
Factories: Newark and Maplewood, N. J., Lansdale and Robesonia, Pa.

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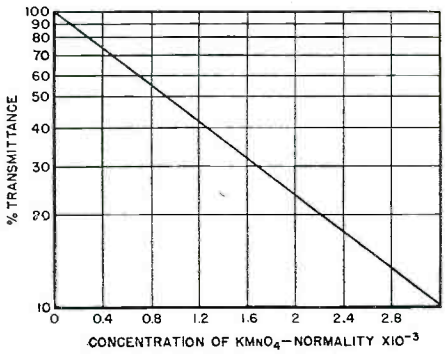

Fig. 7. Concentration curve of $KMnO_4$.

expected to be uncommonly susceptible to stray 60-cycle fields from the laboratory wiring. This difficulty must be overcome by reducing the amplifier gain to a value as near zero as practicable.

Cathode-ray and photographic recording systems are not practical in encephalographic studies because of the long continuous records required and because these two systems do not in general permit of easy monitoring. Electromechanical inking recorders are therefore required. The recorder has offered a particular challenge to the engineer, since its requirements are that it respond quickly, without lag or overswing, in the 1-50-cycle region and that it exhibit no electrical or mechanical resonance in that region.

Miscellaneous Applications

Supersonic frequencies have already been utilized in the laboratory and in industry for sterilization, flocculation and emulsion in liquids, and the acceleration of certain chemical reactions. These ultra-high audio frequencies are at present receiving a large share of attention in biological and bacteriological circles.

Irradiation by means of ultra-violet and similar illumination is a new safeguard against infection. Lamps for the purpose are already in operation in surgical operating rooms, and small "sterilamps" are being applied to numerous field uses. Several manufacturers assure us that these lamps, installed in our refrigerators, will arrest bacterial growth in foods in the home of the future.

The measurement of d.c. potentials at various points in the human body and between various parts is a study yielding a large amount of data annually. Research men are striving to correlate these results with certain life phenomena which will make such observations valuable in diagnosis and treatment.

Appreciation is herewith extended to the Barnstead Still and Sterilizer Co. in permitting reprinting of Figs. 2 and 5 appearing within the article and to Coleman Electric Co. in submitting photographs and schematic arrangements of professional type equipment shown in Figs. 1, 4, 6, and 7.

—30—

Postwar Opportunities
(*Continued from page* 29)

bottom and acquire seasoning, maturity and a great deal of practical experience under a variety of conditions. He should come in contact with many people, a goodly portion of whom should be practical men.

To such readers who have these engineering requisites or desires, the writer wishes to convey this message. There are youngsters reaching maturity who will need jobs and opportunities. In most cases they will be too immature and inexperienced to commence in any but a junior capacity. It is up to you men to recognize your duty and perform it. That duty is to yourself and to everyone else . . . and it is to qualify as an engineer and to cease remaining in the status of a technician or serviceman. Any indifference or disinclination you may have to get ahead or to disturb any snug situation now enjoyed is holding up the line for everybody behind you. Do not force less capable men to pass you up because of your failure to move. You should be the engineer because you have much of the know-how already and can acquire the remainder needed without much additional preparation. The fact that you lack a sheepskin, or that you have only a layman's knowledge and appreciation of history, literature, ancient civilization and polished manners is unimportant. That is not the issue. It is desirable only that you be honest with yourself as to what your real limitations are and make a sincere effort to correct them. These may perhaps be unpleasant speech, poor habits, envying of the successful people in your field (although you do nothing yourself to acquire similar success), inferiority complex, poor spelling, poor at arithmetic or mathematics, or carelessness in heeding technical information and modern developments in the field.

The real truth is that radio and electronics are not complicated. People can be made to think it is but that still does not make it so. The fact is that radio troubles can be great in numbers, but are very few in type. Radio and electronics have never been, are not now and probably never will be more than an inductance, a resistor, a condenser and a vacuum tube. It is only their size, number and manner of connection that make up a thousand different kinds of useful apparatus. Understand inductance, resistance, capacitance and vacuum tubes and add them to your backlog of practical experience.

In Table I are enumerated 100 opportunities, each of which can in turn be subdivided as many as 100 times or more. Some of them may become greater than all radio itself. Magnetism and magnetic phenomena can in time overshadow the rest of radio and electronics. It may break suddenly without warning. Already the existence of a magnetic current has been discovered and disclosed. The cyclotron is another basic development which can be compared with Edison's first electrical discovery.

If prospective engineers follow the advice contained in this article and find it difficult to know how to apply their qualifications, it is suggested that:

If you cannot develop or design equipment,
then build it,
or sell it,
or repair it,
or use it,
or show some one else how to do any of these things.

If no one wants to hire you at it, then do better and develop your own enterprise. Anyone approached for placement who will not furnish same, must run the risk of creating a competitor. If you do not recognize at least one thing in the list that you have sufficient confidence in yourself to successfully put across, then you are indeed an unfortunate person with questionable qualifications for a radio or electronic career.

Radio and electronics will always need men with creative ability, vision, courage, initiative, willingness to be both teacher and pupil as occasion may dictate, unselfishness and confidence.

—30—

FM Station, WWZR

(*Continued from page 22*)

from the standpoint of operating effiency, stability, and long tube life. Authorization was granted on March 1, 1940 for the change of station license call letters to W9XZR. Test transmissions with a power of five kilowatts were started on November 11, 1940, and regular operation with five kilowatts was undertaken on February 10, 1941. Shortly before this time, a reactance type of modulator, developed by the staff at the Zenith factory, was installed and has provided excellent uninterrupted service up to this time.

Move to a New Location

A site offering many advantages over that provided at the Towers Club was selected for the permanent location of the station. This structure is one of the tallest and most modern buildings in the Middle West and is one of the few buildings in this district where a.c. current is available.

Moving of the station from the location to another was accomplished in a short period of time. The whole operation was completed in less than eleven hours. The regular program was concluded at the regular time, midnight, February 26, all equipment dismantled, moved, and reassembled at the new location, and the first carrier test put on the air at 10:55 a.m. on February 27, 1941. A regular schedule was undertaken on the 28th and maintained until March 31, 1941, when a new authorization provided for the call letters of W51C and the operating frequency changed from 42.8 megacycles to 45.1.

The installation of the equipment called for a good deal of ingenuity. The penthouse structure, which was to house all power equipment, water pumps, and cooling systems, was nearing completion in June of 1941. Considerable interest is attached to this structure and unique methods were employed to overcome some of the unusual problems encountered in the design and building of the penthouse. The beams and the antenna pole, for example, had to be cut into pieces and then raised by elevator to the roof and welded together again.

This penthouse, located on the roof of the building, is approximately 150 feet away and two stories above the rooms on the 45th floor in which the transmitter is located. Of steel beamed and reinforced concrete and brick construction, it is divided into two separate rooms with individual fire-proof steel doors. The smaller room is used for the power vault. This houses the station power distribution board to which 3-phase, 208-volt, 60-cycle a.c. is supplied from the Edison Company mains. All a.c. power for the station is distributed from this point in the penthouse.

Here, also, is located the Westinghouse Automatic Voltage Regulator, the 50-kw. amplifier power supply transformer, and power supply reactor. All power and control circuits are properly channeled to the transmitter room on the 45th floor, where it is in turn distributed to the various units by a central duct system, along which all cubicles are placed. The larger room is used to house the duplex water circulating system. This consists of two complete systems, storage tanks, pumps, and cooling unit. The transmission lines terminations, the antenna phasing network, and antenna terminations to the antenna along with storage facilities and a workshop are housed in this structure as well. A view of the room shows these details and very clearly indicates just how the antenna pole, which is based on the roof of the building or the floor of the penthouse and socketed through the roof of the penthouse, is mounted. This pole, 14 inches in diameter at the base, tapers to approximately 8 inches in diameter at the top, is 45 feet long, and rises about 33 feet above the penthouse. The phasing network is clustered around the mast in the penthouse.

The antenna elements and coaxial feeders are fastened to the pole and disposed to form a turnstile type antenna system, which incorporates features that provide an effective 50-kw. FM field pattern and require that the

RADIODDITIES

The same components used for coupling in an audio amplifier are also used for decoupling.

Among the interesting, but lesser publicized effects discovered by tube engineers is the emission of X-rays by radio tubes. Few experimenters know, too, that small currents are set up in receiving tubes by photoelectric action arising from the lighted filament.

Every amateur call area in the United States touches an ocean or foreign country.

One of the most popular factory-built home receivers of the middle 1920's was of wooden breadboard construction.

Both the audio and radio channels of a 'phone transmitter often start out with crystals—microphone and frequency control.

Diathermy machines operated in Canada and Mexico have been known to cause radio interference deep in the United States, and vice versa.

Odd, isn't it, that a tube plate circuit tightly coupled to a load "sees" a resistance load as a *resistor;* but a condenser load as an *inductance,* and a coil load as a *condenser.*

History of Communications Number Two of a Series

COMMUNICATIONS BY ROMAN POST RIDERS

MODEL
1700-UB

In the early days of the Romans and Phoenicians the fastest means of communication was the post riders, who carried news and War dispatches from the battle front. As fleet as their horses might have been, their speed does not begin to compare with electronic voice communication. The twist of a dial and the pressing of a button—in the flash of a second the message comes through. Clear cut speech transmission with Universal microphones reduces error and expedites the delivery of the message.

Today Universal microphones and voice communication components are being used throughout the world on every battle front filling a vital need and "getting the message through."

< Model 1700-UB, illustrated at left, is but one of several military type microphones now available to priority users through local radio jobbers.

UNIVERSAL MICROPHONE CO., LTD
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final amplifier operate with a plate power input of only 30 kw.

During the time the penthouse was under construction, the antenna system developed by Mr. Aram, a Zenith engineer, was being subjected to exhaustive tests at the factory. At the same time, the 50-kilowatt FM power amplifier, probably the first of its kind incorporating the water-cooled GL 880 tubes, which as yet had not been put to commercial use, was nearing completion. On July 10, 1941, the power amplifier was moved into place on the 45th floor of the Field Building, and the turnstile type antenna system and transmission lines were being installed. By August, 1941, the completed system was put to test.

The performance characteristics of the entire system fully met the rigid requirements established by the Federal Communications Commission to uphold the very high standards of FM broadcasting. Regular broadcasts were started in October, 1941, with full licensed power.

General Description of WWZR

The equipment which comprises the WWZR transmitter is so disposed as to allow immediate accessibility to any unit or part of a unit to facilitate operation and emergency requirements when called upon to make necessary replacements or repairs. Wherever possible, the equipment has duplicate units provided to do the same work so that in an emergency the only time lost would be that required to determine the source of trouble and the switch-over operation. At the present time, the source of programs is a pair of RCA type 70-C turntables, using Western Electric type 9-A pickup head assemblies. Additional suitable filtering networks are incorporated so that proper reproduction of all types of transcriptions and recordings is obtained.

The program input equipment is the RCA type 76 B-1 consolette. This has provisions for emergency operation in case of failure of either its power supply or program amplifier. This incorporates provisions for handling four studios, as well as twelve outside program sources. There are two modulating units, the one used for regular service being the Zenith type ZR-17 reactance modulator. The standby is an R. E. L. 494-B Armstrong modulator. The intermediate power amplifier is comprised of three stages of balanced amplifiers. The first stage is a pair of Eimac 35-T tubes. These excite a pair of Eimac 250 TH's, which in turn supply excitation to a pair of Eimac 2000-T's. This comprises the intermediate power amplifier ZR-10.

The ZR-10 intermediate amplifier is rated at from one to five kilowatts. Air cooling is used for all tubes in the intermediate power amplifier, with forced air blast cooling for the seals of the 2000-T's. Grid leak bias is used in all stages with a fixed bias supply in series with the grid leak of the 2000-T stage. The bias supply consists of a pair of 872-A's mercury vapor rectifiers, and suitable filtering and a heavy bleeder circuit.

The ZR-10 power supply consists of two sections, first a 2000-3000 volt single phase, full-wave rectifier system, the other a three-phase, full-wave supply system. By a switching arrangement, power for the 2000-T stage can be supplied at 2000, 3400, or 5800 volts. All rectifiers are the mercury vapor type 872-A's. The capacity of each supply is such that in case of failure of one supply, the other can be bridged over and used to supply power to all stages of the intermediate power amplifier. All doors are interlocked to remove high voltage when opened. Tuning and controls are operated by key type of knob inserted in the pin holes of the drive shaft inset flush with the front panel.

The final power amplifier is a pair of General Electric GL 880's water cooled. The 880 power amplifier power supply is divided into two parts. The rectifier cubicle and control board are located in the transmitter room adjacent to the 880 power amplifier cubicle, while the transformer, voltage regulator, and reactor are located in the penthouse. This system also uses three-phase, full-wave rectification, and uses the Westinghouse type 881 mercury vapor rectifier.

Associated equipment for monitoring purposes includes: a monitor receiver and calibrated deviation indicator, a visual frequency limits monitor, an audible indicator beat note

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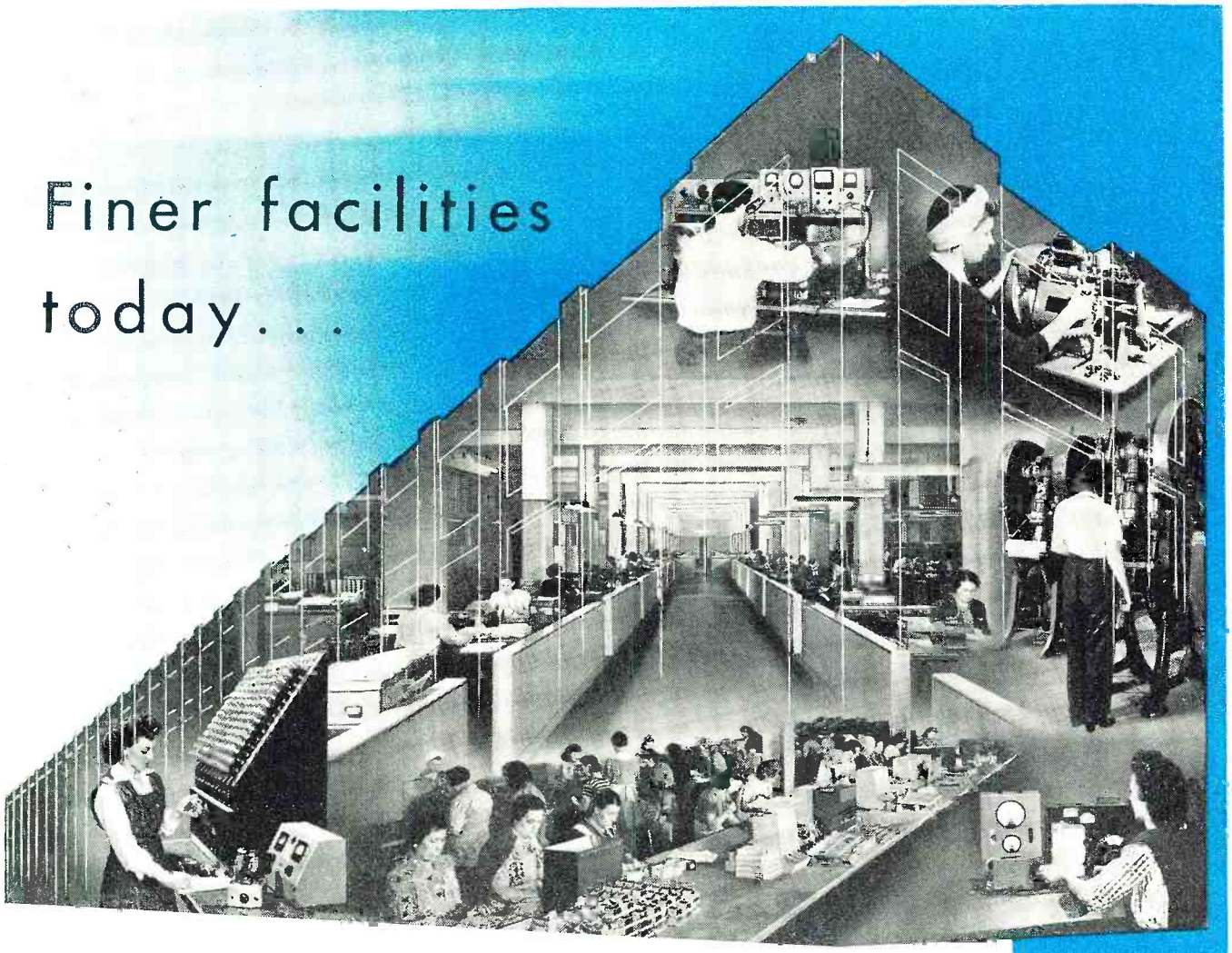

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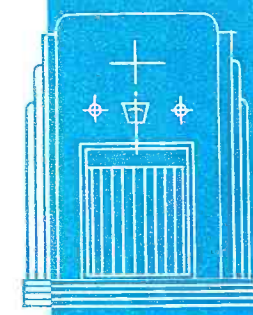

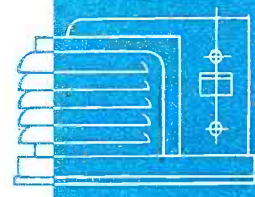

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reference monitor, and power output indicator for antenna power.

Circuit Operation Reactance Modulator

The reactance modulator used at WWZR operates as follows: a self-excited oscillator operating at 22.55 megacycles, or half the operating frequency of WWZR-45.1 megacycles, has the plate tank circuit shunted by the plate impedance of a receiver type tube which is operated so that when the audio-frequency voltages suitably pre-emphasized from the program amplifier is applied between one of the grids and the cathode, the plate impedance is varied. This effectively changes the frequency of the oscillator circuit, causing a change of frequency that is a function of the audio-frequency voltage amplitudes, while the various audio frequencies determine the rate at which the modulated oscillator changes its frequency above and below the operating or mean frequency. Adequate provision is made for linear modulation. The frequency-modulated signal is applied to a buffer amplifier, followed by frequency doubler stage and then the amplifier stage. The output from this stage is brought to a transfer switch, where it is fed into the coaxial line that connects with the input circuit of the intermediate power amplifier. In case of a failure in the modulator unit, the transfer switch is thrown over to connect the output of the emergency modulator unit and disconnect the inoperative unit from the following stages.

Mean Frequency Control

In order that the carrier or mean frequency be held within the assigned limits (plus or minus 2000 cycles per second), a reference frequency control system is used. By means of this system, a series of frequency deviations due to modulation is allowed to take place, yet at moments of no modulation the modulated oscillator does not possess the required frequency stability and the carrier or mean frequency would drift up or down in frequency as a result if the control circuit were not incorporated. This circuit literally measures the amount of frequency variation above or below the operating frequency and corrects the condition by causing the modulated oscillator to return to the proper operating frequency each time a momentary pause in the modulation process occurs. The ordinary pauses in speech or music of any program is sufficient to allow this circuit, which is on duty at all times, to do its very important work.

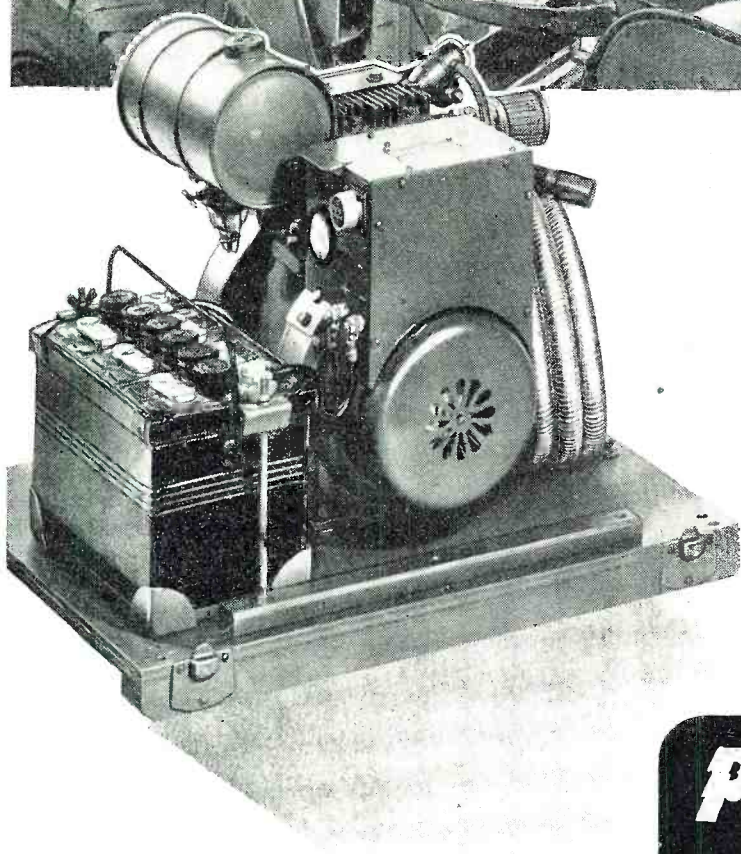
How it works is as follows: A receiver type mixer or first detector tube operates into an intermediate frequency amplifier of approximately 3.5 megacycles. The output of the i.f. amplifier is applied to a discriminator circuit which developes a d.c. voltage that is added to or subtracted from a bias voltage applied to a control element of the modulated oscillator's modulator tube which directly controls the frequency of the oscillator.

The mixer tube referred to above has applied to its control elements or grids two signals; one signal voltage is picked off from the tank circuit of one of the amplifiers which follow the modulated oscillator stage; this voltage is of the frequency of the modulated oscillator, 22.55 megacycles. The other signal voltage is the third harmonic of a very stable, temperature controlled crystal controlled oscillator circuit, the output of which is applied to a tripler, and then a buffer amplifier which supplies the mixer grid. When the beat note developed in the plate circuit of the mixer and amplifier by the i.f. stages is exactly 3.5 megacycles, the output of the discriminator is zero. When the modulated oscillator's frequency drifts above the assigned frequency, the i.f. or beat note increases in frequency and causes the discriminator to develop a d.c. voltage of such polarity and amount that the bias of the control or modulator tube causes the oscillator (modulated oscillator) to change frequency to bring it back to normal. When the frequency changes in the opposite direction the beat note is lower than the i.f. frequency and the discriminator d.c. output voltage is of opposite polarity and amount (determined by the amount of drift) and causes the opposite results to the modulator and modulated oscillator.

The frequency deviations within the audio spectrum cannot cause the control circuit to actuate the modulator and oscillator because of a filter in the output of the discriminator which does not allow any audio frequencies to vary the d.c. voltages used for control purposes.

It should be mentioned that the modulated oscillator, operates at one half of the operating frequency of 45.1 megacycles. A variable coupling inductance loop is used to vary the output of the I.P.A. thus controlling the excitation to the GL 880 power amplifier stage. The output of the unit can be varied from 1 to 5 kw. by means of the switching arrangement in the intermediate power supply, and this variable coupling unit. The pair of lines from the I.P.A. output terminals run to the two pole position transfer switch which also mechanically operates an interlock cutout circuit. This switch mounted in the P.A. cubicle can be operated only when power is shut off from this stage. This switch connects the output intermediate P.A. to an inductive coupling link for the grid tank of the GL 880's. In case of trouble arising in the P.A., its power supply or the regular antenna system, all power is removed from this stage, and the switch is thrown over to disconnect the P.A. from the intermediate P.A. stage and the output is applied to the transmission line connected to the emergency antenna, and broadcasting continues on reduced power with only a momentary interruption.

Dependable Power...



Probably the most important single factor in modern warfare is complete, dependable communications. Dependable communications require a dependable power supply. Pincor is proud of its part in furnishing portable gasoline-driven and other electrical power supply units to the fighting front as well as to the home front.

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This provides conditions for rapidly effecting whatever change is necessary to resume operation at normal power with as little delay as possible.

880 Grid Tank Circuit

Normal tuning is accomplished by a grounded blade knifing between the parallel bars that make up the quarter-wave grid tank circuit.

Dampening is required in the grid circuit for stability and to broaden out the grid tank resonance curve. By using a quarter-wave tuned line shortened at one end and capacitively tuned to resonance at the other the required resistance effect for dampening purposes is introduced into the grid tank circuit by connecting this damper at the proper point from the shortened end to a point some distance from the grid terminals on the grid tank by means of a pair of copper lines.

The GL 880 has two grid terminals, one of which is used for neutralization connections; the neutralization capacitors are mounted on the water jackets and suitably insulated. It is mechanically independent of all other construction supports, thus as a part of the jacket tube assembly is free from whatever mechanical or thermal moving effects that could possibly change the neutralization.

Plate Tank Is Also Water Jacket

The water jackets are so designed that they form the plate tank circuit; this takes the form of a quarter-wave length tuned line. The entire jacket assembly is mounted on stand-off insulators. Rough tuning is accomplished by a bar or plate near the base of the tubular copper jackets into the top of which the tubes are set; vernier tuning is accomplished by a small variable capacity connected across or between the tube jackets near the plate end. The jackets are designed to allow the cooling water to rise up the inner column flushing over the entire plate area and returning to outlet port in the space between the inner column and the outer. The jacket inlet and outlet ports are connected by bronze unions to the two water insulation coils, each made up of 25 feet of one inch I.D. steam hose wound on a suitable frame.

The Water Cooling System

The water cooling system was designed to afford a maximum of protection against operational failure.

The interlock system has the following water cooling system control devices: over and under pressure Mercoid switches, water jacket temperature inlet and outlet thermometers and excessive temperature operated cutout switch and pressure gauges.

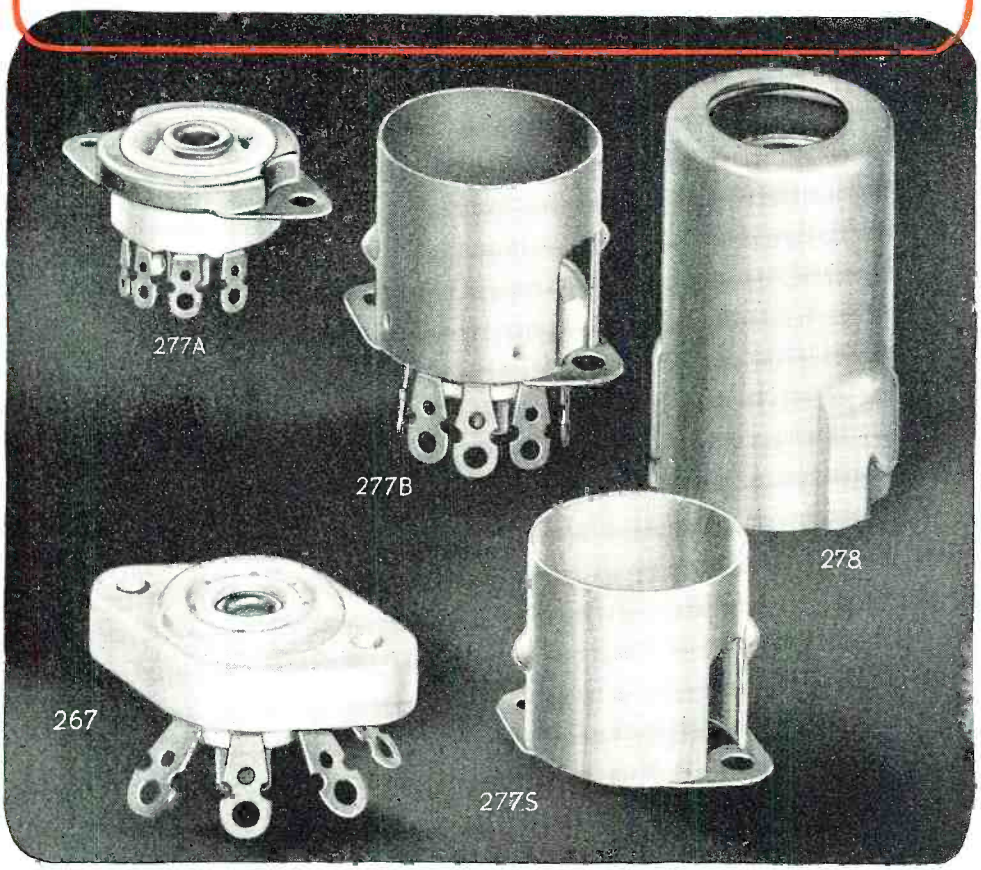
A valve box is located in a compartment accessible from the front of the P.A. cubicle, and connects with the 1⅜" streamlined copper supply and return lines run from the water cooling equipment in the penthouse. This valve box provides for controlling the inlet and outlet water supply to the jackets of the GL 880, as well as a by-pass valve and a bleeder valve. When it is necessary to change a tube during operation time, all power in the P.A. is shut off, emergency antenna is connected to the I.P.A., the by-pass valve is opened, the inlet and outlet valves are closed and small amount of water in the jacket is drained out through the bleeder valve. When the by-pass is opened, the water pressure drops, the valve system remains in operation, and the tube can be changed without shutting down the cooling system.

The cooling system consists of a duplex installation using distilled water. At any time the idle system can be put into use and the running system can be shut down by valving and switching operations. The distilled water from one of the two 300-gallon storage tanks is pumped through the cooling unit conducted down to the transmitter inlet port. After passing through the jacket the temperature is raised by carrying off the heat developed at the plates of the GL 880, and is returned to the storage tank in the penthouse.

The cooling system operates in this manner: air drawn in through an 8 ft. by 10 ft. grill protected louvered opening in the wall of the large penthouse room passes through an air filter maize for cleaning and then through a steam radiator and through a honeycomb cell water cooling radiator by means of a squirrel cage fan. From here it is either forced out through a passage to the other side of the penthouse or recirculated until the air reaches a certain minimum temperature. A water temperature controlled motor-operated damper directs the air to the return duct or to be forced out through an outlet duct opening in the opposite penthouse wall. The steam supplied to the air heating radiator from a main steam line is controlled by a motor-operated link valve which is operated by the temperature of the indrawn air.

If the temperature falls below 45° F. the proper amount of steam is admitted to the heating radiator. The danger of a freeze-up during the time of shutdown when water is not circulating or great fluctuations in temperature are thus provided for. By returning the water directly into one of the 300-gallon storage tanks before being pumped into the cooling unit, the returned water imparts its temperature to the mass of water in the tank; this acts as a temperature filter and allows the control devices a minimum of action. The pumps are of the single impeller type using an asbestos packing. The shafts are run in ball bearings. Each pump is mounted on a bed plate inset in a concrete foundation platform. A 35-h.p. motor mounted on the bed plate is coupled to the pump. The motors are

JOHNSON MINIATURE SOCKETS



Pre-eminent in the ceramic socket field, it was to be expected that Johnson was asked in 1941 to develop the first miniature ceramic socket (No. 267), or that it was quickly approved and widely adopted a year or more ahead of the field, and today is going into critical equipments by the hundreds of thousands.

The same Johnson skill in engineering both ceramics and metal has gone into the No. 277, and the associated shields and shield base (usable with other sockets as well). These Johnson sockets not only meet standards (developed jointly by us, the W. P. B. Socket Sub-committee, Signal Corps, Navy and private laboratories); in each of them you may count on that EXTRA value that's typical of products bearing the Viking mark. High grade steatite insulation with long creepage and arcing paths and low inter-contact capacity; accurately formed and processed contacts of silver plated beryllium copper or phosphor bronze, freely floating and with just the right tension, feature this series of sockets.

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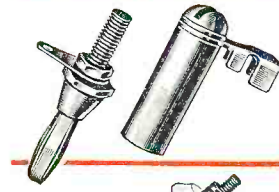

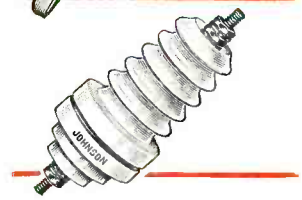

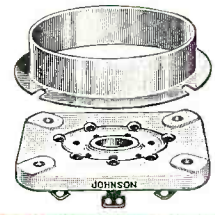

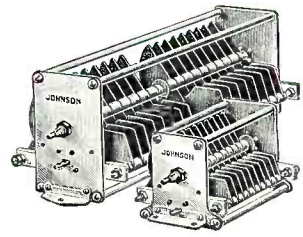

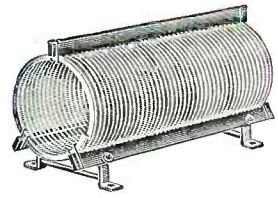

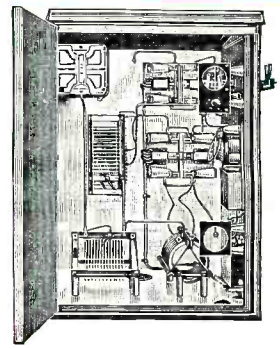

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protected by thermal relays as well as no voltage release switch circuit. The same protection is applied to each of the three phase 2-h.p. cooling unit fan motors. The operating procedure is to run number one pump and its motor, number one fan motor and associated water storage tank, when the water is changed, which time is determined by measuring the leakage resistance of the water, and the alternate number two system is put into use.

GL 880 Filament Circuit

The filament of the GL 880 is rated at 12.6 volts and 320 amperes each. The requirements for normal operation are such that approximately 80% to 83% of the rated voltage is used with consequent reduction of the power consumption. Each tube filament is heated by its own transformer in its own single phase circuit in which a quadrature relationship is established between the two circuits (one for each tube) to effect cancellation of the modulation of the plate current caused by the hearing cycle of each filament. The filament hearing cycle is the second harmonic of the 60-cycle current. Protection for the filaments from injury resulting from the initial current flow when the filaments are cold is obtained by the high leakage reaction of the special filament transformers.

The single phase 230-volt primary power for each tube filament is obtained from a three-phase 208 sixty-cycle to two-phase 230-volt four-wire transformer. Each phase is coupled to a transtat or variable transformer which allows each filament voltage to be controlled manually by introducing a counter voltage into series transformer between the transtat and the primary of the individual tube transformer.

Each filament transformer secondary circuit is connected to its tube filament through a concentric one-inch copper line, the outer conductor serving as one feed line and the insulated inner conductor provides the other. Thus, one line is used for each tube. Suitable flexible braid connects the outer and inner to the tube connector chucks. This insures freedom from damage to tubes that might result from strain due to rigid connections.

The line for one tube is run parallel to the line for the other tube and tuned to a half-wave length of the operating frequency. This tuned half-wave length line serves two purposes. First it allows the filament transformer and associated equipment to be placed in a convenient position in the cubicle and clear of the r.f. fields; second, the filament line is tuned and grounded by means of capacitors at the point one-half wave length away from the filaments, thus reflecting a ground at the proper point, the electrical center of the filaments, which would be rather difficult to obtain if grounding were attempted at the filaments pins, due to the length of the filaments in the tubes and the spacing and lead length requirements encountered in operating at a frequency of 45.1 megacycles.

Protection of the tubes from damage due to filament power with insufficient water is provided by the water supply operated switches which remove all power under these conditions.

50 kw. Power Supply

The power supply system is unique in several respects. A maximum of operational flexibility is obtained which fulfills all requirements of FM broadcasting. While normal operation requires only thirty kilowatts of d.c. plate power, the power supply can deliver 90 kw. as an operating maximum. As described previously, all transformers, power contractors, and voltage regulators, as well as the filter choke, are located in the vault room of the penthouse. The rectifier cubicle with filter capacitors is located in the transmitter room adjacent to the power amplifier cubicle. This cubicle contains the three-phase full-wave rectifier. An extra preheat position is provided in the cubicle for a spare tube which is instantly available as a replacement for any rectifier tube failure. Adequate protection is provided in the a.c. and d.c. circuits by breakers for overload and primary power failure as well as interlock and personal protective devices. In operation a timing relay provides for proper warm-up of 881's filaments before high voltage can be applied.

High voltage controls are conveniently located in the front of the 881 cubicle, and after the filaments have been heated sufficiently and high voltage is to be applied to the power amplifier the high-voltage switch energizes a step contractor circuit which applies power in two steps; the first step connects the three-phase 208 V power through heavy protective resistors which minimizes the initial surge, and the second step cuts out the resistors and establishes direct connections to the voltage regulator. An automatic control circuit associated with the voltage regulator causes the regulator to return to minimum voltage position at any time power is removed, insuring that a minimum voltage only will be applied to the the primaries of the plate power supply transformer, following any kind of interruption to power.

Plate voltage is controlled either manually or automatically from the transmitter room by means of the motor-operated voltage regulator. Plate power then is continuously variable from the minimum position through the normal operating point. Normally, power is slowly raised by closing the manually-controlled raising circuit till the operating point is reached and then transferred to automatic control position which maintains proper voltage. If an interrup-

tion occurs, the breakers circuit removes high voltage, the voltage regulator goes to minimum position and plate power is reapplied. The voltage is slowly raised automatically from minimum back to the operating voltage.

Power Output

A variable coupling unit consisting of a "U" shaped open loop is inductively coupled to the lower end of the plate tank circuit. Operated from the front panel, it is mounted in bearings set in the protruding ends of the inner conductors of the pair of four inch coaxial lines which connect to the main transmission lines. The outers are connected by copper bonding sleeves over the gas seals and the inners through the conductor of its respective insulator. These lead through conductors different in length by one-quarter wave length, allowing the balanced 1800 voltages induced onto the pickup unit and then causing a delay of 90° in one of the transmission lines so that the two lines serve as two phase transmissions with the voltages in quadrature instead of the usual balanced 180° relationship transmission line.

This was done for two reasons: First, the antenna system and element exicitation feed method developed by Zenith would allow the antenna system to be fed from any quadrature relation transmission line system instead of the usual balanced lines generally used; and second a much neater installation for the transmission line could be effected by having the lengths of the two lines differ. Obstructions in the ideal path between the transmitter output junction S and the point under the ceiling where the lines would be run in a verticle path through the ceiling and the roof of the building and the floor of the penthouse required that several bends in the horizontal plane and the vertical plane of lines be used. The effects in the characteristics of the transmission lines caused by the turns and bends were minimized both by making the turns as gradual as possible, and by the use of special compensating fixtures or junction boxes. The lines are run up to a point above the terminals of the transmitter and then disposed as nearly parallel as possible and suspended by cradle supports from the ceiling.

Moisture Protection of Transmission Lines and Coaxial Antenna Element Feeder

The entire system is protected from moisture that might collect across the spacer insulators in the transmission line and cause a breakdown and ruin the lines due to short circuits by charging and maintaining a pressure of approximately one pound per square inch of the entire transmission line system with dehydrated air.

An outlet of the building compressed air supply is connected to a pressure reduction valve. This connects into a commercial type refillable "torpedo" tube containing silica jel. This jel is changed frequently and periodically to insure maximum absorbtion of moisture at all times. A glass "U" tube filled with a moisture indicator and silica jel is connected between the torpedo tube and a mechanical strainer filter that connects through a check valve to a manifold where the dried air is conducted to the fitting on each of the transmission lines. Valves and pressure gauges allow checks for leakage and pressure indication on each line. Indicating agent changes color when moisture is present in the air.

The Antenna System and Phasing Network

At points adjacent to the position on the floor of the penthouse where the antenna supporting pole is based, the transmission lines are brought up through the floor and terminated in two adjacent circular shielded junction boxes. The boxes are grouped around the mast or pole and occupy the corners of an imaginary square around the pole. Boxes diagonal to each other contain the connections for the termination of feeder coaxial lines of the radiating elements of a panel array. The feeder lines run straight up the mast pole and are bonded at intervals along their lengths along with all other vertical feeder coaxials. An important feature is the method used to obtain proper phasing of each element by the phasing network in the protected penthouse. This requires no adjustment and allows the feeders to be run straight up the mast or pole to the proper points and eliminates all feeder transposition from bay to bay. The junction points along the feeders, where connection is made to the radiating arm from the inner conductor are shielded by a "T" connector, the two ends form part of the feeder coaxial line with the inner running through and the open end has inset insulator bushings through which the inner is connected to the arm.

It is the antenna system that allows a 50 kw. signal field strength or effective power of 50 kw. while the transmitter, capable of delivering 50 kw. to the antenna is only required to supply a fraction over 18 kw. to the antenna, effecting a great saving in operational expenses and contributing to greatly extended power amplifier tube life.

The turnstyle type of antenna with circular field pattern and power gain dependent upon the number of bays and the wide band characteristics is ideal for the requirements of very high frequency FM propagation. As used in the WWZR installation the undesirable mechanical and electrical features have been greatly minimized or dispensed with and the desired features used to greatest advantage. Lightning protection is assured by the fact that the entire system is grounded. Four bays or levels are used, and this allows a power gain of "2

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HERE'S a big brother to those super-value twins, the RCA-811 and RCA-812. Same rugged construction. Same high perveance, which means high output with economical, low plate voltage. And the 8005 is designed for even longer life than the 811 and the 812! Its hard-glass envelope provides exceptional durability under continuous operation. Its zirconium-coated molybdenum anode provides high heat-dissipation and excellent getter action.

The RCA-8005 is a medium-mu triode. It can be operated at full ratings up to 60 mc; at reduced ratings up to 100 mc.

Used in diathermy and industrial applications, the 8005 has proved highly dependable, and long-lived. As an output tube in medium power transmitters, or an intermediate stage in high power equipment, 8005 provides economy and stability.

Low driving power—only 8 watts—reduces the number of preceding stages needed, and facilitates quick band change.

Today the 8005 is at work in a variety of war jobs. We'll gladly consult with you now about your immediate requirements. Write to RCA at Harrison, N. J., or see your RCA Tube and Equipment Distributor.

You will find more complete data on the RCA-8005 in your RCA Transmitting Tube Guide, or send for free "data sheet RCA-8005." RCA, 718 So. Fifth St., Harrison, N. J.

Technical Data

Fil. Volts.....10 Fil. Amp.....3.25
Amplification Factor.....20
Max. Overall Length, Inches.....6 11/16
Bulb.....ST-19 RCA Socket.....UR-542-A
Base.....Medium Metal 4-Pin, Bayonet

MAX. RATINGS—CLASS C TELEGRAPH

	Continuous (CCS)	Intermittent (ICAS)
D-C Plate Volts	1250	1500
D-C Grid Volts	—200	—200
D-C Plate Milliamperes	200	200
D-C Grid Milliamperes	45	45
Plate Input, Watts	240	300
Plate Dissipation, Watts	75	85

Typical Power Output: Continuous Commercial Service, 170 Watts; Intermittent Service, 220 Watts.

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and 7" compared with a basic one half wave length antenna.

In accordance with established standards, horizontal polarization is used.

Each bay is one-half-wave length above the other, and is made up of four folded one-half wave length arms making each arm one-quarter wave length long. One end of the arm is grounded at the pole, the other connected to the feeder line. In shielded connection junction "Ts" the four arms extended out radial from the pole with the angle of 90° between adjacent arms. Opposite arms make up the element of the panel. One panel is the NE-SW the other panel is NW-SE or combination of elements. A panel is the plane the elements or a combination of elements make in the array. All the arms in one plane make up the panel.

—30—

Book Review

(*Continued from page* 48)

sult that the real beginner finds the presentation too difficult from the start.

The first part of the book deals with the definition of the terms encountered in the book, the sources of electro motive force and Ohm's law. Later chapters cover the construction, operation and explanation of various components found in radio. The mathematics of the text is limited to arithmetic and logarithm tables. Problems are included at the end of each chapter to enable the student to check his grasp of the subject matter included. The correct numerical answers are given in the appendix.

RADIOMAN'S GUIDE, by Edwin P. Anderson. Published by *T. Audel and Company,* 49 West 23rd Street, New York City. 880 pages. Price $2.00.

In this latest edition of Audel's manual for radiomen, the theory, construction and servicing of radio, as well as television and other allied electronic equipment, has been presented.

This book has been written as a self-study text and covers the many problems and questions which arise in the course of radio studies. In order to provide up-to-date data on marine and aircraft radio and servicing, new chapters covering these specialized fields have been added to the material included in earlier editions.

Of particular value are the complete appendices included in this book. The Underwriters' Standards, tables of abbreviations and symbols, standard radio code and other information is given in handy form for ready reference.

The book is printed in large and clear type and is of manual-size to permit easy carrying for ready reference. The radio student and radio serviceman alike will find much valuable data which will be of interest and instruction in this text.

—30—

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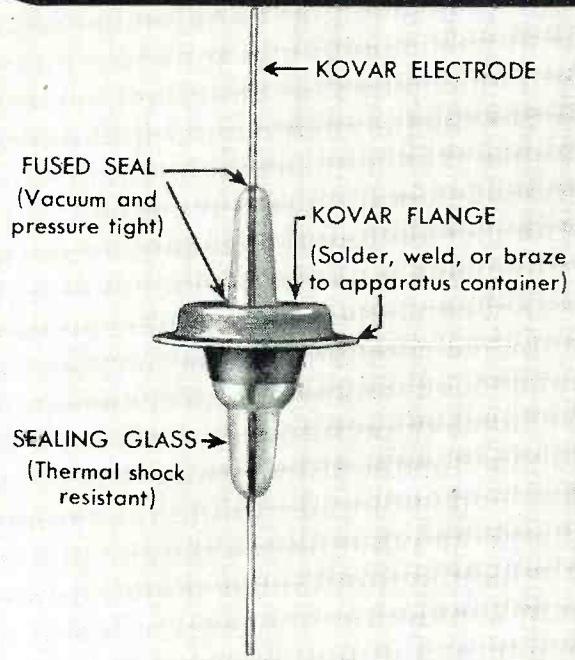

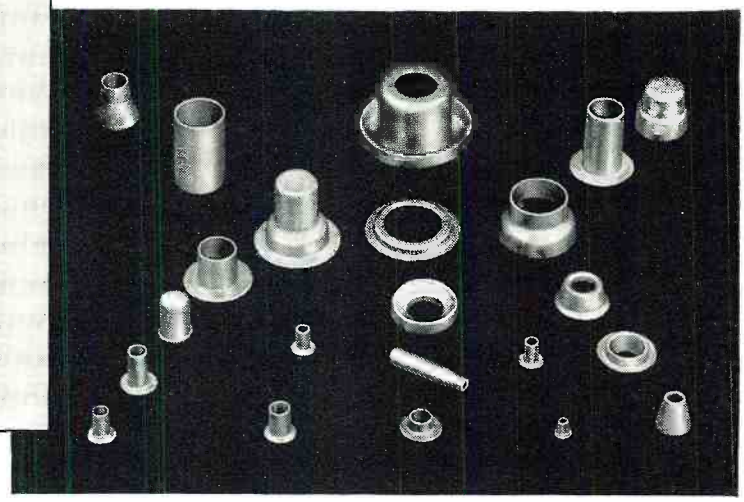

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Antenna Mast

(*Continued from page* 31)

tennas can conveniently be mounted on opposite ends of the crossarm. Where more than two channels are required, a double crossarm can be furnished with members at right angles to each other (see Fig. 6). By using this double crossarm, four separate vertical dipoles may be mounted on a single mast. At frequencies above 80 megacycles, dipoles mounted at the ends of the 12-foot crossarm will be sufficiently distant from the mast proper and from the guy wires so that their effect on the radiation pattern becomes negligible. If vertical dipoles are used at lower frequencies, it may become necessary to extend the crossarm and break up the guy lines with strain insulators. Many modifications of the single-element vertical dipole, e.g., folded dipole, J-antenna, coaxial antenna, may also be mounted directly at the ends of the crossarm.

Advantage of Antenna Arrays

In the v.h.f. and u.h.f. frequencies, the reduction in the size of antennas invites the use of antenna arrays with corresponding power gains in desired directions. Directive arrays may consist of a group of driven elements, a single driven element with parasitic reflector and/or director, or a combination of both driven and parasitic elements. With receiving antennas in the v.h.f. and u.h.f. range, arrays are particularly important due to the property of antennas of absorbing energy from only that portion of the wave front in close proximity to the antenna. As the antenna becomes smaller with higher frequencies, it becomes increasingly difficult for it to absorb sufficient energy to overcome noise unless an array is used. Where the noise or interference is coming from one direction, it can largely be eliminated by rotating the array so that the field pattern shows a null in the direction of the noise. With the proper combination of driven and parasitic elements, a field strength increase in the desired direction by a factor of 100 over the field strength of a single dipole is not uncommon.

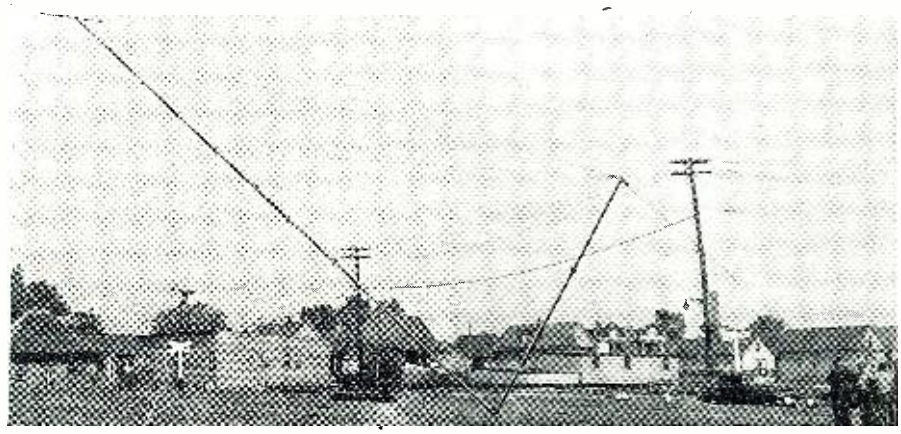
Directive Arrays with Vertical Dipoles

Simple modifications of the antenna crossarm permit a large variety of vertical arrays with either driven or parasitic elements, or a combination of both. At frequencies below 100 mc., collinear arrays of vertical dipoles, which will bring about low angle radiation, may prove impractical due to the great height required. At frequencies above 100 mc., they can easily be affixed to the ends of the crossarm by means of an auxiliary wooden shaft. Broadside arrays of driven parallel elements, which have maximum radiation broadside to the plane of the antennas when fed in phase, and along the line of the antennas when fed out of phase —may simply be mounted by attaching perpendicularly to the ends of the crossarm an auxiliary arm to which the elements can be attached (Fig. 5).

This method of providing directivity is especially effective, inasmuch as the crossarm can be rotated and fixed in any position, so that the direction of maximum radiation may be changed at will. With infrequent changes in direction, it will prove most practical to lower the mast whenever the crossarm is to be rotated. For frequent changes, the crossarm clamp may be left loose, and the crossarm rotated and held in place by ropes to the ground from both ends. Parasitic elements may be mounted on an auxiliary right-angle arm similar to the one described above for mounting the broadside array of driven elements (see Fig. 5). Judicious use of these parasitic elements will produce maximum radiation in one direction along the line of the antennas. By making the mounting bracket of the directors and reflectors adjustable to any distance from the driven element, a very flexible system will result which can be used over a range of frequencies.

The "ground-plane" antenna is one in which the driven element is vertical and the parasitic elements are horizontal, spaced radially about the axis of the dipole at its center. An antenna of this type may be mounted directly on

Fig. 7. Raising the complete antenna mast is a simple operation. The entire mast can be assembled and erected by five men in approximately one hour.



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the ends of the crossarm. It is effective in providing low angle radiation so desirable in ground to ground communication (as distinguished from ground to airplane communication) at v.h.f. and u.h.f. frequencies.

Horizontal Dipoles and Arrays

Commercial FM and television utilize horizontally polarized waves for most broadcasting functions. Some of the reasons which have been advanced for using this type of polarization are:

1. There is less reflection from buildings in urban areas.
2. There is less interference from man-made noises.
3. Arrays of horizontal dipoles are easier to construct.

A single element horizontal dipole is slightly directive in itself, having maximum radiation in a broadside direction. This directivity may be increased by using a long wave antenna, or a collinear array of dipoles. Parasitic elements tend to concentrate the radiation broadside in one direction.

In addition to directivity in a horizontal plane, maximum vertical radiation at low angle is a most desirable feature for antennas in the v.h.f. and u.h.f. frequency ranges. This effect may be achieved with a broadside array of horizontal dipoles stacked one above one other. In commercial FM and television, uniform radiation in a horizontal direction is often also desirable, so that points in all directions may be served equally well. This uniform horizontal radiation pattern may be produced by crossing two horizontal dipoles perpendicularly at their centers, which combination of dipoles is known as the "turnstile" antenna. A stacked array of "turnstile" antennas will serve two desirable functions, both concentrating the radiation in a horizontal plane and distributing it uniformly in all directions along this plane.

Horizontal dipoles may be mounted directly at right angles to the crossarm. At the lower frequencies, these dipoles, unless made out of rigid tubing, may need auxiliary support in a horizontal plane. Parasite elements may be mounted in a manner similar to the dipoles. Inasmuch as the crossarm may be rotated in any direction, the directivity of such an array may be changed at will. A stacked broadside array may be mounted by using an auxiliary vertical shaft affixed to the crossarm. For "turnstile" arrays, however, as with other special horizontal arrays, it may prove most expedient to dispense with the crossarm and make the mounting an integral part of the array.

—30—

Saga of the Vacuum Tube

(*Continued from page* 54)

three-contact socket, and had a machined fiber base. The grid was of fine tungsten wire wound on a glass frame. The plates were of sheet tungsten. Subsequently, these tubes were made with the later standard four-point base and one of this variety, using a metal base, is shown in Fig. 143. These tubes were also provided with an adapter which enabled them to be used in the candelbra socket which was characteristic of previously made Audions. The "CF-185" tubes were the first to be made by de Forest using oxide-coated filaments and were claimed to have a life of 5000 hours at a filament current of 0.85 ampere.[170]

It will be remembered that when de Forest sold the rights to the Audion to the A. T. & T. Company he retained a personal, non-transferable right to make and sell Audions for radio use. This he continued to do. In 1914 the Marconi Wireless Telegraph Company of America, owners of the United States Patent on the Fleming Valve, instituted suit against de Forest and the de Forest Radio Telephone and Telegraph Company, claiming that the de Forest Audion was an infringement on the Fleming patent. De Forest promptly filed a countersuit claiming infringement of his patents by the Marconi Company. Before the cases came to trial the Marconi Company confessed judgement as to its infringement of the de Forest patent and were enjoined from further infringement. The case against de Forest, which will be discussed in a later article, was tried and the decision of the Circuit Court was filed on September 20, 1916.[171] This decision was later upheld by the Circuit Court of Appeals.[172]

"Oh hello, is that you, Mert?"

The decision held that the Fleming patent had been infringed and an injunction was issued restraining de Forest from further manufacture and sale of Audions for radio use. This produced a stalemate. De Forest could not make Audions because they infringed the Fleming patent. The Marconi Company could not make Audions because that would infringe the de Forest patent. They could make Fleming Valves, but that was not what they wanted.

During World War I de Forest made Audions for the U. S. Government under guarantee of immunity. After the War the Marconi Company sued the U. S. Government because of the infringements, and this suit was decided only last year. The decision of the United States Supreme Court, handed down on June 21, 1943,[173] held that the Fleming patent had not been infringed, and that the patent itself was void, thus, in effect, reversing the decisions rendered back in 1916 by the Circuit Court and confirmed by the Circuit Court of Appeals.

After the war the injunctions again became operative and the stalemate was restored. It was broken early in May, 1919,[174] when representatives of de Forest and Marconi met with a West Coast manufacturer named O. B. Moorhead. Moorhead had been making and selling "Electron Relays" before the war and was ready to engage in the manufacture of tubes. The conference resulted in de Forest joining forces with Moorhead, in order to permit them to use de Forest's personal license to manufacture Audions, and in the Marconi Company's extending their patent rights to the combination for the manufacture and sale of receiving tubes. The Marconi Company was made the distributing agent for the combination. Two distributing companies were organized. The Pacific Radio Supplies Company had the West Coast territory and the Atlantic Radio Supplies Company covered the eastern part of the United States.

The first tubes put out by this combination were the unbased Moorhead Electron Relay and the Moorhead VT Amplifier.[175] This latter was a high-vacuum tube which had been made by Moorhead during the war and sold to the U. S. Navy under the designation "SE-1444."[176]

The unbased Electron Relay was soon abandoned in favor of a based tube[177] which was also called the "Moorhead Electron Relay." The base was the so-called "Shaw Standard"[178] and was used on the SE-1444 and the Moorhead VT Amplifier as well.

The Marconi Company, in advertising the hard tube, designated it as the "Marconi VT." This tube bore the de Forest and Marconi markings on the brass base, in depressed characters, and the Moorhead markings etched on the glass bulb. The life was claimed as 1500 hours.[179] The glass of some of these tubes had a golden tinge, and the tube was familiarly known as the "Golden VT." It operated with a fila-

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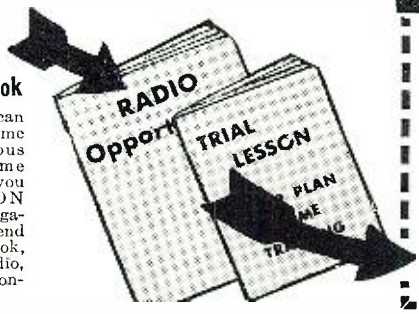

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ment current of 0.7 ampere at about 4 volts.[180]

The tubes made and sold by this organization were the only receiving tubes legally available to the public until the foundation of the Radio Corporation of America.

A short time later the "Electron Relay" was replaced by the "De Forest Type 20" detector. This was at first advertised[181] as a "soft" tube, and is shown at the left in Fig. 144. Later it was apparently made as a hard vacuum tube since the variant at the right in Fig. 144 has a getter.

After World War I de Forest began to develop the higher power Oscillions. This he could do because the injunction applied only to receiving tubes. Two of the postwar Oscillions are shown in Fig. 145. The tube at the left is of 250 watts *input* rating and that at the right is 500 watts *input* rating. Fig. 146 shows a transmitter made by the de Forest Company using two of these "500-watt" tubes. Later models of these tubes are shown in Fig. 147.[182] These later models, as will be seen from the figure, were provided with end fittings to facilitate mounting and connecting into the circuit. They appeared on the market about 1920. In addition to those shown there was also made a 1000-watt *input* tube of similar construction.

With the advent of broadcasting the market for receiving tubes expanded enormously and the demand became huge. The Fleming patent expired in 1922 and its expiration left the de Forest Company free to manufacture Audions for radio use. Some time later the De Forest Radio Telephone and Telegraph Company underwent a reorganization and became the De Forest Radio Company. The new company proceeded to put out a line of vacuum tubes for the broadcast receiving set market.[183] They also made transmitting tubes, one of which, designated as the "Type H" and intended for amateur use, is shown in Fig. 148. This tube was rated at 150 watts *input* and operated at plate voltages from 500 to 3000 volts.[184] There was also a rectifier version of this tube known as the "Type HR."[185]

De Forest's interest in the newly reorganized company was a nominal one, and he began the pursuit of other goals, notably in the sound motion picture field.

The development of the hard vacuum tube occurred almost simultaneously in the laboratories of both the Western Electric Company and the General Electric Company. The work of the Western Electric Company has been covered in previous installments. In our next article we will discuss the evolution of this type of tube in the laboratories of the General Electric Company.

References

168. *Lubell, Samuel*—"*A Magnificent Failure.*" *Saturday Evening Post, Vol.* 214, *No.* 31, *January* 31, 1942, *page* 27.

169. *de Forest, Dr. Lee*—"*Audion Bulbs as Producers of Musical Tones.*" *Electrical Experimenter, Vol.* 3, *No.* 8, *December* 1915, *page* 394.

170. *Kahn, Bernard*—"*Navy Type Audion Detector.*" *QST, Vol.* 1, *No.* 12, *November* 1916, *page* 335.

171. 236 *Federal Reporter* 942.

172. 243 *Federal Reporter* 560.

173. *Marconi Wireless Telegraph Company of America vs. U. S. Government, No.* 369, *United States vs. Marconi Wireless Telegraph Company of America, No.* 373, *Opinions of the U. S. Supreme Court, Vol.* 87, *No.* 18, *pages* 1296-1337.

174. *Radio Amateur News, Vol.* 1, *No.* 2, *August* 1919, *page* 77.

175. *Pacific Radio News, Vol.* 1, *No.* 10, *May* 1920, *inside back cover.*

176. *Moorhead, O. B. and Lange, E. C.*—"*The Specifications and Characteristics of Moorhead Vacuum Valves.*" *Proceedings I. R. E., Vol.* 9, *No.* 2, *April* 1921, *pages* 95-129. *Paper presented at San Francisco Section on November* 19, 1919.

177. *Pacific Radio Supplies Company advertisement in Pacific Radio News, Vol.* 1, *No.* 11, *June* 1920, *inside back cover.*

178. *U. S. Patent* 1,458,153.

179. *Marconi Wireless Telegraph Company of America advertisement in Radio Amateur News, Vol.* 1, *No.* 2, *August* 1919, *page* 52.

180. "*The Marconi VT.*" *Wireless Age, August* 1919, *pages* 33-34.

181. *Pacific Radio Supplies Company advertisement in Radio Amateur News, Vol.* 1, *No.* 11, *May* 1920, *page* 606.

182. *Catalog No.* 101, *Lee de Forest, Inc., San Francisco, Cal.*

183. *Radio Broadcast, September* 1923, "*Advertiser Section.*"

184. *De Forest Radio Company advertisement in QST, Vol.* 10, *No.* 8, *August* 1926, *page* 77.

185. *De Forest Radio Company advertisement in QST, Vol.* 10, *No.* 12, *December* 1926, *page* 99.

CAPTIONS FOR ILLUSTRATIONS

Fig. 135. "Type S Oscillion." Reproduced from page 920 of April, 1917 Electrical Experimenter.

Fig. 136. Early "Singer" type Audion with candelbra base. Tube loaned for this photograph by Robert F. Gowen.

Fig. 137. Later version of "Singer" type Audion.

Fig. 138. Front view of rectifier tube of Singer type.

Fig. 139. Early type of Oscillion Aircraft Transmitter, held by Dr. de Forest. Photograph courtesy of Robert F. Gowen.

Fig. 140. High power Oscillion (250 watts), vintage of 1915.

Fig. 141. Improved form of spherical Audion detector, with glass arbors to promote rigidity of elements.

Fig. 142. "Type T" Audions. Left—with paper label. Right—turned to show "DF" stamped on plate.

Fig. 143. "Type CF-185" with four-point base and socket.

Fig. 144. De Forest "Type 20." Left—early type of soft tube. Right—later tube with magnesium flash.

Fig. 145. 250 watt input and 500 watt input Oscillions—front view.

Fig. 146. Oscillion Transmitter "Type OT-200" using 2500 watt input Oscillions. Photograph courtesy Robert F. Gowen.

Fig. 147. 250 watt input and 500 watt input Oscillions—vintage of 1920—with end fittings. Photograph courtesy Robert F. Gowen.

Fig. 148. De Forest "Type H" short wave transmitting tube—vintage of 1926.

(To be continued)

Conquering Mixed Code

(*Continued from page* 51)

we use groups made of two letters, one number and one letter, the letters themselves spelling easy words, insofar as possible. As in the previous test, the numbers provide stumbling blocks. Do not expect too much at first run of this code test; it is the most difficult we have yet tried.

AG1E BE2E CO3T DI4M ER5G
FI6N GO7B HU8M IS9M JA0M
KE1Y LA2G MO3E NA4N OI5L
PU6N QU7E RE8D SU9N TO0O
US1A VO2W WE3N XA4N YO5U
ZO6O AN7D BU8G CA9D DI0D
EG1O FA2N GA3G HO4D IR5E
JO6E KE7N LI8P MI9N NI0L
ON1E PU2T QU3O RI4P SK5Y
TI6N UN7I VA8T WO9E XA0K
YE1A ZO2E

Considerable time will have to be put in on this last material before the student makes a solid copy, and there is no substitute for the hard work and patience required to put this test in the "can do" category.

When it has been conquered, we have one more type of group which, by this time, should be easy compared to the earlier struggles and first attempts. Four short tests are given for practice, to be used one at a time at first; finally to be added into one long practice test. The very common errors of confusing 2 and 3, as well as hesitation in differentiating between 7, 8 and Z should be carefully guarded against. J and 1 are often trouble makers when they are in the same group. Logically, the combinations that prove most difficult should be given the hardest workout until they are licked.

One Letter and Two Numbers

A12 B23 C34 D45 E56 F67 G78
H89 I90 J09 K89 L78 M67 N56
O45 P34 Q23 R12 S01 T11 U22
V33 W44 X55 Y66 Z77 A88 B99
C00 ?X?

Two Numbers and One Letter

12A 23B 34C 45D 56E 67F 78G 89H
90I 09J 89K 78L 67M 56N 45O 34P
23Q 12R 01S 11T 22U 33V 44W 55X
66Y 77Z 88A 99B 00C ?X?

One Number, One Letter, and One Number

1A2 2B3 3C4 4D5 5E6 6F7 7G8 8H9
9I0 0J1 1K2 2L3 3M4 4N5 5O6 6P7
7Q8 8R9 9S0 0T1 1U2 2V3 3W4 4X5
5Y6 6Z7 7A8 8B9 9C0 ?Z?

Reverse of Above Test

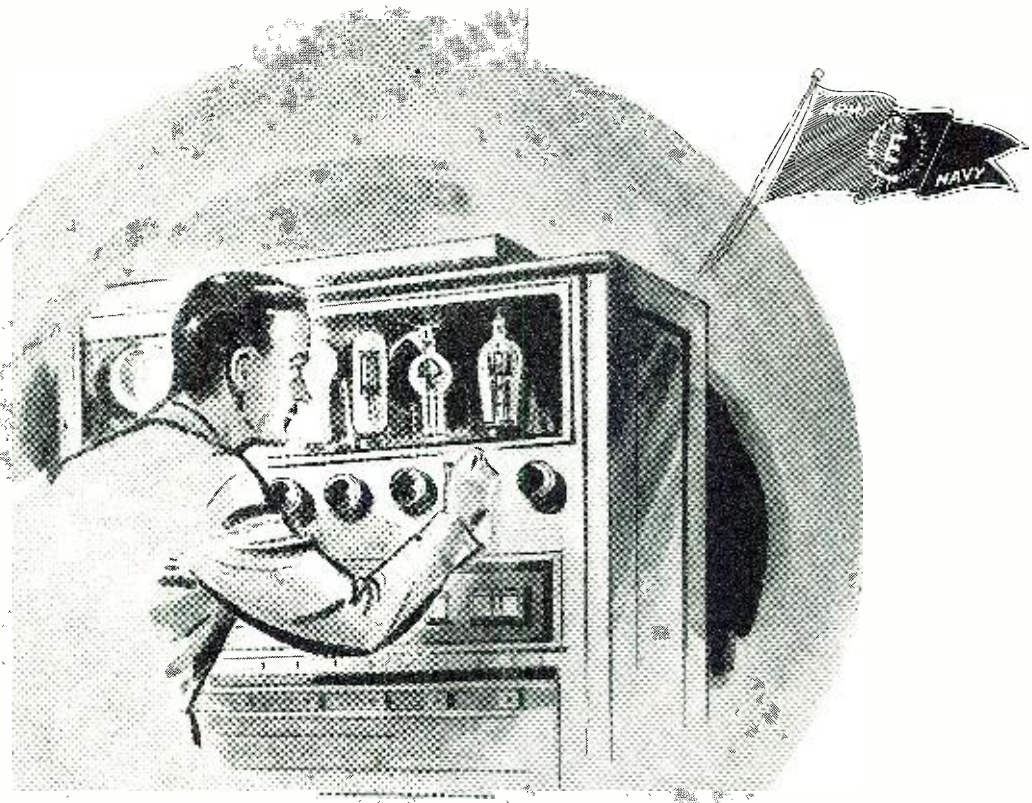
2A1 3B2 4C3 5D4 6E5 7F6 8G7 9H8
0I9 1J0 2K1 3L2 4M3 5N4 6O5 7P6
8Q7 9R8 0S9 1T0 2U1 3V2 4W3 5X4
6Y5 7Z6 8A7 9B8 0C9 ?Z?

When you copy code, endeavor to put down the characters in groups exactly as they are sent, in neat groups and not as a series of isolated characters. When code is sent in groups it is to be copied in groups and you must not expect the Radio Inspector to tie up your isolated letters or figures into the proper grouping if you have made a copy "a la spaghetti" fashion. If you have copied only isolated characters instead of grouping the letters and numbers correctly and happen to leave out a single character, it is a very difficult task to pick up the following characters in proper order. Whoever checks your copy will have to probe around until he picks up a group that is correct, and then start the fatal count of "16 groups" from that point. Non-grouping of code words in a test is no more logical than would be the copying of a weather or press dispatch wherein the operator merely put down disconnected letters and left it up to the reader to put the letters together into words. If the man who cannot copy groups will practice it a bit at slower speed he will find it not too difficult. One easy way to start is to use standard typing paper for copy paper. Fold the sheet lengthwise, fold it again, and when you unfold you can use the creases as lines to guide your groups. Always copy your groups across the page, never up and down in columns or the examiner may get lost when he checks your copy. For the average writer, four groups across the sheet will give good separation and spacing. Writing or printing of uncertain quality is more easily deciphered if it is well spaced.

The law demands that your copy be legible if you are to obtain a license, so it behooves you to cross your T and X and leave airholes in your L and E if you wish them to be recognized as such. It is not sufficient that you be able to read your copy, it must be legible enough for anyone to read it, so if your writing is not up to par it might be well to get busy on it while time permits.

When accuracy has been reasonably well attained on the previous tests at moderate speed, it may be well to check the speed accurately, and for this purpose the sending machine or instructor should use a word that complies with the requirements of a standard word in radio communications. Using an automatic standard transmitter in commercial service, 24 puller holes are accepted as the length of a standard word. The words "FRANK" or "JAPES" will be found acceptable as standard, and the number of times they are sent in one minute will be the speed per minute. It will be easily understood why transmission should be checked by such standard before the actual code is transmitted. A code group such as ZYCJO or 00Z takes a lot more time to send than TEISH or 55E and if transmission were checked by variable type of code groups, an erroneous idea of speed might result.

The auto transmitter at the Radio Inspector's office is equipped with a speedometer that registers machine speed visually and it is very accurate. On two occasions, in different cities it was the author's privilege to watch the Radio Inspector check machine speed against a standard word tape. On both tests the speed checked right on the button. This is mentioned only



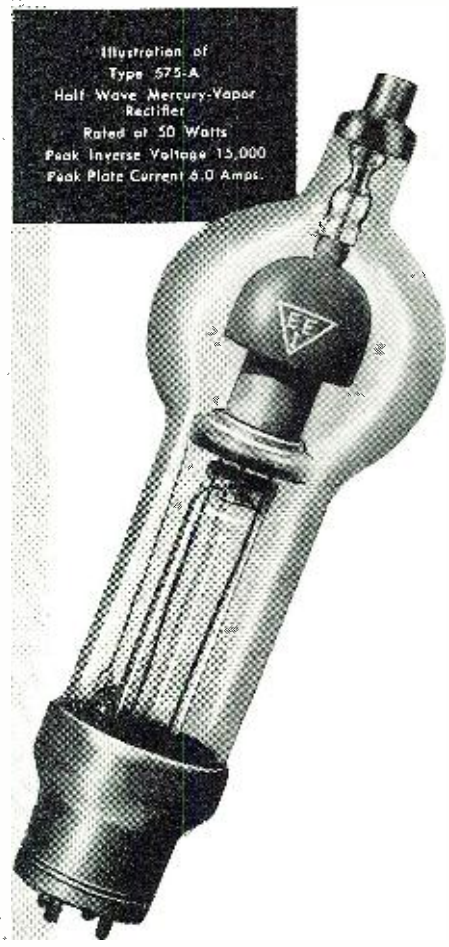
E-E Rectifiers

. . . SUPERIORITY via SPECIALIZATION!

E-E engineering efforts have been channelized toward optimum design in power rectifier and transmitting tubes. Such specialization has culminated in original tube structures of unusual ruggedness with highly desirable operating characteristics. The 575-A heavy duty vapor rectifier typifies these advantages. Two of these tubes connected full wave are capable of handling 5,300 volts (rms) per tube and delivering 3 amps. D. C. Peak inverse voltage is 15,000 volts (rms). Despite its high power rating the filament consumption of this rectifier is surprisingly low. Internal drop is but 10 volts.

Their long life and stability have been proven in combat service throughout the world . . . attesting to the resourcefulness of E-E engineering.

For complete information write today—without obligation.



ELECTRONIC ENTERPRISES, INC.

GENERAL OFFICES: 65-67 SEVENTH AVENUE, NEWARK, 4, N. J.

EXPORT DIVISION: 25 WARREN STREET, NEW YORK, 7, NEW YORK

CABLE ADDRESS: SIMONTRICE NEWYORK

ELECTRONIC ENTERPRISES

because frequently men who missed out on the mixed code test have protested loudly to their colleagues, "That test was run at nearly thirty words per minute." Obviously, if they were good enough to pass there would not have been such vehement protest. It is unfortunate, but true, that many inexperienced code men have an inflated idea of their receiving ability, mainly because no one ever made them get down to brass tacks and prove their ability by receiving an accurately clocked test. Deflation of ego is painful but necessary when both speed and accuracy are paramount objects in code.

Let us set our transmission speed to 16 "FRANK" or "JAPES" per minute and try the following test, which includes a great deal of what has gone before, plus some other wicked groups. It will not be too easy this time.

QXZYJ VBG3 HOLRN 7ZLQ
ZRKLF XCS5 JOHNY 27U
8QLD CRYHK BVGAI WETOC
BFJ1 WTKUA 3VHQ VGBHX
VCU9 RADIU 98Z, 2CXN
PLZXA OIQWR PJOYD CXZ4
BOBBY 9CRX LKJFM NWM7
QPUZS H81 6ZXJ PAPPY
HANKW 23Z ?E? BLA8
XC3R XCHNJ 1XRE PLOIF
95X CVA4 LKGRW DEBES
S96 B72 9UKE X6FQ
VBNMY JDS9 PDSAJ 5X9
DB7Q ZONAH DYGMN 31J
N99 7ORA N5AT SOLAX
WRY2 QWOTU 8M3 XDA4
PLQWU MAGEY 52M Z17
3HKL W7OV ZIPRO ZS1M
KQLZU A67 RP9T ZORAF
MAQRW 12X P24 E?EE
C3UV GLOMX D4GU VADMO
U81 PJ3N BOGRL ZRSTU
Y71 D92 ZX3V QKD8
PWONT C5LW QWGXA N91
J1MO LTYCW FINIS

It may be a long time before a perfect copy is made from such a test, but it can be done. If a speed of 16 groups per minute is over the student's head, the speed should be reduced to that value where a fair copy can be made. Nothing is gained by an excess speed, if guessing at characters begins and accuracy falls off tremendously. If the student can attain a perfect copy at 16 groups, the speed should be increased to 18 groups per minute. This advance of two groups per minute seems very slight, yet proves an alarming increase to the average beginner on mixed code, whereas it would not probably bother him on plain language where he has the assistance of context and can guess right most of the time if he is following the material intently.

Copying behind on mixed code is not recommended for the beginner, at least not more than a character behind, for a difficult group may trip up the receiver and he may lose all that he was holding in memory if he attempts to retain too much before he puts it down. Every attempt should be made to develop reserve speed, once accuracy has been attained. The average code man must discount a large portion of his normal receiving ability when he sits for the test at the Radio Inspector's, and his nerves may be a bit jumpy. This reaction is normal with most people under strain and it is no disgrace to any radio man to be nervous during such a test. If you can mesh your mental gears to this nervousness you may be able to utilize the surplus energy in recognizing characters faster and be able to put them down more easily. It is suggested that a student attain at least 30 consecutive groups in every 90 group test sent at 18 groups per minute before he sits for license examination. This will give him fair leeway and reserve, but a copy of 45 consecutive groups would be playing safer and his chances of passing will be a lot better.

Perfection in mixed code receiving means more than just obtaining a radiotelegraph license, it means that the holder of such a license will prove valuable to "Uncle Sam" when he enters the Armed Forces or Merchant Marine as so many patriotic young men are doing daily. The difficult A7Z or 5HSI that he stumbled over yesterday may be part of an important military message tomorrow, and instead of being just a pencil twister, may be the coded address of a General or Admiral, a task force, an air base, a battle-wagon or a submarine, GHQ or a collective call for other units. Accuracy will be of paramount importance on land, sea and in the air; the effort spent in attaining it will be well rewarded some day when we can take the seals off our transmitters, turn on the juice and open up on the free ether of a free earth.

—30—

International Short-Wave

(*Continued from page* 44)

12 midnight, 2:30 a.m., and 5:30 a.m. JZJ (11.80) and JLG2 (9.505), are heard 3:15 p.m.-6:30 p.m.; news in English at 3:15 p.m. and 6:00 p.m. (the last is directed to East Coast). JZJ (11.80) and JZI (9.535), are heard 6:00 a.m.-7:45 a.m., radiating to East Coast listeners, with news in English on the hour.

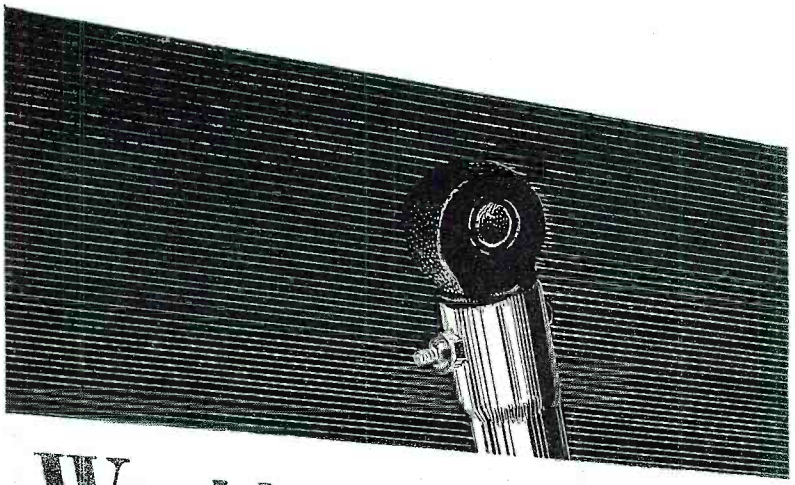
Shonan (Singapore) (9.555), heard irregularly to 11:00 a.m.; English news at 3:30 a.m. and 10:15 a.m.

Manila, PIAM (9.64 and 6.14), 1:00 a.m.-6:30 a.m.; English news at 6:00 a.m.

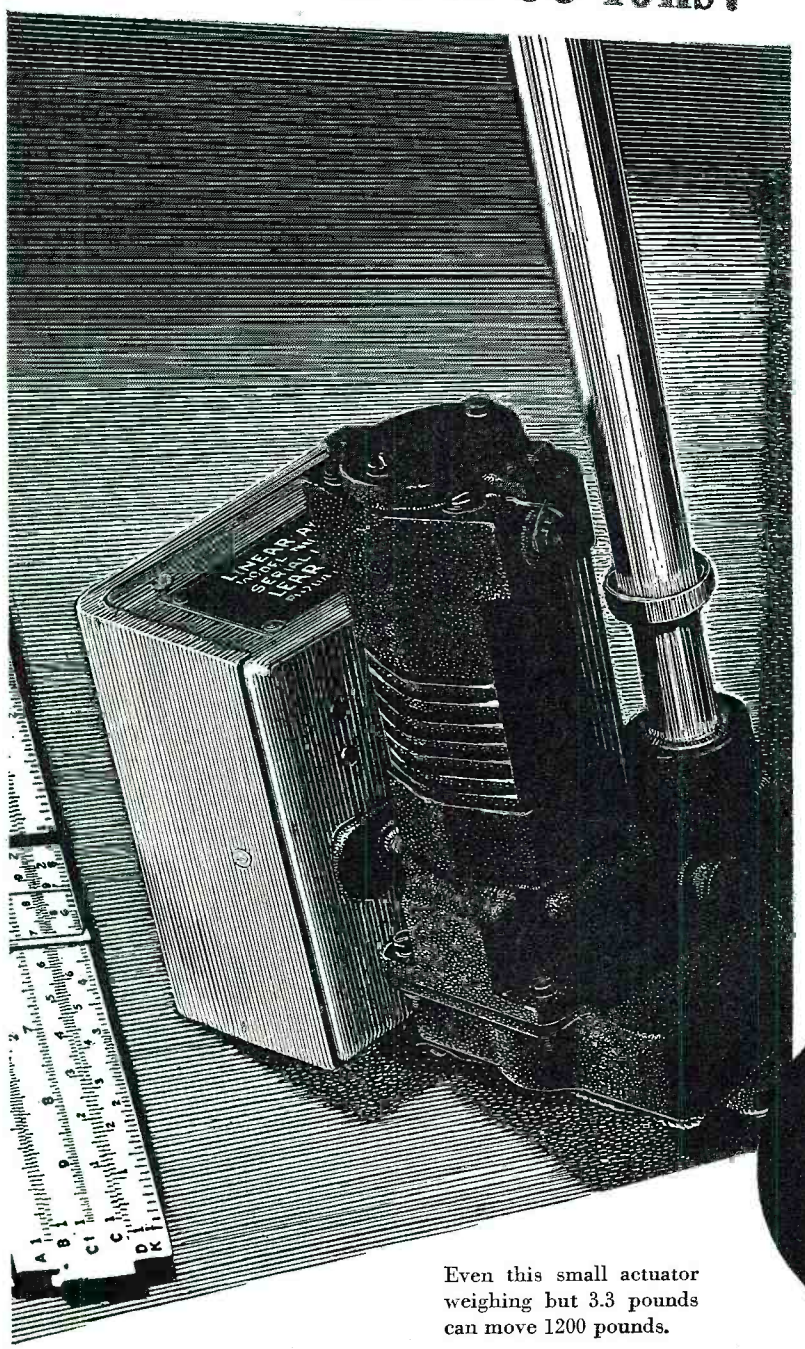
Melbourne, VLG4 (11.84), has English news at 1:00 a.m.; also carried at same time on VL14 (7.22). VLG (9.58), is heard 7:15 a.m. to 8:00 a.m., radiating to Asia; English news, 7:15 a.m.

Perth, VLW3 (11.83), has English news at 1:00 a.m., and its schedule is from midnight to 4:00 a.m. VLW6 (9.68), is on the air 4:00-8:00 a.m., with newscast at 4:00 a.m. (seldom heard now).

Capetown (5.88), 8:45 p.m.-10:30 p.m., except Saturday.



Want to move 35 Tons?



Even this small actuator weighing but 3.3 pounds can move 1200 pounds.

WE wouldn't tell you how fast America's fighting planes go. That's a military secret.

But we've all read it's well over 300 miles an hour.

We've read too how they hit 700 or 800 miles an hour in dives. And how paint was peeled by the air pressure.

Did you ever stop to think that the plane's flaps and controls have to work surely, smoothly and dependably against pressures like that?

It's done by such mechanisms as you see in the picture.

They are called Lear Actuators.

They are powerful. Some can push up to 75,000 pounds.

They are light. That's a "must" in aircraft.

They are small. They have to fit in available space.

A good many preconceived notions had to go by the board to meet all these requirements. For example, the little electric motor that runs them is full of revolutionary engineering refinements.

Every man and every minute we have now can't make all the motors and actuators that we would like to deliver for Uncle Sam's aircraft.

But the day is coming when they will have different jobs to do. New jobs on peacetime products—perhaps like steering ocean liners, or parking cars, or things we've never thought of.

That is one reason for this advertisement. We want to know who can use an actuator or a motor like these.

Another reason is, we want you to know that there is available the kind of thinking and engineering which have produced these and some 250 other Lear products.

LEAR AVIA INC.
PIQUA · OHIO

Peiping, China, XGAP (6.105), is on 1:00 a.m.-8:50 a.m. (no English).

Hongkong, JZHA (9.47), heard irregularly to 6:40 a.m., with news in English at 6:00 a.m.

Madagascar, Tananarive (6.17), is heard 8:00 a.m.-9:00 a.m. (in French only).

Djarkarta, Jaca, is heard 6:00 p.m. to 7:30 p.m. on 18.13.

Saigon, Indo-China, "Radio Saigon," is heard from 2:00 a.m. to 8:30 a.m., with news in English at 7:00 a.m. and 7:45 a.m.

Hsinking, Manchukuo (11.775), is heard 10:00 p.m.-12:00 midnight, with news at 10:30 p.m. and 11:30 p.m. From 6:00 a.m. to 8:00 a.m. this station radiates on 6.12, with news in English at 6:30 a.m.

Chungking, XGOA (5.98), is heard 4:00 a.m.-10:00 a.m., with news at 7:00 a.m. XGOY (6.05), is on from 4.35 a.m. to 9:30 a.m., with news in English at 7:00 a.m.

Khabarosvk, U.S.S.R. (5.94), is heard between 10:00 p.m. and 7:00 a.m.

Komsomolsk, U.S.S.R. (9.565), is heard 7:00 p.m.-9:30 p.m., and 12:00 midnight-6:30 a.m.

* * *

NEWS OF PRISONERS INTERNED IN MALAYA

The transmission for North America from Shonan (Singapore) on 9.555 megs. is being heard very well each morning in the Eastern United States. The station comes on at 6:00 a.m. (EWT), woman anouncer. News from the capitals of the world is given until approximately 6:20, by a man; then the woman reads messages from American prisoners-of-war interned in Malaya, for about 10 minutes. At 6:30 the man returns with a war commentary for 15 minutes, then until 7 o'clock more messages from war prisoners are read by the woman announcer.

The station comes in with good volume and clarity, especially during the first half hour. Some mornings it fades out around 6:45 o'clock.

* * *

SYDNEY, N. S., RELAYS EARLY BBC NEWS

CJCX (6.010), Sydney, Nova Scotia (Canada), relays the BBC news at 7:00 a.m. (EWT). The station's schedule Monday to Friday is 7:00 a.m. to 11:00 a.m. (EWT); Saturday, 6:45 a.m. to 11:00 a.m. (EWT); and Sunday, 8:00 a.m. to 11:00 a.m. (EWT). In addition to the BBC news, CJCX relays several other London programs.

* * *

NEW BBC TRANSMITTER IN NORTH AMERICAN SERVICE

Early this year the British Broadcasting Corporation added another station to its North American Service—GRC (2.926), which radiates from 7:00 p.m. to 12:45 a.m. (EWT), daily. While reception from this station has been extremely good during the late winter, as spring progresses this frequency is becoming quite noisy during the early evening hours. There are, however, several other frequencies from which to choose in listening to the North American Service from London: GSC (9.58); GSW (7.23); GSU (7.26); GRJ (7.32); GRW (6.15); and GSL (6.11). The North American Service normally is heard from 5:15 p.m. to 12:45 a.m. (EWT).

* * *

LATIN AMERICAN BROADCASTS

While the series of Latin American broadcasts radiated by United States stations, WNBI, WLWO, WBOS, WLWK, WCRC, WRUL, WGEO, WRUS, WRUW, and WCDA are in languages for those countries (Spanish or Portugese), we are listing the schedules below for listeners in Latin American nations, for those here at home who understand the languages used as a medium of broadcast, and for those who will enjoy the musical treats which go to make up a large portion of the transmissions:

16-meter band—WNBI, 17.78 megs., 5:30-6:45 p.m. (EWT). WLWO, 17.8 megs., 5:30-6:45 p.m. (EWT).

19-meter band—WBOS, 15.21 megs., 5:30-8-15 p.m. (EWT). WLWK, 15.25 megs., 5:30-8-15 p.m. (EWT).

25-meter band—WCRC, 11.83 megs., 5:30 p.m.-12:00 midnight (EWT). WRUL, 11.73 megs., 7:30 p.m.-2:00 a.m. (EWT). WNBI, 11.87 megs., 7:00 p.m.-12:00 a.m. (EWT).

31-meter band—WGEO, 9.53 megs., 5:30 p.m.-12:00 midnight (EWT). WLWO, 9:59 megs., 7:00 p.m.-12:00 midnight (EWT). WRUS, 9.7 megs., 7:30-p.m.-2:00 a.m. (EWT).

41-meter band—WBOS, 7.25 megs., 8:30 p.m.-12:00 midnight (EWT).

49-meter band—WRUS, 6.04 megs., 7:30 p.m.-2:00 a.m. (EWT). WCDA, 6.06 megs., 7:30 p.m.-2:00 a.m. (EWT). WLWK, 6.08 megs., 8:30 p.m.-12:00 midnight (EWT).

Direction of beam, operators of these stations, and their locations are as follows:

SOUTH AMERICA—Atlantic region—WBOS, Westinghouse Stations, Inc., Boston, Mass.; WGEO, General Electric Company, Schenectady, N. Y.; WNBI, National Broadcasting Company, New York City. Pacific region—WCRC, Columbia Broadcasting System, New York City; WLWK and WLWO, The Crosley Corporation, Cincinati, Ohio.

CENTRAL AMERICA—WRUL and WRUW, Worldwide Broadcasting Corporation, Boston, Mass.

MEXICO—WCDA, Columbia Broadcasting System, New York City; WRUS, Worldwide Broadcasting Corporation, Boston, Mass.

* * *

VICHY NOW HAS ENGLISH PROGRAM

Vichy, announcing as "The Voice of France," has an English program for North America now, beginning daily at 12:45 p.m. (EWT), on TPC5 (15.24). This station comes in with great volume and distinctness daily in the Eastern United States.

BEST BET PROGRAMS OF THE WORLD

Eastern War Time--Dial in Megacycles

7:35 a.m.—Chungking—Chinese Na-

PREPARE NOW! FOR A BETTER FUTURE

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LEARN AT HOME DeFOREST'S A-B-C WAY

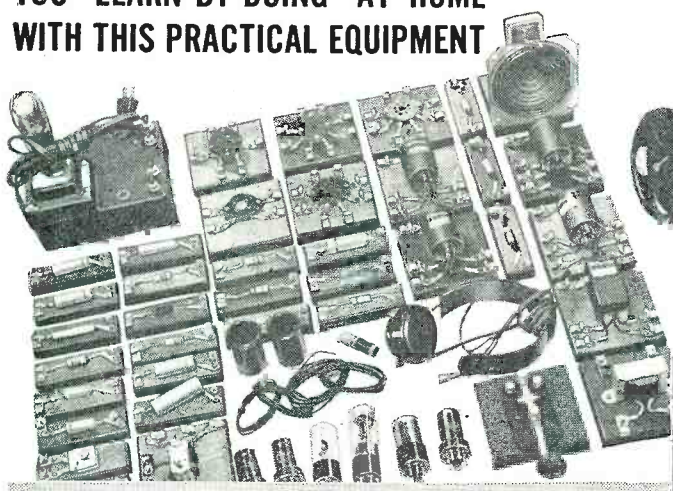
This message is addressed to you men who are alert to *both today's* needs and *tomorrow's* opportunities for good jobs, good pay, and a wide variety of employment possibilities in the BILLION DOLLAR RADIO-ELECTRONICS INDUSTRY. Write today for DeFOREST'S BIG, FREE, ILLUSTRATED BOOK, "*VICTORY FOR YOU*". See how you may prepare quickly, easily—in your spare time at home—to make your start toward an interesting and profitable Radio-Electronics future.

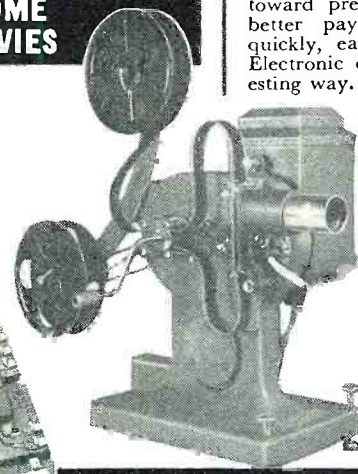
YOU GET DeFOREST'S 3-WAY COMBINATION TRAINING—

a simple A-B-C course of instruction—an exclusive, 3-way combination of illustrated Text, Movie Training Films, and actual Shop Work in your own home. You learn-by-SEEING—and *prove* your knowledge by DOING. You use (A) a genuine DeVRY Movie Projector and instructive Training Films to make your preparation clearer, easier. You use (B) EIGHT big Kits of "HOME LABORATORY" Radio Parts and Assemblies for working out 133 interesting experiments. You get (C) 90 well-illustrated Loose-Leaf Lessons, prepared under the personal direction of Dr. Lee DeForest, often called "*the Father of Radio*". And once you are trained, DeFOREST'S EXPERIENCED EMPLOYMENT SERVICE helps you make your start.

"Learn-by-Seeing" FASTER . . . EASIER With the Aid of HOME MOVIES

YOU "LEARN-BY-DOING" AT HOME WITH THIS PRACTICAL EQUIPMENT





LET THEIR EXPERIENCE GUIDE YOU

Dr. Lee DeForest supervised the Preparation of DeForest's Training.

PUT YOURSELF IN THIS PICTURE

Dr. Herman A. DeVry — Visual Education Pioneer — founded DeForest's Training.

GET INTO ONE OF AMERICA'S GRAND OPPORTUNITY FIELDS!

TOMORROW: FM Radio, AIRCRAFT Radio, RAILROAD Radio, MARINE Radio, POLICE Radio, and other exciting branches of the Billion Dollar Radio-Electronics Industry will need *trained* men. Sight and Sound Motion Picture Studios and Theaters will employ *trained* Radio-Electronic technicians. The improvements in Radio Picture Projection—the increasing use of PUBLIC ADDRESS SYSTEMS by Industrial Plants, Stores, Offices, Schools, etc.—the peacetime uses of such war-born discoveries as RADAR—INDUSTRIAL ELECTRONICS—all of these give you an idea of the bright future of the Radio-Electronics Industry *for men who are trained*.

TODAY: A working knowledge of Radio-Electronics can help you to a better job and a fat pay-check in Essential Industries. It can pave the way toward a part-time or full-time Radio-Electronics Sales and Service *Business of Your Own*. Or—if you are eligible for military service—it can help you toward preferred Military Classifications and better pay. DeFOREST'S can help you quickly, easily, to prepare for many Radio-Electronic opportunities, in a practical, interesting way.

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Simply PRINT your name and address neatly on the coupon below. Mail it. Get BOTH the colorful KIT SUPPLEMENT and our BIG illustrated book, "VICTORY FOR YOU". Get pages of valuable information on present and future RADIO-ELECTRONICS opportunities. See how effectively DeFOREST'S can help you—in your spare time at home—to make YOUR start toward a Radio-Electronics FUTURE!

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Send me BOTH your big book, "VICTORY FOR YOU" and your KIT SUPPLEMENT —showing how I may make my start in RADIO-ELECTRONICS your A-B-C-simple Home Training Way. No cost! No obligation!

Name_____ Age_____
(Please Print)

Address_____

City_____ State_____

☐ Check Here, if Under 16, for Special Information.

tional Program for North America; 10:00, 11:00 a.m., English news: XGOY (9.645). Daily.

9:00 a.m. — Tokyo — Program for Eastern North America; news, followed by American prisoners-of-war messages: JZI (9.535) and JZH4 (6.13). Daily.

1:45 p.m.—Guatemala—Midday Marimba concert: TGWA (15.17). Daily.

5:50 p.m.—Berlin—English program for North America: DJD (11.77), DZD (10:54), DXJ (7.24), DXL13 (9.52), DXB (9.61), and DXP (6.03). Daily.

6:15 p.m. — Tokyo — Program for Eastern North America. News in English at 6:15 p.m. and 9:20 p.m. Recorded messages from prisoners in Japanese prison camps at 9:20 p.m.; JLGR (15.105) and JVW3 (11.725). Also try, JLG2 (9.505). Daily.

6:47 p.m. — Moscow-Komsomolsk — English program for North America: (15.23, 15.11, 12.19, 9.48, 9.88, and 11.947). Daily.

7:30 p.m.—Quito, Ecuador—"The Friendship Hour": HCJB (12.455 and 9.958). Daily.

7:45 p.m. — Brazzaville, Middle (French) Congo—English program for North America from Fighting French Headquarters in the Middle Congo: FZI (11.97). Daily.

8:15 p.m.—Leopoldville, Belgian Congo—English program for North and South America and the East from the Belgium National Broadcasting Service: OPL (9.785). Daily.

9:30 p.m. — Berlin — "Calling Back Home": DZD (10.543), DXJ (7.24), and DJD (11.77). Saturday.

10:00 p.m.—Rio de Janeiro—Goodwill program in English for North America: PRL8 (11.715). Daily.

10:00 p.m.—London—Preview of programs to be heard in North American Service next week: GSL (6.11), GSU (7.260) and GSC (9.58). Saturday.

11:00 p.m.—London—"Radio Newsreel"—News by the men and women who make it: GSC (9.958), GSL (6.11), GRX (9.69), GSU (7.260), GRC (2.926), GRW (6.15), and GSW (7.23). Daily.

11:40 p.m. — Tokyo — Program for West Coast listeners: JZJ (11.80), JLG2, (9.505). Sometimes carried by JLG4 (15.105). Daily.

12:00 midnight—Guatemala—Dance music with Marimba orchestra: TGWA (9.685), and TGWB (6.48).

* * *

RANDOM TIPS

Listeners in the Eastern United States will find the best transmission daily from Australia this spring is that of station VLG2 (9.54) in the 31-meter band, which is heard very well between 8:00 and 9:00 a.m. (EWT), with a program directed to Eastern North America. The news is given at 8:00 and 8:45 a.m. There is usually a news commentary, as well as brief musical numbers to intersperse the comment.

At 12:45 p.m., (EWT), Sundays, listen to "Variety Band Box": GSF (15.14), and GSP (15.31), from London.

Bern, Switzerland, has been heard in the Eastern United States with an early evening program lately in the 31-meter band. Try for them around 7 p.m. (EWT).

HVJ (11.74), Vatican City, has English programs for North America scheduled for 9:30 p.m. (EWT), Thursdays, Sundays.

Another favorite program from London is "World News Roundup," at 7:15 p.m. (EWT), Sundays, featuring direct pickups from Algiers, Moscow, Cairo, Sydney, etc.: GSC (9.58), GRG (11.68), and GSL (6.11).

The London variety program, "Shipmates Ashore," is heard at 5:00 p.m. (EWT), Monday, in the General Overseas Service of the BBC, and is clear on GSB (9.51).

—30—

Spot News
(*Continued from page* 14)

Eastern Vice Chairman, H. A. Pope
Western Vice Chairman, E. G. Carlson

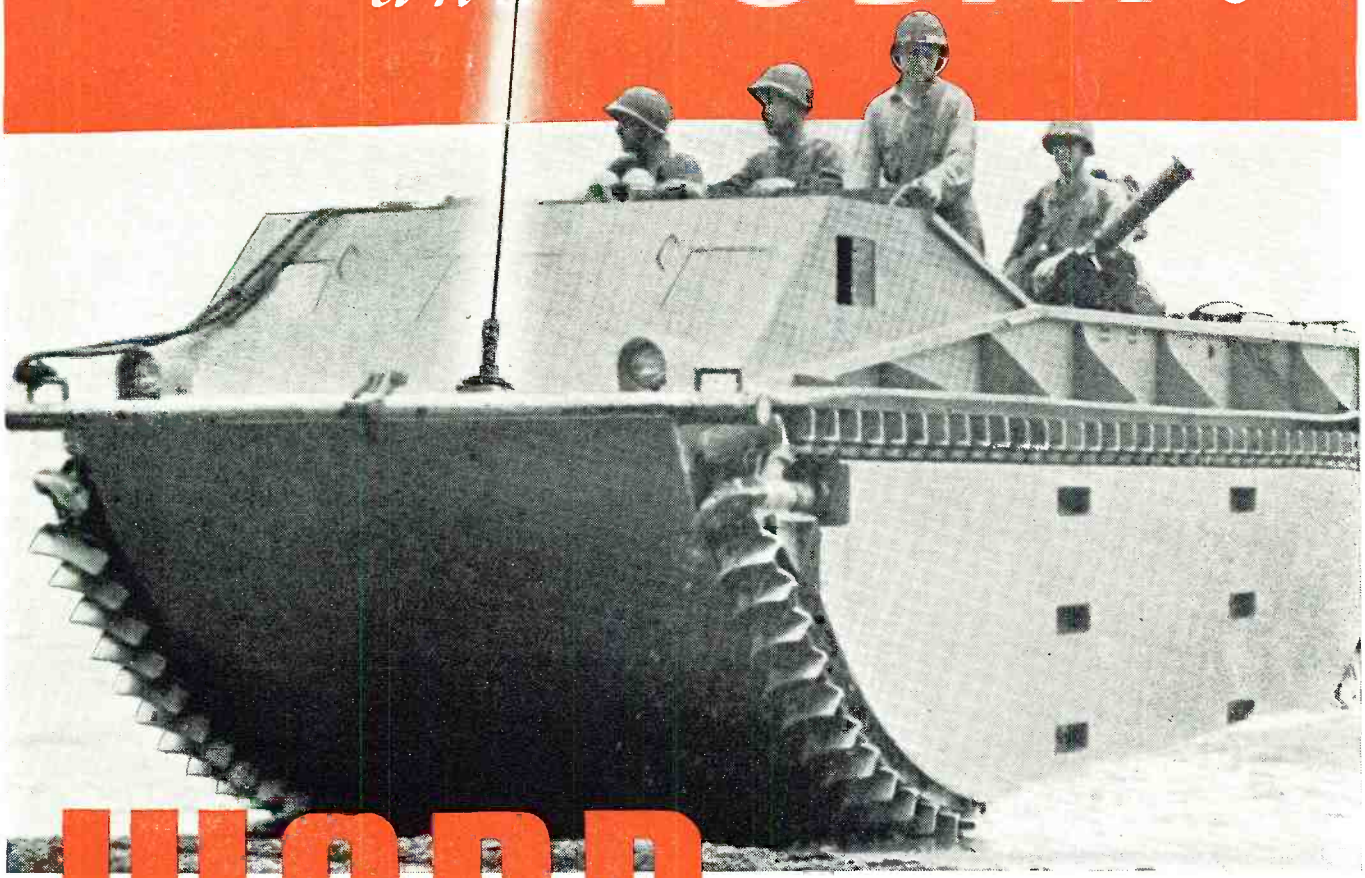
2:00 p.m.—RMA Service Committee Chairman, M. J. Schinke

RMA revealed during their recent spring conference in New York City that their manpower survey indicated over fifteen-thousand workers in the twenty-two to twenty-six year old group among six-hundred companies engaged in making electronic equipment. Of these, over seven thousand were claimed as irreplaceable.

During the New York conference, the addition of fourteen new member companies, which brings the RMA membership total to the two-hundred mark, was also revealed. The new member companies of RMA are: Continental Electric Company, Geneva, Illinois; Electronic Corporation of America, New York City; Electronic Specialty Company, Los Angeles; Harvey-Wells Communications, Inc., Southbridge, Massachusetts; Industrial and Commercial Electronics, Belmont, California; Kegron Manufacturing Company, Inc., New York City; Kuthe Laboratories, Inc., Newark; Libbey Glass, Division of Owens-Illinois Glass Company, Toledo; Meissner Manufacturing Company, Mt. Carmel, Illinois; Packard Manufacturing Company, Indianapolis; Precision Specialties, Los Angeles; Telicon Corporation, New York City; The Ward Products Corporation, Cleveland; and Western Electric Company, New York City.

A WIDENING OF THE PRESENT FM BAND from the 40-channel limit to 80 or 100 channels was proposed by RTPB Panel Five at its recent session in Chicago. A continuous band of 80 to 100 channels minimum was advocated at this session, which was presided over by C. M. Jansky, Jr. This expansion would extend over the number 1 television channel of from 50 to 56 mc., and the amateur band of from 56 to 60 mc.

Yesterday *and* TODAY!



WARD ANTENNAS

In the last peacetime year alone, **THE WARD PRODUCTS CORPORATION** made two million antennas. This established **WARD,** by an overwhelming margin, as the leading producer of aerials used by manufacturers of automobiles, radios and portable radios before the war.

Since Pearl Harbor all production has been going to further the war effort. **WARD PRODUCTS** may be found on communication equipment used on all fighting fronts. Men in tanks, planes, command cars, P-T boats — on communication units of all kinds — are becoming familiar with the name **WARD**. . . . When we return to the arts of peace, the superior designing ability, manufacturing knowledge and production efficiency that made **WARD** the leader in the pre-war period and in wartime will be supplemented by knowledge gained from the war effort. There will be new and better products for the post-war period. If your post-war planning includes the use or specifying of antennas, look to **WARD!**

THE WARD PRODUCTS CORPORATION, 1523 E. 45TH STREET, CLEVELAND, OHIO

This Panel, which incidentally also may be hereafter known as the FM Broadcasting Panel instead of V.H.F. Broadcasting Panel, adopted a formal resolution citing that its "Committee on the State of the Art" reported that there are no systems of modulation, classified or otherwise, which show any indication of being either as good as or better than the FM system now in use.

The FM parade of interest seems to have grown, too. Thus far, there are forty FM stations operating on a commercial program basis, and approximately a dozen experimental and educational stations on the air. About seventy-eight applications for construction permits or reinstatements have been filed with the FCC. According to a survey described in a recent Zenith FM bulletin, there are one hundred and forty-four companies who plan to open FM stations as soon as possible after the war. Some two hundred and fifty companies have already planned a service area, selected a frequency, and initiated claims for FM stations.

Many of the proposed FM stations will use the lower power of 250 watts which, according to station specialists, will provide more than four times the nighttime coverage of a 250-watt AM transmitter, operating on 1,000 kc.

Incidentally, on Mach 18th, eight years ago, Major Armstrong appeared before the FCC to testify for his new development, FM. Among the questions that faced the commission at that time were: can FM render an acceptable regular service; what are the relative merits of FM as against AM in the ultra-high frequencies; what are the relative merits of the wide band against the narrow band FM; and is it possible for FM to provide a satisfactory national service when the requirements of other services, including television, government, aviation, and police are taken into account. A New York newspaper, commenting on this testimony, said, "There is no indication yet as to what the commission thinks of the practicability of using FM in commercial broadcasting. It is probable, however, that any change from standard to the new type of broadcasting would be made gradually, and that the commission will do everything in its power to avert any undue loss to the broadcasters and the owners of standard receiving sets."

The intervening years have certainly answered all of the questions which puzzled the commission at that historic meeting, as the situation today shows.

SOME FIVE THOUSAND FAMILIES WILL BE INTERVIEWED in the third consumer requirements survey, conducted by the Office of Civilian Requirements. The survey, which will be divided into two parts, will cover household articles and appliances. Radio tubes are included in the household article classification.

The information provided by this survey will be used to revise and improve existing programs, and also prepare for the future when some of the items now restricted again can be made.

These families, which have been selected as proportionally representative of the population, will be asked questions similar to those presented in the other surveys. That is, they will be asked which articles they would buy immediately if there was plenty of everything available, and in what order they would be likely to make purchases when goods again are available.

In previous surveys the OCR learned that fifty-nine per cent of the families in this country have one radio; twenty-four per cent have two radios; and six per cent have three or more radios. These previous surveys also revealed that sixty-three per cent of the families in the country have at least one set in working order; fifteen per cent have two sets in operation; while four per cent have three or more sets in operating condition. The surveys revealed, too, that sixty per cent of those who required tubes, were unable to get them. Incidentally, these previous surveys also disclosed that approximately one per cent of all the families in the country were able to buy a new receiver during 1943. In 1944 this percentage will probably be reduced to a small fraction of one per cent.

ALTHOUGH FIRE AND STORM have played havoc with several broadcast stations recently, the "show must go on" attitude of the staffs kept the transmitters and programs of these stations on the air. When a fire broke out in the studio building of KGLO, Mason City, Iowa, the staff kept the station on the air until smoke drove them out. And when that happened, they went to the transmitter where announcements were continued, as if nothing had happened.

Recently, the flood waters of the Mississippi inundated the tower site of WCBI, Columbus, Mississippi. The flood became so severe that the supporting guy wires of the tower snapped. Nevertheless, the station remained on the air, with bulletins on flood conditions and highway information supplied by way of a mobile unit.

Another victim of the Mississippi flood, WGRM, Greenwood, Mississippi, was forced off the air when the flood waters roared into the transmitter house. However, the station did come back on the air after two days of silence to serve the community.

BECAUSE AN OIL-WELL steel derrick, mounted close to the transmitting tower of KWFT, Witchita Falls, Texas, interfered with the transmission of the station, the derrick is being removed. Oil gives way to radio!

THE NEW YORK CITY WERS gave a command performance recently

before members of the Army, Navy and FCC. Hundreds of amateurs gathered on the East River Drive of New York City to demonstrate a variety of portable and mobile equipment.

Among the unique receivers shown was a four-pound handie-talkie operated from a motorcycle battery.

Citations to the five borough WERS coordinators for distribution to the several hundred amateurs present at the ceremonies, were offered by Vincent T. Kenney, radio aide to Mayor LaGuardia, and director of the emergency services. Inspector Arthur W. Wallander, chief of staff of the New York City defense forces administered the FCC oath of secrecy to the WERS members.

Several units of the New York City WERS had an opportunity earlier in the year to demonstrate their ability to establish instantaneous contact, when a mock air raid was held in the 42nd Street area. During that demonstration magnesium flares were dropped to simulate the fall of bombs, and flares burned brightly atop many rooftops. The WERS units kept up a running description of the "air raid" from various points. In some instances the walkie-talkies were used to supplant telephone facilities which were supposed to have been damaged in the "air raid." The demonstration was a huge success. Other communities have held similar trials and have reported effective results. But, as we have said in the past, let's hope that it is only necessary to conduct these trials and demonstrations, and have to contend only with magnesium flares and not dynamite.

THOSE LEND-LEASE RECEIVERS shipped to England will cost almost five times their original price when they go on sale, according to reports from London. The receivers, which cost about $16.00, will probably cost the Londoner around $68.00, say these reports. This increase in price will be prompted by freightage, insurance, handling charges, wholesaling costs, and government taxes. And, of course, the retailer will be expected to step in and add a bit to cover his costs. So, some $52.00 might have to be added to the cost of the receivers before they are finally available for sale in England.

THE AURORA BOREALIS, radio's Nemesis, visited New York recently but fortunately did not cause the customary disturbance. The surprise appearance of this phenomenon and its complete snub of radio, puzzled many. For, several years ago when it visited the eastern area, the disturbance was so great that transmission was blotted out for many hours.

Astronomers state that the phenomenon of the aurora may be compared to the lighting of a neon sign. They point out that the current emitted from the sun or sun spots strike the rare gasses in the upper atmosphere and then perform in the same way as electric current does when it flows through a neon sign. The greenish-white color which predominates in the aurora is believed to be caused by electric particles that pass through the oxygen in the air.

The aurora borealis, also known as the northern lights and attributed to sun spots which set up magnetic disturbances, have established no timetable of appearances. When and if such a schedule can be set up, a closer study of ways and means of combating the disturbance may be established. Until that time comes, we'll have to let nature have its way.

THE VACUUM TUBE MAY BECOME ENEMY NUMBER ONE of fish, for the U. S. Fish and Wildlife Service scientists have devised an electronic echo-sounding device that eliminates the trial and error method of fishing. A series of echo-sounding experiments are now being planned by the Office of the Coordinator of Fisheries and the Navy in the California waters, with pilchard, popularly known as California sardines, as the victims of the experimenters. With this new echo-sounding device it should be possible to locate schools of pilchards throughout the entire day, instead of during the night only when they are usually caught. Night fishing of pilchards has been popular because the fish possess phosphorescent surfaces which glow in the dark. Ordinarily, moonless night periods were used for such fishing, thus restricting the fishing to semi-monthly periods.

In the prewar era, the North Sea saw extensive use of echo-sounding devices for location of schools of herring. And last fall, similar tests were conducted in the British Columbian waters.

Echo or depth sounders are also being used by large fishing vessels to locate ocean-floor fish.

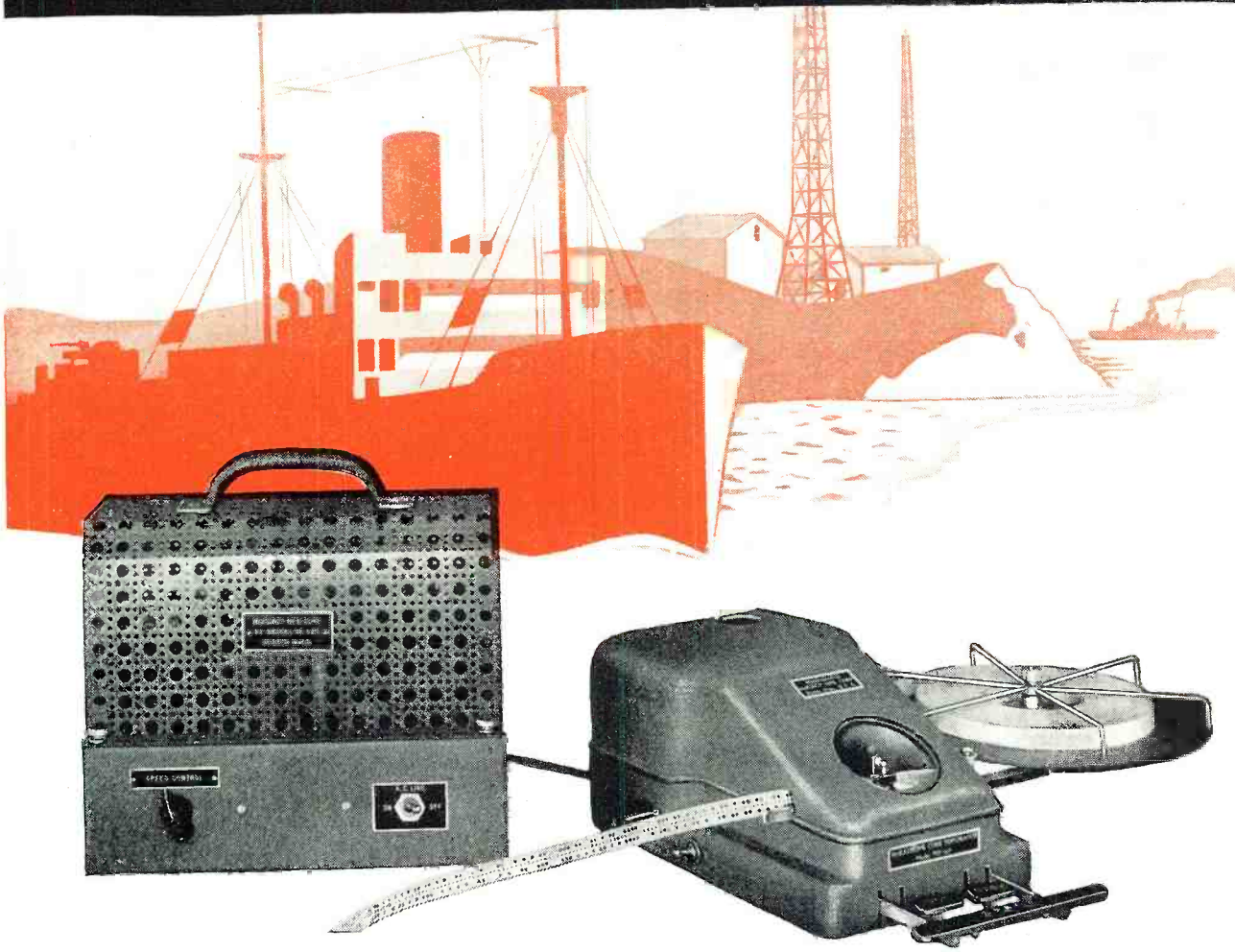
Looks as if Mr. Fish will have to look out for those electrons!

A DECREASE OF SUPPLY-DEMAND PRESSURE in crystals has prompted the WPB to restore several prewar crystal uses. It will now be possible to manufacture oscillators and filters directly allied with defense, public health, welfare or security, thus permitting the police, forestry services and others to secure quartz plates. Commercial broadcasting and other commercial communication systems will also be able to apply for quartz crystals. In addition, manufacturers of optical or electrical parts, used in research or production instruments, will be able to fill orders that are rated AA-2X or better.

The easing stipulations are contained in an amendment to general conservation order M-146.

LAST PREWAR RECEIVER SALES are now becoming quite common in many parts of the country. In Chicago two large department stores,

For every ship and marine station!



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CODE TAPE PERFORATOR PFR - 443 - A

For High Speed Radiotelegraph Transmission

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SHIP-to-SHORE
POINT-to-POINT

Entirely mechanical the PFR - 443 - A not only improves the efficiency of transmission but confines human error to minimum. Comprising two units—the Keying device and Electronic mechanism—this Perforator can be operated by anyone with a basic knowledge of dots and dashes. Those with experience can easily maintain an accurate speed of more than 40 words per minute in all Morse combinations assigned to the Russian, Turkish, Arabic, Greek and Japanese alphabets and languages. Sending is automatic . . . tapes are clean and precise. Time, expense, and even lives, may be saved. The PFR-443-A has aroused more than usual enthusiasm. May we send complete details?

ARMY E NAVY

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WE CREATE...DESIGN...BUILD...WE ARE NEVER SATISFIED WITH MEDIOCRITY

KEEP IT UP...BUY MORE AND MORE WAR BONDS

Carson, Pirie, Scott & Company and Marshall Field, recently sold the last of their prewar receivers. According to the manager of Carson, Pirie, Scott, they were able to hold out longer than any other department store in that city. Incidentally, the buyer of the last receiver at Marshall Field was CBS. The receiver was donated to the hospital at the Great Lakes Naval Training Station.

IN 1940 CANADA PRODUCED ONE-MILLION DOLLARS WORTH of communications equipment. Today, orders totalling four-hundred million dollars are on the books, according to the Hon. C. D. Howe, Minister of Munitions and Supply. In a speech made in the Canadian House of Commons on war appropriations, Mr. Howe said that the radio and communications industry of Canada is now operating on a level some eighteen times greater than in 1939. There are approximately forty-five hundred different items in current production by some fifty prime contractors and several hundred subcontractors, he pointed out. Among these items are twenty-three types of radio transmitters, twenty-five types of radio receivers, and nineteen types of transmitting and receiving sets.

The entire communications program is coordinated by the Signals Production branch of the Department of Munitions and Supply.

Canada has certainly hit a new high in communications equipment production.

AUTO RECEIVERS IN ENGLAND can be used again, for the ban imposed in June, 1940, at the time of the invasion threat, has been lifted by the Postmaster General. When the restriction was put into force, approximately fifty-thousand receivers were removed from automobiles, for it was feared that invading German paratroopers might utilize these receivers for receiving instructions. All owners of such receivers are now able to recall them from the police stations where they have been impounded during the past four years.

MORLEY BROTHERS of Saginaw, Michigan, have been appointed distributors for the Admiral Corporation. They will distribute Admiral Radios and Home Appliances to the entire state of Michigan with the exception of the city of Detroit and immediate vicinity.

THE UNIVERSAL MICROPHONE COMPANY, Inglewood, Cal., has issued a bulletin to sub-contractors discontinuing three of its wartime catalogue items, viz., plugs, jacks and switches.

Small quantities, however, will continue to be available to jobbers on priorities until the present stock is depleted.

The discontinuance of these items was necessary because current prime contracts for microphones have absorbed the manufacturing facilities of plugs, jacks and switches into 1945.

O. F. (JERRY) ACHTENHAGEN, for the past two years general manager of the Philco Training School, Philadelphia, Pa., has purchased the Radio and Appliance Distributing Company of Denver, Col., a long-established Philco distributor serving the Colorado area. The new president and owner of Radio and Appliance Distributing Co. will keep the company name, take over all assets and occupy the same building at 1708 Sixteenth Street, Denver, Colorado.

OPENING OF A WEST COAST HEADQUARTERS office at 111 Sutter Street, San Francisco, in charge of B. K. Wickstrum, Pacific Coast Sales Manager for the company's lighting products, has been announced by Sylvania Electric Products Inc., at the home offices, 500 Fifth Avenue, New York City.

ACCELERATED DEMANDS FOR CRITICAL U. S. Navy equipment have made necessary the expanded facilities taken over by Atlas Sound Corporation, in Brooklyn, manufacturers of specialized loud speaker equipment for many years, who have been engaged in designing and making vital war materiel since the beginning of the present conflict.

MANY MORE RADIO AND ELECTRONIC MANUFACTURERS have received Army-Navy "E" awards.

The Thomas & Betts Co., Elizabeth, N. J., manufacturers of electrical fittings, has been awarded a second star for their "E" flag.

In an impressive program, the presentation of the Army-Navy "E" was made to the Carlton Lamp Corporation of Newark, N. J., in recognition of the contribution of the employees to the war effort.

The Electro Motive Manufacturing Company of Willimantic, Connecticut, has won the production award for the second time, adding the first White Star to its "E" flag.

Another company which has received its second star is the Stromberg-Carlson Company. The award was made in a simple ceremony outside the Rochester war plant.

A White Star has also been added to the flag of the National Union Radio Corporation of Newark, N. J. Announcement of the award was made in a letter from Under Secretary of War Robert P. Patterson.

Brigadier General Edgar L. Clewell, Commanding General, Western Signal Depots presented the Army-Navy "E" award to Admiral Corporation of Chicago, Illinois, at a recent ceremony.

DIXIE B. McKEY, general communications engineer for Graybar Electric Company since 1942, has been appointed technical supervisor of radio operations of the Oklahoma Publishing Co. He will be concerned chiefly

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These easy-to-follow, inexpensive manuals will help you repair radios faster. This volume covers 1941 models, with alignment data, I.F. peaks, and replacement parts lists. Compiled by M. N. Beitman, radio serviceman for many years, author and teacher. Do radio servicing expertly; simplify your work. 192 pages, 8½x11 inches. Only **$2.00**

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Let this important manual give you over 80% of all 1940 circuits you will ever need, acquaint you with developments of the period, train you to service quickly and efficiently millions of sets. Data on F.M., portables, recording, etc. 417 models of 43 manufacturers. 208 pages. Net price, only **$2.00**

Most Popular Models Made by:
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Another handy manual of most-popular diagrams you need. Circuit data, hints, and information are time-savers and money-makers for you. Let these diagram manuals guide you to easier service work. Why try to get along without helpful diagrams? Use this volume with 192 pages of diagrams of most popular '39 makes. Order today. Price only **$2.00**

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The most popular volume of the series. Will pay for itself with the time saved during the first day of use. Includes all the popular old timers. Save hours on every job. 427 diagrams of the most-serviced radios of this period, with parts lists and alignment information. 244 pages, 8½ x 11 inches. Sold with a money back guarantee. Postpaid, only **$2.50**

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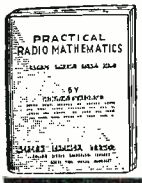

Introduces and explains the use of arithmetic and elementary algebra in connection with units, color code, meter scales, Ohm's Law, alternating currents, ohmmeter testing, wattage rating, series and parallel connections, capacity, inductance, mixed circuits, vacuum tubes, curves, the decibel, etc., etc., and has numerous examples. A remarkable value for only **25c**

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with the technical and practical operational problems of FM and television, as the Oklahoma Publishing Company has filed application for licenses to operate in these fields for two of the three stations it operates: KLZ, Denver; and WKY, Oklahoma City.

CHARLES S. POWELL has become a Vice President and Director of the Graybar Electric Company.

Mr. Powell began his career with Graybar (then Western Electric Company) thirty years ago immediately after attending Stanford University and Case School of Applied Science where he was graduated in Electrical Engineering.

THE VALPARAISO TECHNICAL INSTITUTE, which has been in existence for a few months, will carry on with full-time operation in new quarters, with greatly expanded facilities as far as their physical plant is concerned. Everyone who has been associated in the operation of the Dodge Telegraph and Radio Institute is transferring to the new organization.

WITH 126 FACTORIES, Chicago will top the world in postwar days in the production of electronic, radar and radio equipment, according to J. C. MacKeever, president of the Illinois Manufacturers' Association and head of the Gerlach-Barklow Company of Joliet.

THE FADA RADIO AND ELECTRIC COMPANY, INC., of Long Island City, makers of Fada Radios, has begun sponsorship of Tro Harper's 2:30 p. m. Sunday AP news period over WOR, effective Sunday, April 2.

MULTIMILLION DOLLAR POSTWAR plans for television were revealed recently by top executives of national network broadcast stations, telephone companies and manufacturers. One of the most extensive television projects was disclosed by Niles Trammell, president of the National Broadcasting Company. In his discussion of the part that NBC will play in postwar television, he pointed out that of all the postwar developments promised by the progress of the art and science of radio, television presents the greatest challenge and the greatest opportunity. He said that television is as great a forward stride in the field of communications as aviation has proved to be in the realm of transportation. Network television programs on a nation-wide basis will be one of the major services that the twentieth century will offer the American people, explained Mr. Trammell.

The highlight of Mr. Trammell's statement was his discussion of the national network that NBC is planning. To establish the anchor points of such a system, NBC has filed applications for construction permits for television stations in Chicago, Cleveland, Denver, San Francisco and Los Angeles. The present plans call for an eastern network that will extend from Boston to Washington, with stations located at Worcester, Providence, Hartford, Schenectady, New York, Philadelphia, Wilmington, and Baltimore, with possible extensions to Syracuse, Rochester and Buffalo. A Midwest network is also planned with Chicago as the centralized point. This network would cover Milwaukee, Minneapolis, St. Paul, Des Moines, St. Louis, Indianapolis, Detroit, and Cleveland. A Pacific coast network is also planned with Hollywood as the operating hub. No intervening cities were cited.

Commenting on the proposed network, Keith S. McHugh, vice-president of the American Telephone and Telegraph Company, said that the Bell System is planning to construct, within the next few years, a large amount of coaxial cable that would be of service in network television activities. Tentatively, according to Mr. McHugh, between six and seven thousand route miles of coaxial cable are scheduled for manufacture during the next five or six years. The equipment now developed will provide a one-way television channel of 2.7 megacycles in width.

"Future technical developments will increase this to 4 megacycles," said Mr. McHugh, "and also provide for simultaneous use of a single coaxial unit to transmit a television channel and a large number of telephone channels."

A tentative program of coaxial cable routes was also offered by Mr. McHugh. He said that in 1945 the New York to Washington link might be ready. And in 1946 the completed routes will include New York to Boston, Washington to Charlotte, Chicago to Terre Haute to St. Louis, and Los Angeles to Phoenix. In 1947 the proposed route will cover Chicago to Toledo to Cleveland to Buffalo. A southern transcontinental route, which will include Charlotte, Columbia, Atlanta, Birmingham, Jackson, Dallas, El Paso, Tucson, and Phoenix, is also proposed. Between 1948 and 1950 the southern transcontinental route should be completed. This will include Washington, Pittsburgh, Cleveland, St. Louis, Memphis, New Orleans, Kansas City, Omaha, Des Moines, Minneapolis, Atlanta, Jacksonville, Miami, Los Angeles and San Francisco.

Four years after the war, most of the homes in Rochester, New York, will have television sets, predicted Lee McCanne, secretary and assistant general manager of Stromberg Carlson in discussing the Trammell plan. Mr. McCanne also pointed out that a full year would elapse after war ceases before new television transmitters could be built.

Television interest appears to have soared in a few department stores in New York, who had television sets. They announced that most of their television receivers had been sold during the past four months. One large store sold over twenty-five such receivers. Purchasers included advertising agencies, broadcasting stations, hospitals, and engineers, as well as consumers.

Wall Street has also taken a new interest in television, with television stocks on the rise. Some of the recent popular stocks have been Philco, Farnsworth, and RCA.

A recent survey by the NBC television department disclosed that of the five thousand television receivers in the New York area, more than two-thirds are in operating condition.

In England television activity is resuming its prewar popularity. Two television committees have been appointed to serve on the Radio Manufacturers Association to plan policies and commercial development procedures. Relay systems are also being studied. A method now under consideration would cover eighty-five per cent of Britain's homes, and could be placed into operation nine months after the war. The extremely low price of $100 is proposed for the receivers.

The increased tempo of television activities has also prompted the formation of a television press club in New York, of which your correspondent is a member. At recent luncheon

meetings with the club, Dr. Alfred N. Goldsmith, chairman of Panel One of the RTPB, and B. Ray Cummings of Farnsworth Television, appeared to discuss television of today and tomorrow. Dr. Goldsmith proposed a transition plan, so that the introduction of radically new technical apparatus would not cause chaos in the industry. In his plan, which would cover a period of ten years, prewar equipment and methods would be used in the immediate postwar period. This would be followed by a three-year transition stage, during which prewar and improved equipment would be used experimentally. Then a second three-year period, during which the public would be educated in the new designs, would follow. In the final stage only the improved equipment would be available. During this operation, of course, it would be necessary for the government to limit production on the new developments. A similar plan was in use in England, explained Dr. Goldsmith, and operated very satisfactorily. Dr. Goldsmith also pointed out that there appears to be no limit on the development possibilities in television. He cited the request of a motion picture television executive for information on frequency allocations and facilities for 1,000-line pictures operating on 15 megacycles, believe it or not.

CONSTRUCTION WORK HAS RECENTLY BEEN COMPLETED on an addition to the plant of Webster Products, of Chicago, Illinois. Increasing the previous floor space by nearly 20 per cent, the addition will meet Webster's pressing need for increased general manufacturing space for radar-radio components war production, consisting mainly of dynamotors, voltage regulators and inverters.

One special feature of the addition will be separate division for impregnating and baking operations. A new entrance for employees is also provided in the new arrangement. Actual production in the new building began during the first week in March.

FORESEEING EFFECTIVE AND RELIABLE home and office type radio facsimile recorders capable of printing news at the rate of several hundred words a minute and pictures equal in quality to the best found in newspapers, E. W. Engstrom, Research Director of RCA Laboratories, Princeton, N. J., placed this new type of radio service at the side of television

Exclusive photograph taken by RADIO NEWS staff photographer, W. E. Smith, shows the results caused by concussion to a Japanese communications center in the Pacific Theater of War. Note the two elaborate receivers and the boxes containing the special shielded plug-in coils. Similar sets were described completely in the February, 1944, U. S. Army Signal Corps issue of RADIO NEWS.

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for

ENGINEERS

at

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THESE ARE OPPORTUNITIES. We are adding to our staff engineers who specialize in

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DEVELOPMENT
MEASUREMENTS
PHYSICS
ELECTRICITY
TRANSMITTING TUBES

Our laboratories in Newark, N. J., offer ideal working conditions. We prefer that you have a degree in electrical engineering, physics, chemistry or mathematics—your experience, however, may be sufficient.

Why don't you find out whether there's a place for you with our fine staff of specialists. Write and tell us about yourself or Phone HUmboldt 2-5252, Ext. 72, for appointment.

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ELECTRONIC DESIGN, PRODUCTION METHODS, QUALITY CONTROL ON VARIOUS TYPES OF X-RAY AND RADIO VACUUM TUBES.

PRODUCT DESIGN, TRANSFORMERS (ALL COMMERCIAL FREQUENCIES INCLUDING INDUCTOTHERM RANGES), CONTROL CIRCUITS, AND SWITCH PANELS WITH FOLLOW THROUGH TO COMPLETED PROJECT. IN REPLY STATE AGE, EDUCATION, EXPERIENCE, DRAFT STATUS AND SALARY REQUIREMENTS. W.M.C. RULES ENFORCED.

c/o RADIO NEWS BOX NUMBER 346

RADIO ENGINEERS

At least two years' design and development experience with Radio Communications Equipment manufacturer on items subsequently satisfactorily produced in quantity. Knowledge and experience in two-way mobile equipment, low power transmitters, receivers, and control equipment essential. Permanent position. West Coast Manufacturer. Will pay expenses to coast for interview if qualifications satisfactory. Write giving complete past experience, employment record, salary received, and technical references.

BOX NO. 338 c/o RADIO NEWS

MECHANICAL ENGINEER

of exceptional caliber. Experience with small mechanical devices, such as adding machines, typewriters, etc. Must be able to do basic design and development work independently and see it thru into production. This work is in connection with Radionic Devices and has an ideal post-war future.

Can also use Designers, Draftsmen and Checkers

ZENITH *LONG DISTANCE* RADIO
RADIONIC PRODUCTS EXCLUSIVELY—
WORLD'S LEADING MANUFACTURER

6001 W. Dickens, Chicago

PRODUCT DESIGNERS AND DETAILERS

Work on small electro-mechanical devices. Excellent post-war prospects. Must comply with W.M.C. Address reply to:

Lear Avia, Inc.
Piqua, Ohio—Att: R. J. Biggs

Wanted—

Assistant Electrical Engineer by large manufacturer of abrasives. Duties cover installation and maintenance of motors, furnaces and lighting—power distribution. Prefer college graduates under 27 years of age with 3 or 4 years practical experience—although the latter requirement is preferable, it is not essential. Write giving full details. Those now in war work need not apply. % Radio News, Box No. 351.

"This section is designed to help the radio industry obtain trained, experienced, technical men to facilitate vital war production. Before applying for any of these positions consult your local United States Employment Service office to determine War Manpower Commission regulations concerning the changing of jobs. If you are already employed in war work at your highest skill, stick to your present job."

ENGINEERS....

Are You Concerned With YOUR POST WAR FUTURE?

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IN A MAJOR POST WAR FIELD

Openings available at our Research Laboratories and Electronic manufacturing unit. Leaders in the design and development of vital electronic equipment for the armed forces.

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Write, stating experience, education, draft status, salary requirements or apply to

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GYROSCOPE CO., INC.
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c/o Radio News, Box No. 345

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Ideas and Inventions for Postwar Products

Automatic Electric Company, originator of the dial telephone and leading manufacturer in the field of communication and electrical remote control, seeks to make contact with inventors and others who may have patentable ideas or inventions for sale or license. Objective is the acquisition of newly invented or improved products which have peacetime application, which will make use of the company's expanded productive capacity, and which will help to maintain employment for its engineering, production and sales personnel during the postwar period.

Inventions should relate to wire communication, point-to-point radio, electrical remote control, or to mechanical, electrical or electronic devices used in such systems, and replies should be addressed to Mr. C. S. Cadwell, vice-president. All ideas submitted will be given careful consideration and treated with the utmost confidence.

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℅ Radio News Box 344

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to work with us on the design, development and production of radio tubes, fluorescent lamps, electronic equipment and devices.

We want men who have the "know how" of getting things done under pressure, and who would like to become associated with a company whose post-war future is indeed encouraging.

Reply giving age, education, and experience to our

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in our organization for men having radio training or experience. Our needs are such that there is room for men having varying amounts of training or experience. The rate of pay is open, and will vary with the individual's qualifications.

Citizenship is required. The post war opportunities are excellent. The current work is 100% for the war effort.

Contact us by letter or wire with a complete résumé of your experience and personal history.

℅ RADIO NEWS BOX 347

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To be used in connection with the manufacture of a wide variety of new and advanced types of communications equipment and special electronic products.

Apply (or write), giving full qualifications, to:

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EMPLOYMENT DEPARTMENT

Western Electric Co.

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Applicants must comply with WMC regulations

Technical Writers Wanted!

Engineers and physicists who have had experience in (spare time) writing technical manuscripts on electronic design or applications including radio, television, facsimile, etc. Highest rates.

Reply Box 310, c/o RADIO NEWS
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Experienced in loud speaker design and acoustics, plus knowledge audio amplifier design and construction.

If interested in a permanent position with an excellent future, write and include full details. Laboratory and plant located in Brooklyn, New York.

BOX 350, RADIO NEWS
270 Madison Ave. New York 16, N. Y.

and frequency modulation (FM) broadcasting as a definite possibility for expansion early in the postwar period.

Addressing several hundred members of the American Marketing Association at a "Radio-in-Wartime" luncheon at the Hotel Sheraton, Mr. Engstrom said: "Facsimile is a service that now can be made available. There is still needed a comprehensive market survey to indicate the form it should take and the kind of services it should render."

Mr. Engstrom expressed it as his belief that television, FM, and radio facsimile are the three most significant trends in the broadcasting field.

"Television is a new service ready for public use," he said. "It is a new medium of presenting news, entertainment, education and sales appeal directly in the home in visual form. Frequency-modulation broadcasting is in addition to the already established and accepted sound broadcasting service. Facsimile is a new service which awaits knowledge of how it should be introduced and used."

Envisaging radio facsimile as a third form of broadcasting service, Mr. Engstrom pointed out that such a service would make possible the printing in home and office of a news sheet complete with pictures, maps, cartoons, and other types of graphic material. Facsimile receivers, or recorders, he explained, were built before the war and were used by several broadcasting companies experimentally in sufficient numbers to indicate public reaction and to emphasize the special problems of developing this type of service.

In discussing "Postwar Trends Resulting from Radio-Electronic Research," Mr. Engstrom pointed not only to television, FM, and facsimile, but also to new developments in electronics such as radio-frequency heating in industrial processes, the electron microscope which is enabling major advances in many fields of science, and radio-electronic control and navigation devices.

All of these advances in radio-electronics, which would touch more people more intimately in their home and work lives than any other new activity, provide a concept of postwar readiness in the radio industry.

Contributing to this concept are five factors:

1. A large number of scientific workers skilled in the use of radio and electronics.
2. A large number of young men and women returning from the Armed Services, who will be skilled in the use and maintenance of complex radio and electronic equipment.
3. A much expanded radio and electronic manufacturing industry.
4. A large number of men and women who will wish to continue employment in the radio-electronic field.
5. A pent up desire for the new things which radio and electronics can provide.

"The new products and new services should help solve the problem of employment for those now in war work and for those released from our Armed Services at war's end," Mr. Engstrom concluded. "We need a determined effort to proceed with these new things and we need constructive planning and understanding on the part of Government to make our progress successful."

WITHOUT CHANGING OWNERSHIP or management, Sprague Electric Company is now the official name of the Sprague Specialties Company of North Adams, Mass., designers and manufacturers of condensers, resistors, power factor control equipment and other electrical components. The company believed for some time past that the word Specialties did not adequately indicate the nature of its business.

Personals . . .

Dr. Albert Hoyt Taylor of the Naval Research Laboratory in Washington was recently awarded the Medal of Merit for his discovery and development of radar. **Cordell Hull,** Secretary of State, presented Dr. Taylor with this outstanding award. Mr. Hull is chairman of the Medal of Merit board, which included **Henry L. Stimson,** Secretary of War, and the late **Frank Knox,** Secretary of the Navy. . . . **E. H. Rietzke,** president of Capitol Radio Engineering Institute, has been appointed president of the recently formed National Council of Technical schools. . . . **John M. Clayton,** who for the past two years has been with the Navy, has returned to his desk at General Radio, where he will resume direction of technical and trade advertising. . . . **Leon Golder** has resigned as secretary and sales manager of Rola Company. He was with Rola since its establishment. . . . **Oden F. Jester** has left Utah Radio Products to join Meissner Manufacturing Company as a vice president. . . . **Joseph K. Fabel,** former assistant district manager of the New York section of ANEPA, is now with Allen D. Cardwell Manufacturing Corporation as vice president in charge of sales. . . . **A. H. Hardwick,** former president of Hardwick, Hindle, Inc., is now with IRC, managing the New York City sales and customers offices. . . . **Col. C. R. H. Firth** is now in charge of procurement, research and development of all types of radio and communications equipment and small power units in Supply Directorate IX of the British Supply Mission, Washington. Assisting Col. Firth are **R. P. Ross,** who is concerned with research and development, and **Lieut. Col. R. V. Coles,** who is directing procurement activities. **A. E. Barrett** of the BBC is also on the staff of SDIX. . . . **Rear Adm. Aaron S. Merrill** has succeeded **Capt. Leland P. Lovette** as director of public relations for the Navy. Capt. Lovette returns to sea duty.

—30—

PHOTO CREDITS

Page	Credits
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32 (left), 33 (Fig. 4), 34 (Fig. 6), 99	Coleman Electric Co.
32 (right), 34 (Fig. 5)	Barnstead Still and Sterilizer Co.
49	Official U. S. Marine Corps

INDEX OF Advertisers — JUNE 1944

COMPANY	AGENCY	PAGE No.
Aerovox Corporation	Austin C. Lescarboura & Staff.	145
Alexander Hamilton Institute	The Ralph H. Jones Co. Adv.	12
Allied Radio Corporation	Henry H. Teplitz Adv. Agency	62
American Condenser Corp.	C. Wendel Muench Agency	114
American Phenolic Corporation	Evans Associates, Inc.	70, 71
American Photocopy Equipment Co.	Klau-Van Pietersom-Dunlap Associates	136
American Radio Hardware Co., Inc.	Shappe-Wilkes, Inc.	7
Audel, Theodore & Co.	Grant & Wadsworth, Inc.	139
Automatic Electric Company	The Buchen Company	141
Belmont Radio Corporation	Beaumont and Hohman, Inc.	72
Best Vibrator Co.		139
Eliley Electric Company	W. S. Hill Company	88
Bogen, David Company	Shappe-Wilkes Inc.	75
Breeze Corporations, Inc.	Burke Dowling Adams	89
Burstein-Applebee Co.	Frank E. Whalen Adv. Co.	120
Candler System Co.	Galen E. Broyles Co.	139
Capitol Radio Engineering Institute	Henry J. Kaufman	112
Centralab	Gustav Marx Adv. Agency	108
C. P. Clare & Company	J. R. Hamilton Adv. Agency	68
Commercial Radio Institute		138
Connecticut Telephone & Electric Division	Wilson & Haight, Inc.	79
Consolidated Radio Products Co.	Burton Browne Advertising	101
Cornish Wire Company, Inc.	Hart Lehman Advertising	56
Coyne Electrical School	McJunkin Adv. Co.	136, 143
Crowe Name Plate & Mfg. Co.		133
DeForest's Training, Inc.	MacDonald-Cook Co.	129
DeJur-Amsco Corporation	Shappe-Wilkes, Inc.	57
Detrola Corporation	Zimmer-Keller, Inc.	105
DuMont, Allen B. Laboratories, Inc.	Austin C. Lescarboura & Staff.	91
Echophone Radio Co.	Burton Browne Advertising	15
Electro-Voice Mfg. Co., Inc.	Shappe-Wilkes, Inc.	97
Electronic Corp. of America	Shappe-Wilkes, Inc.	93
Electronic Enterprises, Inc.	George Homer Martin Adv.	123
Fada Radio & Electric Co., Inc.	Sternfield-Godley, Inc.	17
Federal Telephone & Radio Corp.	Shappe-Wilkes, Inc.	9, 125, 141
General Electric Co.	N. W. Ayer & Son, Inc.	19
General Motors, Delco Division		67
Gold Shield Products	Sternfield-Godley, Inc.	132
Gothard Manufacturing Co.	Merchandising Advertisers	120
Greenlee Tool Co.	Howard H. Monk and Assocs.	126
Guardian Electric Mfg. Co.	Kennedy & Company	81
The Halldorson Company		114
Hallicrafters	Burton Browne, Advertising	Back Cover and 5
Hammarlund Mfg. Co., Inc.	Roeding & Arnold	20
Hytron Corporation	Henry A. Loudon Adv.	2nd Cover
Illinois Condenser Co.	Sander Rodkin Adv. Agency	130
Indiana Technical College	N. W. Ayer & Son, Inc.	143
Instruments Publishing Co., Inc.		116
International Resistance Co.	Lavenson Bureau	95
International Telephone & Telegraph Corp	Marschalk & Pratt Co.	72
Jensen Radio Manufacturing Co.	Burton Browne, Advertising	6
Johnson, E. F. Co.	David, Inc.	109
Kato Engineering Co.		126
Knights, James Company	Turner Advertising Agency	111
Lafayette Radio Corp.	Burton Browne, Advertising	87
Lake Radio Sales Co.	Sander Rodkin Adv. Agency	122
Lear Avia, Inc.	Arthur Kudner, Inc.	127, 140
Leotone Radio Co.		141
Lincoln Engineering School	Buchanan-Thomas Adv. Co.	138
McElroy T. R. Mfg. Corp.	Shappe-Wilkes, Inc.	135
McGraw-Hill Book Co., Inc.		128
Maas & Waldstein Company	Sheldon, Morse, Hutchins & Easton, Inc.	69
Mallory, P. R. & Co., Inc.	Aitkin-Kynett Co., Adv.	65
Meck, John Industries	Western Advertising Agency	100
Mercury Electronic Laboratories		132
Merit Coil & Transformer Corp.	Ross Llewellyn, Inc.	96
Millen, James Mfg. Co., Inc.	James Millen Inc.	10
Murdock, Wm. J. Co.	John A. Smith & Staff	64
National Company, Inc.	Graydon Smith, Advertising	83
National Electronic Supply		132
National Radio Institute	Van Sant, Dugdale & Co.	3
National Schools	The McCarty Co.	119
National Scientific Products Co.	Kennedy & Company	78
National Union Radio Corp.	Sayre M. Ramsdell Associates, Inc.	98, 140
Nelson Co.	A. N. Baker Adv. Agency	122
Ohmite Manufacturing Co.	Henry H. Teplitz Adv. Agency	55
Onan, D. W. & Sons	Pioneer Advertising	80
Permoflux Corporation	Turner Advertising Agency	99
Pioneer Gen-E-Motor	Burton Browne Advertising	107
Press Wireless, Inc.		142
Radio & Technical Division of Murray Hill Books, Inc.	Harry P. Bridge Co., Adv.	63
RCA Communications	J. Walter Thompson Co.	142
RCA Institutes		138
RCA Victor Division	Kenyon & Eckhardt, Inc.	113
Radolek Co.	Turner Advertising Agency	134
Randolph Radio Co.	Burton Browne Advertising	106
Rider, John F. Publisher, Inc.	Lansford F. King	104
Runzel Cord & Wire Co.	Duane Wanamaker Adv.	121
Sauersein Cements Company		138
Scientific Radio Service System	Chicago Union Adv. Agency	143
Shure Brothers	Henry H. Teplitz Adv. Agency	85
Sigmon Radio Supply		138
Snyder Manufacturing Co.	Philip Klein Adv. Agency	110
Solar Manufacturing Corp.	O. S. Tyson & Company, Inc.	11
Sprague Products Co.	Harry P. Bridge Co.	61
Sprayberry Academy of Radio	Harry P. Bridge Co.	13
Sperry Gyroscope Co., Inc.	Equity Advertising Agency	141
Standard Transformer Corp.	Burnet-Kuhn Advertising Co.	90
Stevens Walden, Inc.	Howard-Wesson Co.	14
Stupakoff Ceramic & Mfg. Co.	W. S. Hill Company	115
Supreme Instruments Corp.	O'Callaghan Adv. Agency, Inc.	102
Supreme Publications	Henry H. Teplitz Adv. Agency	137
Sylvania Electric Products, Inc.	Arthur Kudner, Inc.	8, 142
Teleplex Co.	Terrill Belknap Marsch Assocs.	128
Templetone Radio Co.	Peck Advertising Agency	77
Thordarson Electric Mfg. Co.	Duane Wanamaker Adv.	92
Tobe Deutschmann Corp.	Franklin Bruck Adv. Corp.	146
Triplett Electrical Instrument Co.	Western Advertising Agency	16
Turner Co.	W. D. Lyon Co.	117
United Transformer Corp.	Shappe-Wilkes, Inc.	3rd Cover
Universal Microphone Co., Ltd.	Ralph L. Power, Ph.D.	103
Vaco Products Co.	Duane Wanamaker Adv.	130
Valparaiso Technical Institute	Smith, Benson & McClure, Inc.	138
Wallace, Wm. T. Mfg. Co.	Michael F. Mayger Adv.	82
Ward Leonard Electric Co.	E. M. Freystadt Associates, Inc.	18
Ward Products Corporation	Burton Browne Advertising	131
Warwick Manufacturing Corp.	Agency Service Corp. Adv.	59
Western Electric Co.	Deutsch & Shea	142
Westinghouse Electric & Mfg. Co.	Fuller & Smith & Ross, Inc.	86, 140
Wiley, John & Sons	S. Duane Lyon Inc.	134
Zenith Radio Corp.	Critchfield & Co.	140

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WANTED: RCA type 931 or 931A tubes from individual or company. Can supply AA-1 priority. Reply Box 349, care of Radio News.

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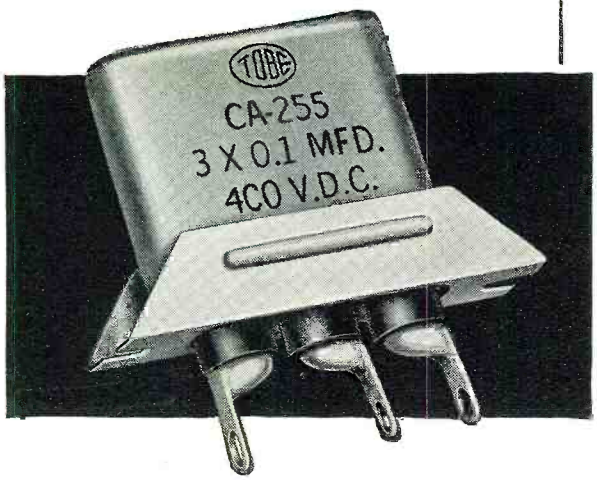

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Mineral Oil Impregnated and Filled. Aluminum Foil. Highest Grade Kraft Tissue.

CAPACITY RATING..... 3 x .1 mfd.
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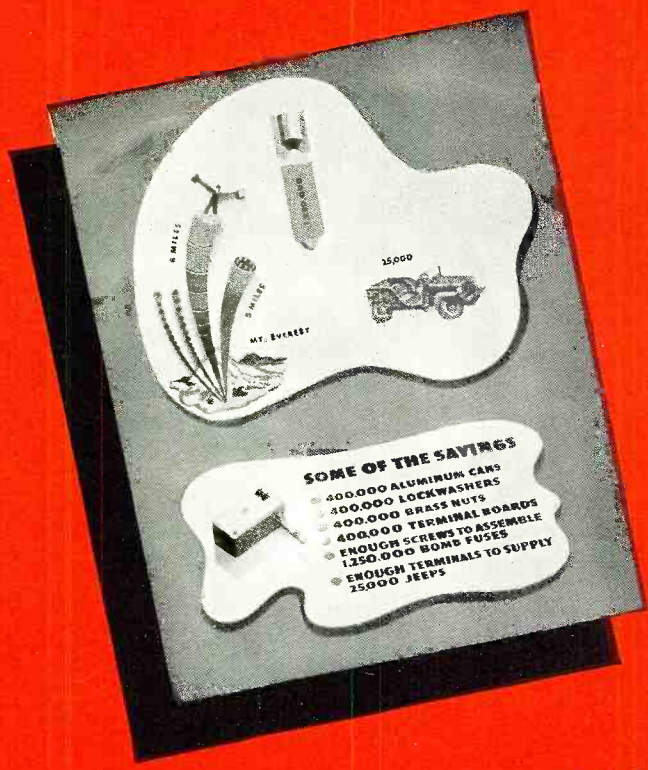

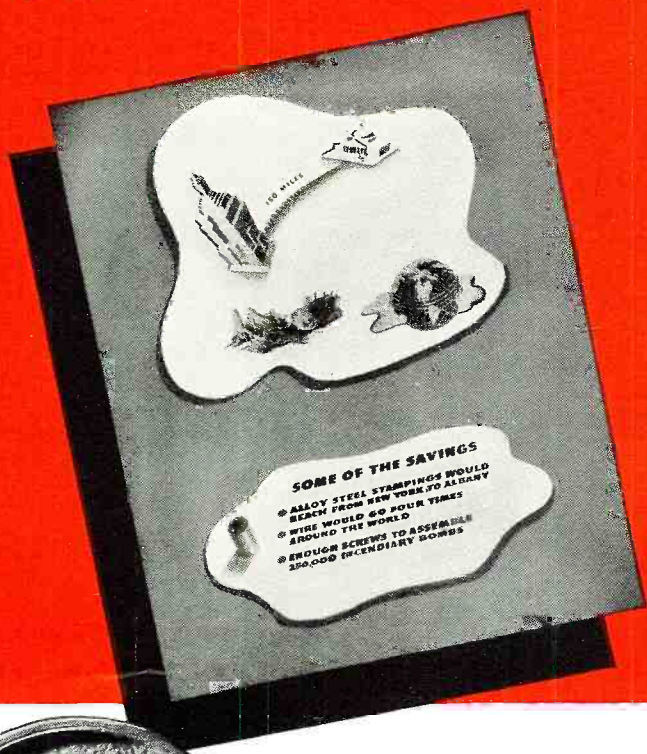

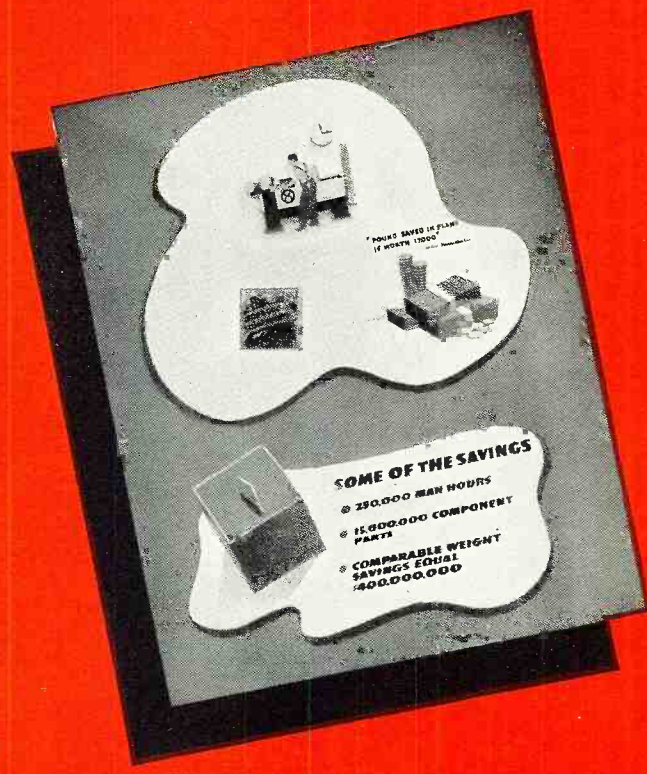

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