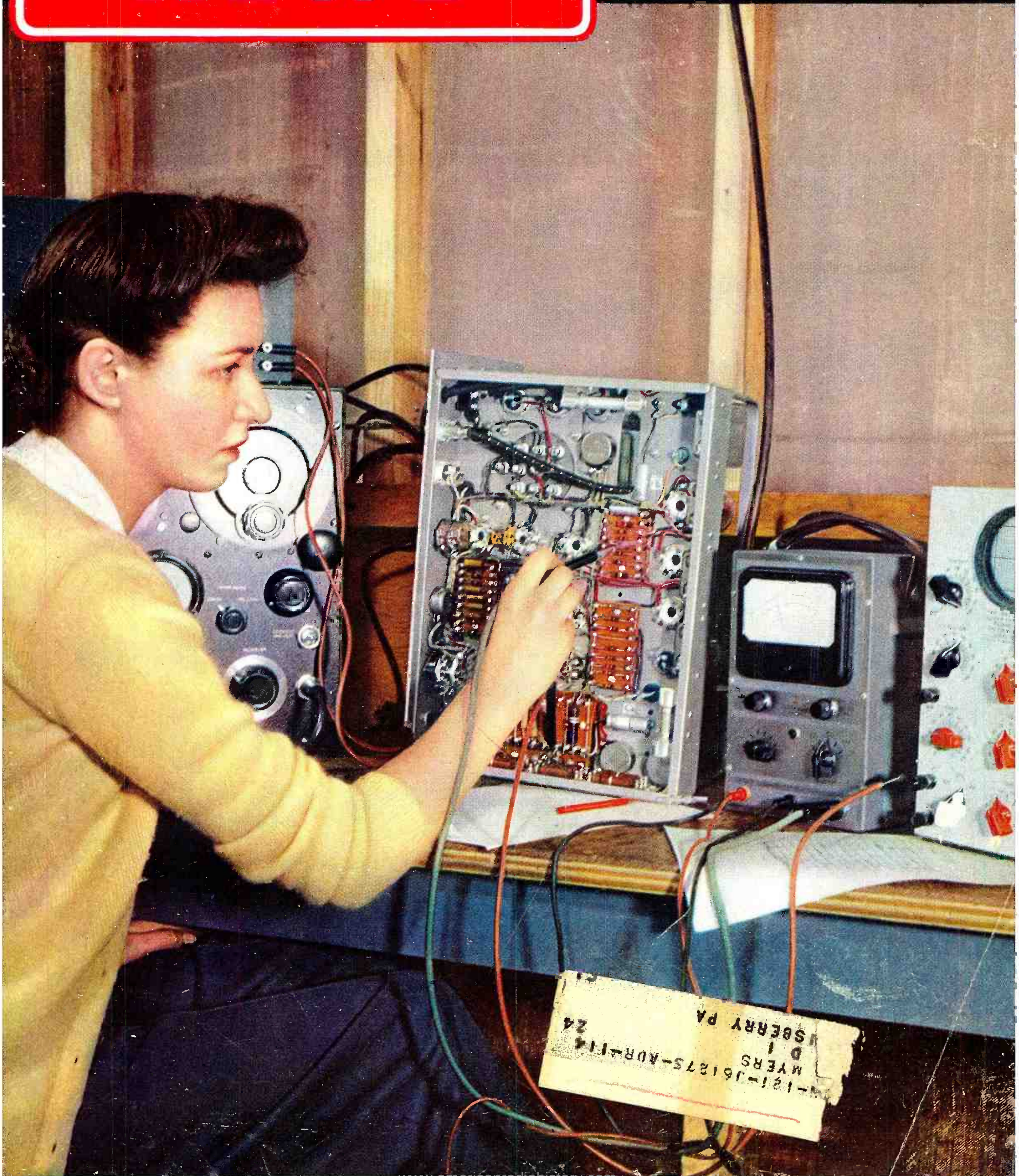
RADIO NEWS

NOVEMBER
1944
35c
In Canada 40c



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

NOVEMBER • 1944 VOLUME 32, NUMBER 5

CONTENTS

FEATURES

Weather and War Above the Clouds........................
........................*W. R. Thickstun and M. L. Blanc* 25

Gallups Island Goes to War................*Lt. John J. Canavan* 28

Recording FM Bursts for Observation..............*Oliver Read* 31

Principles of Signal Tracing................*Nicholas B. Cook* 32

Let's Talk Shop..................................*Joe Marty* 35

Mass Production of U.H.F. Transmitting Tubes......*J. Coleman* 36

Electronically-Regulated Power Supplies...........*M. S. Kay* 38

Electronic Microscope.....*Perry C. Smith and Robert G. Picard* 41

A New Crystal Pickup Cartridge..................*B. B. Bauer* 44

Versatile Test Gadget........................*Robert Merten* 47

Serviceman's VTVM-Capacity-Ohm Meter......*Wilbur Flaherty* 48

Practical Radio Course....................*Alfred A. Ghirardi* 52

The Saga of the Vacuum Tube..............*Gerald F. J. Tyne* 56

Electronic Life Detector.....................*Leslie W. Orton* 70

Mathematics in Radio.......................*Rufus P. Turner* 79

DEPARTMENTS

For the Record... 8

Spot Radio News.. 12

QTC ....*Carl Coleman* 51

International Short-Wave..................*Kenneth R. Boord* 54

Technical Book and Bulletin Review....................... 62

What's New in Radio...................................... 64

Within the Industry...................................... 104

Manufacturers' Literature 114

Letters from Our Readers................................. 136

COVER PHOTO

By Frank Ross
(Staff Photographer)

Performance tests on military equipment being conducted within copper-screened booth at RCA laboratory.

WILLIAM B. ZIFF
Publisher

B. G. DAVIS
Editor

C. R. TIGHE
Ass't to Publisher

OLIVER READ, W9ETI
Managing Editor

WM. A. STOCKLIN
Associate Editor

HAROLD S. RENNE
Technical Editor

JOE MARTY, JR.
Field Editor

FRED HAMLIN
Washington Editor

HERMAN R. BOLLIN
Art Director

E. H. SEHNERT
Chief Draftsman

K. R. PORTER
War Correspondent

FRANK ROSS
Staff Photographer

GEORGE BERNER
Advertising Director

S. L. CAHN
Advertising Mgr.

J. M. ECKERT
Midwest Adv. Mgr.

H. G. STRONG
Circulation Director

H. J. MORGANROTH
Production Director

ZIFF-DAVIS PUBLISHING COMPANY
Editorial Offices: 540 N. Michigan Ave., Chicago 11, Ill.
Member of the Audit Bureau of Circulation

RADIO NEWS is published monthly by the Ziff-Davis Publishing Company at 540 N. Michigan Ave., Chicago 11, Ill. New York Office, Empire State Building, New York 1, N. Y. Washington, D. C., Office, Earle Bldg. Los Angeles Office, William L. Pinney, Manager, 815 S. Hill St., Los Angeles 14, Calif. Subscription Rates: In U. S. $3.00 (12 isseus), single copies, 25 cents; in Mexico, South and Central America, and U. S. Possessions, $3.00 (12 issues); in Canada $3.50 (12 issues), single copies 30 cents; in British Empire, $4.00 (12 issues); all other foreign countries $6.00 (12 issues). Subscribers should allow at least 2 weeks for change of address. All communications about subscriptions should be addressed to: Director of Circulation, 540 N. Michigan Ave., Chicago 11, Ill. Entered as second class matter March 9, 1938, at the Post Office, Chicago, Illinois, under the Act of March 3, 1879. Entered as second class matter at the Post Office Department, Ottawa, Canada. Contributors should retain a copy of contributions. All submitted material must contain return postage. Contributions will be handled with reasonable care, but this magazine assumes no responsibility for their safety. Accepted material is subject to whatever adaptations, and revisions, including by-line changes necessary to meet requirements. Payment covers all authors, contributors or contestants rights, title, and interest in and to the material accepted and will be made at our current rates upon acceptance. All photos and drawings will be considered as part of material purchased.

ZIFF-DAVIS PUBLISHING COMPANY

A SPECIAL MESSAGE TO ALL AMATEURS ABOUT POST WAR PLANS AT HALLICRAFTERS

"What about post war plans at Hallicrafters?"

That's the subject of many inquiries we get every day. For many reasons, including the prime one of military security, we can't go into all the details of what your post war short wave radio equipment will be able to do. But although most of the details must be withheld, we can and do make this promise: All of our attention and the best of our efforts will continue to be focused on the amateur -- the ham, the fellow who actually helped us develop Hallicrafters equipment to the high pitch of perfection it enjoys today.

After all, it was the ham, the amateur enthusiast who helped us get short wave out of the attic, out of the shack and into the battle line. And it was the ham who went into the service and into the labs to keep working with short wave until it became what it is now, a prime battle instrument, a life saver.

Some day (soon, we hope) the ham will come home from his war communications job bringing new enthusiasm, new appetites for the wider horizons that can be reached by short wave. And some night soon we'll all be able to throw a switch when the big "all clear" signal sounds and we'll all be back on the air searching for new thrills, experiencing once again that old excitement.

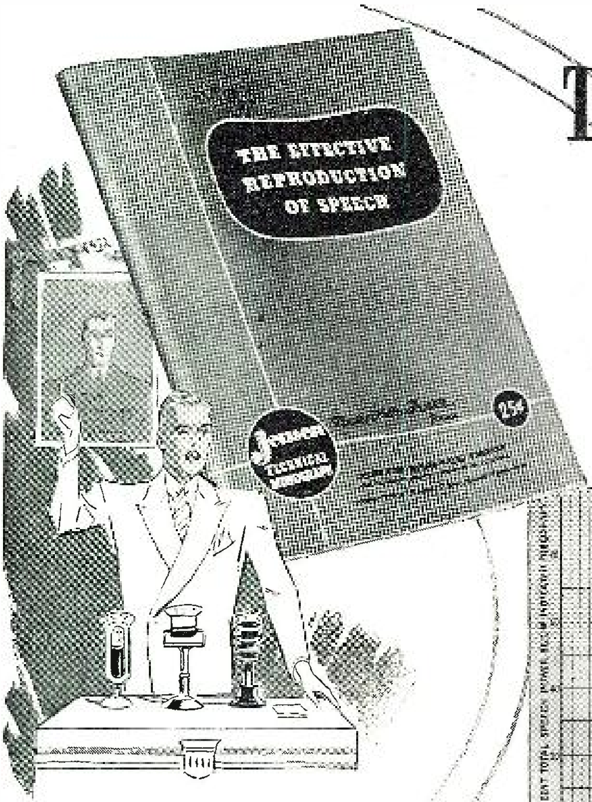
When that signal sounds Hallicrafters will be ready -- ready for the ham with new and finer equipment, a tougher kind of equipment that has been tried under fire and found to have what it takes.

At Hallicrafters, you can be sure, the ham will continue to be the key man in our post war plans and his wants will be the prime object of oun peace time production.

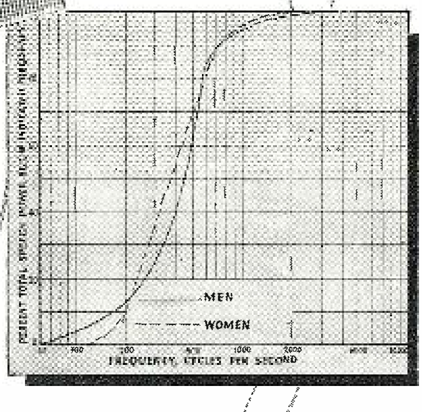
William J. Halligan

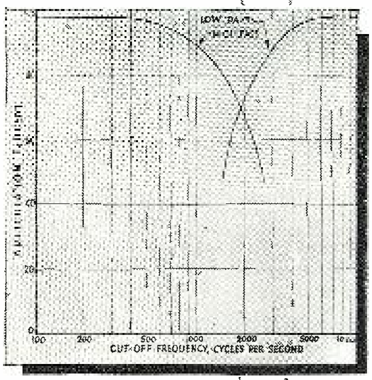
hallicrafters RADIO

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



THE EFFECTIVE REPRODUCTION OF SPEECH...





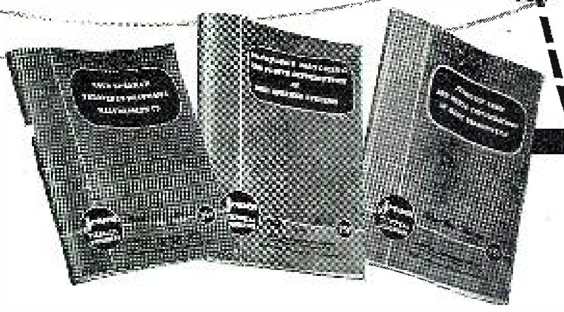
When casually considered, the reproduction of speech may appear to present less exacting requirements than the reproduction of music. Yet *faithful* speech reproduction requires a frequency band almost as wide as for music. Amplified speech for strictly *communication* purposes usually presents a different requirement. Here, such matters as articulation, loudness, masking, power requirements and the ability to deliver the message through noise, become the more important considerations.

"The Effective Reproduction of Speech"—Number 4 in the series of JENSEN Technical Monographs—presents much up-to-date data on this important subject in convenient form, together with useful conclusions and practical information for everyone interested in sound reproduction. Get your copy from your JENSEN jobber or dealer, or fill out the coupon and mail it with 25c for each copy ordered.

The Series So Far Issued

No. 1. Loud Speaker Frequency-Response Measurements.
No. 2. Impedance Matching and Power Distribution.
No. 3. Frequency Range in Music Reproduction.
No. 4. The Effective Reproduction of Speech.

FREE to men in the Armed Services, and to Technical Schools, Colleges and Libraries.



Jensen

RADIO MANUFACTURING COMPANY
6617 South Laramie Avenue
Chicago 38, Illinois

Send me ☐ The Effective Reproduction of Speech.
☐ Frequency Range in Music Reproduction.
☐ Impedance Matching and Power Distribution.
☐ Loud Speaker Frequency-Response Measurements.

(Check one or more. Send 25c for each book ordered.)

NAME____________________
ADDRESS____________________
CITY__________ ZONE____ STATE______

FOR THE RECORD

by the editor

MANUFACTURERS in the radio-electronic industry will lose no time in manufacturing receivers and transmitters for civilian consumption once Germany capitulates. One of the major factors now confronting the field is the distribution of their products. The problem will be most difficult where markets are situated far from the source of production. This will be due to wartime controls over shipping and transportation and will no doubt delay deliveries. On the other hand factories located relatively close to the source of markets will be able to find ready distribution of their goods.

Hundreds of small war plants will face an immediate reconversion once the Nazis have been licked. Our industry will be faced with a critical distribution problem when these newcomers make their appearance with their products in a competitive market. Trade names heretofore unknown will appear. Some will find their way to the established distributor's stock shelves. Many others will not. We have witnessed an increasing flow of publicity material emanating from dozens of new entrees into this field. Since Pearl Harbor these manufacturers, many of them subcontractors, have been doing minor assembly work on radio and electronic units for military consumption. Most of them have engaged recognized radio or electronic engineers. Many of these engineers are directly associated with the administration of their company and therefore, have a voice in the future policies which they will pursue. Being set up to produce radio and electronic equipment, many of them have made the decision to remain in business status quo.

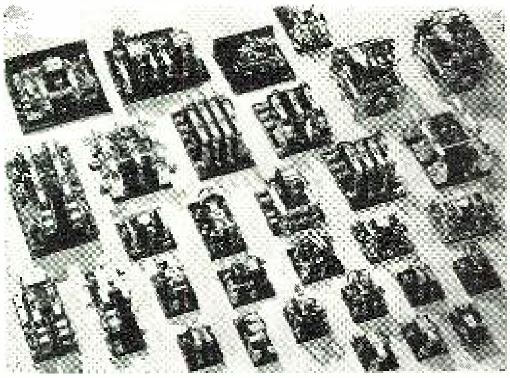
It now appears that the goal for the first year's production after reconversion will be based on 1941 demands and will mean an output of 10,000,000 to 16,000,000 sets. Most of these will go into American homes to replace inefficient and obsolete sets and as extra receivers. Next will appear heavy demands for automobile radios as soon as new car production resumes its 1941 pace and when gasoline restrictions are once more relaxed. The end of the war in Germany will result in at least a 30% cutback in military orders for radio-electronic equipment according to latest information from the WPB. This means that there is a possibility that a limited number of receivers will be produced and placed on the market before Christmas. The radio industry at the present time is producing at a rate ten times greater than prewar volumes. The release of manpower resulting from cutbacks in other industries will permit radio-electronic manufacturers to hire additional skilled help which will be needed. Many manufacturers will take a long range viewpoint, particularly those engaged in the manufacture of large transmitters, so that a gradual reconversion to normal operations may be spread over a period of ten months to a year.

There is a heavy demand for new transmitting equipment. Applications for construction permits are being received by the FCC at an increasing rate. The market for such equipment will be most lucrative. Here again distribution will become an important factor. Small stations situated in remote spots will find it difficult to receive shipments of heavy equipment for several months to come. And here again it will be necessary for the government to expedite deliveries just as soon as demands upon the railroads subside.

While FM transmitters are being produced there will be a period of delay in introducing FM receivers to the public. At the present time there are more than 50 FM stations in operation or under construction and it is now apparent that at least 200 more will be on the air within a year after reconversion. The sale of new FM sets naturally will be slow until the new stations actually begin broadcasting.

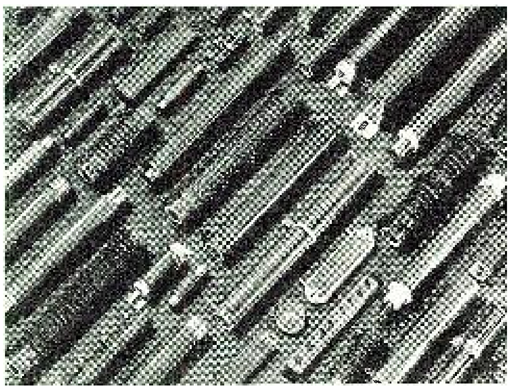
There is no doubt that television someday will become as popular as radio broadcasting itself. Here again we find that plenty of groundwork has been laid and, like the production of radio receivers for FM, only awaits the availability of television material to start the ball rolling. Manufacturers of video sets are now lining up their distribution in all parts of the country and a few of them are conducting classes for the training of servicemen to maintain their television receivers after they are sold. There still is a general lack of information available to those who will sell and service television receivers. One large manufacturer in the East is now conducting special classes for the training of men. We hope that others will follow. It's a step in the right direction........................O.R.

BUILT FOR SERVICE



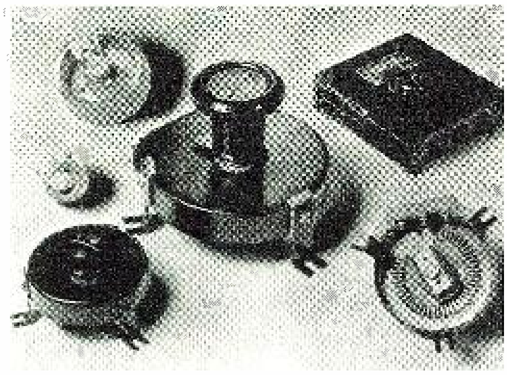
RELAYS

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.

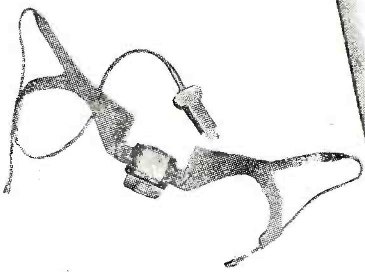
Ward Leonard Relays, Resistors and Rheostats are carefully designed and conscientiously made. They are conservatively rated to insure dependability and long life. They meet all the rigid requirements of service. Complete data Bulletins on the various products are available. Send for bulletins of interest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

WARD LEONARD

Electric control (WL) devices since 1892.

WARD LEONARD ELECTRIC COMPANY, 47 SOUTH STREET, MOUNT VERNON, NEW YORK

This is the now-famous Electro-Voice "Lip Mike" which began a new era in transmission of voice and the cancellation of ambient noises.



. . . and this marks the second step in the development of a full line of Electro-Voice Differential (noise-cancelling) Microphones.

Electro-Voice DIFFERENTIAL MICROPHONE

NEW MODEL 205-S

Designed, developed and built by E-V engineers and technicians

- Provides extremely high intelligibility even under intense surrounding noises
- A most efficient microphone for aircraft, factories, railroads, police and emergency services
- May be used in all temperatures from −40 to +185 degrees, and is interchangeable with conventional carbon microphones
- Close-talking, blast proof, waterproof and shock-resistant
- Operates satisfactorily in all positions
- Frequency response substantially flat from 100-5000 c.p.s.: high output level: −20 DB (0 DB = 1 volt/dyne/cm^2); internal noise level below .001 volt.
- Press-to-talk switch opens microphone and closes relay simultaneously, if desired
- High impact phenolic case, 4" x 2-5/16"; Fiberglas wind noise filter; weighs less than 8 ounces
- Cable length, 5 ft.; panel mounting on the back; available in two models: Model 205-S, and 205-SL with switch lock.

If your present limited quantity needs can be filled by any of our Standard Model Microphones, with or without minor modifications, please contact your nearest Electro-Voice distributor.

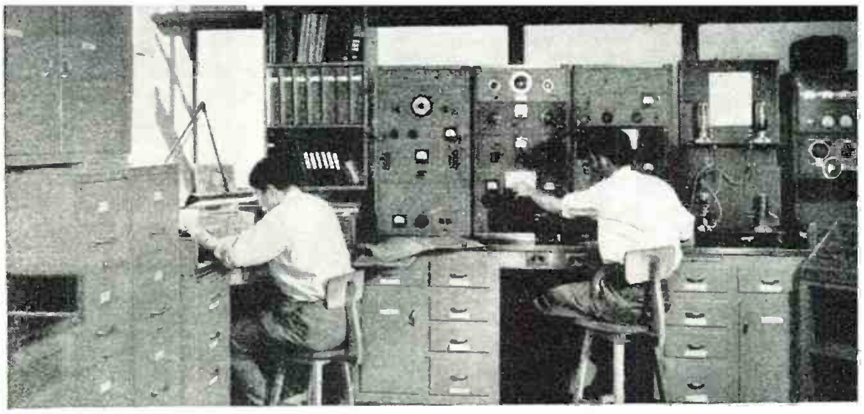
Electro-Voice MICROPHONES

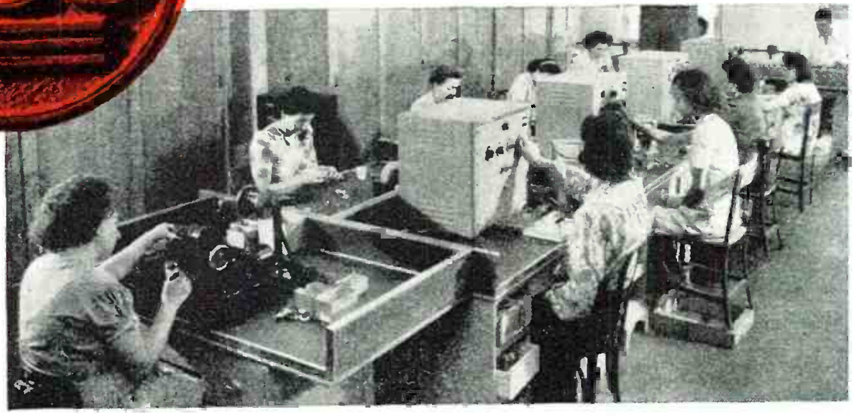
ELECTRO-VOICE CORPORATION • 1239 SOUTH BEND AVENUE • SOUTH BEND 24, INDIANA

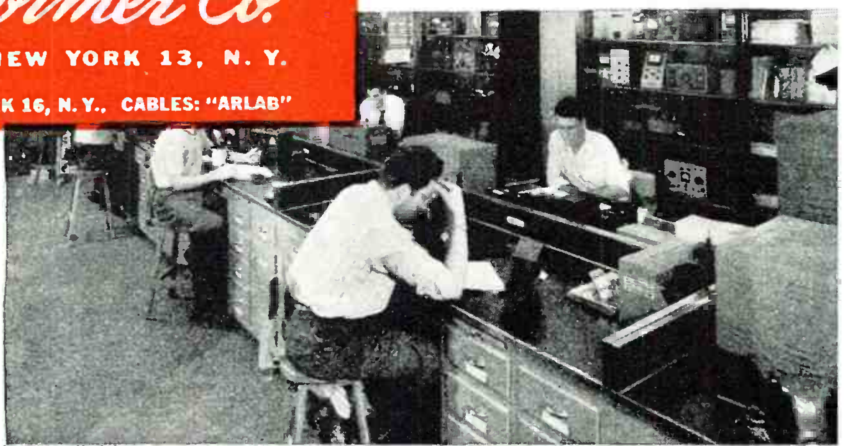
Export Division: 13 East 40th Street, New York 16, N. Y., U. S. A. Cables: Arlab

Engineering at UTC

A MAJOR FACTOR LEADING TO OUR PRESENT POSITION AS AMERICA'S LARGEST SUPPLIER OF TRANSFORMERS TO THE ELECTRONIC INDUSTRY







United Transformer Co.

150 VARICK STREET NEW YORK 13, N. Y.

EXPORT DIVISION: 13 EAST 40th STREET, NEW YORK 16, N. Y., CABLES: "ARLAB"

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

Spot Radio News

By RADIO NEWS Washington Correspondent

Presenting latest information on the Radio Industry.

WHEN V-E (VICTORY IN EUROPE) day comes, the world will learn about it in a matter of minutes, quite unlike the six-hour delay that prevailed in the first World War. According to Signal Corps officials, in less than a half hour from the moment the words "cease firing" are heard, the surrender message will be on the air. In 1918, although the Armistice was signed at five o'clock in the morning in Paris, it was not until eleven o'clock that the world knew, and hostilities were concluded. During this interim many men died needlessly. Signal Corps officials say that this time all corners of the world will be linked within several minutes for Armistice-word transmission.

Arrangements are also being made to provide for transmission of the surrender news to the Germans. This will be done by front-line public address systems, radio announcements in German on German frequencies if possible, or announcements in German on our frequencies. There are possibilities that a German official arranging for the Armistice will appear before an American microphone, and tell his troops and countrymen about the end of the European war.

The "cease firing" order will reach our troops through Army networks and will travel to tanks, jeeps, planes, walkie-talkies, field units, and fixed equipment throughout various theaters of the battlefield.

ANTICIPATING AN EARLY V-E DAY, members of the RIAC gathered recently in Washington to study postwar pricing of radio receivers. The RIAC (Radio Industry Advisory Committee) which was recently formed, met with officers of the OPA. Pricing committee members include: Benjamin Abrams, Emerson Radio & Phonograph Corp., New York; R. C. Cosgrove, Crosley Corp., Cincinnati; J. J. Nance, Zenith Radio Corp., Chicago; J. M. Spain, Packard-Bell Co., Los Angeles; A. S. Wells, Wells-Gardner & Co., Chicago; P. S. Billings, Belmont Radio Corp., Chicago; P. V. Galvin, Galvin Mfg. Corp., Chicago; E. E. Lewis, Radio Corp. of America, New York; E. H. Nicholas, Farnsworth Radio & Television Corp., Fort Wayne, Ind.; and Fred D. Williams, Philco Corp., Philadelphia.

Two schools of thought exist on pricing. Chester A. Bowles, OPA Administrator stated that prices prevailing in 1942 may be applied. However, James F. Byrnes, Director of War Mobilization has indicated that the prices may have to be higher than those that prevailed in 1942. No definite decision was made at the Industry-OPA meeting. There is belief however that receivers may be priced slightly higher because of increased production costs. As stated in previous columns here, it is expected in some quarters that the increase may be as high as 15%.

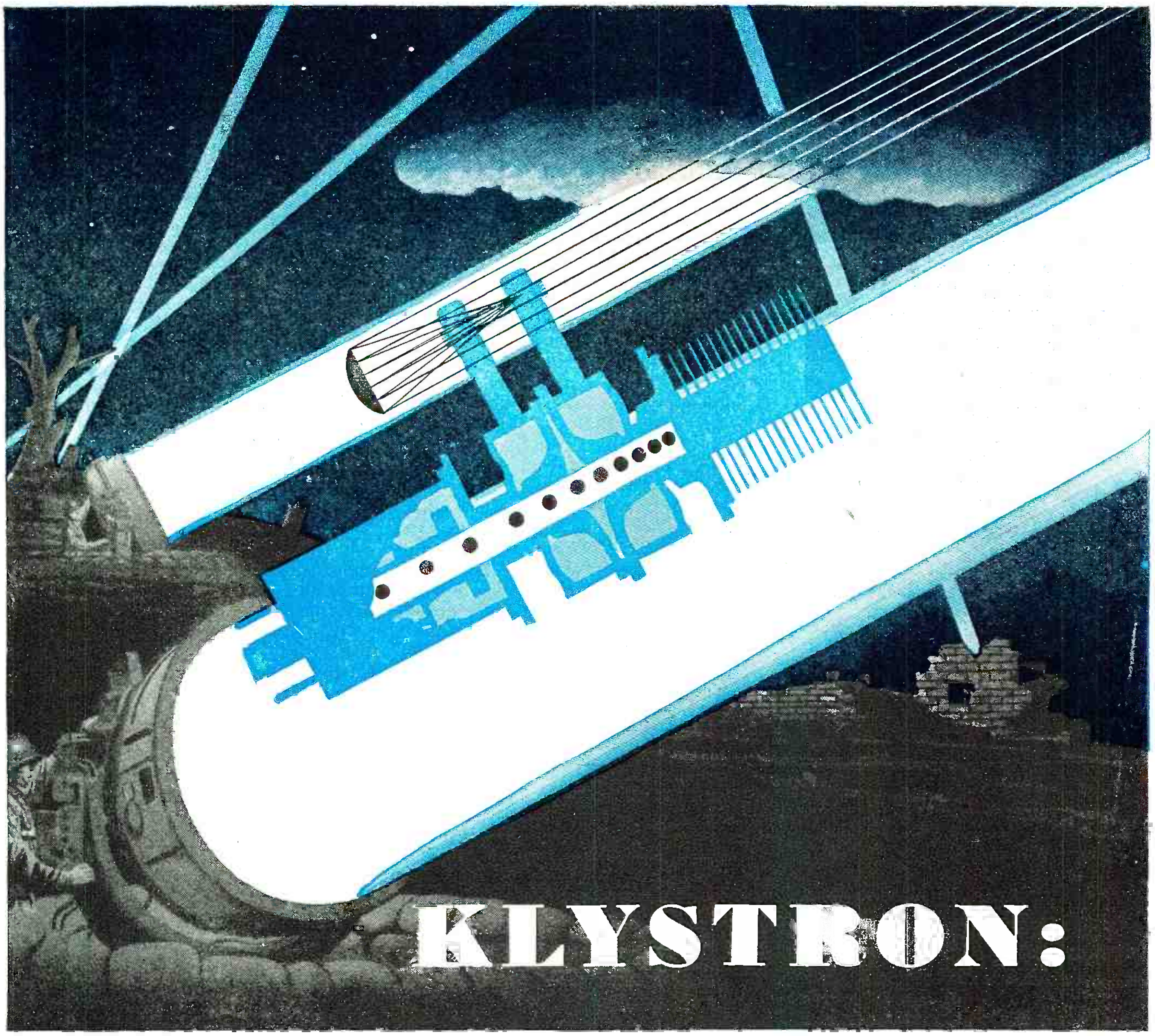
INVASION AND ITS TERRIFYING IMPACT plunged into the homes of Americans recently, when Holland was invaded. For the first time in broadcasting history an airborne invasion was described, with the boys plummeting to earth from the very plane from which the broadcast was being made. It was difficult to believe that as we listened, our boys were dropping down to grapple with the enemy below. Here indeed was a broadcast that will be inscribed in the scrolls of history.

FREQUENCY MODULATION AND TELEVISION will play major roles in our postwar broadcast era according to scores of experts who appeared at the recent war conference of the National Association of Broadcasters in Chicago. Emphasizing this trend, FCC Chairman Fly stated that the future seemed assured with respect to FM. He said that manufacturers are estimating the marketing of 5,000,000 FM receivers during the four years immediately following resumption of civilian production. The average radio receiver today is many years old, he said, and ready and eager for replacement. Postwar sets with FM and AM will serve to replace these receivers.

Television also offers unlimited potentialities for postwar expansion, emphasized Mr. Fly. He pointed out that the Commission has already licensed nine commercial television stations and sixty applications are pending. He said that he is confident that as soon as the practical applications of wartime advances have been worked out, television will be ready to move ahead on a tremendous scale. Discussing the timing of television advance, he pointed out that today the television outlook is clearer and more hopeful than ever before.

He said, "By harnessing this new knowledge of television immediately, it may be possible really to live up to the slogan of the future . . . you're there with a television receiver."

Mr. Fly also pointed out that he was aware of FM problems that were yet to be solved. Such problems which included bursts and secondary FM service were however "the mere growing pains of an important new venture;



A pencil of energy beamed like light

IF YOU'LL imagine an *invisible* searchlight beam, you'll have a good picture of how Klystron-generated radio waves can be directed into a narrow "pencil" of energy.

▶ This direction is accomplished by suitable reflectors. The beam of ultra-high-frequency waves travels in a straight line, and it can pierce fog, smoke, and clouds which would stop a light beam.

Sperry-developed Klystron tubes are used in many equipments now serving our Armed Forces. Later, *Klystronics* will open the door to the development of many ingenious peacetime devices.

▶ **Klystrons are now being produced in quantities, and certain types are available.**

The name "KLYSTRON" is a registered trade-mark of the Sperry Gyroscope Company, Inc. Like many other Sperry devices, Klystrons are also being made during the emergency by other companies.

Sperry Gyroscope Company INC.

GREAT NECK, N. Y. • DIVISION OF THE SPERRY CORPORATION

GYROSCOPICS • ELECTRONICS • AUTOMATIC COMPUTATION • SERVO-MECHANISMS and engineers are already at work to get the right answers." So that FCC engineers may be fully acquainted with FM propagation, a 50-watt, 40-megacycle station has been set up in Washington. Experimental operation of the station should provide many answers, explained Mr. Fly.

The FM television postwar impetus was also stressed, at this meeting, by members of a symposium, discussing postwar broadcasting. William Lodge, acting engineering director for CBS, said that FM offered an improved method of sound transmission and provided many existing broadcasting stations with an opportunity to improve their service. However, he said, it must be remembered that the standard band will remain the broadcaster's breadwinner and chief source of income for many years. It is doubtful too, he said, that the high-powered clear-channel AM station will be replaced within the immediate future as a means of providing widespread rural service. Discussing the coverage of FM stations, he said that they are not as limited as we believe. These signals, he said, are capable of following the curvature of the earth and of bending around buildings and even behind hills. He cited a one-kilowatt station which gave satisfactory rural service 25 miles beyond the optical horizon.

Commenting on the future of television, Mr. Lodge said that there are several pertinent problems that must first be solved before television reaches the point of wide acceptability. He said that at least 25-30 television channels are required to permit the growth of a comprehensive competitive nationwide system. However, because of the requirements of the Government and other safety-of-life services, it is not possible to secure that many channels on the presently proposed bands between 54 and 108 megacycles or the higher frequencies where only six scattered channels are provided, stressed Mr. Lodge. Therefore, he said, whether the television is transmitted on six-megacycle channels or sixteen-megacycle channels, it will be necessary to go to the very-high frequencies where there is sufficient room for the required channels. Describing the CBS approach to this television problem, he said that they are devoting their entire energy to the development of television in the 500-1000 megacycle region. CBS will continue to broadcast with their existing station, WCBW, to gather program experience, explained Mr. Lodge. However, technical development will be carried on at the high frequencies, he emphasized.

Major Edwin H. Armstrong also appeared on the symposium discussing frequency modulation. Analyzing the problem of bursts, Major Armstrong said that he, Commander De Mars, and Pickard had disclosed in 1940 that bursts were not a serious detriment to FM. He said that the multiple-path distortion problem was also of no importance to FM. He cited that this propagation problem was investigated in 1938. Major Armstrong then went on to discuss sun-spot activity. He said that there is no doubt that this phenomenon is annoying. However, he pointed out that the period of time thus far indicated when trouble from the sporadic-E may be expected over any appreciable area of a station's coverage was negligible.

He said, "The best opinion on the subject is that the disturbance will not be serious. It is important to keep in mind the fact that there is no perfect wavelength. Whatever the annoying factor may be, the FM system is the one best able to combat it."

An interesting discussion of facsimile was presented by the well-known engineer-inventor John V. L. Hogan, during the symposium. He said that 1933 facsimile was limited to the transmission of about three-square inches of pictures or about sixty words of text per minute. In 1941 this speed had been increased to about ten-square inches of pictures or two-hundred words of text per minute. Today, he said, it is possible to deliver a forty-eight square-inch picture or about one-thousand words of text every minute.

He pointed out that facsimile is quite simple to network, while the transmitter cost is as low as that of a sound transmitter. Receivers, he said, will probably cost about as much as an ordinary receiver, plus the additional cost of a recorder which would run from about $20 to $100.

Discussing the probable standards of facsimile in the postwar era, he said that these will probably be 4" by 2" columns, 9" paper, 100 lines-per-inch and 600-800 words per minute. In conclusion, Mr. Hogan said that he believed that after the first five years facsimile may provide more receiver hours of use than television and at a far lower cost-per-hour of service.

The public value of facsimile was also stressed in a recent report by the RTPB panel 7. This report revealed that home broadcasting by facsimile is destined to become a service of great public value and that accordingly adequate channel assignments should be provided for the growth and utilization of such service.

THE EDUCATION-VIA-FM MOVE in the U. S. Office of Education has gained quite a bit of momentum during the past weeks. It appears as if there are now 31 states who have either indicated an interest in the program, completed plans for installation or already have complete installations. Specifically, three states are in the process of completing their plans, fourteen more are in the preparatory stages, while five educational systems are already in operation. These five are located in Cleveland; New York City; Champaign, Illinois; Chicago; and Kentucky. FM is used exclusively by all stations which, incidentally, are controlled by the State Boards of Education. The U. S. Office of Education radio division, plays an

advisory part by preparing tentative plans for the state upon request. These plans provide data on location of stations in the state, coverage, power, network links, cost and other technical details. When the State of Michigan recently applied, they were told that about five stations would be necessary to cover their State. Accordingly, plans are now being made for the erection of a 50-kilowatt station near Ann Arbor, another in the vicinity of the Grand Rapids area and the three others at strategic points within the state.

The states will spend between $10,000 and $45,000 for each station, depending upon power and type of installation and studios.

The greatest problem facing the schools appears to be the limitation of channels. A minimum of 22 channels are deemed necessary to serve such areas as the Atlantic States, but unfortunately only five are available. Incidentally, the recent RTPB report of panel 2 allots the 41- to 43-megacycle band for educational broadcasts.

The problem of allocation will probably be discussed again during the FCC allocation hearings, which began on September 28. Every effort will be made to secure more bands. Educational groups who will appear to present their views on the subject will include: The National Association of Educational Broadcasters; the Baltimore State Department of Education; The National Association of State Universities, Columbus, Ohio; National Congress of Parents and Teachers, Chicago, Illinois; University of Michigan; and the National Education Association representing Georgetown Graduate School.

EARLY 1945 MAY SEE a unique production show at the Chicago Coliseum, in which radio and particularly television will play a major role. Plans recently revealed indicate that the show, which will be backed by the National Congress for the Presentation of Products of Tomorrow, will have many exhibits including a television studio of tomorrow which will be on demonstration. It is planned to produce actual programs to be witnessed by a huge audience. Working models of television receivers are also expected to be spotted around the convention hall to permit spectators to view the television broadcasts. An assortment of frequency modulation, combination receivers, auto sets, etc., will also be exhibited according to present plans.

RADIO HAS FINALLY OUSTED WIRELESS in England. Hereafter the Wireless Section of the Institute of Electrical Engineers in London will be known as the Radio Section. To accommodate this change, a modification of the description of the section has been changed. In the new ruling the scope of the section is described as: "the section shall include within its scope all matters relating to the study, design, manufacture or operation of apparatus for communication by wave radiation, for high frequency and electronic engineering or for the electrical recording or electrical reproduction of sound."

THIRTEEN-MILLION RECEIVERS ARE EXPECTED TO BE MADE in the first year following Germany's surrender, provided there are no production restrictions. Such was the estimate provided by Government spokesmen at a recent Radio and Radar Industry Advisory Committee meeting in Washington, supervised by Ray C. Ellis. Since production restrictions do not appear to be imminent, there is a general belief that this output will be maintained. According to some of the members of the industry who attended the conference, it is entirely possible that receivers may start flowing off the production line as early as sixty days after V-E day.

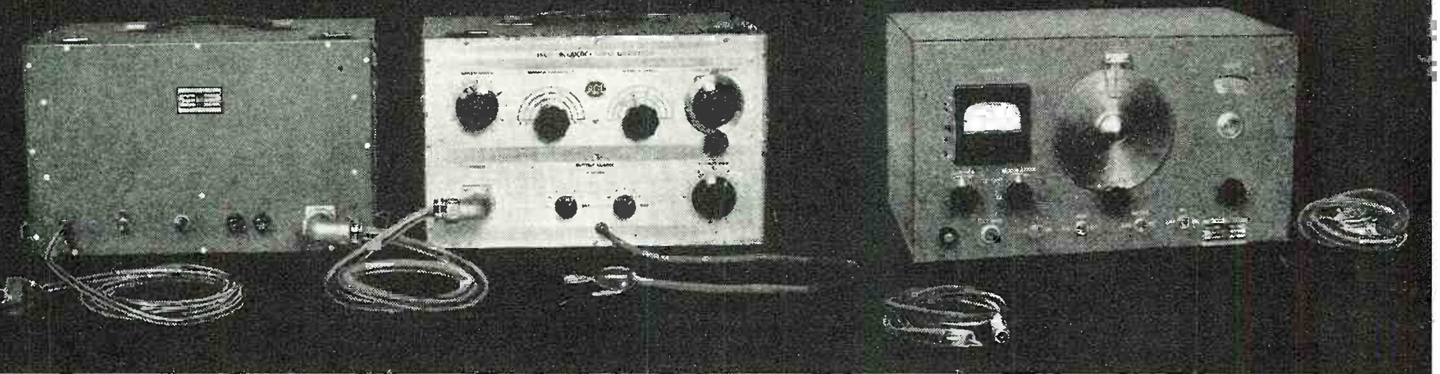
In a discussion of the Army and Navy requirements, Louis J. Chatten, assistant director of the Radio and Radar Division, pointed out that the present rate of $232,000.000 a month, effected July 1. will have to be increased to $270,000,000 in November; thus an increase in production of 16.4% is being effected by the industry.

The important problem of increasing subcontracting on the West Coast was also discussed at this meeting. According to members of the industry, companies in the Midwest and East have been unwilling to let subcontracts on the West Coast because of the distance. A suggestion made called for an allotment of prime contracts of some of the simpler types of equipment to a large West Coast producer, with the stipulation that a certain percentage be subcontracted to smaller facilities there. The suggestion also stated that enough of other subcontracts should be available in other parts of the country to make up for what would be taken from the companies now getting this type of subcontract.

The continuing problem of manpower was disclosed by Harold Sharpe assistant director of the Radio and Radar Division for Manpower. He said that the industry is faced with a problem of recruiting about 20,000 more employees. According to WMC estimates, about 12,000 a month will have to be found to replace those who are resigning. The chief manpower shortages exists in the industries concerned with dry cell batteries, transformers, wire, etc. The chief difficulty according to WMC is that most of the plants are located in labor shortage areas, such as Chicago, Philadelphia, Newark, Buffalo, Syracuse and Schenectady. Incidentally, during the discussion of essential and critical industries, radar was the only branch of the industry classified as critical.

Among those who attended the meeting were M. Cohen of Sickles Company; Ray C. Cosgrove, Crosley Radio; George W. Henyan, General Electric; W. P. Hilliard, Bendix Radio;

2 POPULAR RCA INSTRUMENTS
for high-precision measurement work



RCA High-Frequency Wide-Band Sweep Generator *Type 709 B*

RCA Ultra-High Frequency Signal Generator *Type 710 A*

THE big job is done—valuable development, production and field test experience are combined in two quality products—the 709 B Sweep Generator and the 710 A Signal Generator. Here are two instruments every Television, FM and H.F. Laboratory can rely on for postwar design applications.

The 709 B Sweep Generator covers the frequency band of 5 to 65 megacycles (center frequency). It is ideal for high frequency I. F. curve response study. Its calibration marker permits constant checking of band width characteristics.

The 710 A Signal Generator, with a frequency range of 370 to 560 megacycles, is widely used for checking high frequency devices. This instrument provides smooth and complete attenuation throughout its range, plus precision frequency control.

Planning your postwar activity means planning your laboratory facilities as well. Now is the time to investigate the characteristics of these reliable RCA instruments.

RCA bulletins containing complete descriptions and specifications of the 709 B Sweep Generator and the 710 A Signal Generator will be sent promptly on request.

Please note that deliveries of these instruments are subject to regulations of WPB General Scheduling Order M-293.

Buy More War Bonds

RCA

RADIO CORPORATION OF AMERICA

RCA VICTOR DIVISION • CAMDEN, N. J.

In Canada:

RCA VICTOR COMPANY LTD., MONTREAL

W. F. Hosford, Western Electric; E. E. Lewis, RCA; Percey L. Schonen, Hamilton Radio; Joe M. Spain, Packard-Bell Co.; and A. S. Wells, Wells-Gardner & Co.

HURRICANE WINDS WHICH STRUCK THE EASTERN COASTLINE sometime ago played havoc with broadcast stations, power lines and fire-alarm systems. While the broadcast stations did not suffer too much, thanks to emergency equipment, the wired fire-alarm network was inoperative for several days, a condition that could have been avoided had an emergency radio system been in use. Such a system had been suggested many times but was pigeonholed each time. Expensive, unnecessary and impractical, were the answers given to proposals for such a system at each session. Had such a system been in operation during the storm, many more fire calls could have been put through, hurricane damage could have been further minimized and it would not have been necessary to burden the already overburdened telephone lines with fire-alarm calls. There is hope now that the hurricane has taught a lesson, and that real consideration will be given to an emergency radio network. Such a network will offer invaluable service on many fronts.

The schedules of three stations were upset by the hurricane. These stations were WOR, WEAF and WHN. WOR was off the air only four minutes; WEAF was off the air for twenty-two minutes and WHN was off the air for several hours. CBS's FM antenna suffered the major catastrophe. The eighty-five foot scaffolding surrounding the antenna atop a sixty-story building was nearly completely blown down.

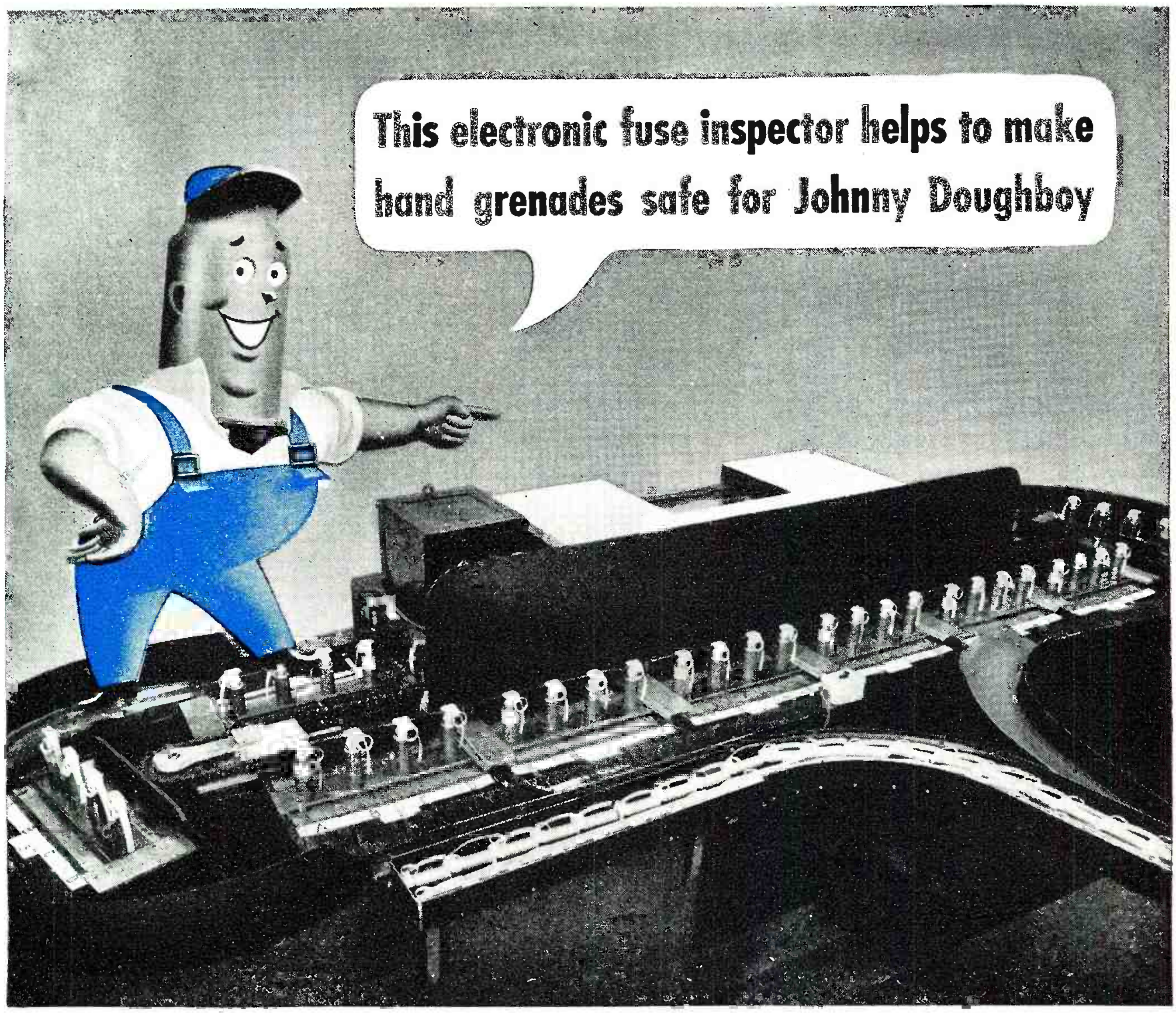
The WERS played an effective role during the storm, assisting the police, fire department, and others in the protective branches of the City. Special broadcasts over local stations brought scores of WERS workers to hurricane scenes. They performed admirably, linking completely isolated areas. Many lives were saved, thanks to their activities. In addition, their efforts minimized damage in the amount of thousands of dollars. A round of applause to WERS.

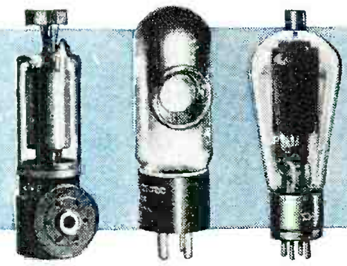
OVER SIXTY-MILLION RECEIVERS are distributed at present, in homes, automobiles, businesses, institutions, hotels, etc., according to a survey recently completed by the National Association of Broadcasters. They report that on the average there are 1.4 receivers in each home, providing a total of 46,300,000. Automobiles account for 9,000,000 receivers, while offices, hotels, restaurants and other institutions account for 4,700,000 receivers. Oddly enough, 3,000,000 new radio homes were established since 1942, by way of receivers from dealers' stocks, repairs and modifications of antiquated receivers. A field research by the Bureau of Census for the Office of Civilian Requirements of WPB indicated that only 15% of receivers have been temporarily out-of-order, with a large percentage of these receivers in homes having more than one set. This same source also cited that there are 33,716,000 radio homes as of April, 1944.

NAB also reports that between 18,000,000 and 20,000,000 tubes have begun to be made available, effective in July and continuing on to December. NAB reports that blackmarket tube operations should disappear entirely in 1945. They say that a large number of merchants have been solicited by black market operators to take over tube stocks at a 40% discount. It appears, therefore, as if the tube problem is on its way to a solution, at long last.

INDUSTRIES IN TWENTY-FOUR STATES and the District of Columbia have become television-conscious, FCC applications reveal. Applicants in California include: Warner Bros., (Hollywood); Hughes Productions Inc., National Broadcasting Co., Earle C. Anthony, Inc., Consolidated Broadcasting, Inc., and Blue Network (Los Angeles); Broadcasting Corp. of America (Riverside); Don Lee Broadcasting System, Associated Broadcasters Inc. and Hughes Productions Inc. (San Francisco); E. F. Pfeffer (Stockton); and J. E. Rodman (Fresno). In Colorado, the KLZ Broadcasting Company of Denver has made application. In Connecticut, the Travelers Broadcasting Service of Hartford and the Connecticut Television Co. of Greenfield Hill are applicants. NBC, Dumont, Philco, Bamberger and the Capital Broadcasting Co. are Washington, D. C., applicants. In Jacksonville, Florida, the Jacksonville Broadcasting Co. has made application. CBS, NBC, WGN and the Blue Network are Chicago applicants. In Indiana, WFBM of Indianapolis and Farnsworth of Fort Wayne are television applicants. Louisiana has two applicants: Maison, Blanche Co. and Loyola University of New Orleans. In Maryland, the Tower Realty Co., Hearst Radio and Joseph M Zamoiski of Baltimore have filed applications. Westinghouse, Dumont, General Television, E. Anthony & Sons and the Yankee Network of Boston are television applicants. In Detroit, Michigan, applicants are: WJR, International Detrola Co., King Trendle Broadcasting Co., United Detroit Theaters Corp., and the Jam Handy Organization. Missouri is represented by the Pulitzer Publishing Co., Glow-Democrat Publishing Co. and Alfco Co., all of St. Louis. Cleveland, Ohio, is represented by NBC, WGAR, and United Broadcasting Co. New York City has the Blue Network, Bamberger Broadcasting Service, Metropolitan Television Inc., Philco, and the Daily News. In Philadelphia, WCAU, WFIL, WDAS, Westinghouse, the Philadelphia Inquirer, Seaboard Radio Broadcasting and the Bamberger Broadcasting Service, are all applicants. Other States include Ne-

(Continued on page 131)





A G-E X-ray tube (1), a G-E phototube (2), a G-E thyratron tube (3), and several G-E amplifier tubes are the "eyes and brains" of this ingenious machine.

To safeguard our fighting men, hand grenades must be flawless—*every* fuse must be timed to split-second accuracy.

From the engineering laboratory of General Electric has come an automatic X-ray inspector—the first of its kind—which checks time fuses at the incredible rate of 4000 an hour . . . with the unerring accuracy no other inspection method can even approach.

A movable belt carries the fuses through the penetrating beam of a 100,000-volt G-E X-ray tube which casts its glow on a fluorescent screen. A G-E phototube, or "electric eye," inspects the glow. If constant, verdict is "O.K." If intensity changes, powder charge is inadequate for proper timing. Instantaneously, a four-way alarm is given . . . a bell rings; a red light flashes; the imperfect fuse gets a dab of red paint; a photo-electric meter chart records the "dud."

It is the purpose of G-E electronic tube engineers to aid any *manufacturer* of electronic devices in the application of tubes. Through its nation-wide distribution system, G. E. is also prepared to supply *users* of electronic devices with replacement tubes.

FREE BOOKLET ON ELECTRONIC TUBES

Send us the names of interested men in your plant. We will mail them, without charge, an illustrated, easily understood book on "How Electronic Tubes Work." 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-C-1-8850

. . . "Among their Latest Triumphs is an inter-communicating telephone for interior use in buildings, which furnishes in itself, by pressing buttons, complete exchange connections, with all parts of the building, and releases the same automatically and comprises the only successful system of its kind of the present age."

The glowing phrases above, written not long after the turn of the century, describe a Connecticut Telephone and Electric "First" which doubtless caused grandpa to wonder, "What won't they think of next!"

The things our engineers are thinking up today in cooperation with U. S. Army engineers are full of interest and promise, but they can't be talked about now. You can count on better communications... in fact, you can confidently expect war-born improvements in all branches of electrical and electronic science.

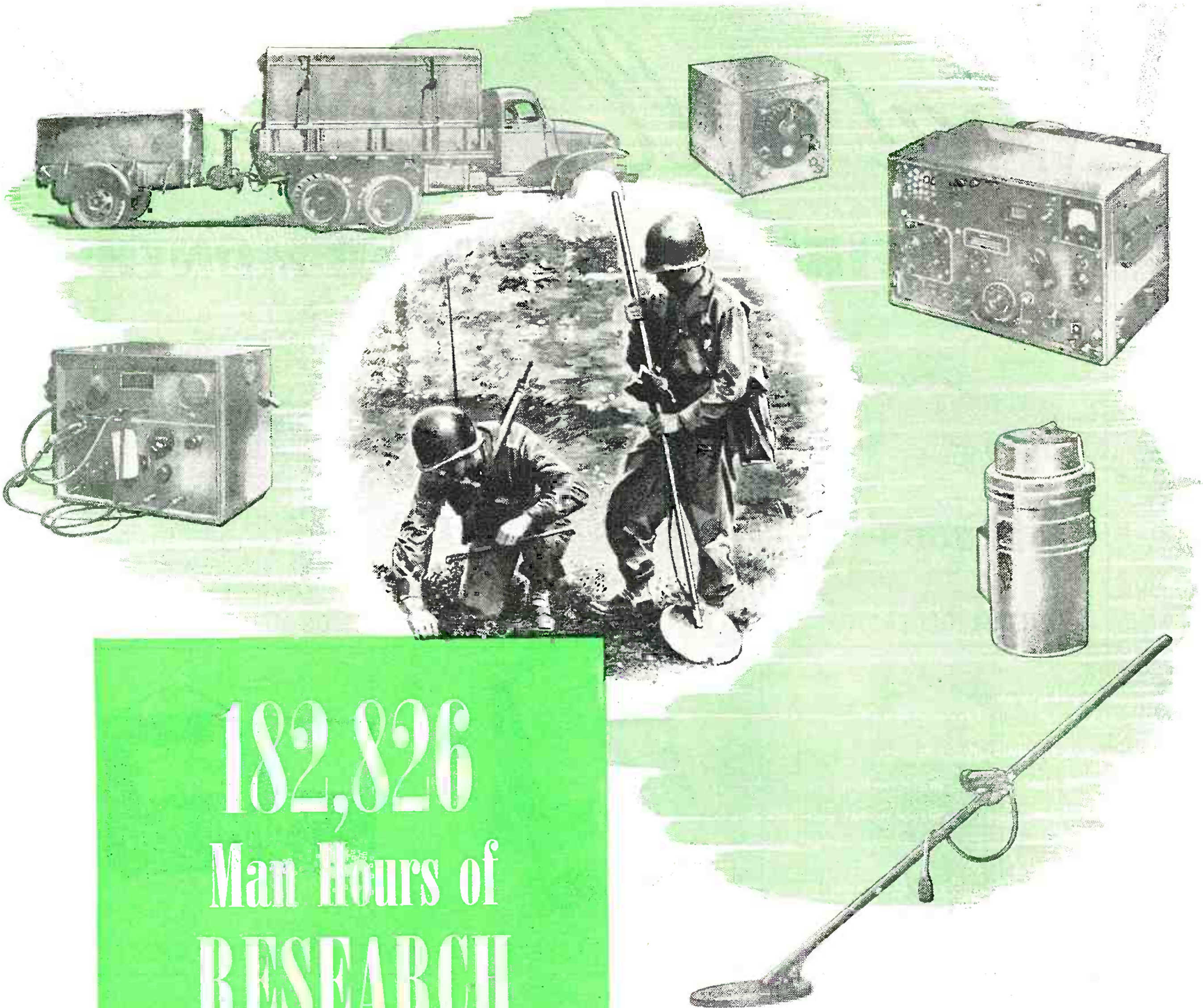
If your product-development plans involve a problem of electrical or electronic engineering and manufacturing, perhaps we can be of assistance. We also invite preliminary inquiries connected with inter-communicating and signalling systems for postwar buildings now in the design stage.

CONNECTICUT TELEPHONE & ELECTRIC DIVISION

GREAT AMERICAN INDUSTRIES, INC.

MERIDEN, CONNECTICUT

TELEPHONIC SYSTEMS • SIGNALLING EQUIPMENT • ELECTRONIC DEVICES • ELECTRICAL EQUIPMENT • HOSPITAL AND SCHOOL COMMUNICATIONS AND SIGNALLING SYSTEMS • IGNITION SYSTEMS



182,826 Man Hours of RESEARCH

Since Pearl Harbor, International Detrola research engineers have logged this amazing total in their successful efforts to develop and improve Mine Detectors, Aircraft Radio Transmitters, and Receivers, and many other important military electronic devices. The company's other engineering groups also have made great contribution to the quality and volume of electronic weapons streaming from its efficient Detroit assembly lines to the many battlefronts of Victory. The same engineering inventiveness and trained imagination will be an inseparable quality of Detrola-built Radio Receivers, Television Receivers, Automatic Record Changers, and other electronic instruments.

DETROLA RADIO

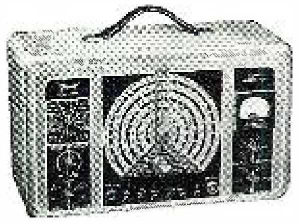
DIVISION OF INTERNATIONAL DETROLA CORPORATION • BEARD AT CHATFIELD, DETROIT 9, MICH.

C. RUSSELL FELDMANN dr PRESIDENT

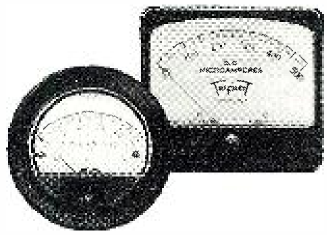
BUY MORE WAR BONDS

What will you need

IN THE FIRST SIX POST-WAR MONTHS

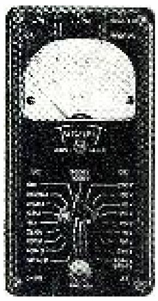


SIGNAL GENERATORS



PANEL INSTRUMENTS

VOLT-OHM-MILLIAMMETERS



POCKET TESTERS

TUBE TESTERS

VOLT-OHM-MILLIAMMETERS

✓ CHECK THE TYPES AND QUANTITY

NOW—right now—is the time to protect your post-war business by estimating your future equipment needs. Check those needs, list them and place a *tentative post-war order* with your jobber now. This foresight will enable him to stock the Triplett instruments you will need, and will assure you quicker resumption of civilian business than you could expect if you wait till the last minute. Give best priority you can obtain to facilitate deliveries as production is available.

Newly perfected developments now being produced on important war contracts, and many other outstanding instruments, will be incorporated in Triplett offerings for the first time beginning with our initial civilian production. Be sure you get the complete list of Triplett instruments and radio test equipment.

Triplett

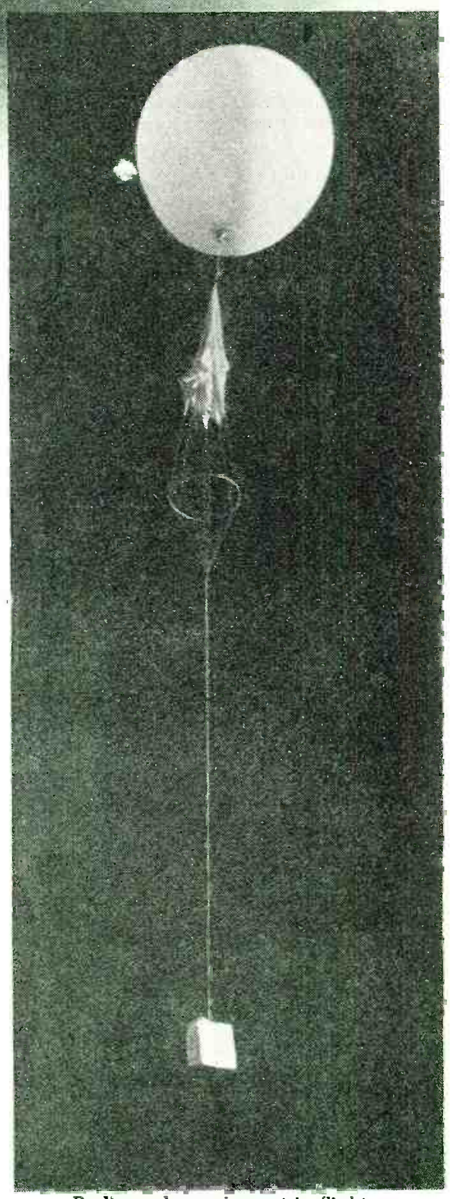
ELECTRICAL INSTRUMENT CO.

STANDARDS ARE SET BY TRIPLETT

BLUFFTON OHIO ★★★

WEATHER and WAR above the Clouds

Formation of Army bombers heading towards target. The radiosonde equipment has made possible complete analysis of weather conditions at the higher altitudes.



Radiosonde equipment in flight. These balloons are capable of reaching stratosphere heights.

By W. R. THICKSTUN and M. L. BLANC*

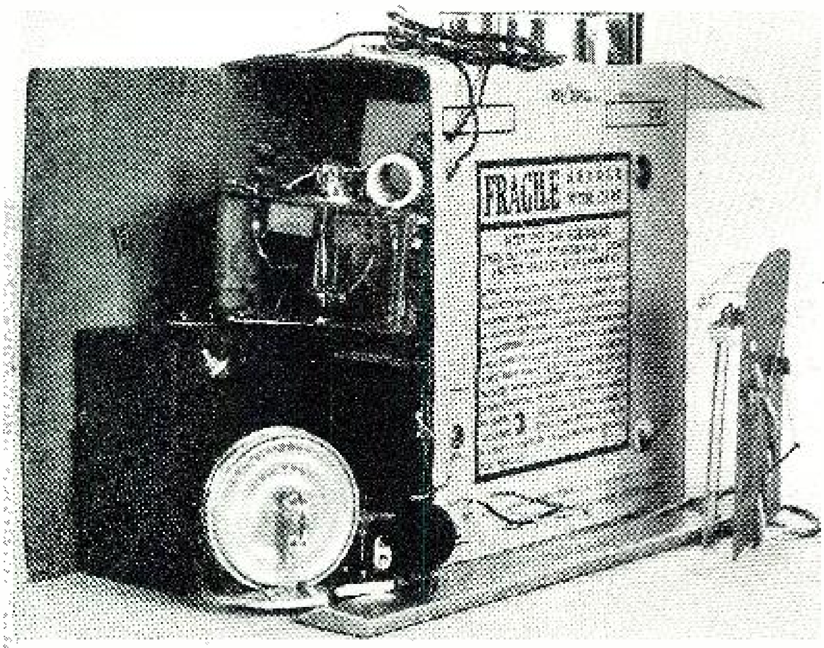
The progressive developments, since World War I, of forecasting the weather, by means of instrument-carrying balloons.

IN A large measure, World War II is a war in the air and therefore it is a weather war. When low clouds and fog pin our bombers and fighters to the ground, submarines operate with impunity, surface craft sneak up on their objectives and tanks may become masters in ground actions. But when the clouds break away, the roar of hundreds of aircraft, signals a change in the course and character of battle. The side which can foretell the weather most accurately has a tremendous advantage: Weather forecasting has become an indispensable part of the tactics and strategy of war.

During World War I, great strides were made in beginning one form of upper air investigation. At night the Allies saw small lights rising above German trenches. They soon discovered that these lights were attached to small rubber balloons which the enemy was using to measure wind directions and velocities in the upper levels for use in figuring ballistic winds and in making forecasts for aircraft.

However, it has been found that the information obtained from these "pilot" balloons, which give only wind direction and velocity while in sight, is not enough. Whenever there are clouds or fog the balloons are likely to be lost and very little information is obtained. In addition, temperatures, humidities, and pressures aloft are needed before a clear understanding of the structure of the upper air is possible. Attempts to obtain this data have been carried on for some

**Mr. Thickstun is at present Chief of the Instrument Division of the U. S. Weather Bureau and is assisted by Mr. Blanc, an expert in the Division of Synoptic Reports and Forecasts.*



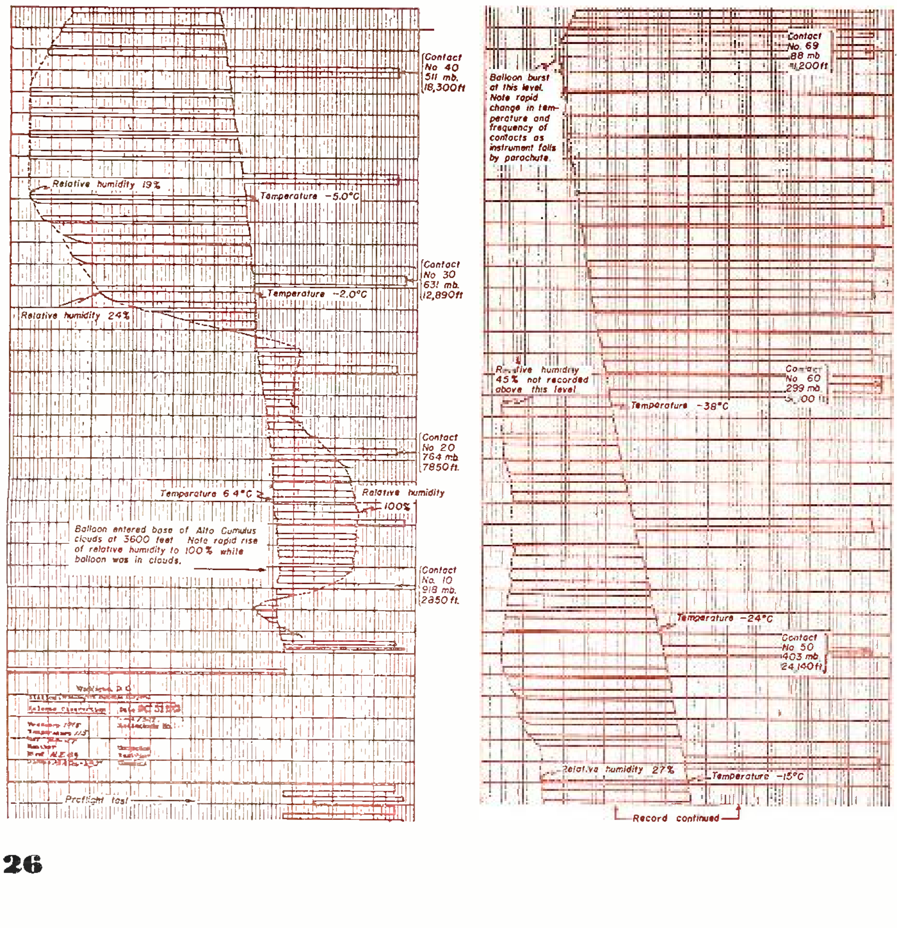
Weather Bureau radiosonde unit. Pressure switching element is at lower left in front of battery. Humidity and temperature unit is shown at lower right.

Unit weighs approximately two pounds and is later covered with foil to reflect solar rays.

time through the use of various devices. For example, the Weather Bureau formerly used meteorographs containing recording instruments sent aloft by kites. The height to which kites can climb is limited and it is not possible to obtain the information on regular schedule since conditions of wind, cloudiness, storms, and lightning hazard greatly affect the possibility of making successful kite flights.

Meteorographs can be attached to the wings of airplanes for exploring the upper air. Such flights can be made to higher elevations and with a greater degree of regularity than with kites, but even these flights are limited to some extent in height and are further limited in their regularity because of adverse weather conditions.

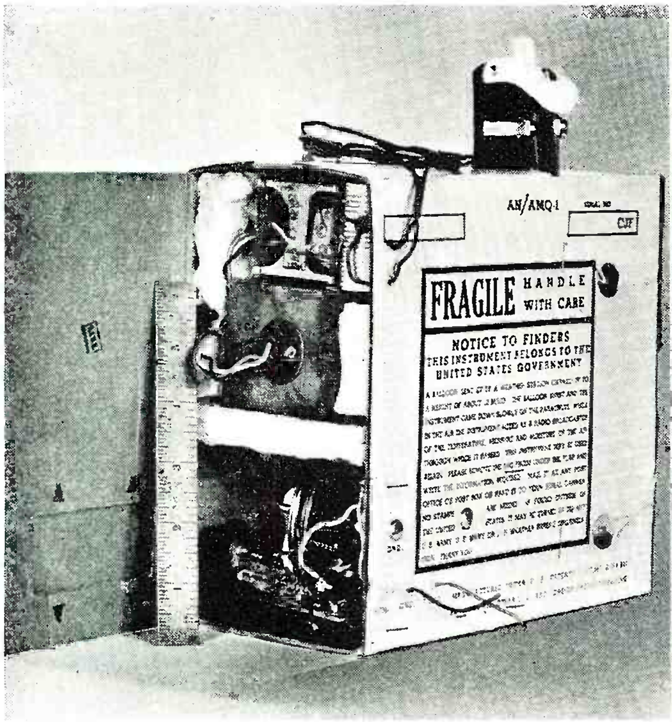
Fig. 1. Reproduction of the potentiometer-type record sheet used by the Weather Bureau.



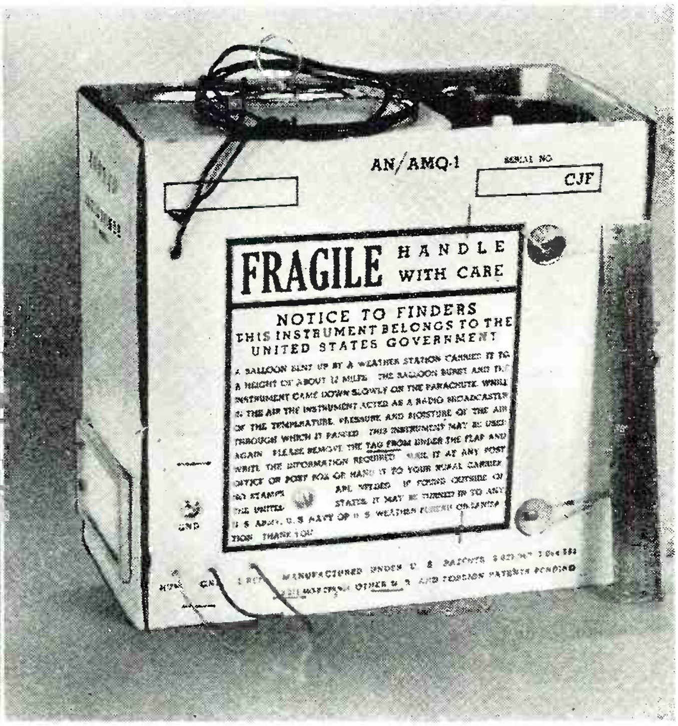
Light meteorographs can be attached to unmanned free balloons which are allowed to rise into the upper atmosphere. These flights reach desired altitudes and are not hampered to any great extent by weather conditions. In such flights, the balloon expands gradually as the surrounding air pressure decreases with altitude until it finally bursts. The meteorograph then descends gently to earth supported by a parachute. The automatic records kept by the instruments are available for study and computation when the meteorograph is returned by its finder to the office of release or to a central collecting office. A few instruments, of course, are never found but a high percentage are eventually returned. However, collection of the information by this means involves too much delay so that it is available only for research and is too old for use in making current weather forecasts.

To overcome this objectionable feature and to make the data immediately available, it was necessary to devise means for transmitting the information to the ground station while the balloon is in flight. Radio showed promise, but very serious technical problems had to be solved in connection with the design of weather instruments and radio devices that would transmit the information to the ground station and yet be light enough to be sent aloft by means of a small, free balloon.

Early attempts at transmitting weather data by radio from free balloons were made by a number of investigators. In 1921, Herath in Germany was experimenting with a spark transmitter sent aloft by a balloon.



Location of parts within the radiosonde unit. Temperature and humidity elements being lowered into open tube at rear of case.



Case containing pressure switching element, battery, and radio set is closed. Temperature and humidity elements remain open.

The signals were too weak to be received at any distance so the experiment was not very successful. Two years later, in 1923, similar experiments were carried on by the U. S. Army Signal Corps with somewhat better results. Four years later, in 1927, some experiments were carried on in France, in which vacuum-tube transmitters were used. The signals which resulted were strong enough to permit reception until the balloon reached the stratosphere. The following year some experiments were made with a lighter and much improved instrument and during the succeeding years various investigators, working with the Weather Bureau, the Bureau of Standards, and the Army Signal Corps, contributed to the art until, by 1936, instruments had been developed which made possible the beginning of a regular program of upper-air soundings.

On December 10, 1936, a radio meteorograph was released from Blue Hill Meteorological Observatory near Boston, and a successful sounding was made up to 25,000 feet. The information was successfully received at the ground station, the necessary computations were made and the data was transmitted to the United States Weather Bureau at Washington for immediate use. This radiosonde flight was the first successful one in this country from which the results were immediately available for forecast work. During that month several more flights were made, some reaching as high as 70,000 feet. The experience gained with these flights led to improvement and standardization of the procedures so that by June 1, 1938, a regular program of radiosonde flights was begun. The program was carried on through cooperation of the Weather Bureau, Navy, and Coast Guard.

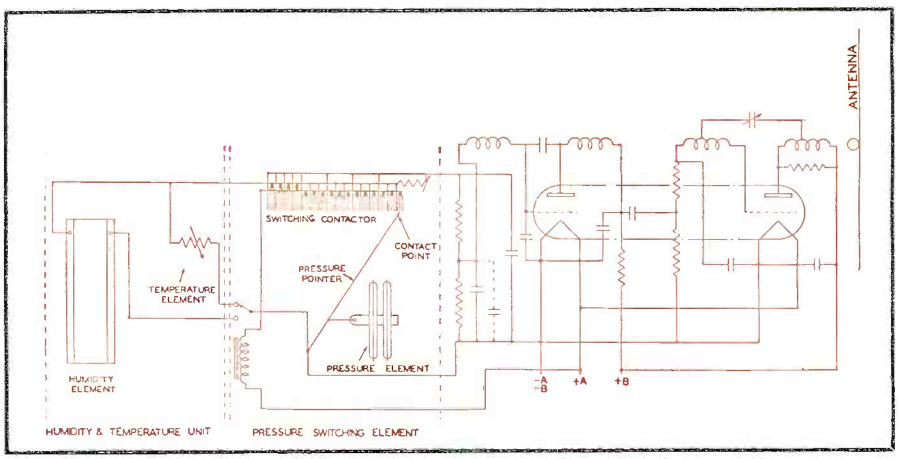
To illustrate the remarkable growth of this phase of meteorological investigation, it is interesting to note that in 1938 the Weather Bureau operated only six stations for regular radiosonde observations. Five years later the Weather Bureau maintained more than 60 stations, making regular twice-a-day radiosonde flights. In addition, the Armed Services have established a large number of stations in various parts of the world to furnish necessary information for their operations.

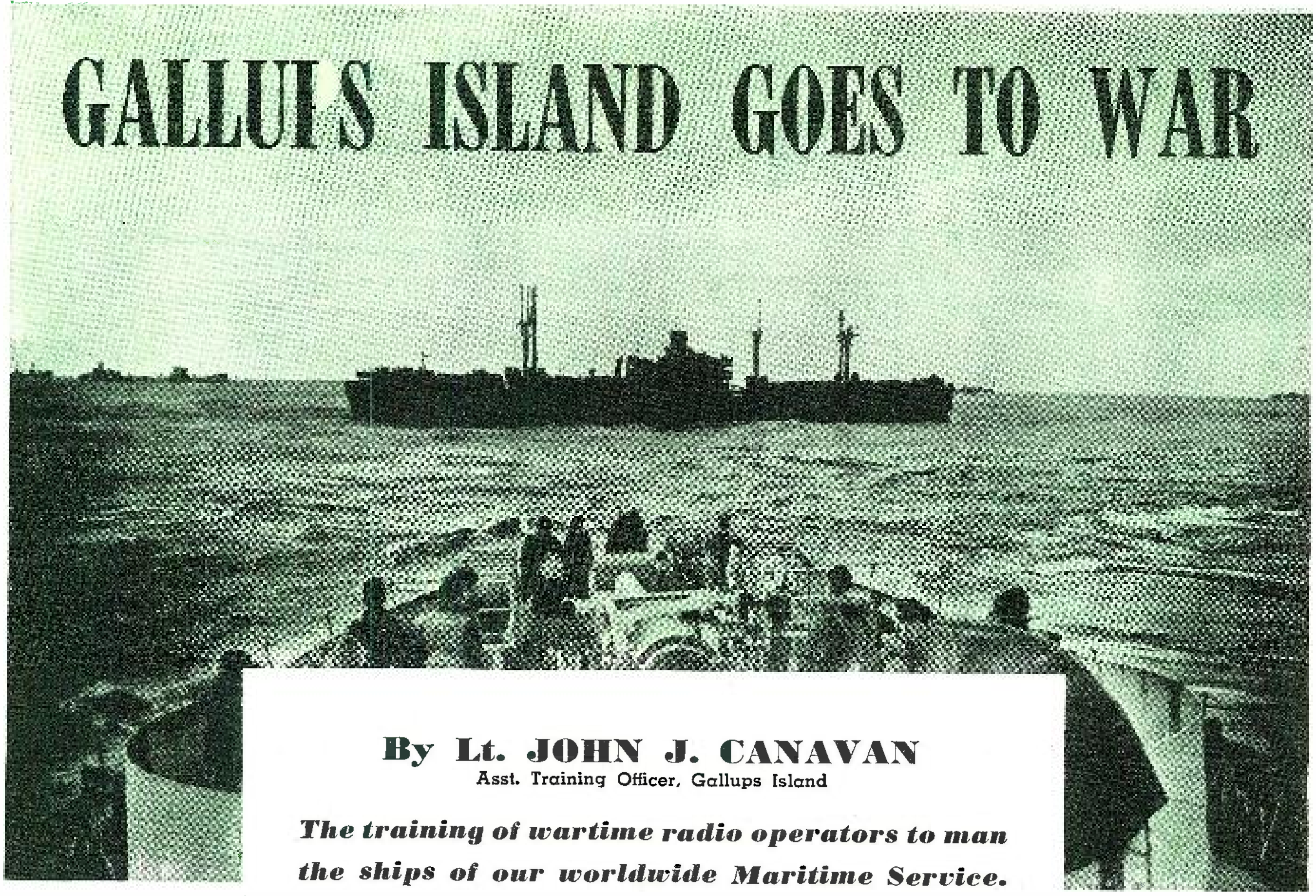
The radiosonde instrument which gradually evolved from the experience and experiments of these investigators is shown schematically in Fig. 2. The basic radio principle is the emission of a carrier wave having an audio-frequency modulation which varies according to the resistance of temperature and humidity elements which, in turn, varies in accordance with changing meteorological conditions.

The essential meteorological recording elements (pressure diaphragm, humidity element, and temperature element) are shown in the diagram. The construction details of the humidity and temperature elements have varied and continue to vary from time to time as refinements in procedures are introduced. Both elements employ some means whereby a change of temperature or humidity in the surrounding air produces a relative change in the resistance of the element. Temperature tubes, containing an electrolytic solution which varies in resistance with temperature, have been used quite successfully. Recently, a carbon-resistor type of temperature element has been introduced and is replacing the liquid type. Hair hygrometers have been used in which changes in the length of the hairs operate a

(*Continued on page* 112)

Fig. 2. Circuit diagram of the Weather Bureau radiosonde unit.





GALLUPS ISLAND GOES TO WAR

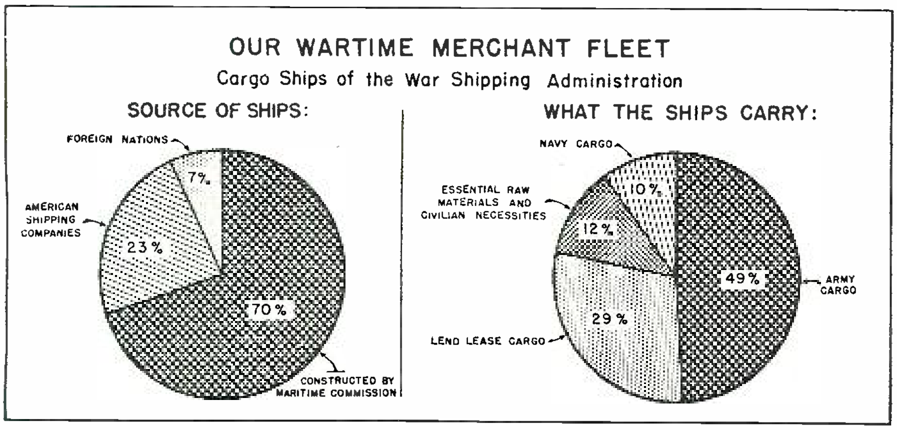
By Lt. JOHN J. CANAVAN
Asst. Training Officer, Gallups Island

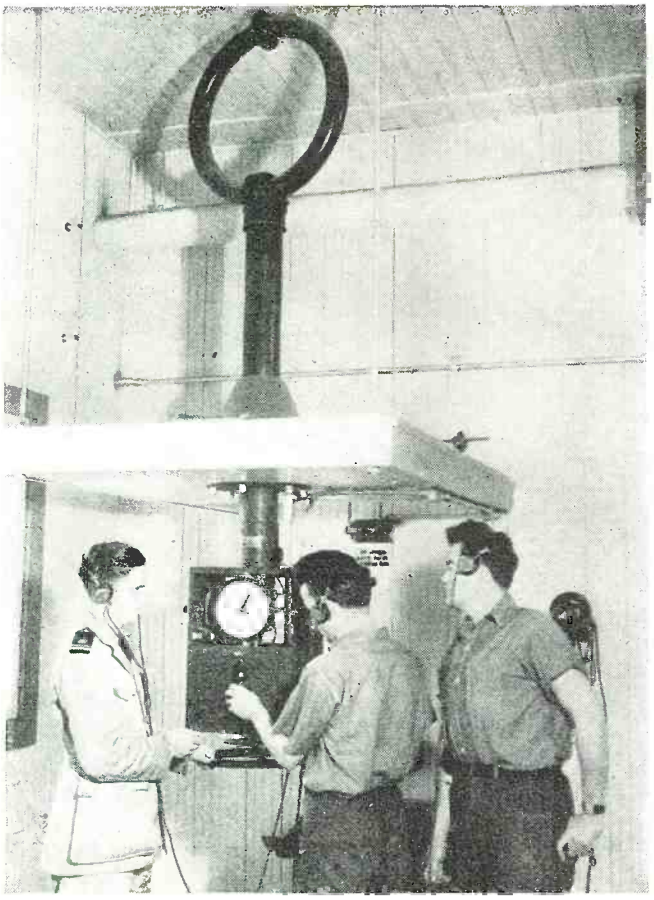
The training of wartime radio operators to man the ships of our worldwide Maritime Service.

THE story of Gallups Island is the story of all Maritime Service training stations. Originally established to serve the dual purpose of training men for licenses as radio operators in the merchant marine and to provide refresher courses for operators working on their licenses at sea, both purposes, under the pressure of wartime conditions, had to be abandoned or rather, subordinated to the job of turning out licensed operators in half the time and five times the number planned as adequate before Pearl Harbor. So well has Gallups Island made this adjustment that over 2600 men have been trained at this Station and released to the merchant marine as radio operators since this "day of infamy." These men, trained in a specialty which admittedly demands the highest type of man in the Maritime Service, survivors of the most rigorous process of screening and elimination in the Service—a process which guarantees their competence—are now manning the radio rooms of innumerable merchant ships roaming the seas of the world carrying the sinews of war to our far-flung battle fronts. As so many other merchant seamen have done, some have given their lives in delivering the goods to the men who deliver the punch.

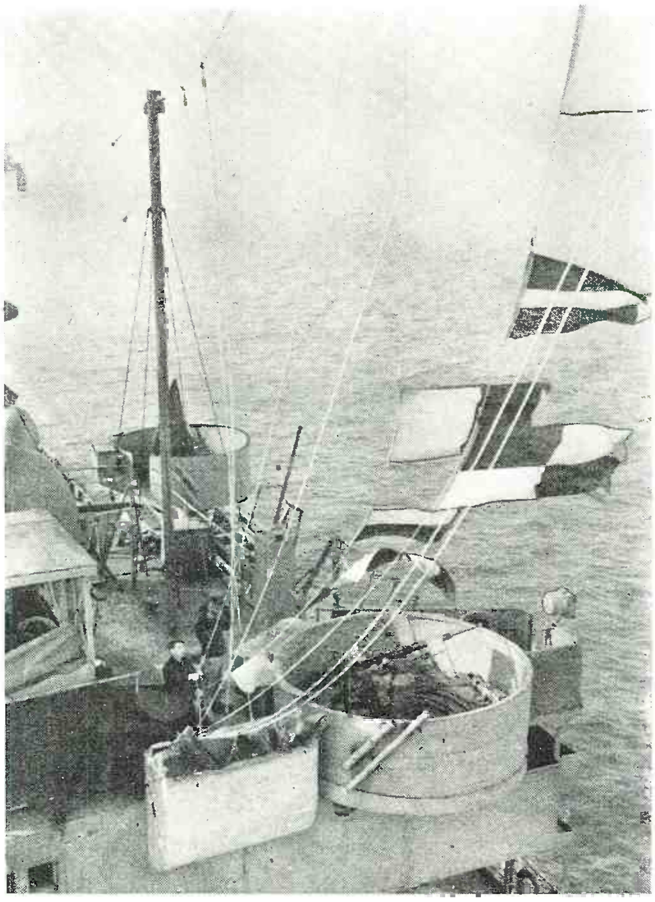
A licensed radio operator is a highly-trained and highly-specialized person, possessing certain special aptitudes and demanding the application of techniques of training not required in learning other maritime skills. Aboard ship he is a department unto himself, responsible only to the master. He has much freedom of action and decision in his job and is usually taken for granted by the crew. Therefore, often only a true emergency will test the mettle of a "sparks" and give him the opportunity to prove that he can save life and property by the exercise of the character he has and the skill he has acquired through proper training as an operator.

The selection of trainees who have the aptitude to acquire this skill in the shortest possible time from a large number of applicants in Maritime Service basic seamanship training has called for much careful thought and planning from Classification and Selection officers. How well they have succeeded may be judged from a comparison between the terrific attrition rate before the program went into effect and shortly after men were *selected* for radio training instead of being sent to Gallups Island simply because they expressed a desire to "learn radio." Experience has proven again and again that only men who receive scores far above average in most of the standard psychological tests, and possess good educational backgrounds and positive code aptitude can hope to survive the heavy, concentrated doses of code, theory, and laboratory work which they must digest to graduate.





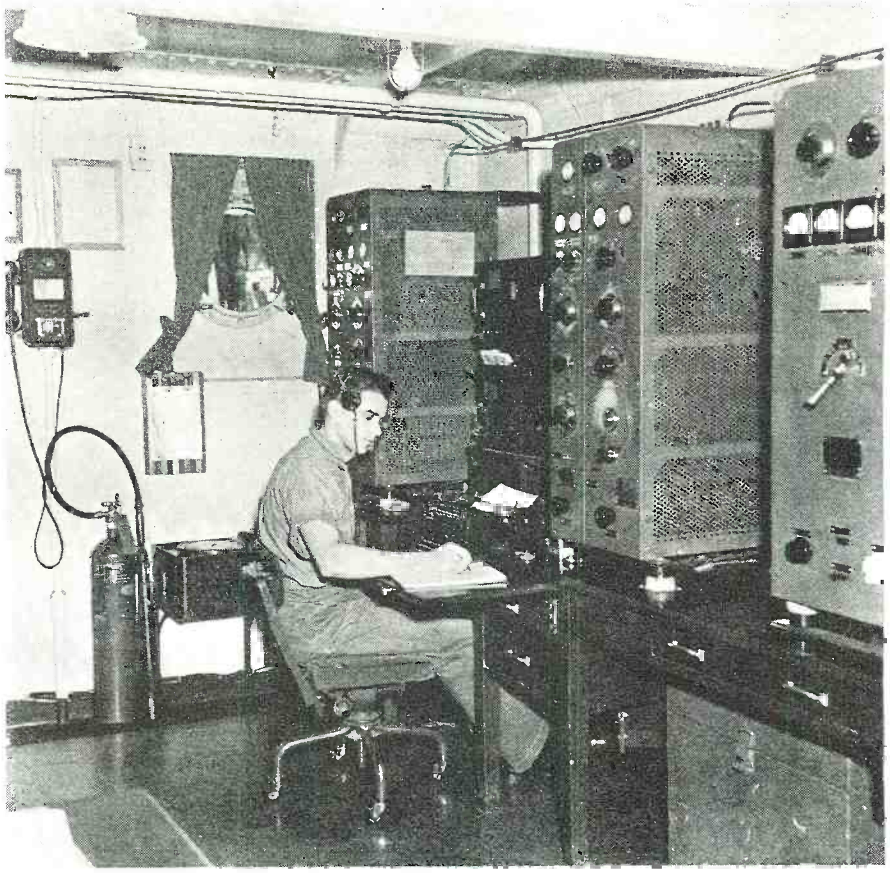
Students are taught the principle of radio-direction finder.



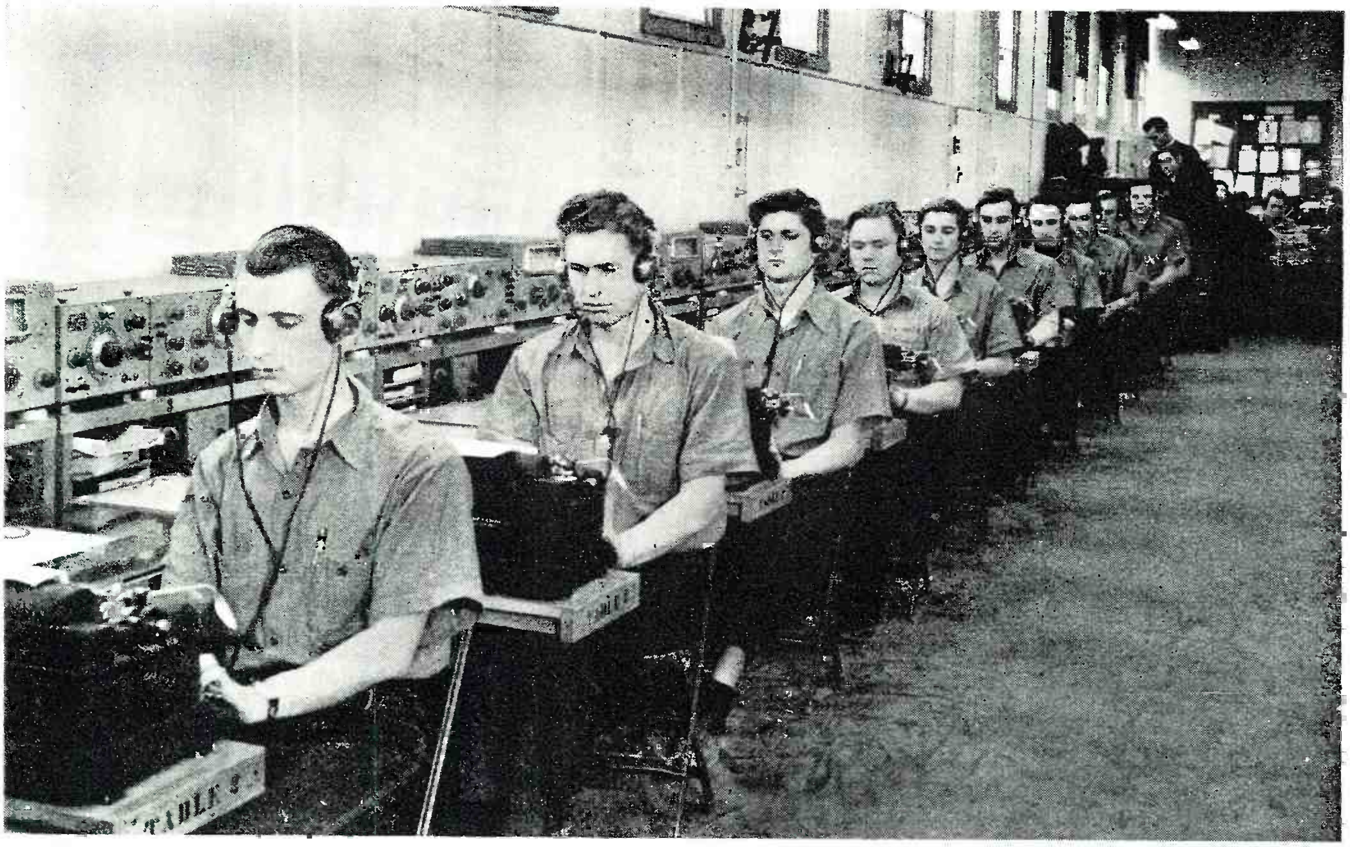
Signal flags are a vital part of the radio operator's training.

This necessity of concentrating as much training as possible into as short a time as possible has forced upon the Training Department a full and careful consideration of every training so as to get the maximum of results from every precious minute of instruction.

From the establishment of this Station by the U. S. Coast Guard as a resident radio school back in 1939, which laid the foundation for all subsequent courses in code, theory, and laboratory, and outlined the general scope of the work to be covered, to the taking over of this job by the Maritime Service (WSA) in September, 1942, all efforts have been directed with one end in view—to turn out as many and as well-qualified radio operators as the exigencies of time and the individual student permits. During this period the program has been accelerated many times. The station has grown from a few buildings housing a couple of hundred men and producing about 25 or 30 graduates every six weeks, to a unit geared to turn out 50 men per week and clothe, feed, house, and provide medical and recreational facilities for a total trainee and administrative complement of some twelve hundred men. Instruction techniques have been stepped up also; nonessentials have been curtailed; new, improved methods adopted. Full government license requirements for radio operators have not been relaxed proportionately; therefore, better instruc-



Radio operators must be proficient in both operation and repair of their equipment.



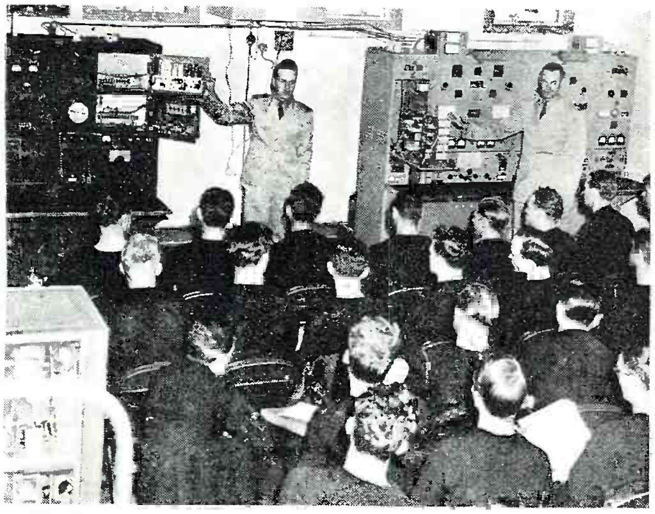
Static and background noises are artificially introduced into closed circuits and students required to copy messages through them.

tion methods had to be adopted to secure the same results in a shorter time.

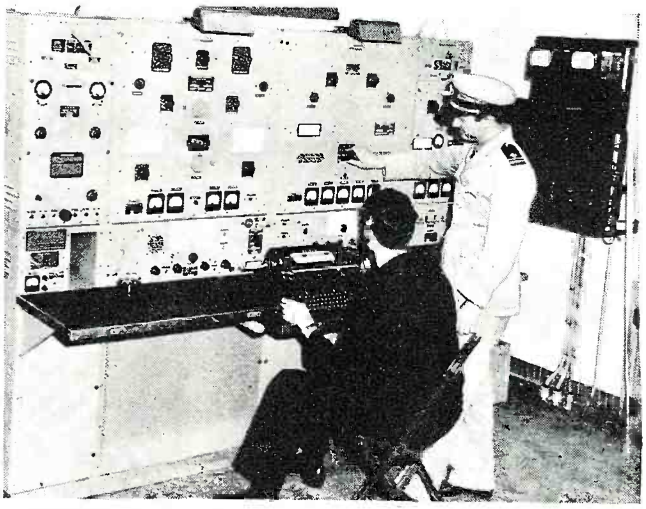
The Training Department at this Station is divided into three divisions—each necessary, but not sufficient, for giving the radio trainee proper equipment to go to sea as a licensed, competent operator. The three divisions together contribute everything except experience towards the making of a well-rounded and thoroughly grounded "sparks." These divisions comprise (1) Operations—which includes code, message procedure, communications laws, and message accounting; (2) radio engineering—all radio and electrical theory necessary to pass second class radiotelegraph license examination given by Federal Communications Commission, and provides an excellent basic knowledge for further advanced study in communication engineering; and (3) laboratory—which gives the trainee an opportunity to put into practice what he has learned in theory about the behavior of electric currents, and also gives him a chance to thoroughly familiarize himself with all representative merchant marine equipment before he encounters it aboard ship. His competence in operating this equipment, which includes direction finders, auto alarms, several types of marine transmitters and receivers, installations of the "unit" type, and the maintenance of all this equipment and storage batteries, is tested by examination. He cannot graduate unless he passes. Trainees work with tools, learn how to make repairs, and how to service their equipment at sea. They learn safety precautions to be observed in working around electrical equipment and what to do if an accident occurs. Instructors illustrate from their own experiences (several instructors have had ships sunk under them) what to do in emergencies both in the radio room and as a member of the crew. The *practical* is stressed.

The decision to use all possible training aids in order to make instruc-

(*Continued on page* 88)



The intricacies of radio equipment are taught to all students.



Transmitter operation is being shown to a future operator.

Recording FM Bursts for Observation

Observations made on the cause of interference emanating from high-powered FM stations.

By OLIVER READ
Managing Editor, Radio News

OBSERVATIONS on a phenomenon in radio propagation hitherto not reported are now being made by the FCC. Their job is to make continuous recordings of long-distance bursts which are causing interference in the very-high frequency band which includes the band 42-50 megacycles now assigned to FM broadcasting.

One of these FM recording installations is located near Allegan, Michigan, at the primary station of the Great Lakes Monitoring area. This department is now engaged in studying the behavior of signals from FM stations in the central area. Heading this Field Division is Irl D. Ball, W8VNY, prominent radio amateur who is Inspector in Charge. His assistant is Richard W. Boll, WEYD, Senior Radio Operator.

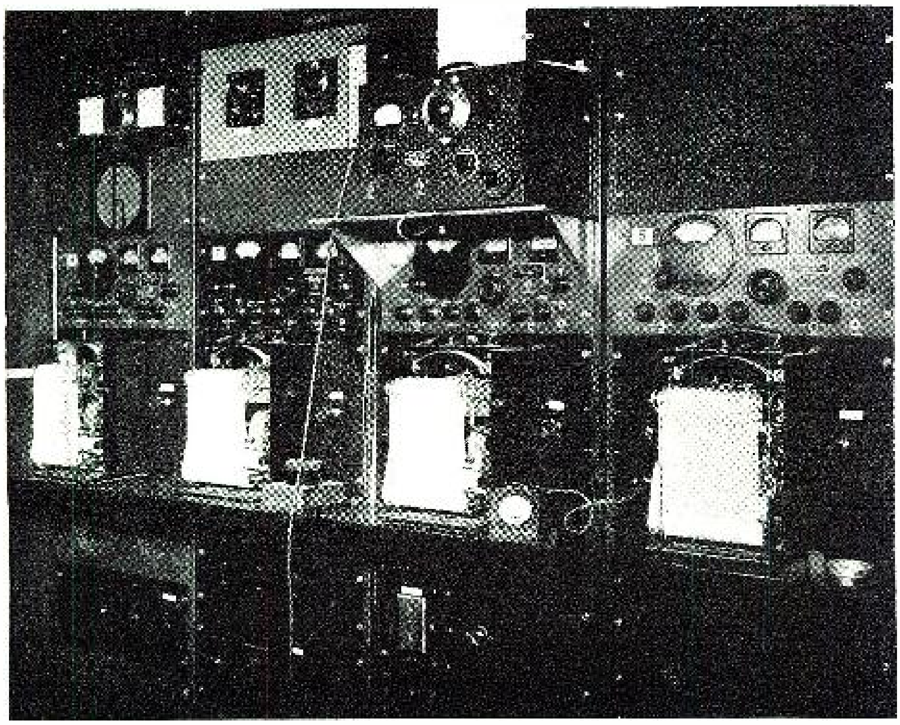
In order to take advantage of noise-free reception, a special FM recording house is located far from the main building which houses the main monitoring equipment. Installed in the recording house are four *Hallicrafters* S-27 receivers which are each tuned to a specific FM station. Operating in conjunction with the receivers are four *Esterline-Angus* recorders which make a permanent record of the signals received. This equipment is in operation continuously. Carrier strength is recorded in microvolts-per-meter and the charts are sent periodically to a central point in Washington for study.

A common doublet antenna, supported on a tall telegraph pole, is used for the four receivers. All inputs are connected in parallel.

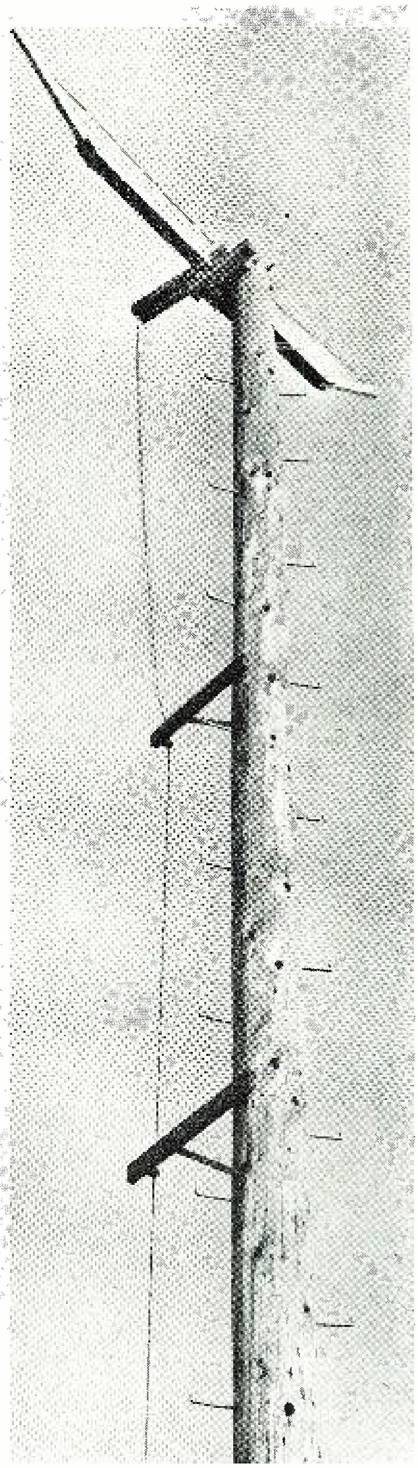
The amplitudes of the bursts, according to FCC engineers, have varied from the lowest levels which can be measured up to levels well in excess of that required to render a satisfactory FM broadcast service. During periods of maximum activity they may occur at the rate of several hundred per hour. However, the amplitudes of but few of the bursts are sufficient to cause serious interference to a receiver operating within the protected area of an FM station under present FCC standards.

A "burst" is defined as a sharp increase of signal strength of very short

(*Continued on page* 118)



Interior of recording house. Four FM stations are being received and their signal strength recorded on special ink recorders. A continuous study is made of the performance of FM stations and charts are sent to Washington for evaluation.



Conventional ultra-high frequency doublet, having twisted pair feeders, is used for this FM recording installation.

PRINCIPLES OF SIGNAL TRACING

By NICHOLAS B. COOK

Fundamentals of applying modern signal-tracing methods to identifying and isolating defects in radio receivers.

THE practical value of signal tracing as a means of rapidly locating trouble in radio circuits is too well known to require any special pleading. Even when used by an inexperienced radio student, this method gives his tentative efforts a quality of directness and continuity. In the hands of an expert, the technique identifies and isolates trouble with incredible speed.

In radio servicing, no man can attempt to clear trouble intelligently unless he knows the function of each part and its relation to every other part. Aside from its practical utility, signal tracing has great educational value. Even on paper, without instruments, a student may be taught to trace the signal from point to point, to describe its character, and to account for any deviation from normal operation.

A most helpful exercise, both for practical work and for an understanding of principles, is to follow the signal along its entire trip through the receiver. A detailed and lettered diagram may be used to indicate the points at which the signal will be examined. Other points will be tested to make sure that the signal has not wandered off onto forbidden paths.

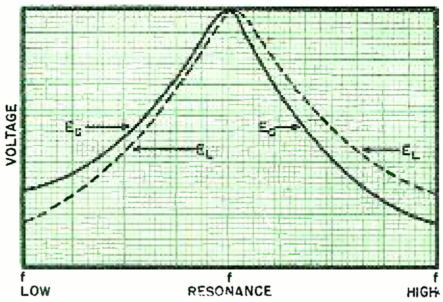


Fig. 1. Resonance curves of the tuned circuit illustrated in Fig. 2.

Fig. 4 shows a conventional superheterodyne receiver with one untuned r.f. stage, diode detector, a.v.c., and pentode output. If the student will master this fundamental circuit, if he will learn "the function of each part and its relation to every other part," he will find that he knows something about radio.

A standard radio receiver can be converted easily into a simple dynamic tester. Such an instrument was covered in an article entitled "Clearing That Intermittent," which appeared in the September, 1944, issue of RADIO NEWS. It traces the signal audibly from antenna post to voice coil. The use of an analyzer of this type (or any professionally-manufactured unit) gives rise to the detailed analysis that follows.

Typical radio service bench. Signal-tracing equipment, when properly employed, will aid in trouble-shooting those more difficult radio repair jobs.

Antenna Post

If the receiver is tuned to a strong local station, the signal should be heard at this point.

Isolating and simplifying the input circuit, we have a circuit as shown in Fig. 2.

The secondary side of the antenna coil is a series circuit consisting of inductance, capacitance, and a small amount of resistance. Series resonance is utilized to obtain maximum voltage across the condenser.

To understand that this is a series resonant circuit, we remember that a series circuit is one in which all the components are in series with the source. Here the source voltage is the e.m.f. induced in the secondary by the current in the primary. The circuit may be redrawn as shown in Fig. 3.

E_s is the voltage induced in the secondary coil. If the frequency of E_s is varied, the current I becomes a maximum at resonance. The voltage E_L and the voltage E_C also reach maximum value at resonance. This is shown in the curve of Fig. 1.

In the receiver, resonance is obtained not by varying the frequency but by tuning the resonant circuit to the frequency desired. For that setting of the tuned circuit, the desired signal will set up a greater voltage than is produced by any other signal having the same intensity but of a different frequency.

When a voltage appears across the secondary of the antenna coil it means that there is a voltage across the primary also, and this is the voltage from antenna post to ground. Because resonance is established in the secondary rather than in the primary, the secondary circuit is a necessary factor in any discussion involving the primary voltage.

Trouble

If no signal is heard it means that there is no voltage across the primary of the antenna coil. Usually this indicates a short circuit, either in the primary or in the secondary.

It might be suggested that the primary could be open. To pursue this line of thought, the following experiment is instructive. Take any ordinary antenna coil, even a very early type, and connect it between the antenna and ground.

If the probe is now applied to ANT. a signal will be heard. More than one signal may be present if there are several strong local stations. The simple coil is not selective. It offers a high impedance to all voltages at radio frequency so that any r.f. voltage picked up by the antenna is available for amplification.

In the average neighborhood there is also a 60-cycle field that sets up a voltage in the antenna circuit. At this low frequency the impedance of the

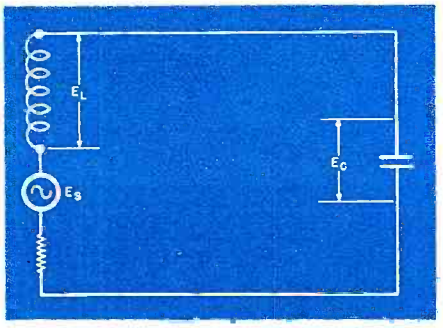


Fig. 3. The equivalent circuit of Fig. 2.

antenna coil is very low and the 60-cycle hum voltage is usually negligible.

Next, let us remove the antenna coil and substitute a resistor of high value, say one megohm. Now we have a high impedance to ground but it is an impedance that is nondiscriminating as to frequency. The small antenna currents set up IR drops across the resistance and these IR drops are independent of the frequency. Consequently, the voltage set up by any signal depends only on the field strength of that signal (assuming that the antenna itself is nonselective). Usually, it will be found that the 60-cycle field predominates and a strong hum will be heard. A powerful local station may be heard faintly through the hum and noise.

Finally, we remove the resistor and thus create an open circuit between antenna and ground. The impedance at 60-cycles is now very great. At radio frequencies the impedance is relatively lower because the stray capacitances (and the input capacitance of the tester) offer a path to ground. Now the hum will be pronounced and no r.f. signal will be heard.

From these experiments it can be understood that the operation of tuning is simply this: The antenna circuits are so adjusted that r.f. waves of the desired frequency set up a considerably greater voltage on the grid of the first tube than do waves of any other frequency. The tuning is done usually by means of a series resonant circuit inductively coupled to the antenna.

Point A—R.F. Grid

Signal should be heard. There will be some gain by virtue of the antenna coil. Gains of 3 to 10 are usual in household receivers and from 10 to 50 in auto receivers. The voltage applied to the grid is in effect the voltage E_C shown in Fig. 3.

Trouble

Failure of the signal to appear with normal gain at A may be caused by one or more of the following: (1) some failure in the coil or wiring; (2) open a.v.c. condenser preventing the circuit from tuning; (3) shorted tuning condenser or trimmer; (4) leakage from grid to ground; (5) tube drawing grid current and loading the secondary.

Another cause is wrong tuning. R.f. coils do not always track accurately with the dial, especially at the low-frequency end, advantage being taken

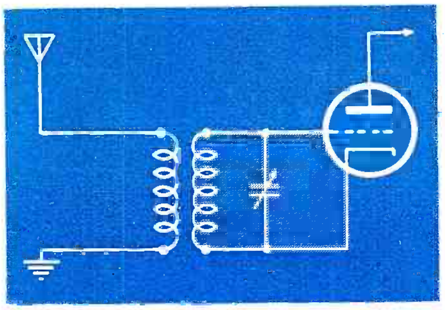


Fig. 2. First r.f. amplifier stage.

of their broadness of tuning to allow for production tracking errors.

B—Plate of R.F. Tube

At B, the plate of the r.f. tube, the signal should be heard with increased strength. Normal gain is about 25 times but may be more or less dependent upon bias voltage.

It is worthwhile here to inquire what we expect of a vacuum tube in this part of the circuit.

In a receiver the vacuum tube may be used to perform a number of highly important functions, namely:

(1) Amplification of a.c. energy without appreciable distortion of waveform.

(2) Rectification of a.c. energy to d.c. energy.

(3) Generation of a.c. waves of high frequency.

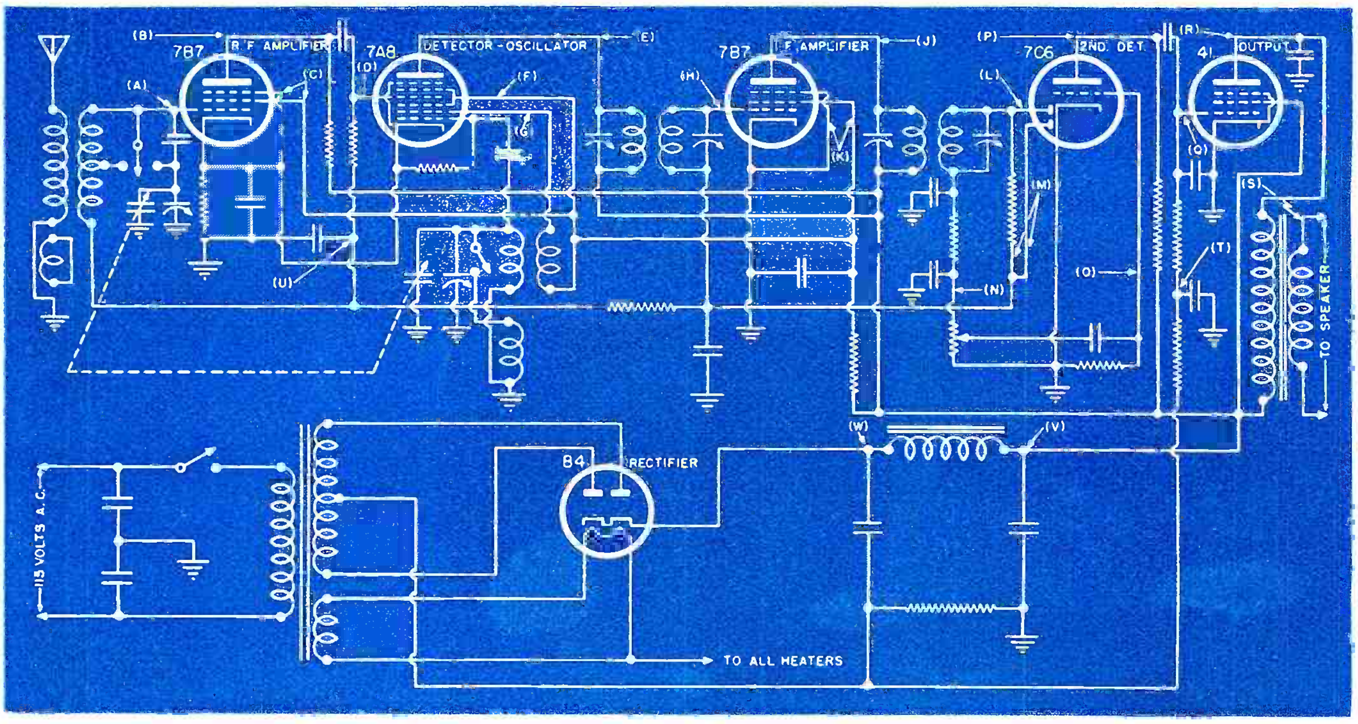
(4) Demodulation of a modulated wave train; i.e., recovering the intelligence impressed upon a "carrier."

(5) Frequency changing.

In Fig. 4 the first tube is a radio-frequency amplifier. Its function is to amplify the r.f. voltage selected by the preceding resonant circuit.

To appreciate what is happening in the tube circuit, it is important to have

Fig. 4. The function of each stage of a superheterodyne receiver should be known before attempting to use signal-tracing methods.



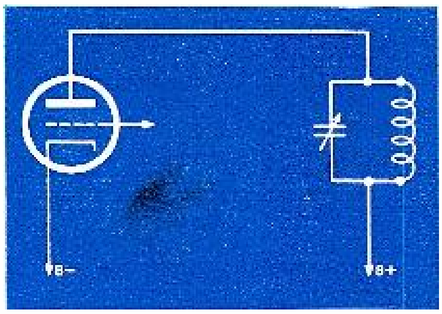


Fig. 5. Primary portion of a tuned intermediate-frequency transformer.

a clear understanding of the following fundamentals:

(1) If a tube is working normally, a reasonably exact reproduction of the voltage applied to the input grid will be found across the plate impedance.

(2) The output voltage may be greater or less than the input voltage depending upon the mutual conductance of the tube and the magnitude of the impedance offered by the plate load *at the impressed frequency.*

The mutual conductance depends upon the grid bias. In Fig. 4 this is the a.v.c. voltage.

When a resistor is used as a plate load, that part of the total plate impedance may be considered constant at all frequencies. The function of a tuned plate impedance, usually a parallel resonant circuit, is to present a much higher impedance at the desired frequency than at any other frequency. In this manner the *selected* signal is amplified much more than any other signals that may be present at the input.

All of this means that if an amplifier tube is working properly, a signal voltage impressed upon the control grid will reappear upon the plate.

Trouble

Failure of the signal to appear at B indicates that the tube is not working. This may be caused by:

(1) Defective tube.

(2) Wrong voltages or absence of plate voltage.

In shooting trouble, one of the principal tests is a voltage check at the tube socket.

D—Grid of Converter

Signal should be heard as at B.

The function of the so-called "coupling condenser" is fundamentally that of keeping the plate voltage (at B) off the grid of the following tube (at D). One point of view is that this is a "blocking" condenser since the *coupling* could be achieved without the condenser. However, the writer is of the opinion that when a condenser actually transfers energy *between stages,* the term "coupling condenser" is more descriptive.

Trouble

If the signal is heard at B and not at D, there is no transfer of signal between these points. This usually indicates a defective condenser. (A *ground* at D would ground the signal not only at D but at B also.) An open condenser will not pass a signal. A leaky or shorted condenser upsets the d.c. voltages and causes bad distortion.

E—Plate of Mixer

Signal should be heard with increased strength. Normal "conversion gain" is about 20 to 60 times, with a.v.c. at minimum.

Within the second tube in Fig. 4, a so-called "converter," is the seed of the superheterodyne principle. Only the prophetic insight of genius could have foreseen that the simple "mixing" of two frequencies to produce a third would become the master key for unlocking any one door of a thousand.

Now it is precisely this apparently simple process of "mixing" that is most difficult to understand. The commingling of two frequencies does not, of necessity, produce a third. It can be demonstrated that when two audio frequencies are sounded together so that the ear perceives a third tone, there are, in fact, still only two frequencies present. The third frequency is considered to be "subjective;" its perception is attributed to the nonlinear response of the ear.

In a superheterodyne the incoming signal voltage is "mixed" with a high-frequency voltage generated within the receiver. The mixing is done electronically in the "first detector" (mixer). If this tube were a straight voltage amplifier the output would be an amplified reproduction of the input; in this case, two frequencies and nothing more. But the mixer is so biased as to have a nonlinear response. It distorts the input waves and produces waves of other frequencies, among which are the sum and difference frequencies of the applied voltages.

In general, at least four frequencies will be found upon the plate of the mixer tube, namely:

(1) The signal frequency, modulated.

(2) The local oscillator frequency, unmodulated.

(3) The sum of these, modulated.

(4) The difference, modulated.

Now, by design, the frequency of the local-oscillator (see G) is so related to the frequency of the incoming signal that their difference is always the same. Whenever a signal is tuned in, the operation of tuning not only selects the incoming signal but also adjusts the frequency of the oscillator to maintain a constant difference.

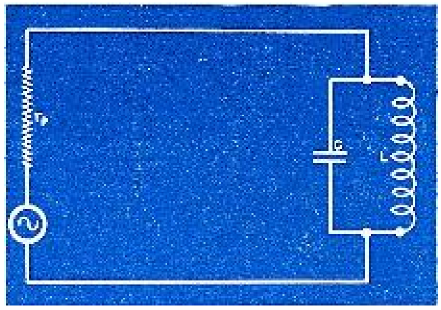


Fig. 6. Equivalent circuit of Fig. 5.

The plate impedance of the mixer tube is a parallel resonant circuit tuned to the difference frequency. Since amplification depends upon the magnitude of the plate impedance (see discussion under B), a voltage at resonant frequency will be amplified to a far greater degree than will the other voltages.

This difference frequency is known as the intermediate frequency (i.f.). Further amplification of the modulated wave is carried on through circuits designed and adjusted to resonate at this frequency.

It is the function of the mixer tube to *generate* the i.f. signal when an r.f. signal is applied at the grid. It is the function of the tuned circuits to *select* and *amplify* this i.f. signal to the exclusion of other frequencies.

Trouble

With an audible signal only, it is not possible to identify the various frequencies that may appear on the plate of the mixer tube. If the signal is heard clearly and with noticeable gain, the performance may be considered satisfactory.

When a more elaborate signal-tracing instrument is used, the various frequencies may be identified, if necessary. It is particularly important that the intermediate frequency be correct.

If the signal can not be heard at E with proper gain, the following troubles may be looked for:

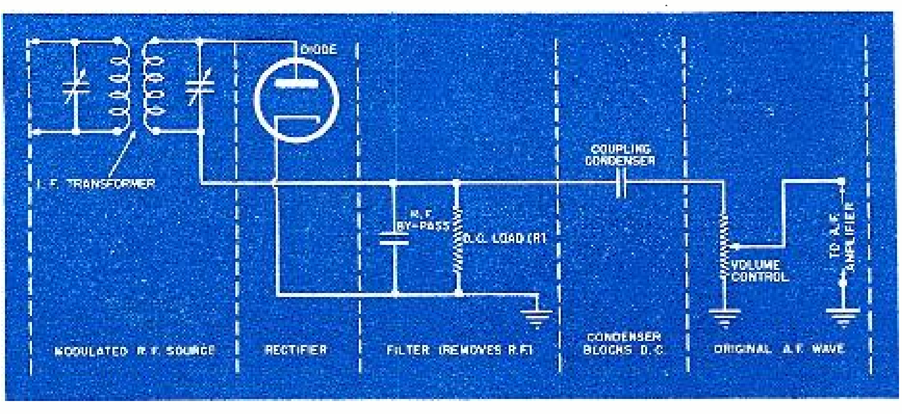
(1) Defective tube.

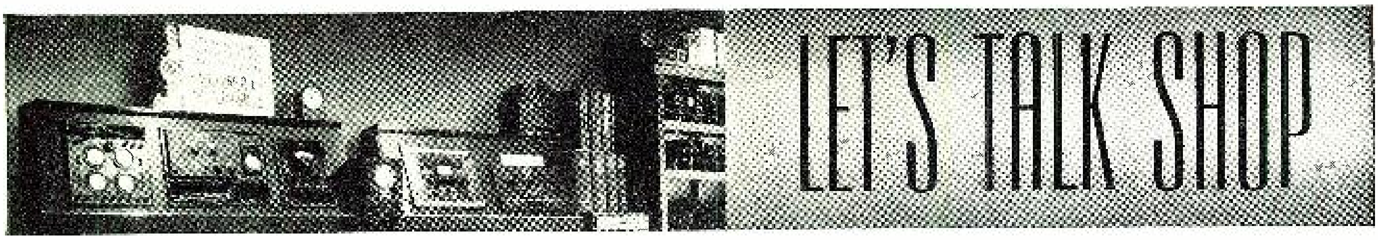
(2) Incorrect d.c. voltages.

(The "converter" tube consists of a "mixer" and a "local oscillator" in one

(*Continued on page* 144)

Fig. 7. Functional diagram of a typical detector circuit.





LET'S TALK SHOP

By JOE MARTY*

Field Editor, RADIO NEWS

The author analyzes current problems encountered by most radio servicemen.

THE need has existed for sometime for a report on, in detail and - - without camouflage of any kind, exactly the present position of the radio serviceman. This is the first report in a series which will appear monthly in RADIO NEWS and which will be devoted entirely to this problem, as well as the delineation of any answers which may be available for the practical solution of such problems.

No long review is needed here of the part the serviceman has played in our war effort. As everyone knows, he is one of the backbones of Signal Corps Operations. In many cases, when he was inducted into the Armed Forces, very little training was necessary before promotion was given, based upon his previous ability and training. Neither is the war record of these men under discussion since on every battlefield and in every air or sea battle in every part of the world the radio serviceman has performed those jobs which have meant adequate communications for our Armed Forces.

More credit is due to servicemen who remained at home to keep civilian radio sets in operation in what has been a most trying time. The first great loss suffered by the radio service industry was a *personnel* loss. Approximately 50 per cent of the top-notch servicemen in the country were either inducted into the Armed Services or were drafted into war industries with a consequent loss to the general listening public. The men remaining in business, in the face of help shortages and nonexistence of tubes and other component parts of radio sets, have managed somehow to keep approximately 80 per cent of the radio sets of the country operating.

Help shortages were, and are, serious and various means used to overcome them only partially effective. Replacement by women workers was tried with varying degrees of success but did not result in any widespread use. Training of new personnel was attempted but here again no conclusions can be drawn as to its effectiveness.

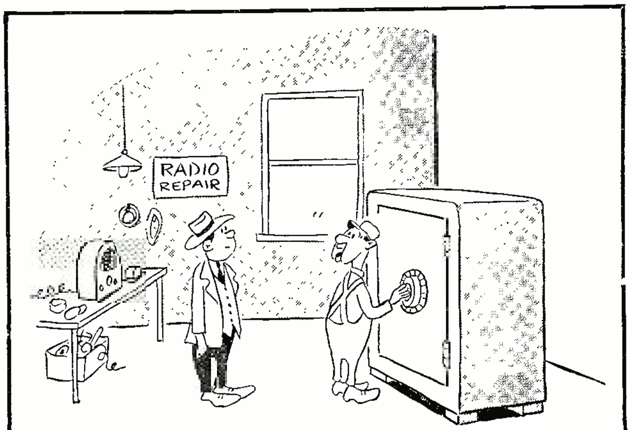
The problem of tube shortages has complicated the repair situation greatly. The serviceman used whatever ingenuity he possessed to obtain tubes required to keep sets operating. Many circuits were changed over to accommodate tube types not originally designed for use in the set. This was fine until a new shortage in these substitute types appeared, necessitating further changes. The result is that the original circuits on a great number of sets have been changed out of all resemblance to the original design. These changes are so serious that it is doubtful if the customer will be willing to pay the necessary large service charge to have them restored to their original condition even if tubes do become available. When peace comes, sets in this condition will be lost to the service trade since it will be cheaper to buy new sets.

The shortage of components, other than tubes, has resulted in a further loss of business to the serviceman. Items such as condensers and transformers are still difficult to obtain and in many cases nonexistent. Great ingenuity was shown by many servicemen in salvaging and reusing parts in order that sets could be kept operating.

For the first time in the history of his business, the serviceman was faced with government control. Such control was both good and bad. The serviceman was forced to keep accurate records of his operations. These records gave him a complete and accurate picture of his business. For many years, advisors to servicemen, as well as authorities in the field, have been urging the keeping of accurate business records in order that they could conduct their business in an orderly and profitable manner. These new government regulations forced them to maintain a price schedule for their services. This price schedule regularized business to the point where they no longer had to argue with a customer on charges for service. This is something that the servicemen themselves should have done many years ago. The government regulations also forced the serviceman to purchase his parts from legitimate sources and placed an obligation upon him to certify that the repair parts were to be used only for the repair of radio receivers. This operated to give stability to the serviceman as an integral part of our economic order. The nondesirable feature of government control was, of course, the added burden it placed on the already overworked serviceman. For the first time he was forced to struggle with a multiplicity of forms. Extra bookkeeping and extra personnel were necessary to handle these additional requirements. All of this came at a time when the serviceman was enjoying the greatest upsurge of business he had ever enjoyed. On the whole, government regulation has operated to aid the conduct of repair business.

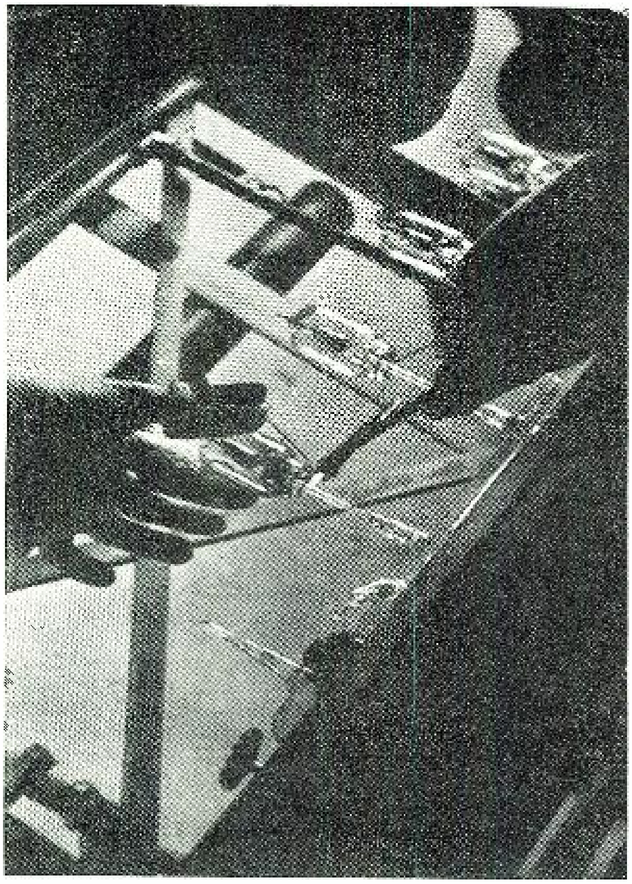
A note of warning should be inserted at this point. As soon as civilian radios are manufactured, there will be a definite slackening in the number of service calls for the repair of old radio receivers. The serviceman must not "kid" himself into believing that the present conditions will continue after peacetime radios are again available. The ground work should be laid now for peacetime operation along sound business techniques. He must learn to be "sales-minded."

Let us examine some (*Cont'd on page* 152)



"Just a minute and I'll see if I have any tubes left!"

* The author's past experience well qualifies him to present his opinions to the serviceman. He owned and operated Wilmette Music and Radio Shop for five years, doing retail and wholesale radio servicing. Organized and was first executive secy. of Radio Servicemen of America for five years, including local servicemen's groups as chapters. Arranged first cooperative sponsorship for servicemen by the RMA and Sales Managers Clubs, as well as the NAB. Sponsored through RSA the "Guaranteed Service" plan for radio servicemen. At present Field Editor for RADIO NEWS, headquartered in the New York Office.



Tipping-off a 24G u.h.f. transmitting tube after vacuum of 10^{-7} mm. of hg. has been obtained.

Mass Production of U.H.F. Transmitting Tubes

By

J. COLEMAN

North American Philips Company, Inc.

Step-by-step production operations in the manufacture of ultra-high-frequency transmitting tubes.

WHEN war hit the United States on December 7, 1941, u.h.f. transmitter tube manufacturers, in general, were making their product mainly by hand. As orders from the fighting forces began to grow in size and number during the months following Pearl Harbor, it soon became evident that techniques had to be revised in order to increase production.

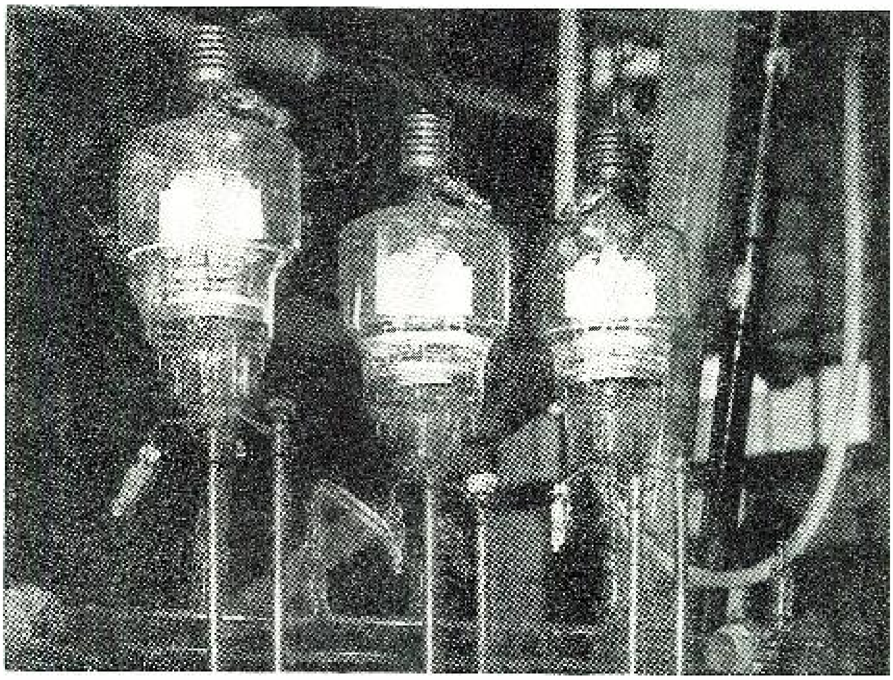
After consultation with experts of Heintz and Kaufman, Ltd. (type 24G) and Eitel-McCullough, Inc. (type 304 TL), North American Philips engineers tackled the mass production problem from many angles. It was necessary to develop methods and machines for manufacturing certain types of transmitter tubes, required for war purposes, in much larger quantities than the industry's prewar facilities were capable of producing.

Production of this class of tube is more difficult than for older types of transmitter tubes since the bulb must be kept clear. Use of "getters" like barium and magnesium are harmful to proper operation—only "getters" such as zirconium can be used.

Engineers found it necessary to design machinery, jigs, and tools which would eliminate as much hand work as possible. Prewar amateur hookups, in general, used one or two tubes, thus absolute uniformity in tube characteristics was not too important. Present-day circuits utilize as many as twelve tubes and they must be as nearly alike as it is humanly possible to make them. If their characteristics are different, the load will not divide equally. The poor tubes take less than their share; the good tubes take more and inevitably are burned up.

To get uniformity in mass production of transmitting tubes, physical relations between parts have to be perfect. All tubes must respond to the same frequency, interelectrode capacity must be identical, amplification constant, and mutual conductance must be held to close limits.

U.h.f. (304TL) tubes on vacuum pumps, with filaments and anode potentials applied. Radiators on anode leads dissipate heat generated during internal bombardment.



Special machinery was developed to do the assembly job on a number of u.h.f. transmitter tubes. For example, in the case of the 24G, the glass envelope is pierced in two places—one hole is made in the closed end for the anode lead and one hole is made in the side for the grid lead. Next, the anode is inserted into position but is not sealed in until after grid and filament sealing operations are completed. Now the bulb is placed horizontally in a stationary fixture having a mandrel that holds the grid in place. The mandrel, an important part of the fixture, lines up the grid perfectly. Gas burners now revolve around the glass button to seal it permanently to the envelope.

The bulb then is placed vertically (anode down) in another stationary fixture. Cathode (filament) assembly is held in the head stock of a specially-designed machine that permits adjustment up, down, and laterally. Since the anode is free and out of the way at this step, visual lining-up of cathode with respect to the grid can be performed accurately. This is extremely important since there is a distance of only .060 inch between cathode and grid. When alignment is perfect, gas burners rotate around the tube and seal in the cathode assembly.

Again, the bulb is held vertically in a stationary fixture—this time with anode up. The same type of machine with vertical and horizontal adjustments holds the anode lead by means of a chuck. When the anode has been properly lined up visually, rotating gas burners seal off the glass button. The foregoing steps, therefore, put the three important components of the tube in place and do it with mass production technique.

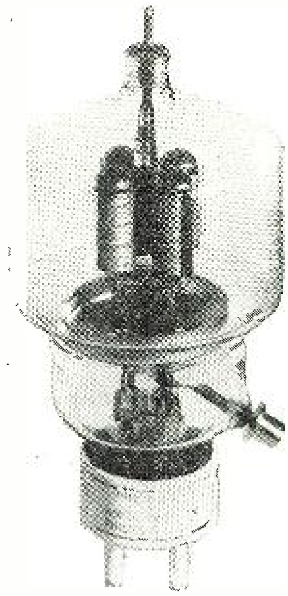
Evacuation must be carried on at much higher temperatures than the tube will experience in normal use. This requires a high degree of vacuum and it is necessary to use diffusion pumps instead of mechanical pumps. Vacuum of 10^{-7} mm. of mercury is required for u.h.f. tubes of this class. Air is first pumped out giving a vacuum of 10^{-3}, next the glass is baked at 450° C. to get rid of water vapor, and then the tube is subjected to external bombardment by means of high-frequency induction heating. After that, the filament is lighted and 1000 volts is applied to the anode. During this internal bombardment, the grid and one end of the filament are grounded—by this means the anode is again heated to a high temperature. Following this, the anode is disconnected and 500 volts is applied to the grid. This final internal bombardment of the grid brings the vacuum to 10^{-7}.

Bases are applied to the u.h.f. tubes in the usual manner. Tubes are aged for one hour under exaggerated service conditions and during this process the "getter" absorbs any tipping-off gas that remains—the aging process also stabilizes the tubes. They are then tested for peak emission, voltage being applied to grid and plate. Static characteristics are read and curves are plotted to show the relationship between grid bias and grid current. Final tests are made with the tubes operating in an oscillator circuit.

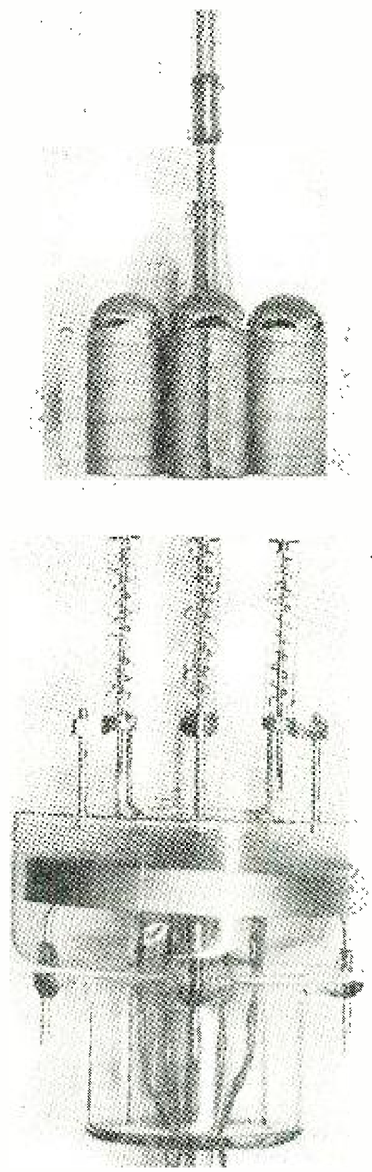
Manufacturing techniques for u.h.f. tubes have come a long way since 1941. The industry can well be proud of the job it has accomplished—it plays a mighty important part in winning the war.

—30—

View of 304TL u.h.f. tube. Anode and cathode-grid assemblies are sealed into glass envelope in final lathe operation. →



Two subassemblies of 304TL u.h.f. transmitting tube. Lathe with headstock and tailstock revolving in synchronism is used for sealing into the envelope.

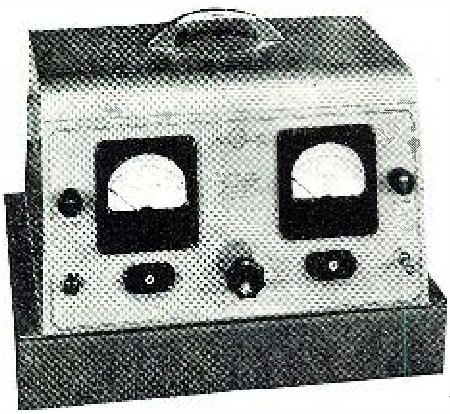


External bombardment of parts in 24G ultra-high-frequency transmitting tube. High-frequency induction heating is used for this work.

ELECTRONICALLY-REGULATED POWER SUPPLIES

By M. S. KAY

A review of the operation and design principles of commercially-manufactured, electronically-regulated power supplies.



Power supply manufactured by the Technical Apparatus Co. Schematic diagram of this unit is shown in Fig. 7.

IN MANY electronic devices, such as oscilloscopes, vacuum-tube voltmeters, signal generators, and test equipment, voltage-regulated power supplies are necessary for reliable operation. The care with which the regulated power supply is built will depend, of course, on how steady a supply output voltage is needed. It is the purpose of this article to review the basic circuits upon which practically all of these power supplies are built. Then, with this in mind, several commercial units will be inspected to see how these fundamentals are applied in practice.

The simplest type of voltage regulators are the gaseous regulator tubes of the VR series, the VR 105-30, the VR 150-30, etc. The first number indicates the operating voltage; the second number the maximum current in milliamperes that can flow through the regulator tube and still obtain the constant voltage drop. Once the gas in the tube has been ionized, any current that will maintain this state of ionization will be sufficient to keep the voltage drop steady. In practice this allows a variation of current from a minimum of 5 to 10 ma. up to the maximum of 30 ma. It is this latter property that makes these tubes so useful. The voltage is constant to 1 per cent while the load current may vary within the above limits. The starting or ionization voltage needed to begin the operation of the VR tubes is generally 10 to 30 per cent higher than the operating voltage.

For use, the circuit given in Fig. 1A is typical. The series resistor limits the current through the VR tube to a safe value. Its resistance can be computed from the following formula:

$$R = \frac{E_{in} - E_{vr}}{I}$$

where

E_{in} is the voltage applied across the resistor and VR tube combination.

E_{vr} is the voltage drop across the VR tube (or tubes).

I is the safe maximum current through the tube.

When greater regulated voltages are desired, an arrangement such as shown in Fig. 1B can be employed. Again the total current *must not* exceed the maximum value as given for the tubes.

Vacuum-tube voltage regulators can be separated, for the most part, into three basic circuits, the first one being shown in Fig. 6. To understand the operation of this circuit, let us consider what would happen if the input voltage, E_{in}, were to increase suddenly. One plausible reason for this might be a line voltage rise. This is certainly a common enough experience. The foregoing change would cause the grid voltage (relative to the cathode) to increase and hence cause more plate current to flow. But I_p must flow through R_3 and the voltage drop across this resistor due to this flow of current would have the polarity as shown. This voltage drop, with its present polarity, would neutralize the increase in E_{in} and thus leave E_{out} unchanged. As can be seen, E_{out} is equal to $E_{in} - E_{r3}$.

On the other hand, a voltage decrease in E_{in} would cause the grid voltage to diminish, and the plate current would likewise decrease. The latter statement is true because the positive potential on the grid is decreasing. With less voltage on the grid and subsequently less plate current, the voltage drop across R_3 is less. This counterbalances the decrease in E_{in}. It can be seen that the action of this stabilizer depends on the effect the grid voltage has on the plate current and this property of the tube is the well-known mutual conductance, G_m. As long as the quantity G_m remains constant, the value of R_3 is given by:

$$\frac{R_1 + R_2}{R_1} \cdot G_m$$

Sometimes a voltage regulator tube is inserted in the cathode circuit of the tube to provide a steady bias. It is desirable to keep R_3 as low as possible in order that the voltage dropped across this resistor will likewise be small. This, in turn, requires that a tube having a high transconductance be used.

While the preceding circuit was dependent on the mutual conductance of a tube, the following circuit, Fig. 3, is related to the amplification factor of the tube. The amplification of a tube is defined as the ratio of the change necessary in the plate voltage to counteract a change in the grid voltage, the plate current remaining constant. Thus, the object in this voltage-stabilizer unit is to apply any variations in the input voltage to both the plate and grid of a tube in such a manner that the plate current remains constant.

Consider Fig. 3A. The input voltage E_{in} is applied across R_1 and R_2, the former located in the grid circuit, the latter in the plate circuit. An increase in E_{in} will cause increased voltage drops across R_1 and R_2. A voltage increase across R_2 will place a higher plate voltage on the tube and result in greater current flow. However, the increase in voltage on R_1 will place a greater negative bias on the grid (relative to the cathode), and this will work against and counteract the increased plate current. If these two effects are correctly proportioned, the net result will be a constant plate current through R_3 and it is from here that the output voltage, E_{out}, is taken.

Notice that the positive sides of both the rectifier and output voltages are common and this would work well in circuits where the high positive voltage is grounded. This type of unit is suitable for equipment that requires low currents and high voltages. The action of this regulator will be satisfactory only so long as the amplification factor remains constant. Then R_1 and R_2 are related by the equation:

$$\text{Amplification factor} = \frac{R_2}{R_1}$$

and the choice of one will immediately determine the value of the other. A battery cell may be inserted in the grid circuit to obtain the best operating bias or a voltage-regulator tube substituted as shown in Fig. 3B. Generally the latter is more desirable, providing the correct VR tube can be obtained. The assortment of these tubes available on the market at the present time is limited to only several values, none of which may fit the vacuum tube used. Any high mu tube such as a 6F5, 6AC5, 6K5, or 6SF5 will work satisfactorily.

It will be noticed that the above two vacuum-tube circuits dealt only with variations in the input voltage, no control being possible over changes occurring in E_{out} due to load variations. The most widely used power supplies employ a degenerative or inverse feedback amplifier and the arrangement is such as to allow variations in either E_{in} or E_{out} to be compensated. The simplest form that this amplifier may take is shown in Fig. 2. Here it can be seen that essentially the tube is in series with the input voltage. This position allows it to act as a variable resistor, the resistance fluctuating in accordance with the needs of the circuit, but always acting in such a manner so as to counteract any changes in either the input or output voltages.

Consider, for example, what happens when E_{in} increases. This increased plate voltage will cause more plate current to flow in the tube. Since the plate current must flow through the resistor combination of R_1 and R_2, a larger drop will appear here and tend to make the grid more negative with respect to the cathode. This immediately will counterbalance the greater plate voltage and E_{out} will remain constant.

Attacking the circuit from the opposite angle, let us suppose that E_{in} decreases. Less positive plate voltage will result in less plate current and the negative bias between the grid and cathode will become smaller. The latter will allow more current to flow and thus work against the lowered input voltage. Similar reasoning may be applied to variations in E_{out} and the same results will be obtained.

By shifting the grid return tap on the resistor combination (R_1 and R_2), we can vary the value of the output voltage. A high negative bias will tend to reduce E_{out}, whereas a small negative bias will bring the output and input voltages closer in value, the difference between the two appearing in the voltage drop across the series tube. Once the tap is set, no matter where this is, the output voltage becomes stabilized due to the above explained action. In operation, the load current must not be greater than the safe operating current of the series tube. One method commonly used to increase this current is shown in Fig. 2B and consists of placing several tubes in parallel. The current will now divide between the two (not necessarily equally) and hence allow more current to be drawn by the load. This point will be mentioned again when the commercial voltage-regulated power supplies are investigated.

While the above regulator gives good results, it is possible to obtain better regulation if the voltage variations are first amplified and then applied to the grid of the series tube. In this way a more sensitive arrangement is obtained. The control tube, in this case a 6J7, is connected into the circuit as shown in Fig. 8. Now, any voltage variations in the output voltage will cause corresponding fluctuations in the grid voltage of the 6J7 and this will, in turn, cause its plate current to change. Since the circuit is so arranged that all this plate current must flow through R_1, these voltage fluctuations will appear between the cathode and the grid of the 2A3. Control will thus be had over the plate current of the 2A3. In order to appreciate fully the circuit operation, it should be kept in mind constantly that the internal resistance of any tube is controlled directly by the bias or voltage on its grid. A more negative voltage here will cause this internal resistance to increase and a more positive voltage will decrease this resistance. In the present discussion, the internal resistance of the 2A3 is in series with the load current and can thus control it.

Returning to the circuit of Fig. 8, let us consider the sequence of events brought on by an increase in E_{out}. The grid of the 6J7, due to this increase, will become more positive and result in an increased plate current. The polarity of the voltage drop across R_1 will be such as to make the grid of the 2A3 more negative than its previous value. Hence, the current of the 2A3 will now decrease, the internal resistance increase and E_{out} will be brought back to its lower value. Taking the above in the opposite direction, with E_{out} decreasing, will likewise bring a compensation. While only output voltage variations have been analyzed, it must be remembered that the output voltage is also affected by line or input variations and should these change the normal value of E_{out}, they would be dealt with immediately.

Bias for the 6J7 is provided by a

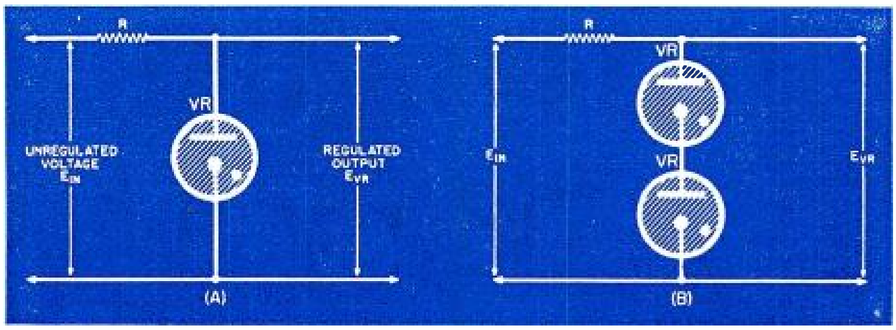


Fig. 1. Simple methods employed to obtain voltage regulation, using VR tubes.

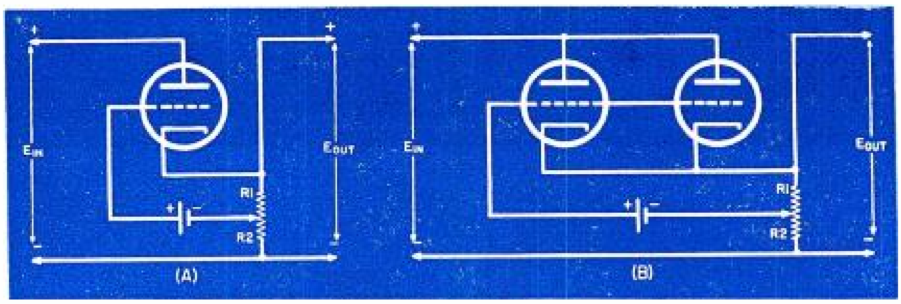
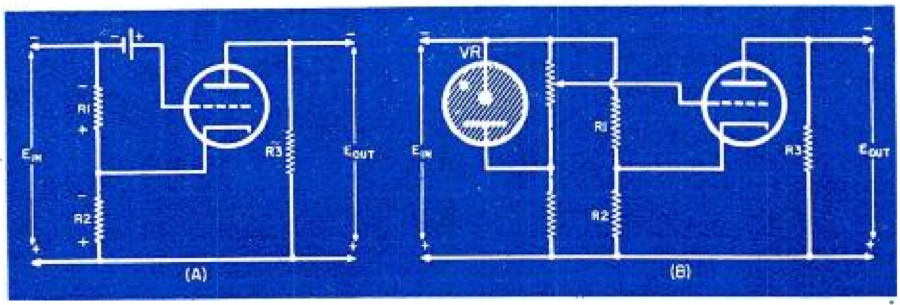


Fig. 2. Electronic regulators that compensate for variations in E_{in} and E_{out}.

Fig. 3. Voltage-regulator circuit using the amplification factor of the tube as its basis of operation. Circuits compensate only for variations in input voltage.



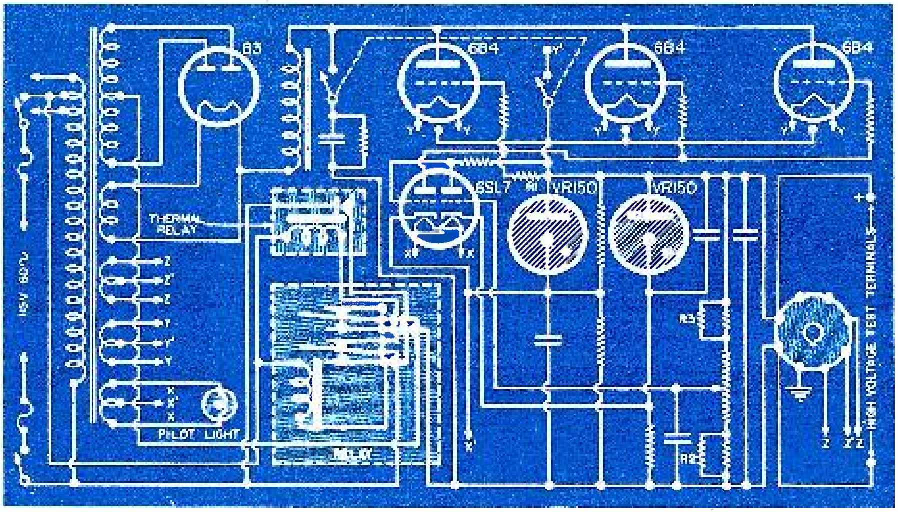


Fig. 4. Electronically-regulated power supply, manufactured by the Communication Measurements Lab. The output voltage variations are amplified twice before being applied to 6B4 tubes. Voltage range may be adjusted by changing R2 and R3.

voltage-regulator tube, VR 105-30. Resistor R_3 is made variable in order that the output voltage may be placed at the desired value. The position of this setting, however, does not in any way interfere with the operation of the stabilizing unit. Condenser C aids the regulating action when changes in E_{out} appear rapidly.

The first commercial power supply schematic is shown in Fig. 5. This circuit is much the same as that given in Fig. 8. The 6SJ7 is the sharp cut-off pentode tube that amplifies the output voltage fluctuations applied at its grid through the series combination of R_1, R_2, and R_3. The setting of R_2 enables the operator to vary the output voltage between 200 and 300 volts. R_4 and R_5 provide the proper screen-grid voltage to the 6SJ7.

Any variations in the plate current of the pentode cause the voltage across R_6 to vary. Since this resistor is connected to the grids of the parallel 6Y6's, their grid voltage will change and thus control will be had over the output current and voltage. R_7 and R_8 are used to isolate the two 6Y6's from each other and prevent any tendency toward oscillation. Meter M_1 and R_9 form a voltmeter to keep constant track of the output voltage. The rest of the circuit is similar to what has been described already and requires no further explanation. Notice how well fused the set is and the use of separate switches for the plate and filament transformers.

The next commercial circuit (Fig. 7) has a slight variation over the foregoing power supplies. Here all voltage fluctuations are applied to the grid of one of the triodes of the 6SN7GT tube. After amplification, the variations are sent through the other triode section of the 6SN7 and on to the 500,000 ohm resistor, R_1, connected between the control grid and plate of each of the three 7C5's in parallel. From here on the action differs in no way from the explanation given previously for either one series tube or two in parallel. With the three 7C5's, a maximum current of 250 milliamperes may be drawn from the supply at a plate voltage of 200 to 400 volts. It is to be noticed here that input voltage changes in the a.c. line immediately affect the grid of one triode section of the 6SN7 and this acts in conjunction with any output variations that affect the other triode. The result is better regulation than if the line voltage instabilities were left to affect the output voltage and then ironed out.

For the final commercial diagram, Fig. 4, we again find a double triode (a 6SL7), this time used differently, however. The output voltage of one triode is fed directly to the grid of the other triode and from thence to the 6B4G regulator tubes. This double amplification gives rise to a very sensitive arrangement whereby even small amounts of ripple may be eliminated. The duo-triode used in the previous power supply described above did not have the output of one amplified by the other. Rather both were connected into different circuits (the output and the input) and their voltage changes worked in conjunction with each other. In the present setup, both triodes deal mostly with variations in E_{out} only, and they are unable to counteract input line changes directly. Resistor R_1 transmits the amplified regulating voltages to the grids of the 6B4 tubes. Note that direct coupling is used throughout most of these amplifiers. This insures that even slow changes in output voltage are effective in this regulating action. Condenser-coupled amplifiers would not be suitable because of their poor low-frequency response.

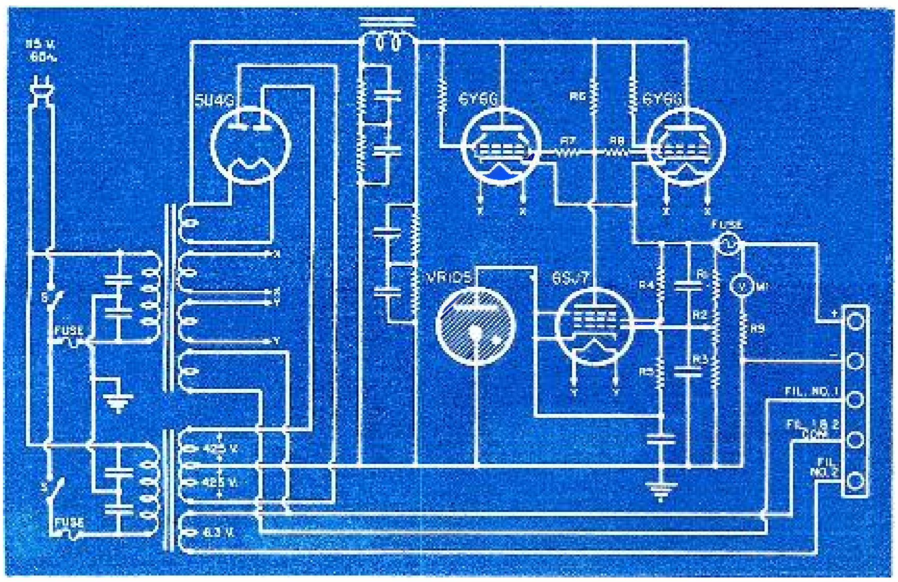
The above power units are indicative of what may be expected in present day electronically-regulated supplies. Each unit is now being sold in the radio market. Now let us see how they may be designed. Fig. 8 will be used as illustration for the procedure.

The first point that must be decided concerns the amounts of current and voltage that the power supply will be called upon to deliver. A thirty per cent tolerance should be allowed between the required load and that which the unit can supply. This will permit a comfortable leeway and prevent overheating of the power transformer. With the current and voltage values determined, the proper electrolytic condensers, filter choke (or chokes) and power transformer can then be chosen. These are connected as shown in Fig. 5. One pi filter section will work satisfactorily since the degenerative amplifier will remove any remaining ripple by its regulator action.

The design of the regulator section is attacked next. The choice of the series tube (or tubes) will depend on the amount of current that the power supply will have to supply. Generally, a power-amplifier tube is used because it will allow greater plate dissipation and current flow than ordinary amplifier tubes. If one tube should prove in-

(*Continued on page* 142)

Fig. 5. A commercial application of the circuit given in Fig. 8. A power supply employing this circuit was designed and manufactured by the Harvey Radio Labs., Inc.



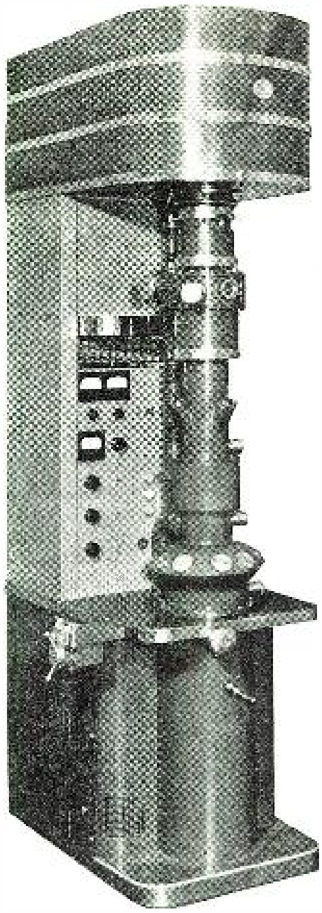


Fig. 1. Type EMB-4 Electron Microscope with diffraction adapter and remote controls for mechanical stage.

ELECTRON MICROSCOPES

By PERRY C. SMITH and ROBERT G. PICARD
RCA, Victor Division

Recent developments in the design of electron microscopes, including a discussion of the construction and operation of current models.

THE electron microscope has already become an accepted and valuable tool in microscopy. Throughout its short commercial history of the past three years, it has contributed unceasingly to our knowledge of the submicroscopic world. The enormous background of techniques and information, built up during the past hundred years by light microscopists, has permitted rapid advancement and intelligent interpretation to be made with this new instrument, using an entirely new method of observation. Microscopists have been generous in their praise of the ease with which electron micrographs may be obtained; the striking similarity between corresponding light and electron micrographs; and the tremendous amount of new information which the electron micrographs have revealed.

The microscopist recognizes the following three main steps as fundamental to the science: (1) specimen preparation, (2) observation (including photography) of the specimen in a microscope, and (3) the study and interpretation of the observations.

An electron microscope simply provides a new and improved tool for step 2 of the processes outlined above. The principal difference between electron and light microscopes is in the type of illumination and its wavelength. Whereas, ultraviolet light provides an illuminating source with a wavelength roughly twice as short as ordinary light, electrons, as a means of illumination, are associated with wavelengths roughly 50,000 times shorter than ultraviolet radiation. The wavelengths associated with electrons are determined by the accelerating voltage. While the wavelengths associated with electrons have not, as yet, provided resolution comparable to that predicted by theory, they have permitted a resolving power from 20 to 50 times better than that obtainable with ultraviolet light.

In December, 1940, an historical date was set when RCA delivered and installed the first commercial Electron Microscope produced in this hemisphere. Since this date, fifty-seven additional Electron Microscopes of the original design—the type EMB—have been delivered and put into service. Throughout the manufacture of the type EMB Microscopes (Fig. 1), numerous instrument design improvements were undertaken and executed. Among the more important of these were an attachment for producing stereo-micrographs, an attachment for producing electron diffraction patterns, and a control mechanism for the specimen stage to permit remote operation. Simultaneously, engineering and research groups undertook a program of advanced development the purpose of which was to provide simplified equipment, engineered to produce improved performance, and designed for the convenience of the research worker and technician. Out of these efforts have come two new Electron Microscopes, the "Universal" or type EMU (Fig. 2) and the "Console" or type EMC (Fig. 9).

In designing these two new instruments, engineers drew not only from a vast background of electronics, but also from the field performance of the many type EMB Microscopes and the more than one hundred thousand micrographs they have produced. Of no little help was the friendly and constructive criticism provided by the many electron microscope technicians and associates scattered throughout the country.

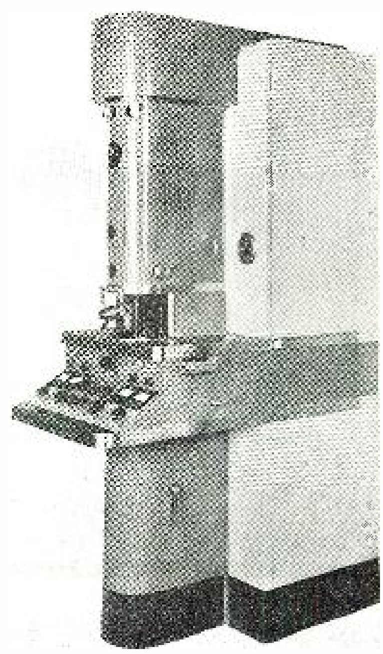
Fundamentally, an Electron Microscope can be considered as consisting of five main elements: (1) a vacuum system, (2) an electrical system, (3) an electron optical system which is the microscope proper, (4) a control system and (5) the housing. In the design of the two new microscopes, the elements were considered individually and collectively from the following main viewpoints:

(1) operator comfort and convenience,
(2) simplicity and flexibility,
(3) consistent top performance, and
(4) ease of servicing.

The Universal Microscope —Type EMU

As the electron beam, used to illuminate the specimen, is rapidly ab-

Fig. 2. New type EMU Electron Microscope.



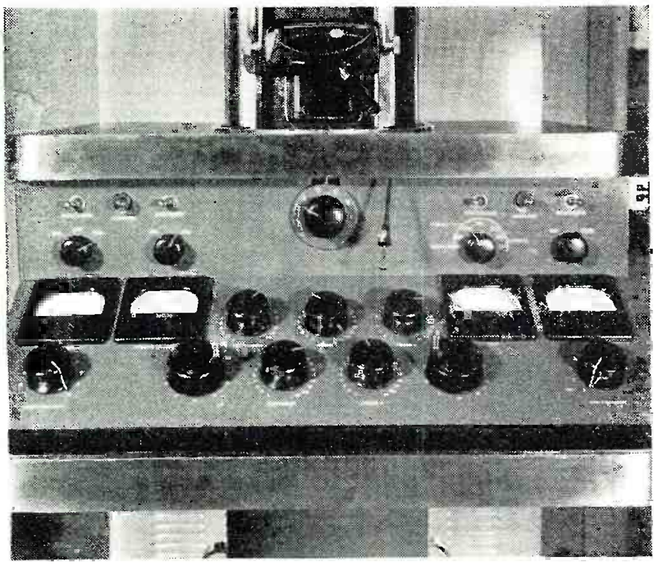


Fig. 3. Control panel includes adjustments for all mechanical and electrical operations, such as specimen movements, intensity, magnification, focusing, and power and camera controls.

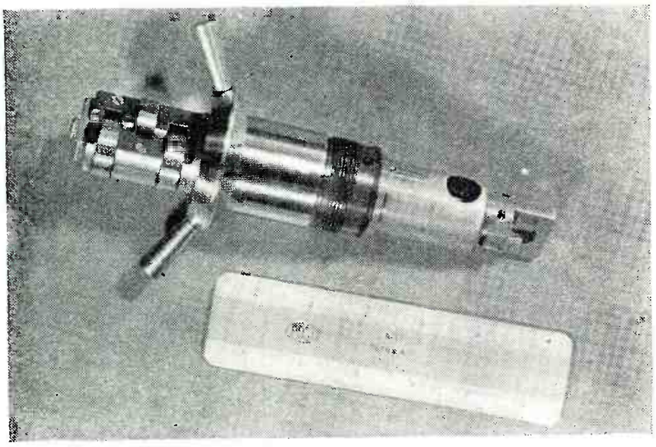


Fig. 4. Mechanical attachment used for making diffraction patterns with electron microscope shown in Fig. 8.

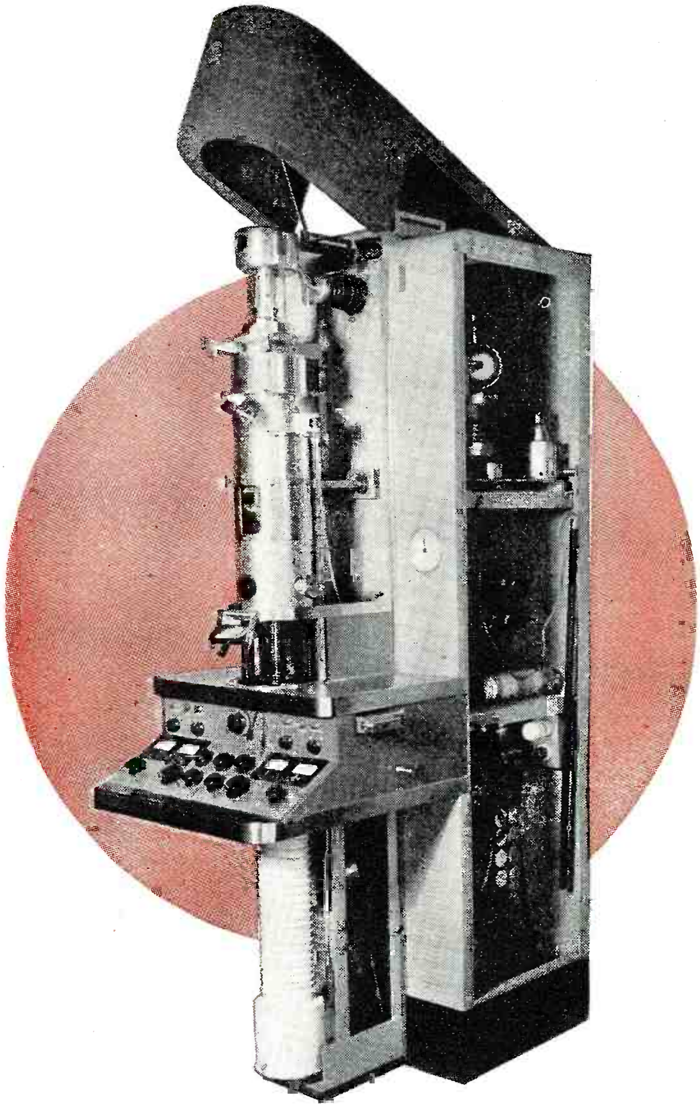


Fig. 8. Universal Electron Microscope with cover removed and hood raised to show electron gun.

Fig. 5. Power supply producing 50 kilovolts, which is automatically disconnected when cabinet door is opened.

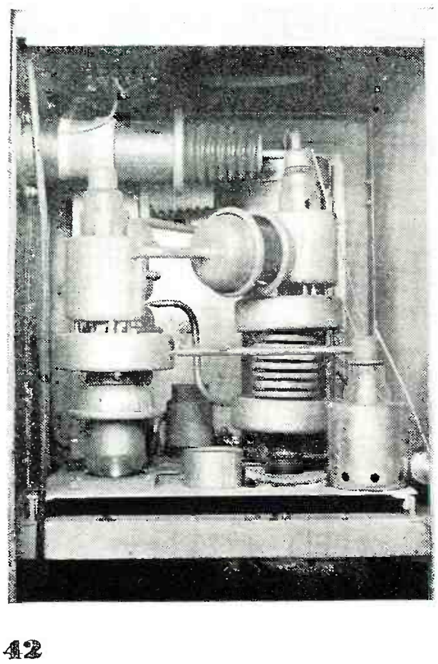


Fig. 6. Specimen holder being placed in opening in front vertical column of Universal Electron Microscope.

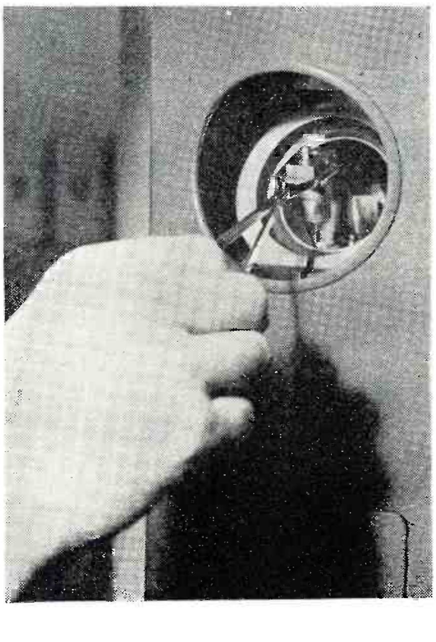
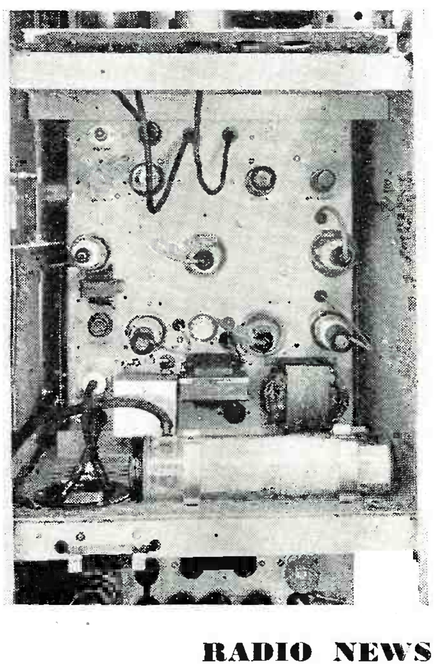


Fig. 7. Component layout of the upper chassis of unit shown above. Air filter and drier are in foreground.



sorbed and scattered by gas molecules. a relatively high vacuum must be maintained in the body of the microscope. Generally speaking, commercial and laboratory vacuum systems are quite complicated, consisting of a multiplicity of controls, valves and pressure-indicating devices. Likewise. a good balance has not always been obtained between the volumes to be evacuated and the pumping systems for them. By referring to Fig. 11 the basic principles of the vacuum and pumping system of the new Universal Electron Microscope are readily comprehended. The valve block shown in Fig. 11 controls all pumping operations. A single crank serves to actuate the valves. A, B, C and D in proper sequence. Assuming that the valving system is in the "loading" position and that a fresh specimen and photographic plate have been inserted in the microscope, the valve crank is advanced one revolution to the "prepump" position. In the prepump position, valves B, C and D are closed and the fore pump is allowed to "rough" pump the microscope. During prepumping the diffusion pump is sealed at both ends by valves B and C and, therefore, it remains in the relatively low pressure condition it was in prior to prepumping. At the end of about one minute the valve crank is advanced one more revolution to the "operate" position. In this case, valves A and D are closed and B and C are open. The fore pump and the diffusion pumps are now in series and both contribute to the column evacuation. In an additional half minute the microscope is pumped to a pressure of 0.1-μ and is ready for operation. The next position, "neutral," closes valve C. In this position the microscope can be shut down, the pumps are isolated from the column, and the column cannot be contaminated by gases except from within its own structure. The "loading" position opens valve D and allows air to enter the column by way of the filter-dryer. The filter-dryer prevents the interior of the column from becoming contaminated with moisture or dust each time a specimen or photoplate change is required. Pressures are read directly by two meters on the control panel—a thermo-gauge indicating forepressure and an ionization gauge indicating the column pressure.

The luminous pointer of the valve position indicator permits easy observation of the valve position when the surrounding general illumination is dim.

Thus, complete vacuum system control is obtained by the manipulation of one crankhandle. Since the column has been designed for a minimum volume and since the column itself is the only portion of the system requiring pumping during operation, the pumping time required to replace a specimen has been kept to a maximum of about one minute and a half, and no air locks or auxiliary pumps are required. By employing a Philips type of ionization gauge which cannot be damaged at any pressure from atmospheric to operating and a unique electronic interlock control, full protection is given to the electron gun filament and high-voltage supply. As a matter of fact, the operator may set all controls as for standard operation, run the valve system through to the "operate" position, and when the proper low pressure has been attained within the column, the high voltage and electron gun filament will turn on automatically and an image of the specimen will appear on the viewing screen.

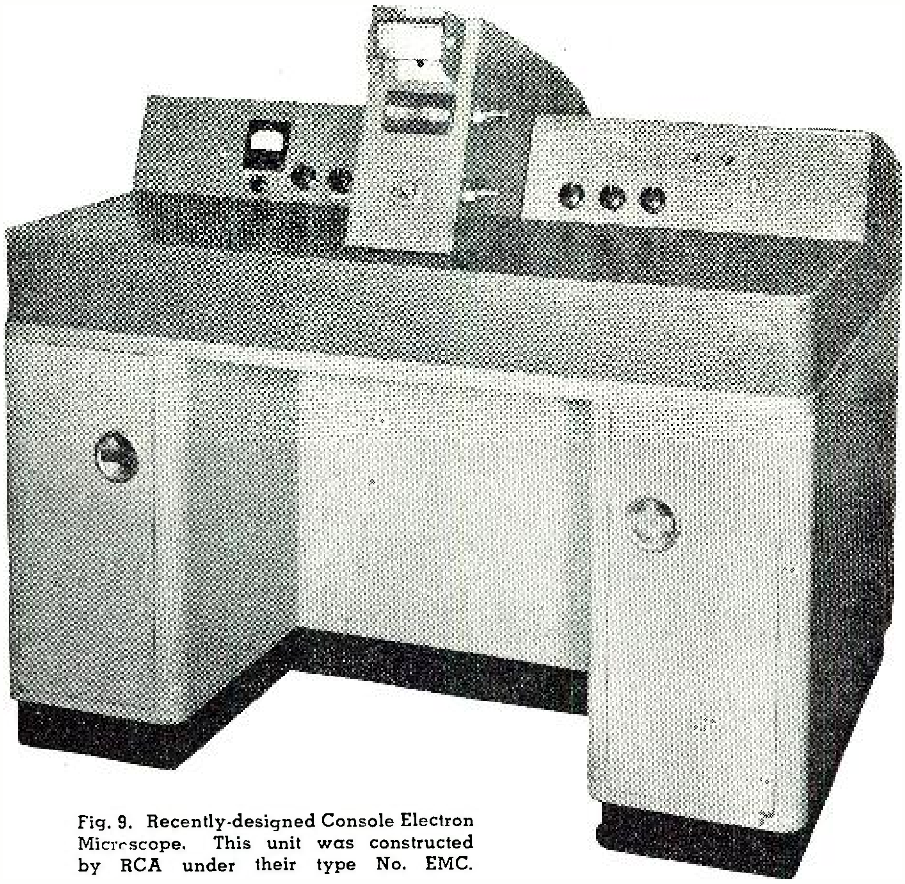


Fig. 9. Recently-designed Console Electron Microscope. This unit was constructed by RCA under their type No. EMC.

The electronic systems which control the accelerating voltage of the electron beam and the power of the lenses of the new microscopes are greatly simplified. For example, the Universal Microscope has only twenty-five vacuum tubes compared to the older EMB Model which had fifty-one. Fig. 5 shows the high-voltage chassis of the Universal Microscope. This unit produces the required accelerating voltage for the electron beam: fifty kilovolts. The design of this high-voltage supply permits operation in air and supplants the large, unwieldy, oil-insulated tank unit employed in the type EMB Microscope. The figure also shows the automatic grounding device which discharges all high voltages when either cabinet door is opened, as well as the rail and channel construction at the base which allows the entire unit to be pulled out readily for major servicing.

Fig. 7 discloses the upper chassis and the vertical method of mounting employed. Tubes and other accessories are accessible from this side of the chassis, and all other circuit components are instantly available from the other side. The horizontal glass jar in the foreground is the filter-dryer of the vacuum system. Both chasses can be quickly and easily removed from the cabinet by loosening a few screws. Examination of Fig. 8 will show how the sectional design quickly and easily exposes every portion of the instrument for service, examination or special experimental work.

The electron optical system or column of the Universal Microscope (including the vacuum system) is a separately-assembled unit constructed in the form of a cross. The horizontal members of the cross support the entire column. A rubber-lined cradle provides a bed for the supporting members and makes the column independent of the cabinet. All cables and connections to the column are of flexible materials. In this way unwanted vibrations are isolated and filtered from the optical system.

Focusing of the electron gun filament can be accomplished while the instrument is in operation. Access to the electron gun filament is gained through the top hood by simply swinging the RCA monogram out of the way and inserting the special insulated adjusting tool in the exposed aperture. The image of the filament can be seen continuously during all focusing adjustments by observation of any of the fluorescent screens. The special insulated adjusting tool affords complete safety to the operator.

The method of introducing and

(*Continued on page 86*)

A NEW CRYSTAL PICKUP CARTRIDGE

By B. B. BAUER
Chief Eng., Shure Brothers

Constructional details of a lever-type crystal pickup cartridge, having lower needle-point impedance and higher output voltage than present-day conventional types.

THE use of transformers for the purpose of impedance matching is well known in electrical work. The novel pickup cartridge described in this article utilizes a "torsional lever" as a mechanical transformer to "match" the crystal to the record groove.

Anyone who critically reviews the evolution of the crystal pickup over the past decade, is impressed with two facts. One is the number of improvements which have taken place in structural details and cost reduction. The other is the lack of improvement in the basic theory underlying the operation of the pickup. Several years ago engineers observed that in conventional crystal pickups a great deal of the energy transmitted from the record into the needle never found its way into the crystal but was used instead in the compression of rubber blocks connecting the needle with the crystal. It followed immediately that improved coupling means might bring about a notable improvement in pickup performance. A research project was started for the purpose of finding these means, and came to a successful conclusion just before the time when all the efforts of the engineering staff were redirected to war production. Recent interest exhibited by the radio industry in postwar products makes it advisable to publish at this time the results of this research.

In this article, the general theory of conventional crystal pickups is reviewed. This is followed by the theory underlying the new pickup and by data showing the improvement in performance which results from its application.

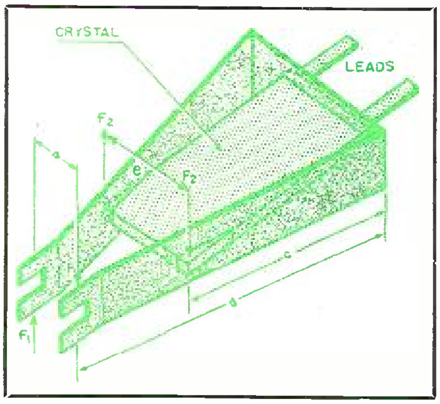


Fig. 1. An isometric drawing of the lever system employed.

Conventional Pickups

Without exception, all present-day crystal pickups employ bimorph, Rochelle salt crystals. The crystal element consists of two slabs which are cut from a Rochelle salt block in such a manner that they respond to shearing stresses. The two slabs are assembled with three foil electrodes so that the assembly is capable of generating a potential between the inner and the outer foils when subjected to a torsional stress. An expanded view of the crystal is shown in Fig. 5.

In a pickup, the torsional motion of the needle is transmitted to the crystal through a needle chuck. The crystal is quite brittle and torsionally stiff. Therefore, if the needle were connected directly to the crystal, the pickup would present a high needle-point impedance to the record. This would result in poor tracking and high record wear. For proper performance, the torsional stiffness of the crystal must be decreased by a ratio of roughly 25:1. Previously this has been done by interposing an elastic rubber block between the needle chuck and the crystal. The pickup "cartridge" shown in cross-section (Fig. 3) typifies this construction. The crystal is held at its lead end by means of two firm rubber blocks. At the front end, the crystal is coupled to the needle chuck by means of a soft rubber coupling. Torsional motions of the needle compress the rubber coupling. The pressure thus developed acts upon the crystal and produces an output voltage proportional to the pressure.

The record groove is capable of transmitting only a limited torque to the needle chuck. This can be seen by examination of Fig. 6 which shows the groove and the needle point in cross section. The walls of the groove are inclined at approximately 45°. Therefore, the side force upon the needle point cannot exceed the vertical pickup force; otherwise, the needle rides "up hill," resulting in distortion and record wear. Torque is force times distance; the maximum theoretical torque T_m which can be applied by the record to the needle chuck of a pickup is given as follows:

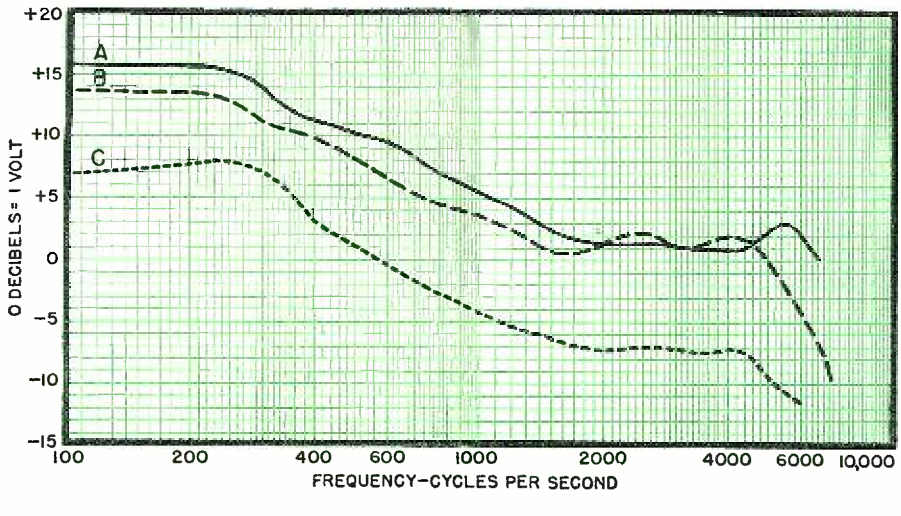
$$T_m = Fh \text{ dynes-cm} \qquad (1)$$

where

F is the vertical pickup force in dynes.

h vertical distance from needle point to needle-chuck axis, cm.

Fig. 2. (A) Lever-type 1-oz. cartridge using straight aluminum needle. (B) Same cartridge using bent aluminum needle. (C) Conventional 1-oz. pickup cartridge. The frequency response curves shown continue a straight line down to 50 cycles per second.



The maximum torque is, therefore, limited by the needle force and by length of the needle, which, because of practical considerations, cannot exceed ½ to ¾ of an inch. The actual torque is considerably less than the value indicated by (1) because of unevenness of records, turntables, and inertia effects of the tone arm. A part of the torque actually generated is lost in the needle-chuck bearings. In a conventional pickup what remains of the original torque is transmitted into the rubber coupling and the crystal. The potential energy (P.E.) due to this torque is divided between the crystal and the rubber coupling in proportion to their respective compliances, in accordance with the equation:

$$\text{P. E.} = \frac{CT^2}{2} \text{ ergs} \ldots\ldots\ldots\ldots (2)$$

where

C is the torsional compliance of the members in radians per dyne-cm.

T is the torque in dyne-cm.

Inasmuch as the coupling compliance is related to the crystal compliance by a ratio of 25:1, it is seen that 25/26th of the energy received from the record is spent in compressing the rubber coupling and is there wasted. The remaining 1/26th is actually applied to the crystal. If means are employed for more efficient transmission of energy into the crystal, the output voltage may be increased theoretically by the square root of the energy ratio, or approximately 5:1. This indicates the desirability of eliminating the elastic rubber coupling. But if the elastic coupling is eliminated the impedance presented by the crystal to the needle is too great for proper tracking. To remedy this, it is necessary to resort to the use of an impedance-matching device. Transformers for electrical impedance matching are well-known to radio engineers. In mechanics, the lever plays the counterpart of an electrical transformer. In the new pickup, a torsional lever system was developed to lower the needle-point impedance and to efficiently transmit the needle-chuck torque into the crystal.

Lever-type Pickup

Fig. 4 shows the new pickup in cross-section and Fig. 1 shows an isometric drawing of the lever system. The lever consists of a single strip of thin aluminum perforated to receive the crystal and bent in a trapezoid shape. The rear portion of the lever and crystal assembly is held in the cartridge case between two firm rubber blocks. The ends of the lever engage the needle chuck through two composition pads which serve to provide longitudinal shock isolation between the chuck and the lever, but have negligible transverse compliance. For all intents and purposes the motions of the needle chuck are faithfully followed by the ends of the lever.

The mechanical advantage due to the lever can now be computed as follows: Let the torque applied to the lever arms be $T_1 = F_1a$, where F_1 is the force upon each lever arm due to the needle chuck and a is the distance between the arms. From elementary mechanics, the force F_2 upon each corner of the crystal equals:

$$F_2 = (d/c)\, F_1 \ldots\ldots\ldots\ldots (3)$$

Where

d and c are the respective distances from the end of lever and the corner of the crystal to the point of fulcrum. The torque T_2 upon the crystal is therefore:

$$T_2 = F_2e = (d/c)\, e\, F_1 \ldots\ldots\ldots (4)$$

But:

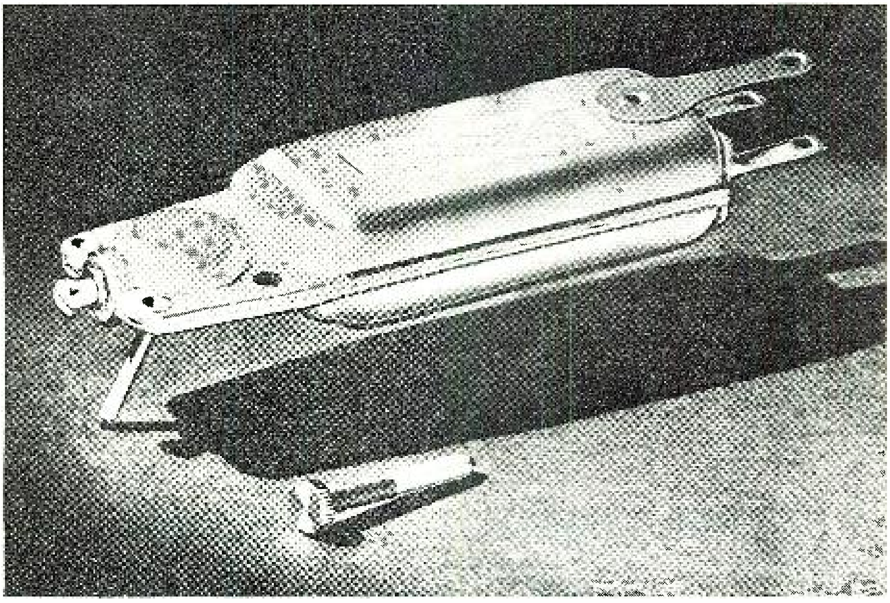
$F_1 = T_1/a$; substituting in (4)

$$T_2 = (d/c)\,(e/a)\,T_1 \ldots\ldots\ldots (5)$$

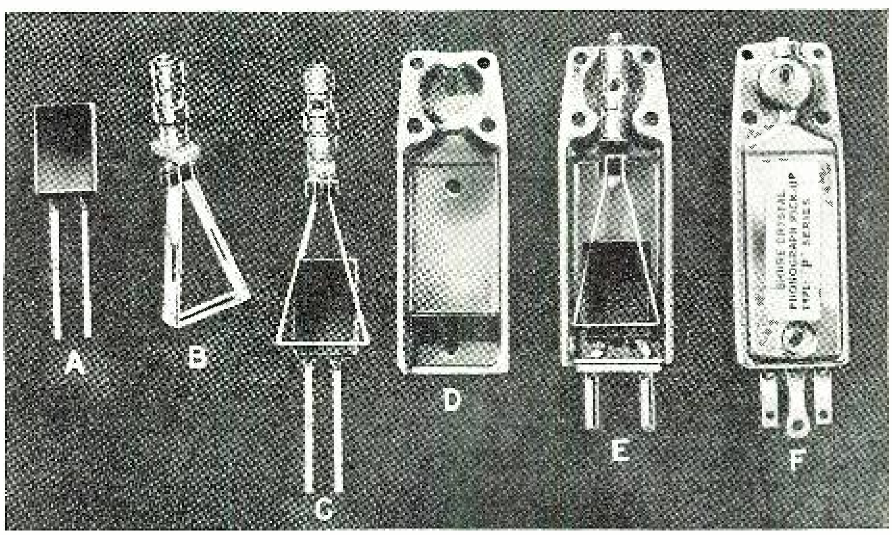
The mechanical advantage (or torque multiplication) is equal to the ratio of the two torques, therefore:

$$\text{m.a.} = (d/c)\,(e/a) \ldots\ldots\ldots (6)$$

In a lever-type pickup cartridge designed to track at 1 oz., the lever dimensions are such that $d/c = 2$ and $e/a = 2.5$. Therefore, the torque multiplication is 5:1. The full five-fold increase in voltage is not realized because roughly 25% of the torque is spent in the lever. At the same time the crystal compliance referred to the needle-point increases as the square of the mechanical advantage or by a ratio of 25:1. Therefore, substantially higher voltages can be obtained than was previously possible with comparable needle compliance. Conversely, standard voltage pickups have been made using the lever principle having an extremely low needle-point compliance and capable of tracking in pickups operating at less than ½ oz. The new lever-type pickups have an important structural advantage over conventional pickups: They do not depend upon soft rubber couplings or other material which deteriorates with age for generation of voltage. The structure of the lever pickup is dy-



Crystal pickup cartridge shown in its completely-assembled form.



Structural details of the new pickup cartridge: (A) bimorph crystal; (B) lever and needle chuck assembly; (C) crystal inserted in lever; (D) cartridge shell; and (E) assembly placed in cartridge case.

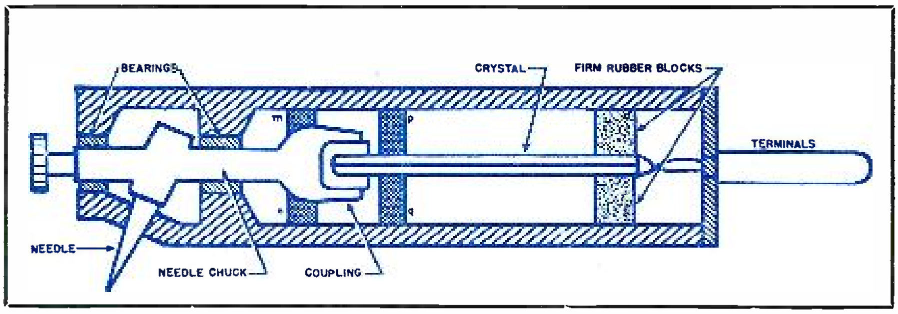


Fig. 3. Cross-sectional view of the conventional-type crystal pickup, showing constructional details. These units employ a soft rubber coupling between the crystal and needle chuck without the aid of a lever arrangement. This automatically results in a limited output voltage which is considerably lower than those pickups which employ the lever arrangement.

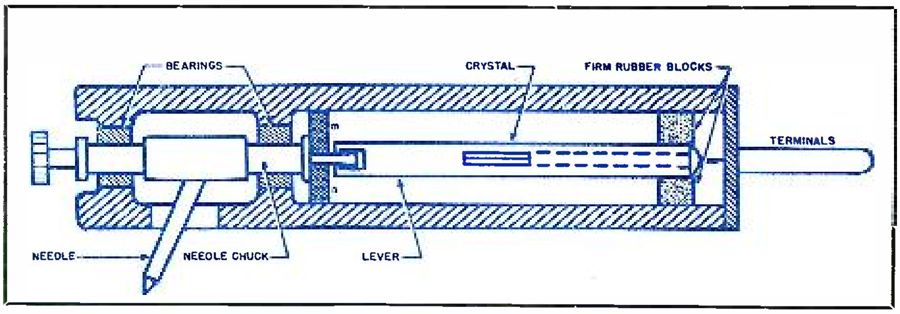
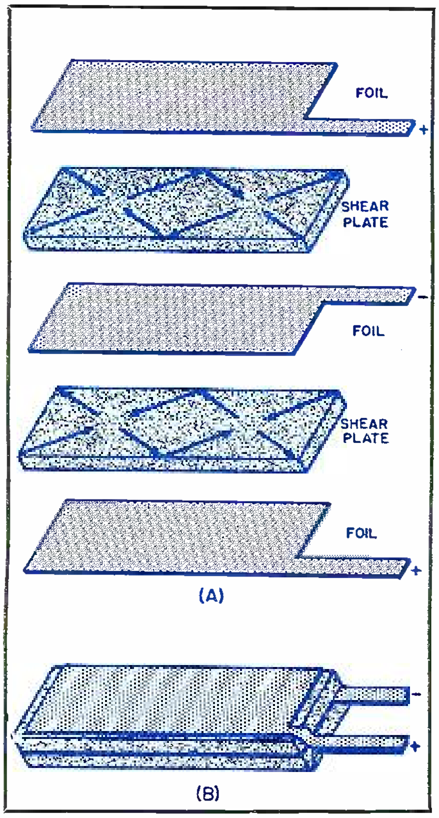


Fig. 4. Constructional details of the lever-type pickup. The motions of the needle chuck are transmitted to the crystal by means of this lever action. With this arrangement there is a torque multiplication of five to one, which is not entirely realized, as 25% is lost within the lever.

Fig. 5. An expanded view of the crystal cartridge. The two bimorph Rochelle salt slabs are assembled with three foil electrodes so that the assembly is capable of generating a potential when subjected to a torsional stress.



namically simple. Since the lever is rigidly coupled to the needle chuck the system has only one degree of freedom and can be damped, therefore, with a single set of damping pads, M and N in Fig. 4. In contrast to this, the conventional pickup has two degrees of freedom; the needle chuck and the crystal which are loosely coupled by the rubber coupling member. Two separate sets of damping pads m n, and p q, are therefore required. The selection and control of two sets of damping pads has made it difficult to control such pickups in production. In the design of the lever-type pickup, care has been taken to hold the lateral mass referred to the needle point to a very low value. The needle chuck is made of a light alloy. When used with an aluminum shank needle it presents to the record a mass of less than 50 milligrams. Tests on frequency records with needle forces of 1 ounce indicate good tracking at all freq.

Experimental Results

Performance of a pickup cartridge is greatly influenced by the tone arm and the needle. Tone arm affects low frequency response, especially if the tone arm mass resonates with the pickup cartridge compliance at 50 to 100 c.p.s.

For the purpose of laboratory measurements, the pickup cartridge is held in a tone arm which is substantially free of mechanical resonance throughout the desired frequency range. The test record may be any one of the several available for pickup measurement purposes. One of the test records frequently used is the "Audiotone" test record which has a continuously varying frequency band from 7000 c.p.s. at the outside grooves to 50 c.p.s. at the inside grooves.

The voltage output is measured by means of a calibrated amplifier or a vacuum-tube voltmeter. In order to determine the effect of input impedance upon the pickup response, the vacuum-tube voltmeter circuit is often provided with a network which simulates the impedance of the network into which the pickup is to work. For comparative purposes, however, it is usually more satisfactory to measure the open circuit voltage generated in the crystal. This is done by employing an amplifier having a high input impedance (5 megohms or more) and low input capacity (50 μμfd. or less). This information together with the statement of the internal capacity of the crystal is sufficient to determine the frequency response of the pickup connected to any network.

Needles affect high frequency response due to additional mass and compliance which they introduce. The effects are especially important with the currently popular semiflexible needles used for surface-noise reduction.

It is almost axiomatic that needle effects will greatly depend not only upon the needle itself but also upon the mechanical impedance of the needle chuck. Pickups with low needle chuck impedance are less subjected to response changes than pickups with high needle chuck impedance.

Fig. 2 shows the response-frequency characteristic of a 1 ounce lever type pickup employing a straight aluminum permanent-type needle and also the response with a bent needle having vertical compliance. Also shown in Fig. 2 is the frequency-response characteristic of the conventional pickup cartridge. Comparison is shown of the lower voltage output of this pickup in relation to that of the new lever-type unit. The voltage gain in the new pickup is roughly 3:1. Listening tests indicate a "clean" transient response which is attributable to the elimination of additional degrees of freedom.

—30—

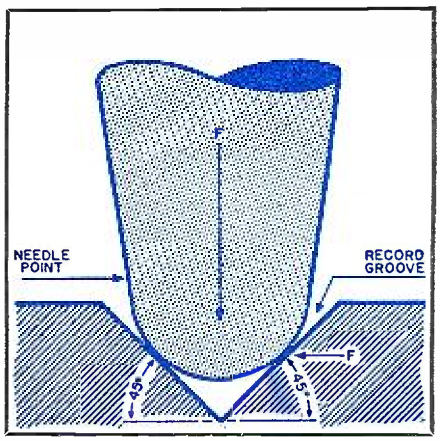


Fig. 6. Cross-section of the record groove and the needle point.

VERSATILE TEST GADGET

By ROBERT MERTEN

An ordinary tungsten lamp, overlooked by most servicemen, can be used as an all-around test instrument.

A MOST useful test instrument, obtainable without priority and costing almost nothing, is available to every radio serviceman. This instrument, which is in its simplest form a series lamp wired as shown in Fig. 1, will indicate approximate wattage, detect overload, help locate shorts and opens, check continuity, provide voltage reduction, act as a current limiter, and protect lines and equipment.

Every man working with electricity has a chance to observe, sooner or later, the destructive effects of a short-circuit. Even though the ordinary house circuits are protected with 15-ampere fuses, a "short" will blow the tip off a screwdriver, burn a hole in pliers, or destroy a 5-ampere switch. The momentary rush of current is enormous.

Yet, there are many occasions when full line voltage must be applied to a pair of terminals, either for testing or for operation. If a short occurs while the leads are held in the hand, the flash may be decidedly unpleasant.

Here is where the series lamp finds one of its most useful applications. No harm is done if the leads are shorted. Full line voltage is available but a wrong connection will not blow up a switch or contact spring. With a 100-watt lamp the maximum current from a 120-volt line is a little over 0.8 ampere.

Following detailed instructions show the variety and scope of this application:

Identifying Windings of Power Transformers

A combination of resistance and voltage measurements will enable the serviceman to identify uncoded windings.

The high voltage secondary is wound with a large number of turns of rather small wire. Its d.c. resistance is the highest of all the windings. This will vary between 200 and 300 ohms, depending on secondary voltage and current ratings.

The primary, whose voltage is high compared with that of the filament windings, is wound with many turns of fairly large wire. Its resistance is more than that of the filament windings but considerably less than the value shown by the high-voltage winding. The ordinary primary may be expected to have a resistance of from 3 to 10 ohms.

Filament windings, having but a few turns of heavy wire, will show about .1- to .5-ohm resistance.

Apply the line voltage through a 100-watt series lamp to the supposed primary. If this winding is the true primary and if all other windings are open, the only current taken through the lamp will be the normal exciting current of the transformer. This will cause only a slight glow in the lamp.

Series Lamp	Load Lamp	Volts Lost
200 Watt	50 Watt	4
	100 Watt	22
300 Watt	50 Watt	2
	100 Watt	11
Two 200 Watt	50 Watt	1
	100 Watt	5
Line Voltage—123 Volts		

Table 1. Voltage drops across series lamps with 50- or 100-watt loads.

Now the other windings may be tested. With an a.c. voltmeter of proper range, check the output of the high voltage winding. This should read from 400 to 800 volts. Half voltage should be obtained from either side to center-tap.

If this high voltage is not obtained, then the wrong winding has been selected as primary. This might be possible in the absence of resistance measurement.

If the voltage from the test lamp were applied to a filament winding, the exciting current would be excessive and the lamp would light up brightly. No damage would be done.

Without the lamp in the circuit, full line voltage would be placed across the filament winding. Before the fuses blew, the high-voltage winding would be subjected to a surge of at least 20 times its normal voltage. The insulation would probably break down, and the transformer would be damaged.

After the primary has been identified, the selection of the other windings is a simple matter.

Checking Coils, Clocks, Etc.

Many electrical devices that operate from 120- or 240-volt lines require approximately full rated voltage but draw only a very small current. An electric clock, for example, takes about 2 watts at 50% power factor. This means a current of about 35 milliamperes. Relays, solenoids, operating coils, and the like usually require very little power.

To test any of these at full voltage, the series-lamp circuit is ideal. Simply make a pair of test leads with a line plug at one end and with prods or clips at the other. Even the most confined and crowded terminal strip offers no hazards.

Demonstration Apparatus

Only those who have put on a "show" or demonstration of electrical equipment can understand the pleasure and satisfaction that the lecturer feels when everything runs smoothly and performs as it should.

No one who has not experienced this sensation can know how much alone the professor is if he inadvertently makes a wrong connection and blows a fuse or causes a bad flash. More likely the short is made by an inexperienced student but the fuse blows out just as promptly. In a strange classroom, where nobody knows the location of the fuses, the restoration of service can be a highly embarrassing problem.

Here, again, the series lamp can be used to advantage. Where three or four groups are experimenting with single-tube circuits or small amplifiers, one 200-watt lamp provides complete protection while allowing normal operation of the equipment. The lamp may be mounted on a small distribution board provided with several outlets.

Where loads are greater, two or more lamps should be used in parallel. Table I shows what voltage drops may be expected.

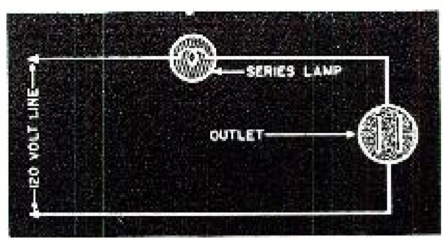
It is clear that the series lamp may be used in any size to limit the current to any desired value. The voltage loss is negligible if the current taken by the load is of the order of one-fifth of the rated current of the series lamp.

Wattage Indicator

When this circuit is used as a wattage indicator, a 50, 100, or 200-watt lamp should be used. The brilliancy of these lamps, when employed with a

(*Continued on page* 141)

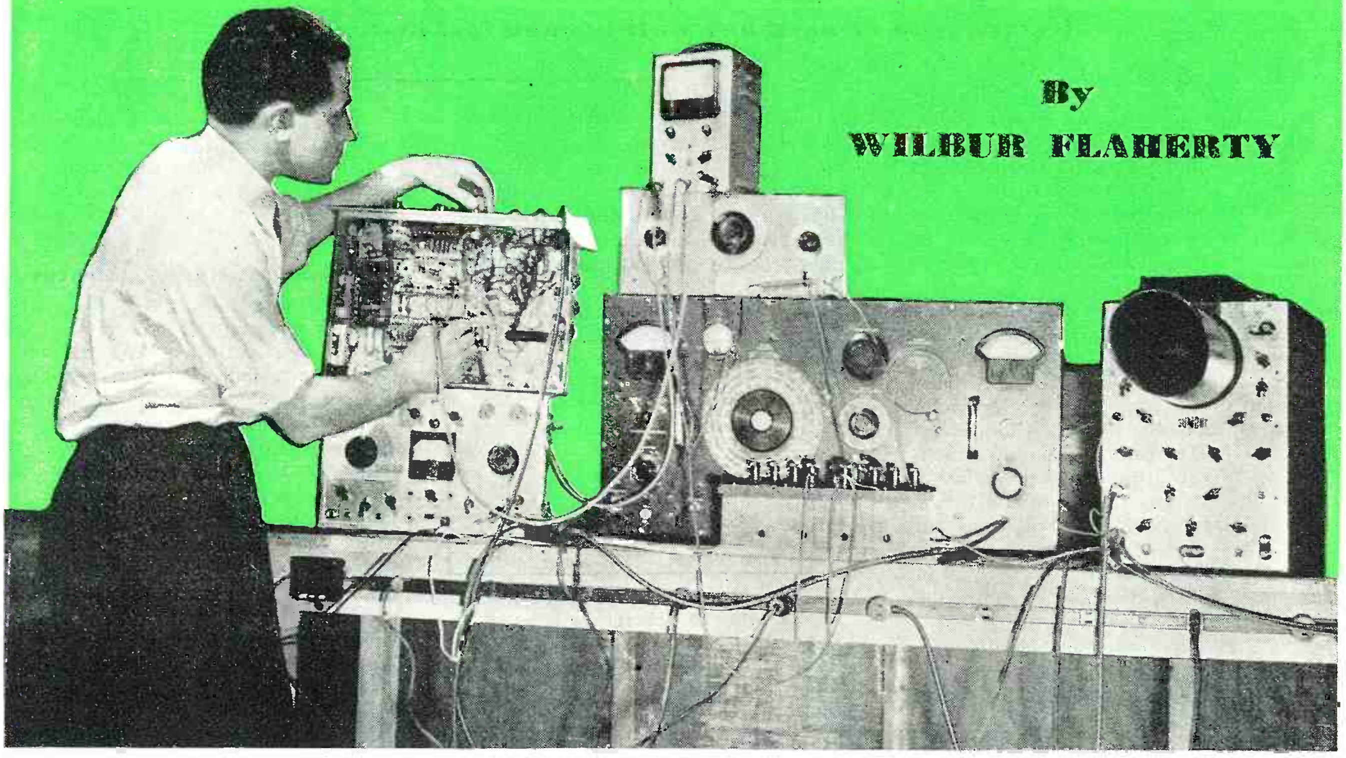
Fig. 1. Diagram of test instrument.



SERVICEMAN'S VTVM—CAPACITY—OHM Meter

By

WILBUR FLAHERTY



This home-constructed instrument may be used like the VoltOhmyst, Jr. shown, for all-around receiver measurements.

Constructed from available parts, this slide-back type universal test instrument, employing an electric eye, may be used both in the shop and home.

SOME months ago your author became obsessed with the desire to own and operate a vacuum-tube voltmeter (more commonly known as a VTVM) for use in sound pictures, transmitter, and general radio work. Nothing was available without a high priority, so the only recourse was to construct one from the never-failing junk box. The meter described here was built from second hand parts, and is essentially a slide-back type. The slide-back voltage comes from the portion of the power supply voltage across the resistors R6 and R7; these resistors are in the form of a dual wirewound potentiometer.

Since no microammeters or milliammeters are available, the only choice was to use a circuit built around a "magic eye" tube such as the 6E5. This is not such a great disadvantage as it first appears because the resulting VTVM is practically immune to damage from overload. The only limit to overload voltage is that which will cause arcing or a breakdown of the elements in the input tube, V1. The cathode follower (or reflex) circuit of the input tube tends to make it self-protecting and stable. Probably 500 volts or more can be applied directly to the grid of the input tube with no harm other than drawing current from the circuit being tested. For the above reasons of safety and because of theoretically infinite input impedance, the reflex circuit was used. Also, the reflex voltmeter is relatively insensitive to changes in tube characteristics and changes in line voltage.

The VTVM here described has d.c. voltage ranges from .1 to 170 volts at infinite impedance, and up to 1700 volts at 20 megohms input impedance using the built-in multiplier. The a.c. range is from .3 to 115 volts at infinite impedance, and to 1150 volts using the same multiplier as for d.c. volts. The ohmmeter section measures from 1 ohm to 1000 megohms in six ranges. The capacity meter measures from 50 $\mu\mu$fd. to 200 μfd. In some cases, where it can be connected in the positive return of the circuit being tested, the VTVM can be used as a milliammeter or microammeter. As such, it is free from the overload damage which could ruin a conventional moving-coil meter.

The reflex VTVM is a "peak reading" device when used on a.c. That is, it gives a reading which is proportional to the peak or crest value of the a.c. wave when that wave has an amplitude greater than one volt. Below one volt the response is more nearly proportional to the average value. Also, if d.c. with an a.c. component is being measured, the reading will be the sum of the d.c. voltage plus the peak value of the a.c. wave. An example of this would be the pulsating d.c. across a filter condenser. By inserting a blocking condenser in the grid lead, only the a.c. component is measured. The a.c. lead in the multiplier section also serves this purpose. The only requirement of the reflex voltmeter is that a return path be provided from the grid of the input tube back to ground (chassis) of the VTVM. The resistance of the return path can be as high as 5 to 10 megohms, though practically always the set being tested will in itself provide a return path from the input grid.

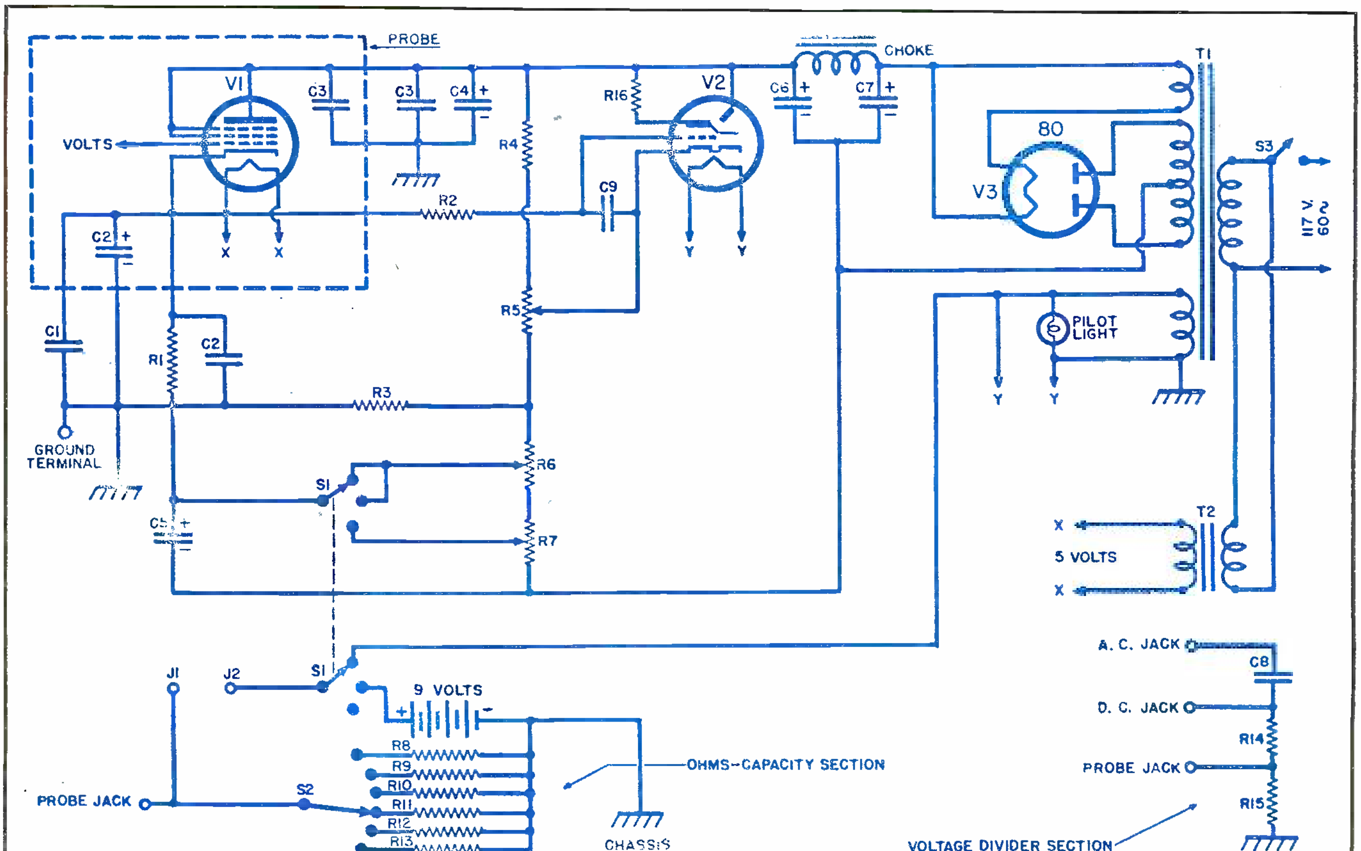
Referring to the circuit diagram, Fig. 1, the input-tube, V1, is not used in the ordinary manner. There is no signal component in the plate voltage. It is by-passed to ground by a 16-μfd. electrolytic condenser (C_4) in parallel with a .001-μfd. mica condenser (C_3). The cathode resistor R_1 can be somewhere around .25 megohm in parallel with a 16-μfd. electrolytic condenser (C_1) of high leakage resistance. A 500-volt dry electrolytic is best for this purpose unless you have the equivalent in a good paper dielectric condenser.

The value of R_1 is something of a compromise. Lower values—25,000 to 50,000 ohms—give a slight increase in sensitivity at the expense of linearity and stability. As used, the 16-μfd. value for C_1 and .25-megohm for R_1 gives an RC product of 4 which is suitable for frequencies down to 25 cycles. In like manner with 2 μfds. for C_1 and 2 megohms for R_1 you still have an RC value of 4 for the cathode circuit. The greater the product of R_1 times C_1, the greater the freedom from waveform error at lower frequencies. Waveform error is an affliction of most commercial and homemade VTVM's, but not a serious one since in test work a sine wave signal generally is used. Most VTVM's represent a compromise of some sort; one thing is gained at the expense of another.

When the grid of V1 is shorted to ground, there is a small voltage drop across R_1. This is the original bias. If positive 10 volts be applied between the grid and ground, the cathode will follow the grid voltage and become almost 10 volts more positive than it was before. A tube so operated has a gain of slightly less than one. For example, if the original bias across R_1 was 4 volts, the resultant bias would be slightly under 14 volts. This action will continue up to the point where the grid and cathode voltages almost equal the plate voltage. Perhaps another example will make this clearer. If the plate voltage is 175, the maximum voltage applied to the grid should not go above 170 volts, for if the grid voltage goes above this, linearity is lost. The limiting factor is the plate voltage, which must always be a little higher than the voltage applied to the grid. Up to this point the input impedance is practically infinite when used on d.c.; if a higher voltage is applied, the input tube draws grid current from the device being tested. The same holds for audio and lower radio frequencies. As the frequency increases, the input impedance drops because of losses from electron transit time. The only remedy for this is to use a u.h.f. tube such as the 954 or the 955. However, with ordinary tubes, such as the 6J7, the useful range is up to about 5 megacycles.

Almost any type of tube with the grid lead brought out on top can be used for V1, even an old 24A. In a reflex circuit, such as described here, the mu and the Gm of the tube have little effect on its action, if R_1 is sufficiently large. If pentodes or tetrodes are used, connect the screen and suppressor to the plate. Metal tubes are preferable if probe type of construction is used. The author was fortunate enough to obtain several used and discarded 1620 metal tubes. These 1620's, the nonmicrophonic equivalent of the 6J7, were discarded for low emission

Fig. 1. Schematic diagram of completely a.c. operated, 3 tube test unit. The voltage divider portion of the instrument, shown at the bottom right-hand corner, is used when extremely high a.c. or d.c. voltages are to be measured.



C_1—See text
C_2, C_3—.001-μfd. mica cond.
C_4—16-μfd., 450-v. elec. cond.
C_5—12-μfd., 450-v. elec. cond.
C_6, C_7—8- or 12-μfd., 450-v. elec. cond.
C_8—.5-μfd., 600-v. paper cond.
C_9—.1-μfd., 6.0-v. paper cond.
R_1—See text
R_2—.251megohm, 1-w. res.
R_3—25,000-ohm, 1-w. res.
R_4, R_6, R_7—See text
R_5—1000-ohm w.w. pot.
R_8—100-ohm, 1-w., 2% res.
R_9—1000-ohm, 1-w., 2% res.
R_{10}—10,000-ohm, 1-w., 2% res.
R_{11}—.1-megohm, ½-w., 2% res.
R_{12}—1-megohm, ½-w., 2% res.
R_{13}—10-megohm, ½-w., 2% res.
R_{14}—18-megohm, ½-w., 2% res.
R_{15}—2-megohm, ½-w., 2% res.
R_{16}—.5-megohm, 1-w., res.
T_1—Midget power trans.
T_2—5-v. fil. trans.
Choke—20-henry, 40-milliamp.
P—6.3-v. panel lamp
Jacks—Amphenol 78-1P phone tip jacks—6 req.
S_1—D. P. 3P. switch
S_2—S.p.6p. switch
S_3—S.p.s.t. switch
Chassis—8x12x2½"
For Probe:
1—Amphenol 3-14 adaptor shell
2—Amphenol S type octal sockets
2—Amphenol CP type plugs, octal
3½ feet shielded 4-cond. cable
2—Amphenol PF8 octal shielded cable connectors with cable clamps. Above parts are for probe using 6J7 tube. If a 955 tube is used the construction will be modified somewhat.
Tubes:
V_1—6J7, 1620, or 955
V_2—6E5
V_3—80

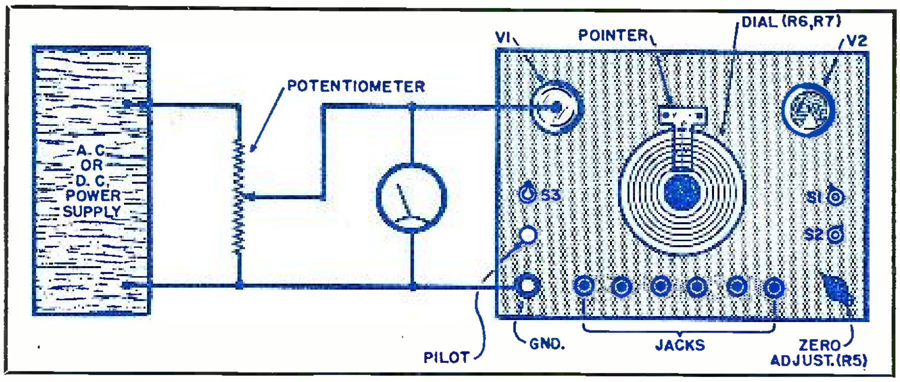


Fig. 2. External connections used when calibrating the instrument. Panel layout shows suggested component placements for maximum operating efficiency.

but were suitable for use in this VTVM. 6F5 tubes seem to be a bit too fragile for use on the end of a probe, possibly on account of the control grid structure. If you should happen to have a 954 or a 955, you are in a position to make a VTVM suitable for use at high frequencies.

Tube V1 can be placed on the front panel of the instrument for close-up work and when desired it can be removed and a probe inserted and then V1 inserted in the end of the probe. For r.f. and v.h.f. work, the use of a probe is necessary. C_2 and C_3 should be placed at the tube socket on the end of the probe and also a similar pair is placed in parallel with C_1 and C_4 on the chassis of the VTVM. The micas are used in the probe at the tube base to by-pass any r.f. at the tube base and prevent resonance in the probe cable. The probe cable should be about 3½ feet long. The parts shown in the dotted square are mounted on the tube end of the probe. This includes the tube, V1 and the condensers C_2 and C_3 which are inside the No. 3-14 adapter shell. Note that one side of the heater of V1 is connected to the cathode at the tube socket on the probe and also to the V1 tube socket on the panel. This is done so that there will be no difference of potential between heater and cathode. This is important.

The 6E5 eye tube (V2) is the indicator part of the meter and is connected in a conventional manner. The 6E5 contains a high mu triode and gives a visible shadow when .1 volt is applied to its grid. This is the lower limit of sensitivity for this tube, and since V1 has a gain of slightly less than one, it follows that the lower limit of sensitivity for the entire VTVM is slightly under .1 volt. R_5 is the zero adjustment for the meter and suffices for all ranges and functions.

The series of resistors R_1, R_5, R_6, and R_7 are so proportioned that the d.c. output of the power supply is evenly divided with R_1 connected to the midpoint. If you have 350 volts available from the power supply, you will want half of it across R_1 and R_5, and the other half across R_6 and R_7. The purpose of R_6 and R_7 is to supply bucking voltage to balance out the voltage drop across R_1.

In the VTVM constructed by the author, R_6 and R_7 is a dual wirewound potentiometer from an old RCA radio. If a dual potentiometer is not available, two standard linear wirewound potentiometers can be mounted on a bracket and their shafts connected by a narrow U-shaped piece of iron drilled and tapped to clamp on the shafts. The ratio of R_6 and R_7 governs the voltage measured on the high and low ranges, respectively. Inasmuch as you are using 9 volts for the ohmmeter section, you want 9 volts drop across R_6 and the balance of the 175 volts across R_7. Thus on the *low* d.c. range the meter will measure .1 to 9 volts and from 9 to 170 volts on the *high* d.c. range. There is no overlap on the two scales, but this is no disadvantage when you consider that each scale is about 12 inches long.

Now assume that you have 9 volts across R_6 and 166 across R_7, and that R_6 and R_7 total 35,000 ohms. R_5 is 1,000 ohms, so R_1 must equal 34,000 ohms to give a midpoint of 175 volts at the junction of R_3, R_5, and R_6. Of course, these values will have to be governed by what resistors and potentiometers you have on hand, but the relative values of these resistors are important. You may have to parallel a resistor across R_6, or perhaps across R_7 to get desired values, but in the end you balance it up by choosing the proper value for R_1. In this series of resistors and potentiometers be sure to use wirewound units.

The power supply is conventional except that the negative leg is *not* grounded to the chassis. The negative terminals of C_6 and C_7 must be well insulated from ground and connected to the center tap of the high-voltage winding of the power transformer T_1. Heater current for V1 comes from transformer T_2, a small 5-volt filament transformer. By using 5 volts on the heater of V1 emission from the cathode is lowered, thus decreasing grid current from V1. Grid current from this tube can be checked as follows: ground the grid through a 10-megohm resistor and adjust R_5 for zero. Now connect the grid directly to ground and see if you have to change the zero setting. When using a 6J7 input tube in this VTVM there should be no change in the shadow angle of V2. This is important when using the ohmmeter section.

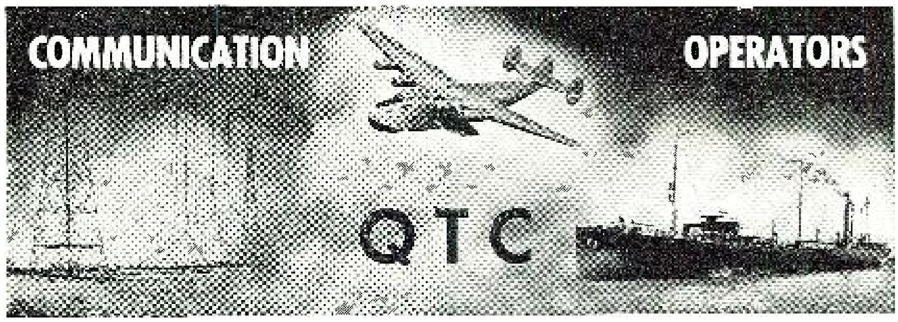
S_1 is a double pole, 3 position selector switch for low and high a.c. and d.c. voltages and for the ohm and capacity scales. In the counterclockwise position, the rotor on the upper deck of S_1 connects to the slider on R_6; and on the lower deck the rotor connects to one end of the 6.3-volt heater winding at Y-Y. The other end of the heater winding connects to ground (or chassis, whichever you prefer to call it). This furnishes an a.c. voltage of approximately 9 volts peak for use on the capacitymeter section. When S_1 is set at the center position the upper deck rotor again connects to the slider on R_6, and the lower rotor connects to the positive 9 volts from the two 4.5-volt "C" batteries in series. The negative end of the 9 volts goes to the chassis. When S_1 is at the clockwise position the upper rotor connects to the slider on R_7 and the lower rotor is open.

S_2 is the range switch for ohms and capacity only. It has nothing to do with the voltage scales, for when S_1 is set to read high volts, the ohms-capacity circuit is disconnected and inoperative. The resistors R_8 to R_{13} form the multipliers for the ohms circuit. R_8 is 100 ohms, R_9 is 1,000 ohms, and so on up in multiples of 10; R_{13}, the final one, has a value of 10 megohms. This gives resistance ranges of Rx1, Rx10, and so on to Rx100,000 ohms. On the capacity scale the multiple is reversed and becomes Cx1, C/10 and so on down to C/100,000 μfd. Needless to say, the greater the accuracy of these resistors, the more accurate will the meter be on the different ranges of R and C.

The voltage divider is conventional and consists of R_{14}, and R_{15} for d.c. volts, and a blocking condenser, C_8, for a.c. volts. The divider has a factor of 10. When C_8 is used, any d.c. component is blocked out and a.c. only is read. If C_8 is not used, d.c., or d.c. with an a.c. component, can be read.

The calibrated scale can be attached two ways: either a pointer attached to the shaft of R_6 and R_7 and the calibrations marked on a suitable stationary dial on the VTVM panel; or a disc six inches in diameter can be mounted on the shaft of R_6 and R_7, and a stationary pointer used. This pointer can be a piece of celluloid or plastic one inch wide and four inches long with a hairline scratched on. The advantage of the latter method is that the figures on the dial are always right side up when under the hairline. On this VTVM you will have six scales: ohms, capacity, low d.c. volts, high d.c. volts, low a.c. volts, and high a.c. volts. If you have noninductive resistors for calibrating, you can add a scale for reading impedance. This will be the impedance at 60 cycles. Along the hairline indicator drill a small hole for each scale, large enough to insert a pin to mark the various calibration points. The dial is easier calibrated if it is faced with a good grade of heavy, smooth drawing paper. After calibra-

(*Continued on page* 133)



By CARL COLEMAN

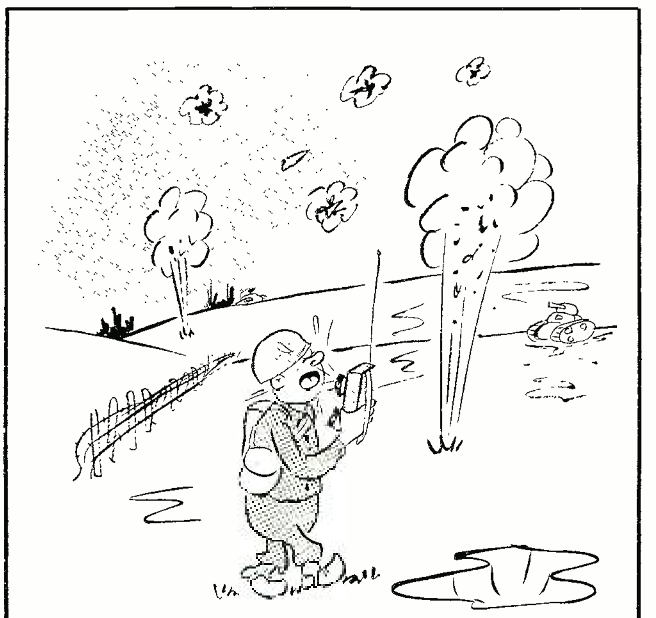
THE Federal Communications Commission has released another list containing the names, addresses, and other information concerning holders of first and second class radiotelephone licenses who have indicated availability for employment since the previous list was issued. These lists are being made available to relieve the present shortage of radio operators and technicians in the communications industry. The FCC cautions that the Commission does not certify as to the experience or availability of any person listed, but that they merely set forth the information as received. Users of the list are also advised to consider the applicable orders and regulations of the War Manpower Commission and the National War Labor Board. FCC also has made a survey of the first and second class radiotelegraph operators to learn how many of the 21.000 licensed operators are available for service in the merchant marine. Some 10.000 radiotelephone licensees already have been canvassed and 750 names of candidates for employment in the communications field have been turned over to the War Manpower Commission and interested groups within the industry. The National Association of Broadcasters has requested a continuance of the survey to meet the continuing shortage of licensed broadcast operators. The new proposed survey of some 21,000 licensed radiotelegraph operators was requested by the War Shipping Administration, which is recruiting such operators to meet the critical need for ship operators in the merchant marine.

FRED HOWE of ROU reports the signing of an agreement with the Los Angeles Tankers Operators. Inc., by their West Coast representative at Wilmington. Fred also reports the signing by four other outfits. and another settlement for back pay. ROU reports the Marine Transport Lines case settled. ROU is expecting new signed agreements in the near future from several other steamship operating companies.

VICE Admiral R. R. Waesche, Commandant, United States Coast Guard, has written a special article entitled "The Quest for Seamen's Safety in Wartime," which appeared in the September issue of the ACA Marine Dept.'s publication "Msg." Admiral Waesche points out the fact that "The consequences of the enemy's 'blitz' against shipping, both before and after Pearl Harbor, indicated that peacetime measures for safety at sea were not geared to the problems which arise in war conditions." The article also deals with the effort of the U. S. Coast Guard and what work has been and is being done for safety at sea in wartime. The Commandant also paid high tribute to radio officers, stating that "the Service recognizes the great part that Radio Officers play in the fight for safety at sea. The heroism of many radio officers has established a high standard of conduct, and is justly deserving of praise."

THE State Department, Division of Passports, new ruling regarding passports for seamen becomes final November 15, 1944. For three months prior to this date it was necessary to have either a valid passport or evidence, usually referred to as a "receipt," that you have applied for a passport within the preceding six months. After November 15th, however, you must have the passport or a special authorization from the Secretary of State.

AMERICAN Communications Association, Marine Dept., has announced the start of negotiations on a national basis with the American Merchant Marine Institute, Pacific American Shipowners Assn. and the Ship Operators Assn., representatives of fifty-seven companies on the east, west and gulf coasts. Harry A. Morgan, of ACA, reports that this will be the first time merchant marine radio officers have had the opportunity to establish a national master agreement with the employers and said that the future of our American merchant marine in the postwar period will be determined by the extent of well-stabilized labor-management relations. Mr. Morgan also announced the opening of hearings before the National War Labor Board on a wage dispute involving twenty-three west coast steamship companies, members of PASA and ACA. The wages will be adjusted in accordance with the final decision of the Board and it was believed that a substantial increase could be expected. ACA also announced that sixteen steamship companies are paying $116,000 in retroactive wages following three years of negotiations, arbitrations and hearings before the War Labor Board. The wage disputes were handled in two separate cases, one involving tankers and the other eight collier companies.



"Doggone-it. Phillip! turn your head when you sneeze!"

LAWSON EXLEY, from the heart of Georgia, is in for a vacation—and a "yankee" bride—good luck, Lawson. Cy Mantel, former editor of "Msg," is vacationing in the big city between voyages . . . and on pay. Bill Klein has taken a C-2 berth. T. Farnan is off and on an APL Liberty bound. Walter Barnes is back from a long trip and vacationing in NY, having refused a "peaceful trip" on the Lakes with D and C Navigation. R. R. Dunn has come back to Galveston as agent for ACA. Santos Athans is going with Lykes from Boston, on a Liberty. Thomas Garvey has been promoted from second to Chief with Intl. Freighting. Arnold Foster has left the beach at Boston and is out as 2nd with Moore-McCormack. Carl Carlson has taken a chief's job out of New York. Rehn Mathes is in from many days in a lifeboat after a torpedoing and is taking a well-earned rest. Carleton Bacon, former instructor in radio training at PS 20 NYK, was in for a few days. What (*Cont. on page* 102)

PRACTICAL RADIO COURSE

By ALFRED A. GHIRARDI

Part 28. Preselector circuit arrangements employed for minimizing image-frequency and other spurious interferences in superheterodyne receivers.

HAVING learned why preselection is necessary in superheterodyne receivers designed to operate on the standard broadcast and short-wave bands, we are now prepared to study practical circuits for providing the necessary amount of preselection.

Desirable Preselector Characteristics

The receiver designer strives for most efficient transfer of desired-signal energy from the antenna to the grid of the mixer or frequency-converter tube, together with satisfactory suppression of image response and as many other undesired spurious responses as possible. The ideal preselector which will allow signal energy of only a single frequency (or a very narrow band of frequencies) to pass unattenuated and will absolutely reject all other frequencies does not exist. In the conventional cascaded selective coupling circuits, gain and image ratio are *inversely* related, because the resonance curves of the individual circuits broaden when the coupling is adjusted for maximum gain. Then, too, the addition of tuned signal-frequency circuits to a receiver in order to accomplish a high degree of preselection is costly. The addition of each such circuit means that more sections are needed in the gang tuning capacitor, more tuning coils and switch contacts (in multiband receivers) are required, and there are more tuned circuits to align in the initial adjustments. Consequently, the final design of the preselector generally is a compromise between allowable cost, gain, and image-frequency rejection. This confliction of interests has been responsible for the marketing of many thousands of superhet receivers of the inexpensive midget type that do not provide any preselection other than that attained by single-tuning the input circuit to the converter tube. Such receivers invariably are subject to spurious image-frequency and other undesirable responses when operated in many localities.

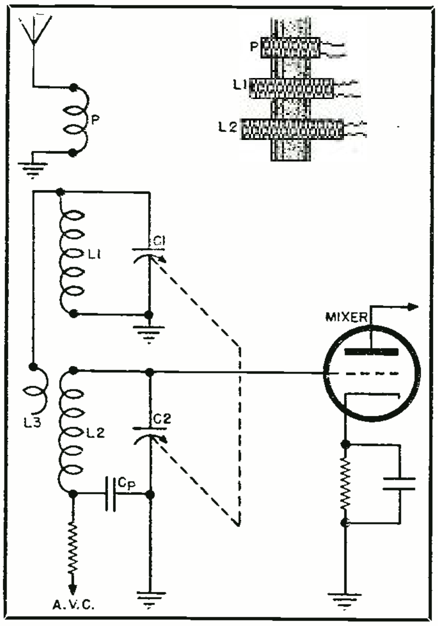


Fig. 2. Many superheterodyne receivers that employ a 3-gang tuning condenser use this simple band-pass preselector circuit, with the compact coil arrangement shown at the right, to preselect the desired signal.

Considerable study has been devoted to the development of simple, practical, inexpensive circuit arrangements for improving the rejection of image-frequency and other spurious responses. The necessity for providing simple waveband-switching arrangements in the preselector circuits also presents a problem when the receiver is of the multiband type, so the tendency has been toward the use of the more simple type of preselector circuits in such receivers.

Simple Preselectors without R.F. Amplification

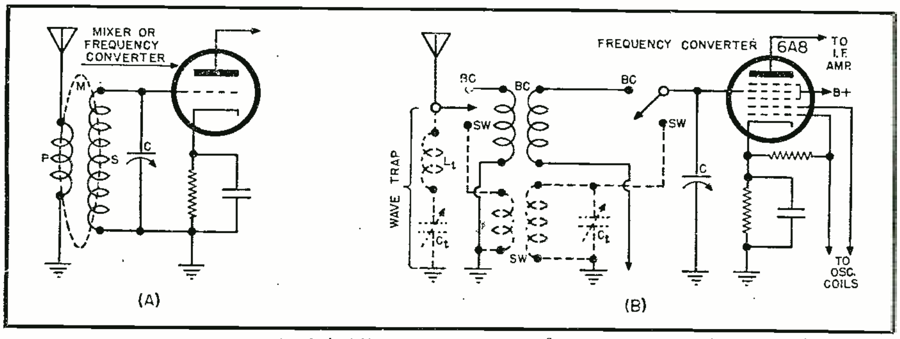
Strictly speaking, the preselector is nothing more than a number of resonant circuits which can be adjusted to the frequency of the desired r.f. signal and reject undesired signals of other frequencies. It may, or may not be accompanied by an r.f. amplifier tube (or tubes). The former type will be discussed first.

Perhaps the simplest of all preselectors is the single-tuned circuit type illustrated at (*A*) of Fig. 1. Its selectivity is essentially dependent upon the mutual inductance M and the frequency of the desired incoming signal; increasing either one reduces the selectivity. In a receiver which is to be used with a short antenna, the mutual inductance usually is made quite large in order that a strong signal be transferred to the tuned circuit. When this simple type of preselector is employed, only an inexpensive, compact 2-gang tuning capacitor is needed—one section, not shown, being required for tuning the local oscillator. It often is sufficiently selective to be quite satisfactory in inexpensive receivers which use a high value of i.f. (which in itself partially solves the image-interference problem).

An interesting practical application of this preselector circuit and its expansion to accommodate band-switching requirements for use in the Wilcox-Gay A-85, 87, 88, and 90 two-band receivers (which employ an i.f. of 456 kc.) is illustrated at (*B*). Notice that the antenna transformer feeds the frequency-converter tube directly, both the antenna and signal grid being switched in the simplest manner for reception on the broadcast and one short-wave band.

When a low value of i.f. is employed in the receiver the likelihood of image-response occurring is greater. Hence, a more selective preselector than the simple type illustrated in Fig. 1 is necessary. Much better image-frequency suppression can be secured with the simple circuit shown at (*A*) of Fig. 3, where the grid of the mixer or converter tube is connected to a tap on the tuning coil which is thereby divided into the two sections L_1 and L_2. Since the coil assembly is so constructed that the antenna primary winding P is loosely coupled only to the lower end

Fig. 1. (A) Simple single-tuned circuit preselector. The application of this type of preselector in the two-band Wilcox-Gay A-85, 87, 88, and 90 receivers is illustrated at (B). The antenna-circuit wave-trap is for eliminating code, beacon, and similar interferences occurring at the intermediate frequency of the receiver.



of L_1, most of the magnetic flux set up by P acts only on L_1, giving in effect the simple resonant circuit illustrated at (B). The circuit L_1 L_2 C, as a whole is tuned to the signal frequency by capacitor C, and the signal voltage developed across L_2 and C in series is applied to the tube. The tapping point is correctly chosen so that L_2 and C form a series-tuned "acceptor" circuit that resonates at the image frequency. At this frequency, therefore, they are equivalent to a short-circuit across coil L_1, and so short out the undesired image signal induced in coil L_1 by the antenna coil P. The action on the signal response is illustrated at (B) of Fig. 4. The circuit really acts as a combination of a single-tuned circuit that is tuned to the desired signal, and also an "acceptor" type wave-trap tuned to the image frequency. This action can occur only at one image frequency for a particular value of L_2, so perfect rejection can be secured for only one image frequency (at one point in the waveband). The circuit is usually designed to give full image suppression at the midpoint of the tuning band (at about 1,000 kc. for the broadcast band). The selectivity of L_2 C is so broad that there also is an effective image suppression to a lesser degree at other frequencies in the band, so an improvement is evident throughout. This arrangement is so simple that it can be applied easily to each signal-frequency circuit of a multiband receiver, but, of course, the tappings will be differently placed on each coil so that the points of maximum rejection are staggered throughout the waveband. Only an inexpensive and compact 2-gang tuning capacitor is needed—one section, not shown, being required for tuning the local oscillator.

Another interesting type of image-suppression circuit which does somewhat the same thing all over the broadcast band by mechanical means, and which was used in the old Atwater-Kent Type H chassis, Model 72 and other receivers, is illustrated at (A) of Fig. 4. It consists of a tuned "acceptor" circuit L_4 C_4—C_3 included in the grid circuit of the mixer tube. The tuning capacitor, C_3, of this circuit is ganged to C_2 and to the oscillator tuning capacitor (not shown). The acceptor circuit is so designed that it is tuned automatically at all times to a frequency differing from the resonance frequency of L_2 C_2 by an amount equal to twice the i.f. employed in the receiver; that is, it is always tuned to the *image* of the frequency to which the main tuning circuit L_2 C_2 is tuned. Consequently, the "acceptor" circuit acts as a short-circuit to the frequency of the signal that might otherwise cause image interference. It really is an "acceptor" type wave-trap that always is tuned to the image frequency. The action is illustrated at (B) where the solid line curve shows the response provided by the ordinary tuning circuit L_2 C_2 in the preselector, and the dotted curve the transmission cutoff at the image-frequency brought about by the tuned "acceptor" circuit. The variable tuning capacitor C_3 of the acceptor circuit must be "tracked" with the remainder of the tuned circuits. Because of the tracking complication involved and the fact that it is not as good as a second tuned circuit between the r.f. amplifier and the modulator, (which it is intended to replace) this arrangement no longer is used. Also, such a circuit only serves to suppress double-spot reception and image-frequency interference. Code interference, intermodulation interference, etc. (about which we later will learn more), can still get through.

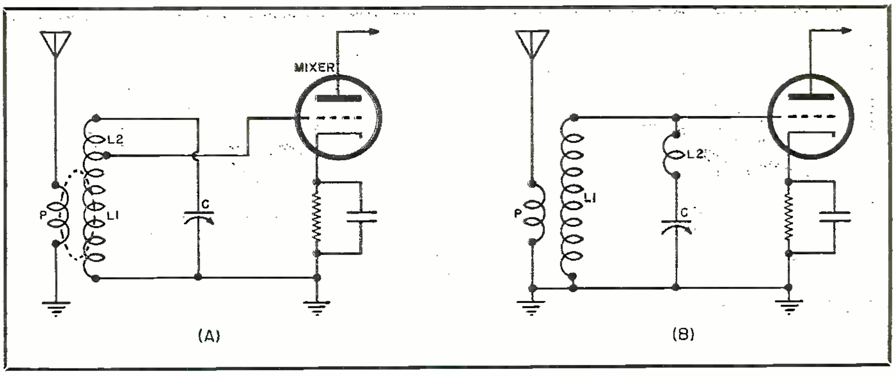


Fig. 3. (A) An improved form of single-circuit image suppressor (preselector). Its equivalent circuit is shown at (B); L_2 and C form an acceptor circuit, tuned to the image frequency. Its transmission characteristic is illustrated at (B) in Fig. 4.

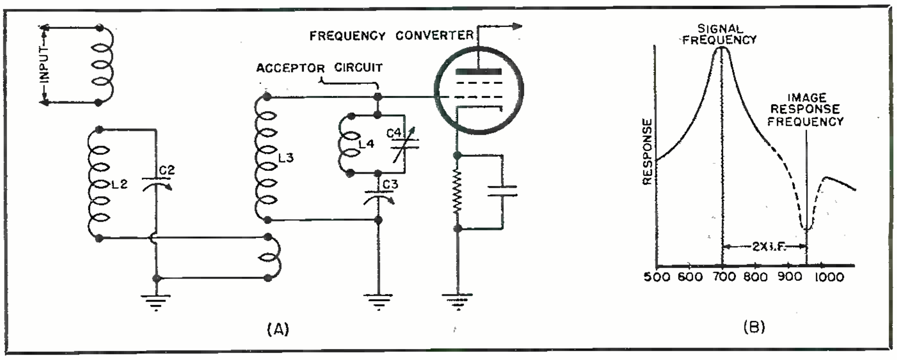


Fig. 4. Image-rejector circuit used in old Atwater-Kent receivers. Circuits L_2C_2 and $L_3L_1C_3$ are tuned to desired broadcast frequency. Circuit L_4C_4-C_3 is always automatically tuned to 260 kc. (twice the i.f.) higher than the desired broadcast frequency. This latter circuit, connected from grid to cathode of the mixer, acts as an acceptor circuit, or short circuit, to the frequency of the signal that might otherwise cause image-interference. The transmission characteristic is illustrated at (B). Notice that the response at the image frequency is greatly reduced.

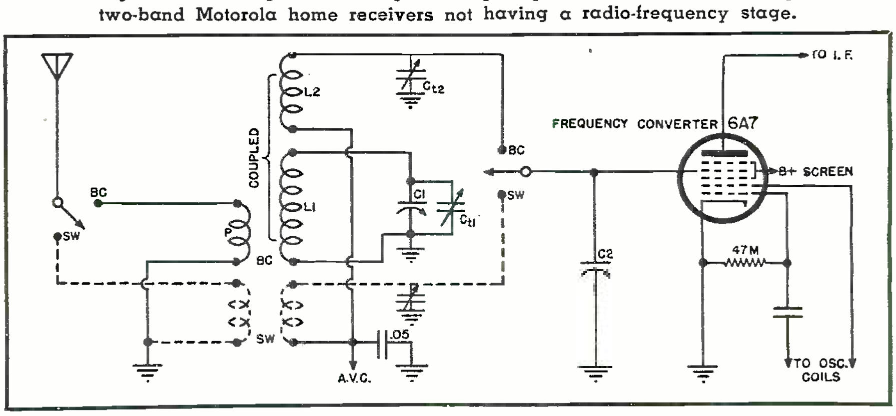
Band-Pass Preselectors without R.F. Amplification

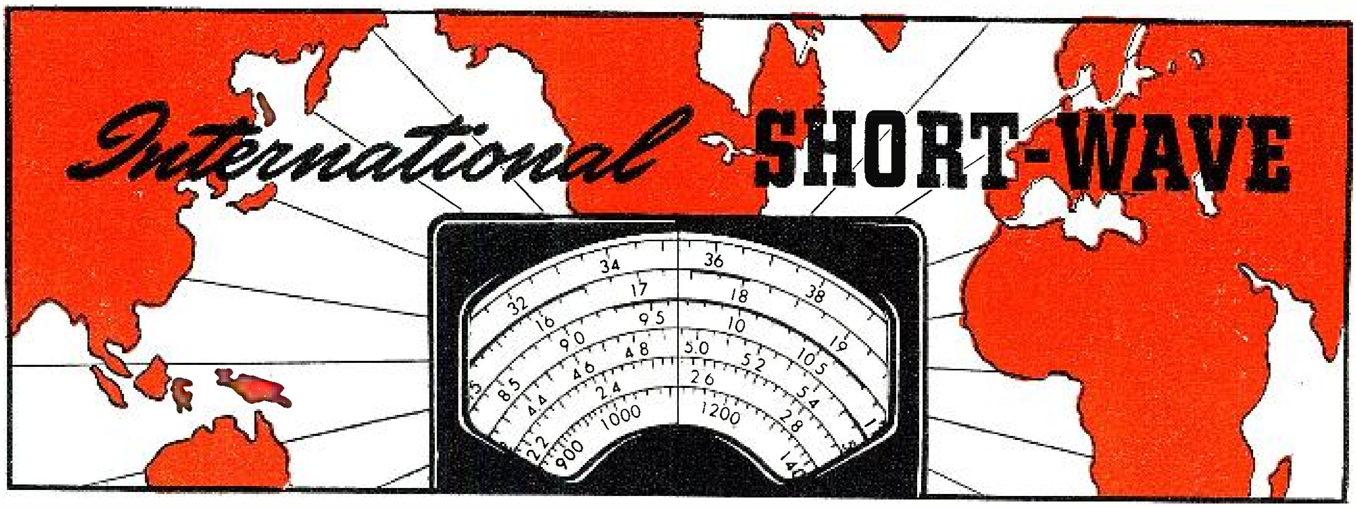
In the simple preselector circuits illustrated in Figs. 1 and 3, only one signal-frequency tuned circuit contributes to the off-channel selectivity of the receiver. The use of an additional signal-frequency tuned circuit connected in cascade, as illustrated in Fig. 2, greatly increases the selectivity and preselection and consequently reduces interference troubles. Another advantage it possesses is that its two tuned circuits can be frequency-staggered to provide desirable band-pass tuning characteristics.

This is one of the simplest band-pass preselector arrangements commonly used in midget superheterodynes that employ a 3-gang tuning capacitor. The type of coil assembly commonly employed in a single-band receiver is shown to the right of the circuit dia-

(*Continued on page* 120)

Fig. 5. Circuit diagram of a simple band-pass preselector, as used in many two-band Motorola home receivers not having a radio-frequency stage.





Compiled by **KENNETH R. BOORD**

REPORTS continue to come in daily from our readers regarding reception of new stations on the air and other DX experiences. Many stations are being heard with improved reception, although some that should be received, such as Paris, Rome, and other liberated areas, are heard only on the East Coast and have not reached the West Coast, according to reports received from that section. However, as evidenced by letters received from all over the country, many people are receiving Tokyo broadcasts of prisoners-of-war messages. We have had one letter in particular from Mr. Jack Sheahen of Alton, N. Y., who wrote us that he has received quite a few letters concerning a broadcast made by his son, who was captured in the Philippines. Such reports make us realize that DX'ing is becoming more widespread throughout the country every day.

* * *

NOTE ON SHONAN

Radio Shonan (Singapore), 9.55 mcs., has been heard better during the early autumn at the editor's short-wave listening post. Recently they were heard to sign off at 6:45 a.m. EWT, immediately following their 6:30 a.m. newscast; they returned to the air at 7:00 p.m. EWT with music (American dance music, evidently old recordings of such tunes as "Always," "My Blue Heaven," and the like), intermingled with news "of the whole world." There is some fading but most of the speech is intelligible.

* * *

LISTS PICKUPS AND WAR BULLETINS

Larry Gutter, monitor for Hallicrafters, reports from Chicago the following list of overseas stations broadcasting pickups and war bulletins for press services (nonbroadcast transmissions). All times are CWT:

"European Theater of Operations," heard on 12.15 mcs. near 5:50 p.m. with spot news for Blue Network. Could be a British transmitter relaying broadcast from France—or it could be France direct.

APH (Advance Press Headquarters), Rome, Italy, reported as 8.96 mcs., with material for New York around 6:00 p.m.

ICD, 13.22 mcs., "Somewhere in Italy." All pickups from Italian area between 7:00 a.m. and about 5:00 p.m. Relayed broadcasts from beaches of southern France. Has been known to relay APH at Rome, which station's regular frequency is 8.96 mcs. Sometimes talks to WQV, 14.80 mcs., New York, during the day. During late afternoons, usually talks with WDK, 10.09 mcs. (Your editor heard this station at 3:45 p.m. EWT on Sunday afternoon recently.)

SUV, Cairo, Egypt, 10.05 mcs., broadcasts all pickups from Cairo to New York between 4:00 and 7:00 p.m. Heard on the average of once every ten days.

AFHQ, 8.96 mcs., Algiers. Reported talking to New York in late afternoons—but has not been heard in Chicago recently.

AFHQ, 16.025, Algiers. Relays dispatches and pickups mornings from 6:00 a.m. Has been heard relaying ICD and APH in Italy. Frequently talks to WQV, 14.80 mcs., New York.

KHE, Hawaii, on 17.98 mcs., heard at 6:25 p.m. with a spot for "News of the World" (NBC).

* * *

BERLIN'S DAYTIME TRANSMISSIONS

The end of the war in Europe appears not very far off. Any day momentous news may be forthcoming from Germany—possibly news of capitulation, assassination, or revolt. The "Berlin Radio" should be the first to give any hint, or the entire story of the situation. Because of this, it would be well if short-wave listeners in this country knew where they could hear Berlin during the day time. (Berlin's broadcasts beamed to the United States are in the early morning and during the evening.)

Berlin broadcasts an *African Service* from 10:15 a.m. until 4:30 p.m. CWT. It can be heard for its entire duration over DJL, 15.11 mcs. DJD, 11.77 mcs., becomes audible in this service about 2:00 p.m. CWT. Strength on both stations is greatest toward the end of the transmission. DJL, however, can be heard readily during the whole program.

The African Service begins at 10:15 a.m. CWT with a program preview in English and German. This is followed by a news bulletin at 10:30 a.m. After the news, names of South African prisoners-of-war interned in Germany are read. Other news bulletins in English are given at 1:15 and 3:15 p.m. CWT. News in German is heard at 12:45 p.m. The 3:15 p.m. English news bulletin is followed by a commentary. Throughout the service there are about three news broadcasts in the Afrikaans language. The remainder of the broadcast consists of music, with the exception of an hour for German and Allied troops (English and German languages). These variety shows are heard between 1:30 and 2:30 p.m. CWT. Closedown is with playing of two German National Anthems.

Berlin has been heard irregularly over DJH, 17.845 mcs., from some time before 8:00 a.m. CWT until sign-off at 10:00 a.m. CWT—with a program to Asia. The program is radiated in English, German, and Asiatic languages. A few news periods in English are included.

Berlin has been heard with the German portion of the early morning transmission to the United States over DJQ, 15.28 mcs. Evidently the station signs off at 8:30 a.m. CWT, because it does not carry 8:30 a.m. CWT English news bulletins beamed to the United States on other Berlin frequencies.

We have a report of news in English (same as over DJB—15.20 mcs.—to the United States) at 8:30 a.m. CWT over a station near 11.70 mcs. Station left the air following this newsperiod.

The 6:30 to 8:45 a.m. CWT transmission to America from DJB, 15.20 mcs., is heard with great strength from about 7:45 a.m. CWT. Before that hour it is very weak. It is reported that from about 7:30 to 8:30

(*Continued on page 96*)

WORLDWIDE LOG OF SHORT-WAVE BROADCASTING STATIONS

(Numbers and letters at start of each item indicate frequency in megacycle and station call letters. To convert frequency to meters divide 300,000,000 by the frequency in cycles-per-second. Unless otherwise indicated, all times are EWT.)

PART I OF THIS LOG APPEARED IN THE OCTOBER ISSUE

7.065 GRS LONDON, ENGLAND (BBC). To Italy and Central Mediterranean, 12:30-6:30 p.m. To Algiers and North Africa, same hours. To West Africa, 4-6:30 p.m. To Gibraltar, 1:30-3:15 a.m. and 4-6:30 p.m. To North Africa, 12:45-1:30 a.m. To France and North Africa, 3:15-4:30 a.m. To North Africa, 3:30-4 a.m.

7.120 GRM LONDON, ENGLAND (BBC). North American Service, 10:45-11:30 p.m. To New Zealand and Pacific Area, 1-5 a.m. To Australia, 1-5 a.m. To Near East and Arabia, 3:30-4:30 a.m. (Arabic). To South America, 6-9:30 p.m. (Latin American Service).

7.150 GRT LONDON, ENGLAND (BBC). To Mexico and South America (North of Amazon), 7-11:30 p.m. (Radio Splendid). To Spain and Portugal, 4-4:30 a.m. To Scandinavia and Finland, 11:30 p.m.-12:10 a.m., 1-1:10 a.m., and 5:15-5:45 a.m. To Norway, 12:30-1 a.m. To Norway, Sweden, Finland, and Denmark, 1:10-1:30 a.m. To Western France, Spain, Portugal, and North Africa, 2:10-2:45 a.m. To North Africa, 3:30-4 a.m. To Norway, Sweden, Finland, and Denmark, 5:45-6 a.m. and 6-6:15 a.m. To Denmark, 6:15-6:30 a.m. To Norway, and Finland, 6:30-7 a.m. To Spain and Portugal, 7:45-8:45 a.m. To Denmark, 10:30-11 a.m. To Norway, Sweden, Finland, and Denmark, 11-11:15 a.m. To Finland and Sweden, 11:15 a.m.-12:15 p.m. To Denmark and Norway, 12:15-1 p.m. To Spain and Portugal, 1:15-1:30 p.m. To Western France and Eastern Spain, 2-2:15 p.m. To Finland and Sweden, 2:30-3 p.m. To Norway, 3-3:15 p.m. To Denmark, 3:15-3:30 p.m. To Spain, Portugal, and North Africa, 3:45-4:45 p.m. To Sweden, 5:15-5:30 p.m. To Denmark, 5:30-5:45 p.m. To Scandinavia, 11:45 p.m.-12:10 a.m. and 1-1:10 a.m. To North Africa, 1:30-1:45 p.m., 2:15-2:30 a.m., 3:30-3:45 a.m. To Norway, Sweden, Finland, and Denmark, 7-7:15 a.m. (French).

7.155 XGOY CHUNGKING, CHINA. The Chinese International Broadcasting Station. "The Voice of China." Summer schedule: To East Asia and South Seas, 7:35-9:40 a.m. To North America, 9:45-11:40 a.m. To Europe, 11:45 a.m.-12:30 p.m. To East Asia and South Seas, 12:30-1:45 p.m. English news, 10, 11 a.m., 12 p.m. English talk, 10:30-11 a.m.

7.185 GRK LONDON, ENGLAND (BBC). To Near East, 12:45-1:30 a.m. (Arabic and Turkish). To Central America, 7-9:30 p.m. (Latin American Service). To Southeastern Europe and Italy, 11:45 p.m.-11:30 a.m. To Holland, Belgium, and Germany, 11:30 a.m.-6:45 p.m. (ABSIE). To Holland, Belgium, and Germany, 4-4:30 a.m.

7.195 —— "DEBUNK—VOICE OF ALL FREE AMERICA." Heard, Tuesday, Thursday, Saturday, Sunday, 8:30-8:50 p.m.

7.205 —— LONDON, ENGLAND (BBC). To France, 3:30-4 a.m., 6:30-8 a.m., 8:30-9:30 a.m. To France and North Africa, 11:30 p.m.-3 a.m. To France, 10:30 a.m.-2 p.m. To France and North Africa, 7:30-9:45 p.m. To Africa, 3-6:45 p.m., 1:30-1:45 a.m., 2:30-2:45 a.m., 3:15-3:40 p.m., 4:00-4:45 p.m., 6:30-6:45 p.m.

7.220 VLI4 SYDNEY, AUSTRALIA. Australian Broadcasting Corporation. Used irregularly.

7.230 GSW LONDON, ENGLAND (BBC). To Iraq and Iran, 1-3:15 a.m. To Near and Middle East and East Africa, 1-3:15 a.m., 12:15-12:45 a.m. To France and Spain, 5-9:30 a.m., 2:30-6:45 p.m., 7:45-8 p.m. To France, 7:30-7:45 p.m. (ABSIE).

7.240 DXJ BERLIN, GERMANY. To North America, 5:50 p.m.-1 a.m. News in English on the hour.

7.250 GWI LONDON, ENGLAND (BBC). To Holland, Belgium, and Germany, 11:30-p.m.-2:45 a.m., 3:15-9:45 p.m. To Italy and Southeastern Europe, 11:45 p.m.-12 midnight. To Syria, 3:15-3:30 p.m. To Italy, 4-4:45 p.m. To Near and Middle East, 5:15-5:30 p.m. To Italy, 8-8:15 p.m.

7.250 WBOS BOSTON, MASSACHUSETTS. Westinghouse Stations, Inc. Eastern South American beam, 8:30 p.m.-12 midnight (Spanish-Portuguese).

7.260 GSU LONDON, ENGLAND (BBC). To New Zealand and Pacific Area, 1-3:30 a.m. (Pacific Service). To Scandinavia, 5:15-5:45 p.m. (ABSIE). To Scandinavia and Denmark, 4:15-4:30 p.m. (ABSIE). To Scandinavia, 4:30-5:15 p.m. (ABSIE). North American Service, 8:15 p.m.-12:45 a.m.

7.280 DXL25 BERLIN, GERMANY. To North America, 5:50 p.m.-1 a.m. News in English on the hour.

7.280 GWN LONDON, ENGLAND (BBC). To South America (South of Amazon), 7-11:45 p.m. (Radio Splendid). To Southeastern Europe and Italy, 12:30-11:30 a.m.; 11:30 a.m.-6 p.m. To Holland, Belgium, and Germany, 5:45-6 p.m., and 6-6:45 p.m. (ABSIE).

7.280 VLI9 SYDNEY, AUSTRALIA. Australian Broadcasting Corporation. Beamed to Britain, 2:55-3:25 a.m., 5:30-6 a.m. Beamed to Asia, 9:35-10 a.m. (Thai). Beamed to Asia, 10:15-10:45 a.m. (English).

7.320 GRJ LONDON, ENGLAND (BBC). To Central and South Africa, 11:30 a.m.-1 p.m. (African Service). To Algiers and North Africa, 12 a.m.-12:45 a.m. (also to Central and South Africa). To South America, 7-10:15 p.m.

7.380 HEK3 BERN, SWITZERLAND. To North America, 9:30-11 p.m. daily. News, 9:30 p.m. (sometimes, 9:45 p.m.).

7.575 WLWO CINCINNATI, OHIO. The Crosley Corporation. European beam, 12:15-4 a.m. English news, 1, 2, 3 a.m.

8.035 CNR-1 RABAT, MOROCCO. Heard at 5 p.m.

8.960 AFHQ ALLIED FORCE HEADQUARTERS, ALGIERS, NORTH AFRICA. Heard afternoons relaying news to U. S. newspapers. On at 6:30 p.m. to networks in the U. S.

9.090 CBFW MONTREAL, QUEBEC, CANADA. (CBC). Sunday, 9 a.m.-11:30 p.m.; Monday through Saturday, 7:30 a.m.-11:30 p.m. (7,500 w.) (Times listed are local.)

9.125 HAT4 BUDAPEST, HUNGARY. Beams to United States, 9-11 p.m. in English and Hungarian. Transmission is reported best at 10 p.m.

9.185 H... BERN, SWITZERLAND. To North America, 9:30-11 p.m. daily. News at 9:30 p.m. (sometimes, 9:45 p.m.). Reported beamed to South America, 7:30-9 p.m.

9.360 CBFX MONTREAL, QUEBEC, CANADA. (CBC). Sunday, 9 a.m.-11:30 p.m.; Monday through Saturday, 7:30 a.m.-11:30 p.m. (7,500 w.) (Times listed are local.)

9.380 PJY WILLEMSTAD, CURACAO. This Dutch station was heard testing at 3:45 p.m. with magnetism definition.

9.410 GRI LONDON, ENGLAND (BBC). To South America, 7-11:30 p.m. (Radio Splendid). To Southeastern Europe and Italy, 3:30-4:15 a.m. To Mediterranean area, Europe, and Africa, 4:30 a.m.-3:30 p.m. To France, Spain, and North Africa, 5:45-6 a.m.

9.440 FZI RADIO BRAZZAVILLE, BRAZZAVILLE, FRENCH EQUATORIAL AFRICA. Heard afternoons and evenings. Reported as heard, 12 noon to 8:45 p.m., and 1 a.m.-2:15 a.m. Free French news bulletins in English begin at 7:25 p.m.; other news, 2:45 and 4:45 p.m.

9.455 GRU LONDON, ENGLAND (BBC). To Algiers and North Africa, 12-1:30 a.m. and 2-4:30 p.m. To Central and South Africa, 12-1:30 a.m. and 2-4:30 a.m. To South America, 6-9:30 p.m. To France, 3:30 a.m.-1 p.m. To France, 4:30-5:45 p.m. (ABSIE).

9.470 JZHA HONGKONG, CHINA. 7:30-9:30-a.m. News, 9 a.m.

9.480 —— RADIO MOSCOW, MOSCOW, U.S.S.R. To North America, 6:48-7:25 p.m. (news at beginning of transmission).

9.490 GWF LONDON, ENGLAND (BBC). To South America, 7-7:15 p.m. (Radio Splendid). To Europe and/or Africa, 12:30 a.m.-5:45 p.m.

9.490 WCBX NEW YORK, N. Y. Beam to Brazil, 5-11:30 p.m. (Portuguese).

9.500 XEWW MEXICO CITY, MEXICO. Heard 9 a.m.-3 a.m. next day. Uses English on Sunday nights when relaying a program to MBS around 10 p.m. (May be heard in English 15 minutes before relaying to MBS, making arrangements to use station as a commercial during relay period.)

9.510 GSB LONDON, ENGLAND (BBC). To Central America and West Indies, 10:15-11:30 p.m. (North American Service). To Far East, 12-4 a.m. and 6:15-11 a.m. To India, Ceylon, Burma, and Malaya, 12-12:45 a.m. To Iran and Iraq, 1-3 p.m. To South America, 5:15-10:15 p.m. To North America, 5-6:15 a.m. To India and Burma, 9-9:15 p.m.

(Continued on page 110)

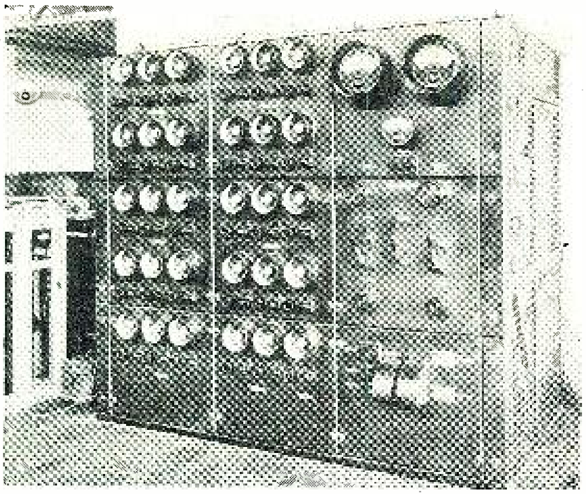


Fig. 155.

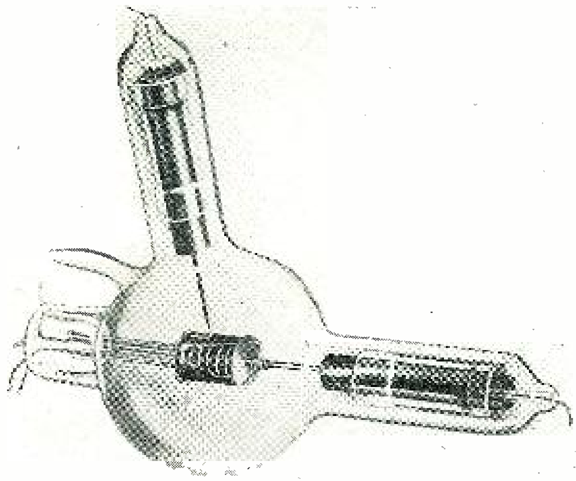


Fig. 156.

THE SAGA OF THE VACUUM TUBE

By GERALD F. J. TYNE

Research Engineer, N. Y.

Part 14. Covering the development of the "Kenotron," "Pliotron," "Dynatron," and "Magnetron" by Drs. Langmuir, Dushman, and Hull of the General Electric Laboratories, during the years 1913 to 1921.

IN APRIL of 1913 Langmuir and Dr. Saul Dushman of the General Electric laboratory attended a series of lectures delivered by Professor Wilhelm Wien at Columbia University. During their return trip to Schenectady they discussed the work which Langmuir and White had been doing and it was agreed that Dushman would take over that portion of the work on the new device which had to do with its use as a high-voltage hot-cathode rectifier and relay, and that White would continue to work on tubes for wireless and similar low-power applications.

By June of 1913 Dushman had a three-electrode tube which was capable of operation, while still on the pump, at 20,000 to 40,000 volts on the anode and with a space current of 100 milliamperes. This tube had been exhausted to a high vacuum by means of a Gaede molecular pump. It was a bulb about 6 or 7 inches in diameter with side arms which contained the leads to the electrode terminals. The anodes were plates of sheet tungsten and the grid a spiral of 1.5 mil tungsten wire wound on glass supports. It was at first operated while still connected to the pump, but was then sealed off and became, in effect, a large power tube. After sealing off, it could be operated without blue glow at 10,000 volts on the anode and space current of 100 milliamperes. It was, on May 14, 1913, used to successfully accomplish what Alexanderson had in mind when he first brought the Audion to the laboratory; that is, to control the output of one of his high-frequency alternators. Still later it was used as a modulator in actual wireless tests.

This single tube was later replaced by a bank of tubes, and in 1919 the 200 kw. Alexanderson alternator, installed at New Brunswick, was modulated through a magnetic amplifier by a bank of thirty Type "P" Pliotrons operated in parallel. Fig. 155 shows the amplifier used in this work. The anode voltage used was about 2300 volts and the anode current varied over the range 0 to 4 amperes. This represented a variation in modulating energy of about 4 kw.

It was in November, 1913 that the need was felt for characteristic names for these new devices, and the term "Kenotron" was chosen for the pure electron discharge tube, and "Pliotron" for the pure electron discharge relay. The word "Kenotron" was derived from the Greek *"kenos,"* signifying *empty space* (vacuum) and the ending *"-tron"* used by the Greeks to denote an instrument. Similarly "Pliotron" is derived from the Greek *"pleion"* signifying *more*. A Pliotron is thus an instrument for giving more, or an amplifier. It was the coining of these and other like words to describe later devices that provoked de Forest into dubbing them "Graeco-Schenectady."

The first publication dealing with Langmuir's work came in October, 1913 when Langmuir read a paper in which he disclosed the method which he had used to prepare the electrodes and exhaust the tubes in such a way as to obtain a pure electron discharge. The paper was read at Columbia University and subsequently published.[192] During the discussion which followed the presentation of this paper, Dr. H. D. Arnold brought out the fact that

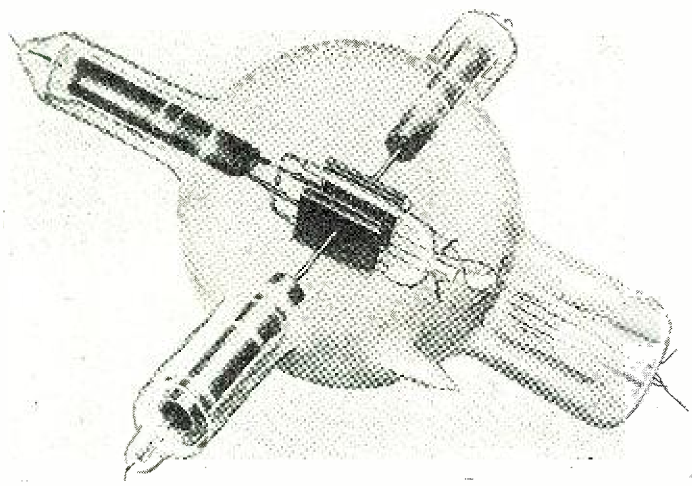


Fig. 157.

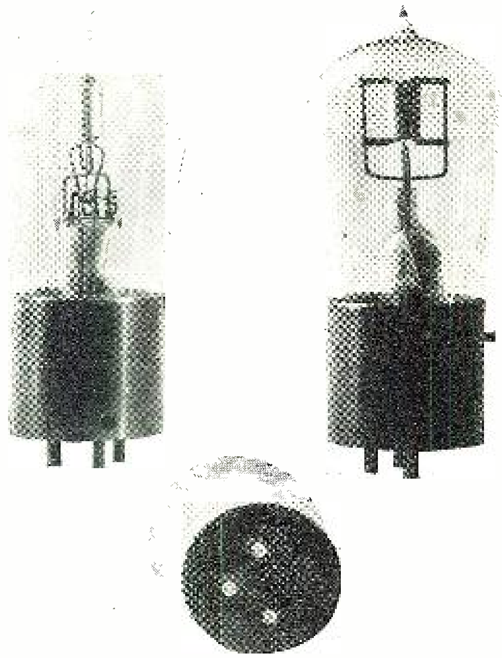


Fig. 158.

the 3/2 power law for the case of parallel plane electrodes had been published by O. D. Child in 1911,[193] and that Lilienfeld had previously obtained the 3/2 power law experimentally and had published his results in 1910.[194]

Later Langmuir published two other papers in German publications. These later papers covered the same ground as his Columbia paper but went into somewhat greater detail. [195, 196]

The next publication was by Dushman in the General Electric Review and dealt with high-power rectifiers.[197] The tubes described were high-voltage rectifiers (Kenotrons) exhausted to a pressure of 5×10^{-7} mm. mercury (0.0005 micron). Tubes which operated at voltages up to 100,000 volts and with space currents up to 100 milliamperes were described.

Then in April, 1915 Langmuir presented to the I.R.E. his famous paper on "The Pure Electron Discharge and Its Applications in Radio Telegraphy and Telephony."[198] In this paper he gave the theoretical equations for the maximum space current between parallel plates, and for cylindrical structures. This equation came to be known, albeit somewhat incorrectly, as "Langmuir's 3/2 power law." He gave diagrams of the structures used in two of the types discussed, both of which had wire elements. He also disclosed that Dushman had succeeded in making Kenotrons for a voltage of 180,000 volts at a current of 250 milliamperes.

Meantime Dr. Albert W. Hull of the General Electric laboratory also had been engaged in work on pure electron discharge devices. This first came to light when he presented a paper, on October 30, 1915, before the American Physical Society in New York.[199] His work was somewhat unorthodox. The title of his paper was "Negative Resistance." He had succeeded in obtaining a negative resistance characteristic in the anode circuit of a three-electrode discharge tube by operating

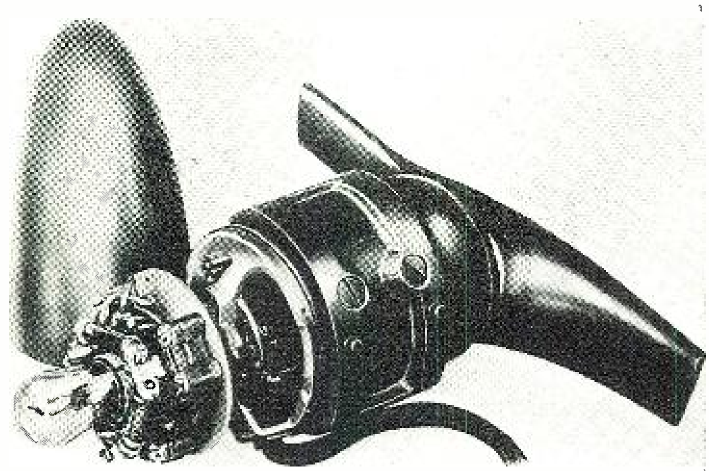


Fig. 159.

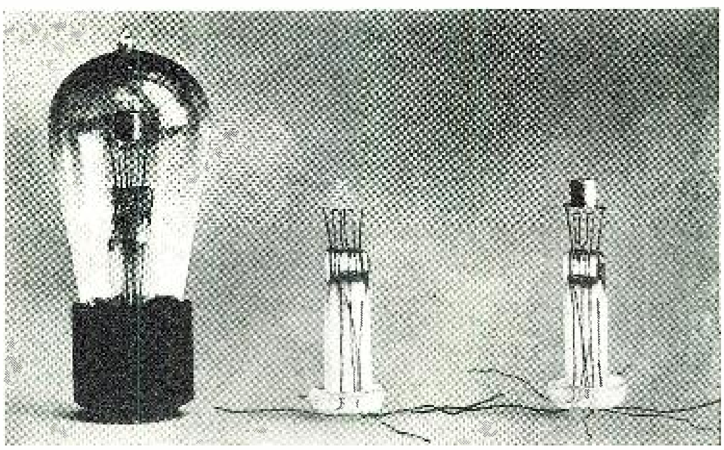


Fig. 160.

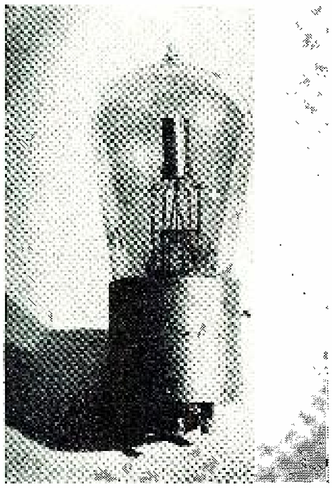


Fig. 161.

Fig. 162.

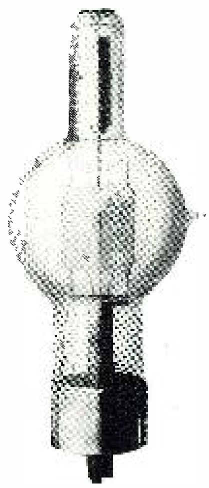


Fig. 163.

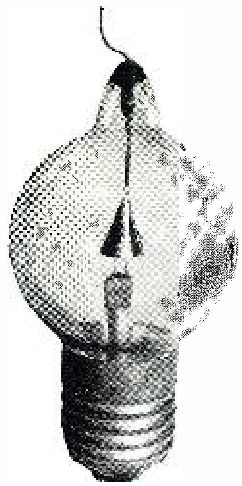


Fig. 164.

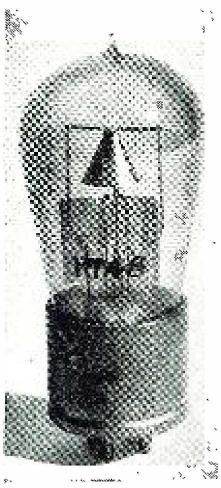


Fig. 165.

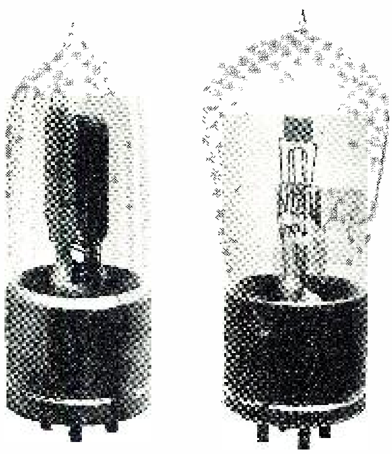


Fig. 166.

it with a positive voltage, higher than the anode voltage, on the grid. That is to say, he found a region of operation where an increase of anode voltage caused a decrease rather than an increase in the anode current. This device was dubbed the "Dynatron" and was described by Dr. Hull in a paper sent to the I.R.E. in January of 1917.[200] This paper is probably the first to describe a four-electrode tube. One of these tubes, called a "Pliodynatron," is described and pictured in Hull's paper. Figs. 156 and 157, reproduced from this paper, show the "Dynatron" and "Pliodynatron" respectively.

Dr. Hull continued his experimental work and some time later published a paper on the "Magnetron," the Graeco-Schenectady name for a vacuum-electric device which was controlled by a magnetic field. Electrically it was a valve operated by a magnetic field. It was really a relay with no moving parts or inertia, the only limitation in speed of operation being the time necessary to build up the magnetic field.

The Magnetron consisted of an evacuated tube of cylindrical shape with an axial filament and a cylindrical anode. The magnetic field was set up by an external coil surrounding the tube in such a way that the lines of force were parallel to the axis of the tube. The characteristics of this device were such that with constant voltage between anode and cathode, the current flow in the filament was not affected by a magnetic field weaker than a certain critical value, but fell to zero if the field was increased beyond this value. This was an extremely sensitive method of control. In fact, with proper adjustment the simple reversal of position of such a tube and coil in the earth's magnetic field is sufficient to completely cut off the space current.

Dr. Hull gave the theory of this tube in a paper published in the Physical Review in 1921,[201] and later in the same year described the tube and its possible applications before the A.I.E.E.[202]

During World War I a very large amount of development work was done in the field of radio transmission. Apparatus developed prior to the war rapidly became obsolete. It was appreciated by those in charge of development of apparatus for the Armed Forces of the United States that vacuum tubes played an important part in the equipment which must be provided. For such uses large quantities of these tubes were required, and a uniform interchangeable product was an absolute necessity. We have seen already that over half a million of these tubes were supplied by the Western Electric Company, some by the de Forest Company, and some by the Moorhead Laboratories. The General Electric Company also was called upon to produce such tubes and because of the research work of Langmuir and his associates, and because of their long experience in incandescent lamp manufacture, they were in an excellent

position to do so. In fact, the General Electric Company supplied over 200,000 tubes to the Armed Forces, the great majority of which were manufactured and delivered in the year 1918. These tubes were, for the most part, manufactured at the Nela Park plant of the National Lamp Works of the Company at Cleveland, Ohio.

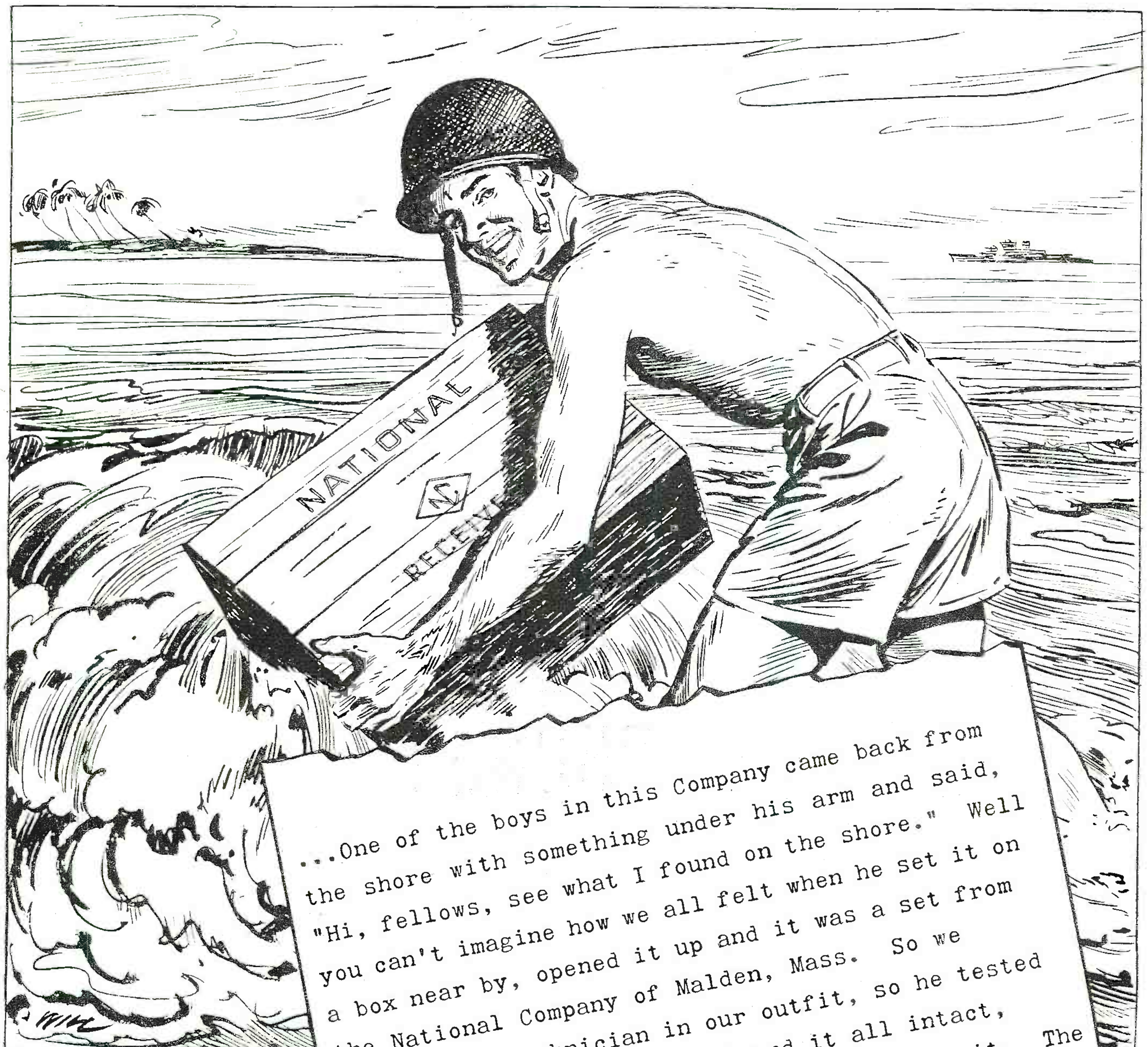
The bulk of the General Electric tubes supplied to the Armed Forces during World War I can be divided into five types. The first of these is the Kenotron which was designated by the U. S. Signal Corps as the "TB-1," of which approximately 4500 were supplied to the Signal Corps.

This Kenotron was used in large numbers for regulation of the output voltage of the wind-driven generators used with airplane radio equipment. Because of the vibration to which they were subjected while in use, they had to be of extremely rugged construction. Fig. 158 shows three views of one of these tubes which, it will be seen, had a base of the three-contact type, and Fig. 159 shows a generator with the tube in place. The bulb was about 1¾ inches maximum diameter and extended upward from the base about 2½ inches. The base was of the "Shaw Standard" type. The filament was made of tungsten wire, 3.15 mils in diameter. It had a total length of about 2½ inches and was helical in form. The inside diameter of the helix was .145 inch and the pitch of the winding was 14 turns per inch. The anode was a molybdenum cylinder, 5 mils thick, 9/32 inch in diameter, and ⅝ inch long. The anode voltage varied under normal operating conditions but had a maximum value of about 250 volts. The maximum anode current was about 125 milliamperes. The filament operated at 1.45 amperes and the maximum filament voltage was 10.75 volts.

The "Type G" Pliotron was used by both the U. S. Navy and the U. S. Signal Corps as a detector, amplifier, and oscillator for heterodyne reception. It was originally made for the Navy under the designation "CG-886." As so made, it had a Navy standard three-point base of composition material. Somewhat later, at the request of the Signal Corps, this same tube was equipped with a four-point base and designated as the Signal Corps "VT-11." The Navy soon adopted the four-point base tube and assigned to it the designation "CG-890." This tube, which is shown in Fig. 160, had a tungsten filament, 3.25 mils in diameter and was approximately 1 inch long, wound as a helix with inside diameter of .065 inch, and a pitch of 22 turns per inch. The grid also was helical, being of 3.9 mil tungsten wire, .120 inch inside diameter, with a pitch of 20 turns per inch. The length of the grid helix was about ¼ inch. The anode was cup-shaped, of 5 mil nickel, about ¼ inch in diameter and 9/32 inch high. The filament operated normally at 1.1 amperes with a voltage of 3.3 to 3.9

(*Continued on page* 124)

"HI, FELLOWS, SEE WHAT I FOUND"



...One of the boys in this Company came back from the shore with something under his arm and said, "Hi, fellows, see what I found on the shore." Well you can't imagine how we all felt when he set it on a box near by, opened it up and it was a set from the National Company of Malden, Mass. So we had a Radio technician in our outfit, so he tested it, looked it all over and found it all intact, closed it up again, grounded it, then tried it. The salt water had not hurt it one bit—it gave us grand reception and each night, we, or about 12 of us, listened in and it seemed like a message from home.

(Excerpt from a letter we received from a soldier in the Pacific.)

NATIONAL COMPANY, INC.

MALDEN MASS, U. S. A.

NATIONAL RECEIVERS ARE IN SERVICE THROUGHOUT THE WORLD

TECHNICAL BOOK & BULLETIN REVIEW

"RADIO ENGINEERS' DIGEST," published monthly by the *Hudson American Corporation.* Subscription rates, $5.00 per year. Editorial Office, 300 Pearl Street, Brooklyn 1, New York.

In keeping with the recent trend in the field of "digested information," the Hudson American Corporation has begun the publication of a monthly "digest" of engineering articles which have appeared in leading technical journals.

The first issue of this magazine, which made its debut in August, contained articles on various technical subjects including television, railroad radio, electronic control maintenance, FM, weather control and demodulation waves.

The Radio-Electronic Engineering Edition of Radio News was represented by an article entitled "Electronic Control Maintenance," by Mr. R. H. Schaaf which appeared in the April issue.

The magazine is attractively printed on glossy paper and is of the handy pocket-size. The first issue contained 28 pages of editorial and picture material.

The publishers indicate that material of interest to engineers in radio and electronic fields, as well as, manufacturers of all types of electronic devices and equipment, will be featured to provide up-to-the-minute information on articles available in current publications.

"POLICE RADIO-'PHONE OPERATING PROCEDURE MANUAL," edited and published by Associated Police Communication Officers, Inc., Chicago, Illinois. 32 pages. One copy furnished free of cost to all members in good standing of the Associated Police Communication Officers, Inc. Additional copies available tc duly constituted police authorities at $.15 per copy and to commercial concerns at $.25 per copy.

The operation of police radio-telephone differs radically from that of aircraft or ship communications equipment, hence the need for an authoritative booklet has been a long felt need of the police radio operator.

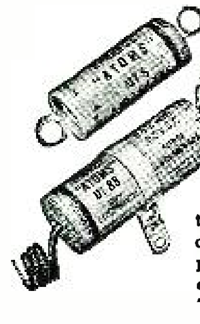
The manual is presented by the Associated Police Communication Officers, Inc. which is a nationwide organization of police operators who are dedicated to the improvement and maintenance of standards of good practice.

It is hoped that police radio operators will avail themselves of the opportunity of securing this book so that police transmissions may exhibit some measure of uniformity throughout the city or state in which the station is in operation.

—30—

SPRAGUE TRADING POST

A FREE Buy-Exchange-Sell Service for Radio Men



REPLACING WET ELECTROLYTICS WITH DRYS

In many cases—particularly in old sets—you can use Sprague Atoms (midget drys) in available Victory Line types to replace unavailable wet electrolytic capacitors. Atoms stand the gaff! A few precautions should, of course, be observed, and these are described in the Sprague "Victory Line" Catalog C-304. Write for your copy today.

WANTED FOR CASH—1A7, 1N5, 1H5, 6A7, 6A8, 6Q7, 6SQ7, 6SA7, 12A8, 12SA7, 12SQ7, 12SK7, 12Q7, and many other tubes. Send list. G. S. Hobbs, P. O. Box 697, Suffolk, Va.

WANTED—Echophone EC-1, in good condition. State price. Ben Ripley, Route 2, Uhrichsville, Ohio.

FDR SALE—Almost new Supreme deluxe #585 diagnometer, $75; also Supreme #450 volt ohmmeter, $25. George W. Bellis, 874 Lincoln Ave., Maywood, N. J.

FOR SALE—Few used 80's, 01A, 24A, 32 and 6K7 tubes; also Echophone #40. Urgently need 1—50L6 (new or used) and 2 inexpensive 60-cycle, 110 v., 78 R.P.M. phono motors. Bill Gordon, Box 42, Oxbow, Sask., Canada.

FOR SALE—Micro-ammeter 0-200, almost new. Urgently need galvanometer 100 micro volts per mm. of deflection sensitivity or better; also 100 megohm grid leak (glass tubular). J. John Porcella, 1133—86th St., Brooklyn, N. Y.

FOR SALE DR EXCHANGE—Peerless, R.C.A., and misc. magnetic A-C, D-C dynamics with rectifier units; audio transformers, power transformers, 1½ and ½v. battery sets and dynamic speakers. Need electric turntable, 2-speed motor; also single 78-speed. Radio Exchange, 1711 Pearl St., Boulder, Colo.

FOR SALE—RCA 6L7's, 85c ea.; 6R7's, 80c ea.; 6J5's, 65c ea.; 6C5's, 60c ea.; 6N7's, $1 ea.; 6A6's, 60c ea.; 10's, $1.50 ea.; Western Electric 215A's, 50c ea.; 239A's, 50c ea.; 104D's, 35c ea.; 211E's, $1.50 ea. Postage additional. Philip Ross, 280 Wadsworth Ave., New York 33, N. Y.

WANTED—Radio tubes: 35Z5, 6K7, 50L6, 35L6, 25A6, 25L6, 25Z6, 12SK7—can be G, GT, or GT/G's. Also need test equipment, tube and set tester. United Radio Service, Box 194, Centreville, Miss.

FOR SALE—Gene-motor, 180 v. 50 mils., $5; Wright Decoster 10" 500 ohm field speaker, $3.50; 10" ohm speaker, $3.50; Instructograph code machine, 2 tapes, like new, $15. Francis Higgins, 14065 Bringard Drive, Detroit, Mich.

WANTED—2 mica condensers (.02 capacity). C. B. Davis, 681 Delmar Avenue, Atlanta, Ga.

WANTED—New tubes, all types. Write quantity and prices. Webster Radio Shop, 418 N. 16th St., Omaha 2, Nebr.

FOR SALE—New Mallory vibrators, in cartons—1-210, 1-230, 1-231, 2-270B, $2.50 each. Ray Vivian, 1065 Third St., San Bernardino, Calif.

FOR SALE—6 brand new 1T4 midget radio tubes, $1 ea.; 1-3S4, 90c; 4 used 6V6, 50c ea., and others. Want good portable radio A-C, D-C or battery. Richard Nateman, 884 E. Lucius Ave., Youngstown 5, Ohio.

WANTED—Back issues of Radio Service Dealer and Electronics magazines. Cash or tube and radio part trades. Philip Rosenblatt, P. O. Box 905, Hoboken, N. J.

FOR SALE—G.E. sig. generator; 100 KC to 32 MC, also 400 cycle audio; Philco wireless station setter. R. S. Komp, Clifton Springs, N. Y.

WANTED—0-3 mil. meter and filament transformer, 1 to 117 v. David Friedman, 1759 W. 7th St., Brooklyn 23, N. Y.

FOR SALE—Brand new pair 813 and 803 xmitter tubes. D. Camreta, 486 Clifton Ave., Newark 4, N. J.

FOR SALE—Approximately 200 brand new tubes, including 50L6, 35L6, 6L6, 12SQ7, etc. Entire lot—50c ea. W. Kuss, 181 Elm Avenue, Hackensack, N. J.

FOR SALE—Radio parts, new and used: I.F. transformers, speakers, choke coils, AC & DC sets, A & B eliminators, power packs, headphones, small microphone and many other items. J. H. Cramer, 1226 Military Ave., Council Bluffs, Iowa.

WANTED—#432A Readrite tube tester. Paul Grauer, Wilson, Kans.

FOR SALE—Philco auto radio #AR-75, with instrument board. Almost new. $50. H. R. Ringold, 132 N. Doheny Drive, Beverly Hills, Calif.

WANTED FOR CASH—Late model tube tester, preferably Precision with roller chart; also Rider chanalyst and Rider manuals 7 through 12. Robert Lee Hester, Shellman, Ga.

FOR SALE—6 v. synchronous vibrator, Radiart #4608; almost new, $6. Lyman D. Mumford, Pine Crest Sanatorium, Salisbury Center, N. Y.

WANTED—45Z3 tube. Cash or trade—what do you need? T. Bullockus, 1328 East Capitol St., Washington 3, D. C.

FOR SALE—30-watt (6 v. D.C. or 110 A.C.) amplifier, with turntable attached; 60-watt power pack to match; heavy duty P.M. speakers; parabolic speaker horns; 72" floor mike, table mike, over 1,000' wire; extra parts. R. E. Finkles, 132 Cherry St., Clyde, Ohio.

FDR SALE—955 acorn, 1T4, 1S4, 1S5, 1R5, 6F8, 6L6, 6C5, 6H6, 78, 75, 1J8GT, 6A8, 6J7, 6K7; paper & mica condensers; resistors; vol. controls; 80-meter xtal; N.R.I. V-T-V-M; complete N.R.I. course, etc. Gene Lesko, P. O. Box 510, Bristol, Pa.

SELL OR SWAP—Meters: 0-15 Weston a-c volts; 0-50 Weston milliamp. high-low-0-8 and 0-200 volt Jewell Confidence tube tester model "C" (needs transformer). What have you? V. A. Birch, 13 Chillum Rd., Hyattsville, Md.

CHOKES WANTED—10 hy. 65 ma., C1708; 9 hy. 85 ma. C1709; and 20 hy. 100 ma. C2305, all Stancor. Frank W. Jones, Gabbs, Nev.

FOR SALE—Hallicrafter SX24, excellent condition, $74.50; also long list of tubes such as 211, 845, 204-A, 852, 100T, 828, 805, etc., transformers, electric drill, etc. Write for list. Fred Craven, 2216 So. 7th St., Philadelphia 48, Pa.

FOR SALE OR TRADE—Custom built port. phono ac-dc 4-watt p.p.; plays 8" and 12" records, built-in 8" P.M. and 10" P.M. hi-fi speaker, separate case, value $100. Also Beede 3¼" 600 micro-ammeter with magnifying condenser, calibrated for V.T. ohmmeter. Want 3" scope, channel analyzer. C. F. Weiland, 3875 Waldo Ave., New York 63, N. Y.

FOR SALE OR TRADE—6 meters: 2 Weston #280 A.C. volts 1-5-10; 1 D.C. amps. #267, range 10 amps; 1 A.C. amps. #476, 15 amps.; 1 Westinghouse D.C. volts, range 8V; 1 Jewell D.C. volts, ranges 12V and 120V. Also offer Meissner remote control push button tuning unit; Bosch Auto Radio with separate speaker and any tuning head; fits any car. Want all-wave sig. generator and Hallicrafter receiver. Fred H. Fries, 60 E. Bringhurst St., Philadelphia 44, Pa.

FOR SALE—Jensen H.F. 18" P.M. 15B concert speaker; G-E F-M converter; Presto 9C recorder; Thordarson 40-watt amplifier with two bell speakers, one mike and stand; Jensen D15 18 watts; Rola G12 18 watts, also meters of all types. Mrs. Mary Ricci, 121 Prospect Ave., Waldwick, N. J.

FOR SALE—Clough-Brengle O.D.A. sig generator; 15—6SH7; 10—3Q5; 3—5Y4; 3—70L7 tubes. Will sell for cash or trade for a-c operated sig. generator. F. & J. Radio Shop, 6 W. Church St., Newark, Ohio.

WILL TRADE—S20R Sky Champion Hallicrafter (1942). Want any or all: modern sig. generator; Rider's Manuals; capacitor bridge; inductance meter; and oscilloscope. Carl Mueller, Box 621, Seward, Alaska.

TUBES FOR SALE—all original boxes, 1B4, 1C5, 1D7, 1E4, 1F4, 1F6, 1J5, 1LA4, 2A7, 3A8, 6A4, 6AC7, 6B8, 6C8, 6F8, 6SD7, 7A4, 31, 33, 36, 38, 39, 89, and many others, some in quantity. Write for list. Hub Appliance & Supply Co., Crown Point, Ind.

WANTED—Jensen JAP-60 or JHP-52 speaker unit. Have much P.A. eqpt. including several large Jensen speaker units, also Precision 500 Electronometer for trade or sale. Write. Kenneth Law, 312 West 3rd St., Fairmount, Ind.

NEW TUBES FOR SALE—A wide variety of types, some in quantity. 20% off OPA list. Write for list. E. A. O'Connell's Radio Shop, Westfield, N. Y.

FOR SALE—Recent editions: Audel's Radioman's Guide, $3.20; Supreme Radio Servicing Course, $2; Supreme Simplified Radio Servicing, $1.20; also Radio Physics Course. ICS course and many others. Write. H. W. Schendel, 518 W. Main, Sparta, Wisc.

FOR SALE—Nine 30 & 40 watt fluorescent starters, 30c ea. or all for $2.50. Tom Yamamoto, 8E-10-B, Amache, Colo.

WANTED—Astatic Xtal mike JT-30 or T3, also tubes: 25L6; 25Z5; 50V6; 50L6; 35Z5; 35L6; 1A5; 1A7; 1N5; 1H5; 1Q5; 3Q5; 12SA7; 12SQ7; 12SK7; 117Z6; 117L6; and 117Z4. H. F. Cushing, 91 Jackson Parkway, Holyoke, Mass.

WANTED—Multi-meter tester & a tube tester, the former must have a sig. generator or oscillator. Not over 2 or 3 years old. Gordon Parrish, Box 264, Toledo, Oregon.

WANTED—Requests for notes on experiments on artificial vision for the blind. Will furnish all data on my experiments to anyone interested. Wm. R. Adameit, South Texas Radio Service, 1704 Laredo St., Corpus Christi, Texas.

FOR SALE OR TRADE—Model CA Solar capacity analyzer; kit of plug-in s-w receiver coils: Stewart-Warner R-113 s-w converter; various milliammeters; #770 Weston tube checker; Philco and Admiral personal radios with batteries. Howard Warner, 406 W. Joppa Rd., Towson, Md.

FOR SALE—#1601 Triplett set and free-point tester, $50; #505 Supreme modernized tube checker, takes most 12V tubes, $40. Both A-1. Will sell or trade for hard-to-get tubes or Rider's manuals. What have you? Frank Theis, 7403 Outlook Ave., Cleveland 9, Ohio.

SELL OR TRADE—RCA oscillator TMV-97-C, battery type, and freq. modulator TMV-128-A for above oscillator, good condition, $25 for both. Want good V-O-M or analyzer and 0-1 mil. Bedee 3 in meter. State price. V. D. Walker, 716 North Street, Pittsfield, Mass.

FOR SALE—91 QST magazines dating from Feb., 1924, to Dec., 1931, only five months missing. National Radio Shop, Mary Lou Apts., Williamson Rd., Roanoke, Va.

FOR SALE—Precision 700 port. set & tube tester; Precision 900 ditto; Solar CB-1-60 condenser analyzer; Dumont 164 oscilloscope; Radiart P6 vibrator tester; Precision E-300 sig. generator; 110V ac-dc 33 1/3 and 78 r.p.m. record player and amplifier in carrying case; Emerson cabinets to fit 301 and 336 radios; used auto radios, etc. Signal Radio, 2077 Coney Island Ave., Brooklyn 23, N. Y.

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

HARRY KALKER, Sales Manager.

SPRAGUE PRODUCTS CO., DEPT. RN-114, North Adams, Mass.

(Jobbing distributing organization of products manufactured by SPRAGUE ELECTRIC COMPANY)

SPRAGUE CONDENSERS *KOOLOHM RESISTORS

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

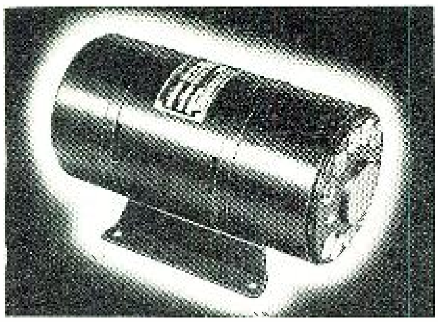
* TRADEMARK REG. U. S. PAT. OFFICE

WHAT'S NEW IN RADIO

New products for military and civilian use.

3000 VOLT DYNAMOTOR

A new 3000 volt d.c. dynamotor which runs from a 12-volt battery primary source has been announced by the *Carter Motor Company* of Chicago.



This unit is 11½" long, 4½" in diameter and 5" high and weighs less than 18 pounds without the filter. It furnishes 3000 volts d.c. at 0.05 amperes. The input to the motor portion of the dynamotor can be had in voltages ranging from 12 volts to 115 volts d.c.

The unit is also available with two 1500-volt, 0.05-ampere outputs instead of one 3000-volt output. Because of the high voltage and the tendency toward sparks and corona effects, the ends of the unit, where the brushes are located, are enclosed in explosion-proof covers permitting the use of the unit in gaseous locations such as near airplane engines, in mines and other similar positions.

Among the postwar uses for this unit suggested by the company are in portable television equipment, portable high-voltage visual signaling devices and all portable and mobile equipment requiring this type of high voltage.

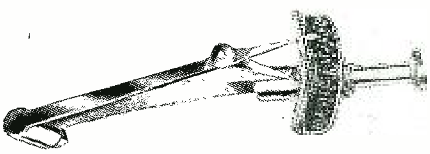
Details are available from the *Carter Motor Company,* 1608 Milwaukee Avenue, Chicago, Illinois.

TORQUE WRENCH

A sensory torque wrench which results in fast and accurate torquing has been announced by the *P. A. Sturtevant Company* of Addison, Illinois.

Added to the usual visual reading type of construction are the features embodying sound and touch.

A trigger finger is provided which can be set at any desired signaling



point. As torque is applied with the wrench, and at the exact instant the "set" torque is reached, the sensory action, (1) sounds a loud and distinct click and (2) imparts a definite strong impulse to the hand. Thus, through three senses, sight, sound, and feeling, the operator automatically releases his pull on the wrench making torque both fast and accurate.

Periodic tests over a 79-day period revealed that this wrench remained accurate and did not require resetting.

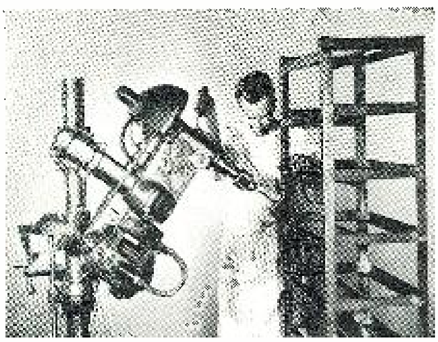
ANGLE BRACKET

An angle bracket for converting a drill press into a versatile, all purpose machine for angle drilling, polishing, buffing, sanding, rotary filing, tapping, reaming and grinding, has been announced by the *Nobur Manufacturing Company.*

Spindle angles can be adjusted to any height, placed horizontally or vertically at any angle, and can be set for greater convenience and operator comfort.

The angle bracket is available for all popular models of drill presses whose construction embodies a round tubular column. The bracket is rigidly constructed, positive locking and adjustable with a single turn of the wrench. Brackets to fit tubular columns from 2¾" to 3²⁹⁄₃₂" are available for immediate delivery.

Full details are available from the



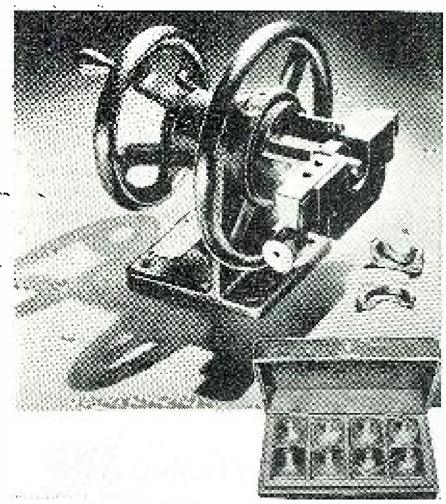
manufacturer, *Nobur Manufacturing Company,* 910 North Orange Drive, Los Angeles, California.

FERRULE CRIMPING

The increased use of flexible aluminum and plastic covered aluminum electrical conduits is causing more widespread ferruling of conduit and cable for greater security of connections. The proper ferruling relieves the electrical contacts of any strain to which the cable is subjected.

To meet this demand, the *American Phenolic Corporation* has made a ferrule crimping machine which is light and compact enough to permit its use on the job in aviation work.

The Amphenol machine is made in two sizes. The model B machine will ferrule a complete range of conduit sizes from ³⁄₁₆" to 2½" while the model



A will handle conduits from ³⁄₁₆" to 1¼".

Collets and mandrels for the various conduit sizes are furnished with each machine. In order to avoid damage or loss of these parts, they are supplied in a compact hard wood case.

Complete details of application and further information may be obtained by writing to the *American Phenolic Corporation,* 1830 South 54th, Chicago 50, Illinois.

SOUND REPRODUCER

A new baffle-type reproducer unit used for voice paging and industrial music has been announced by *Executone, Inc.* This reproducer provides high fidelity reproduction and wide angle coverage of medium and low noise level areas.

The Model HF-6 speaker delivers 4 to 6 watts of output power. The use of several such units, properly spaced in large production areas, provides even distribution of sound. A four-step volume control, with cut-off switch, provides for individual adjustment of each unit.

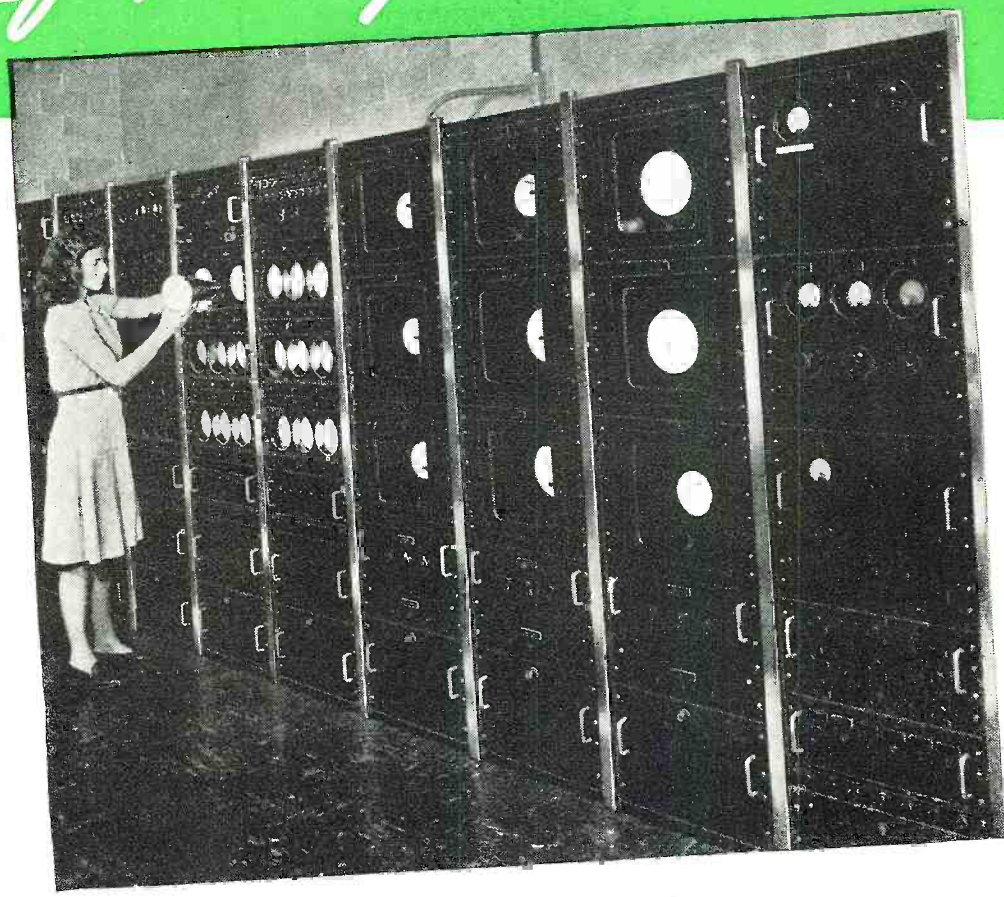
Full details are available upon application to *Executone Corporation,* 415 Lexington Avenue, New York 17, New York.

ALIGNING TOOL

A new tool for the precision alignment of padding condensers in radio receivers and transmitters has been announced by *General Cement Mfg. Co.* The new TL-207 alignment tool is constructed of two basic parts molded from Durez Plastic.

A specially designed barrel with small knurled head accommodates a

Life Testing ON THE GRAND SCALE!



One of the most elaborate cathode-ray tube test racks in this country operates day and night, seven days a week at National Union. For, at N. U., cathode ray tube production is now reaching heights undreamed of in pre-war days. To achieve this production, entirely new testing techniques, on an unprecedented scale, have been developed.

Examples of the newest tried and proven N. U. products are the four cathode-ray tubes illustrated. All of these N. U. cathode ray types can be produced in a variety of screen materials, which will have various postwar applications in television and industrial electronics.

Here at National Union are many such ultra-modern products ready to serve your peacetime needs. Ready, yes, in large volume—and backed by as fine an electronic tube research service as has ever been available to industry. Ready, indeed, from the day our present obligations are fulfilled and reconversion can get under way. Count on National Union.

NATIONAL UNION RADIO CORPORATION, NEWARK, N. J.
Factories: Newark and Maplewood, N. J.; Lansdale and Robesonia, Pa.

NATIONAL UNION
RADIO AND ELECTRONIC TUBES

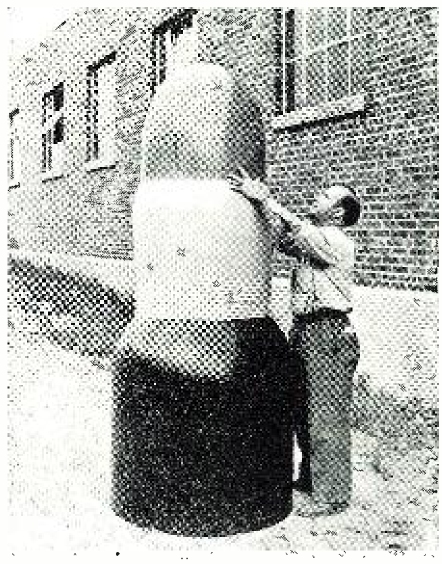
Transmitting, Cathode Ray, Receiving, Special Purpose Tubes • Condensers • Volume Controls • Photo Electric Cells • Panel Lamps • Flashlight Bulbs spring-controlled plunger with a larger control knob. The barrel is hexagonal shaped in its working end to accommodate the condenser adjustment lock nut. The plunger has a metal insert in its lower end resembling a screw driver tip. The spring prevents the plunger tip from protruding beyond the hexagonal end of the tubular barrel. Minute adjustment is made by the plunger when it is pushed forward to mate itself into the cloven pin end of the condenser adjusting screw. Movement of the barrel quickly loosens or tightens the hex locking nut which collars the condenser adjusting pin.

Complete data and prices on this tool may be obtained by writing *General Cement Manufacturing Company,* Rockford, Illinois.

PLASTIC DOMES

The Pittsfield plant of *General Electric Company* is fabricating plastic domes for the protection of wartime radio equipment.

Made of plastic and molded in a single piece, the black dome at the bottom of the "projectile-like" pile is one of the largest single pieces ever made at



General Electric. This dome is 35 inches in diameter, and 43 inches in height.

Equipment on which these domes are used has not been specified in accordance with public safety regulations.

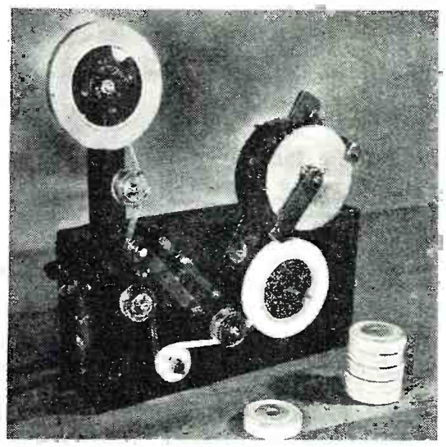
WIRE IDENTIFICATION

Employees of the *Glenn L. Martin Company,* airplane manufacturers, have solved the problem of marking the electrical wires used in planes by developing a printing unit for making this tape.

Formerly, it was necessary to order tapes already printed from commercial firms, but some of the tape dried out or was used up before all of the tape was utilized. By printing the tape at the plant, supplies which were in greater demand could be furnished rapidly, while the less frequently used markers were made in smaller quan-

tities to avoid increase waste materials.

The unit, which carries two rolls of cellulose tape, transparent and white, feeds the tape through a small printing device on which numbers and letters can be interchanged as needed. The unit is driven by an air motor and permits the printing of a roll of tape three inches in diameter in 15 seconds.



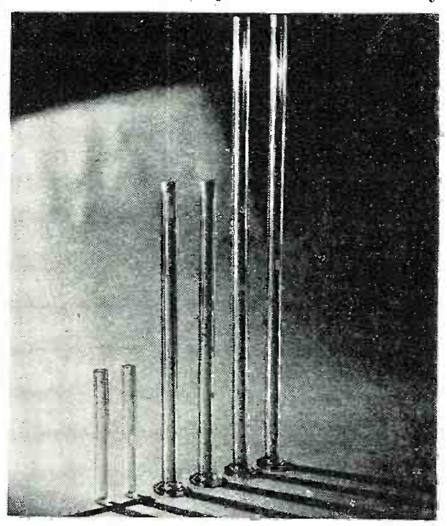
One machine prints all of the tape required in a single plant. Twenty-one employees were responsible for the development and construction of this machine.

PLASTIC FUEL GAUGES

An important supplement to the fuel that powers war machines are the transparent, nonshattering fuel gauges being manufactured of Lumarith or Celluloid by the *Celanese Celluloid Corporation* of New York.

The gauges come in a variety of thicknesses and lengths and are used in planes, tanks, amphibious craft and other types of war and industrial machinery to indicate the supply of fuel on hand.

The gauges will withstand severe impact without denting or breaking. The material may be fabricated by



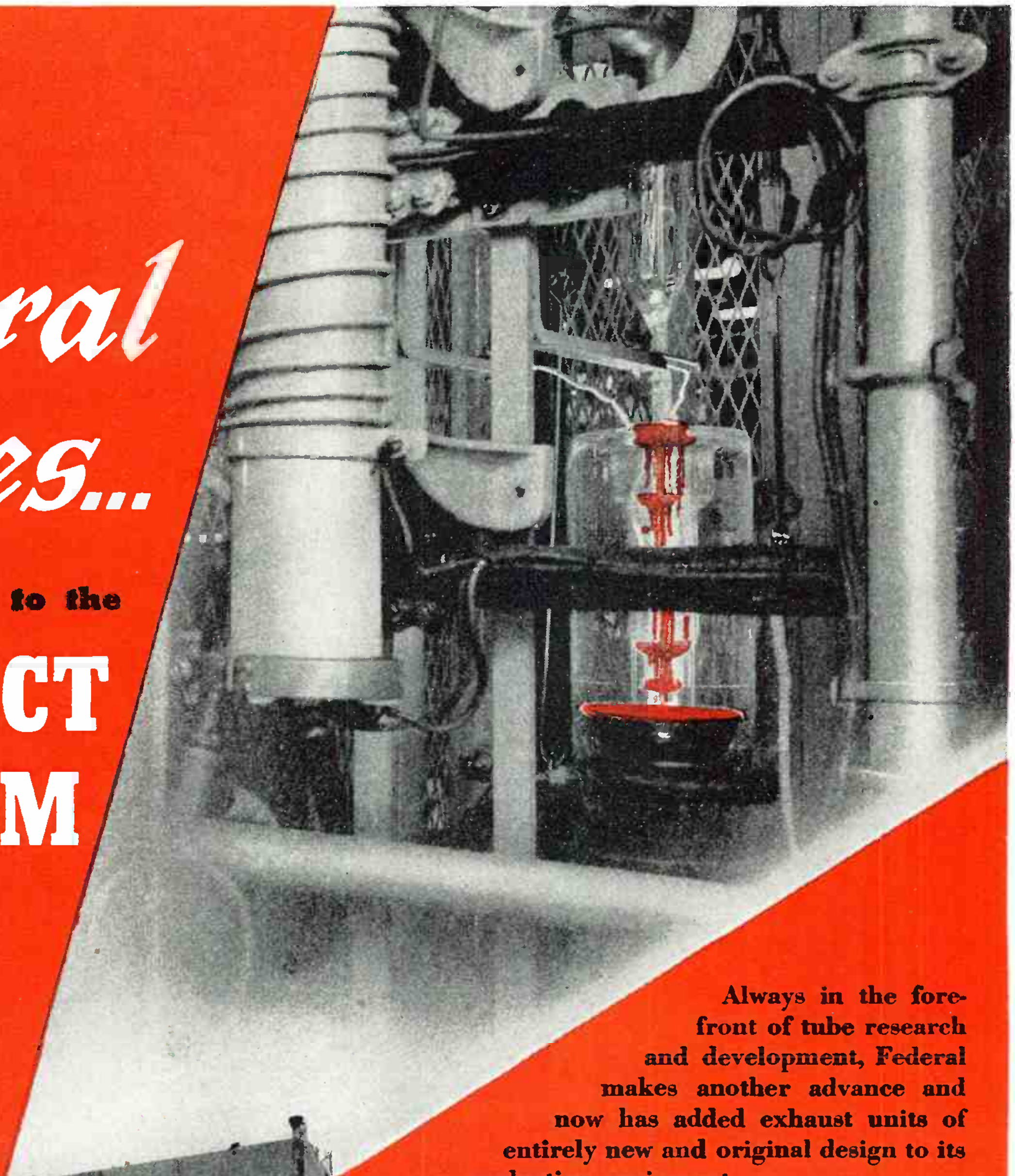
many of the standard processes used in the manufacture of tubing. While the present output of this material is on priority, postwar uses of Lumarith and Celluloid will be expanded to include many electronic applications.

—30—

Federal Tubes...

come CLOSER to the

PERFECT VACUUM

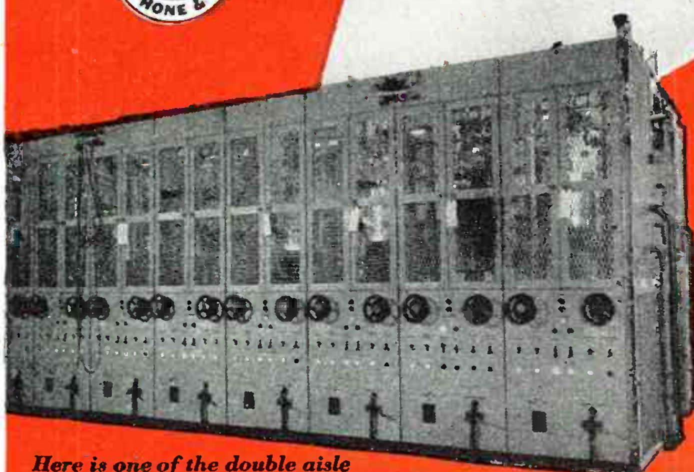


Always in the forefront of tube research and development, Federal makes another advance and now has added exhaust units of entirely new and original design to its production equipment.

This latest Federal achievement produces a tube that is substantially closer to the perfect vacuum—a tube with greater efficiency and longer life.

Arranged in banks of eight and operated with identical control equipment, these units exhaust uniformly every size of Federal tube—assuring a consistent and high standard of quality.

For any communication and industrial power tube need, turn to Federal now—test its reputation that "Federal always has made better tubes."

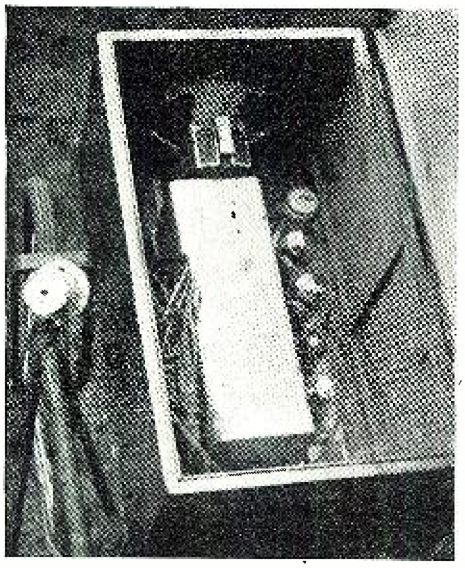


Here is one of the double aisle exhaust banks where 16 high power tubes can be exhausted at one time, each with individual control.

Federal Telephone and Radio Corporation

AN IT&T ASSOCIATE

Newark 1, N. J.



Locator is mounted in a two-wheel push cart. Microphone is shown on tripod.

ELECTRONIC LIFE DETECTOR

Application of a high-gain amplifier and directional microphone to locating entombed robot-bomb casualties.

By
LESLIE W. ORTON
London, England

ON THE eve of Hitler's attack upon the British Isles with rocket bombs, Civil Defence authorities in Uxbridge, Middlesex, gave a special electronic life detector a stringent test in realistic surroundings.

On the 14th of June, 1944, a day later, British national newspapers described those tests and revealed that faint knockings made by casualties trapped under piles of debris were heard as thuds in a loud speaker attached to the output terminals of the apparatus.

A local weekly paper, the MIDDLESEX ADVERTISER, described the test more fully. It revealed that the three casualties were buried under a pile of debris in a huge barn built in 1232 and owned by a well known Middlesex justice of the peace. Three men operated the apparatus. Two used special microphones, one on a telescopic tower capable of being raised to a height of some eighteen feet. Within seconds sounds were heard and arrows were placed at the edge of the debris pointing to the location of the victims. As a consequence the three persons were rescued in double quick time. If it were not for the life saving apparatus, readers were told, rescuers might have commenced searching in places where the casualties were not entombed instead of starting work at the point nearest to them.

The life detector comprises a powerful amplifier, directional microphones, and a piece of apparatus described as a "locator." It was designed with the object of enabling persons trapped amidst debris through air raids, etc. to be located with the greatest speed possible in order that they might be extricated and receive treatment necessary to save their lives.

With its aid, sounds made by trapped persons, though inaudible to the human ear, could be heard on a loud speaker, or headphones, and not only could they be heard, but by a special manipulation of the microphones, the exact spot at which they were buried could be ascertained.

Further, by means of the apparatus described as a "locator," and designed by the author, sounds made by trapped persons could be heard even when considerable external noise was present.

In order to get a true conception of how this apparatus works one should consider what happens when a bomb or plane (or robot bomb—whichever you care to call it) drops. Houses in the immediate vicinity are blasted. If the structure is of lime and mortar the building will be practically demolished leaving a heap of rubble and bricks with beams, joists, and, perhaps, pieces of floor structure, protruding from it. The chances of a person being alive under such a mixture are remote. Firstly, there is a great chance that they have been crushed to death, or so severely injured that they have died almost instantly of their injuries. If they have not died under these conditions, the chances are that they have been asphyxiated by dust. On the other hand, there is the chance in a hundred that when the building collapsed they were saved by being under the stairway (one of the strongest parts of a house), in an air-raid shelter of the indoor kind; or, perhaps, a piece of furniture such as a piano or table, has held up the floor or roof at one point leaving a cavity in which the occupier of the house is trapped. If so, it is more than likely that that person is in urgent need of hospital treatment. They will shout and knock as long as they can in order to make themselves heard. Such sounds may go unheard by the human ear. It is in such cases that the "life detector" may prove invaluable.

America mercifully has not experienced the horrors of air raids. Nevertheless there is no knowing what may happen if the war continues. Robot bombs may be constructed that will fly to New York or some other great American city. A prediction that such would be the case was made by a war commentary recently. Candidly, I very much doubt whether such will be the case. Neverthless there is nothing like being prepared and thus readers may wish to construct a "life detector" for themselves, and, in the event of its being necessary, the detector will be at the disposal of the town or city in which they are inhabitants. In the meantime they may use it for public address work, as a radio or phonograph amplifier, etc.

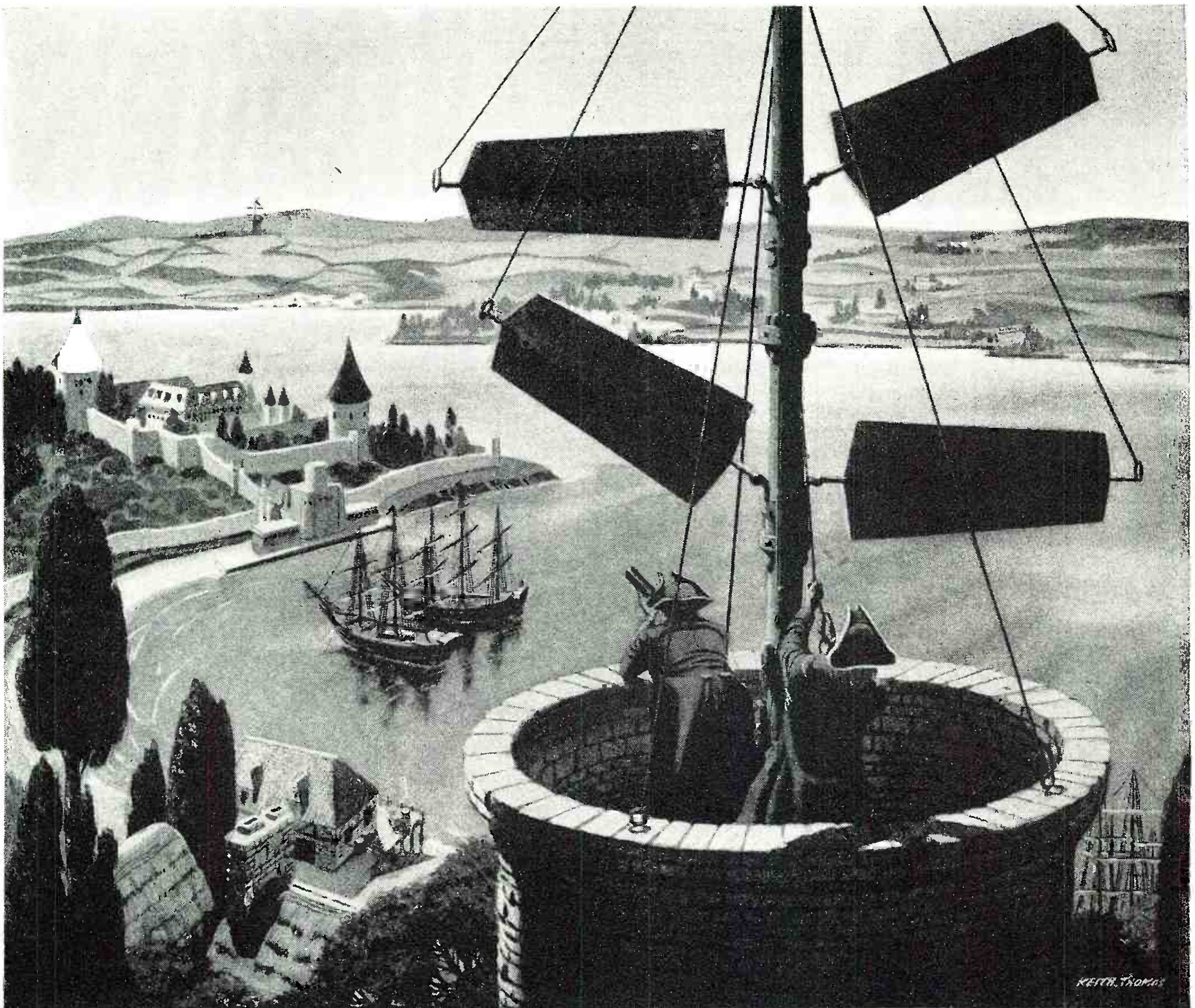
Before describing the actual construction of the apparatus I propose to give a few details about the "ears" of the apparatus. Two of these comprise directional microphones. The third is a "locator." The microphones may be carbon, moving coil or crystal. If the latter, a more powerful amplifier is preferred to that used in conjunction with a carbon or moving coil mike.

Microphones have a directional property but this may be accentuated by placing the mike at the end of a long cardboard tube.

"The locator" is an electronic microphone. It comprises a piece of apparatus much like a phonograph pickup. It has a needle holder and is suspended by a spring from a special three legged stand. Thus by adjusting a screw the pressure of the needle may be varied upon anything on which the locator is standing.

You will get some idea of how the apparatus operates if you take a pickup and hold the point of a needle inserted in it, against a piece of wood. Noises caused by knocking or rubbing the wood, even though hardly audible to the human ear, will be heard distinctly in a loud speaker attached to the output terminals of the life detector.

The great advantage of this apparatus is that it picks up vibrations in

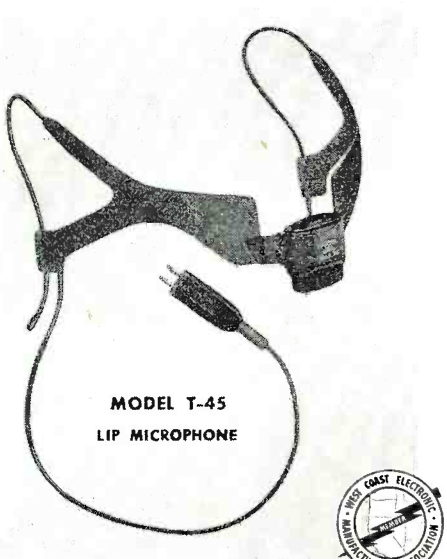


History of Communications Number Six of a Series

COMMUNICATION BY SEMAPHORE

The Semaphore, as a means of communication, met first commercial acceptance in France under the authority of Napoleon in 1792. Restricted by "line of sight" and low power eye pieces, excessive numbers of relay stations, as pictured above, were required for "directional broadcasting" over rough terrain. Weather conditions, too, were a handicap. Because of the code used and its necessary translation, delays and errors were continually encountered.

Today, in the era of applied electronics, Universal microphones are being used to expedite messages on every battle front in the service of the Allies. Universal is proud of its contribution in the electronic voice communications and its every effort to our ultimate Victory.

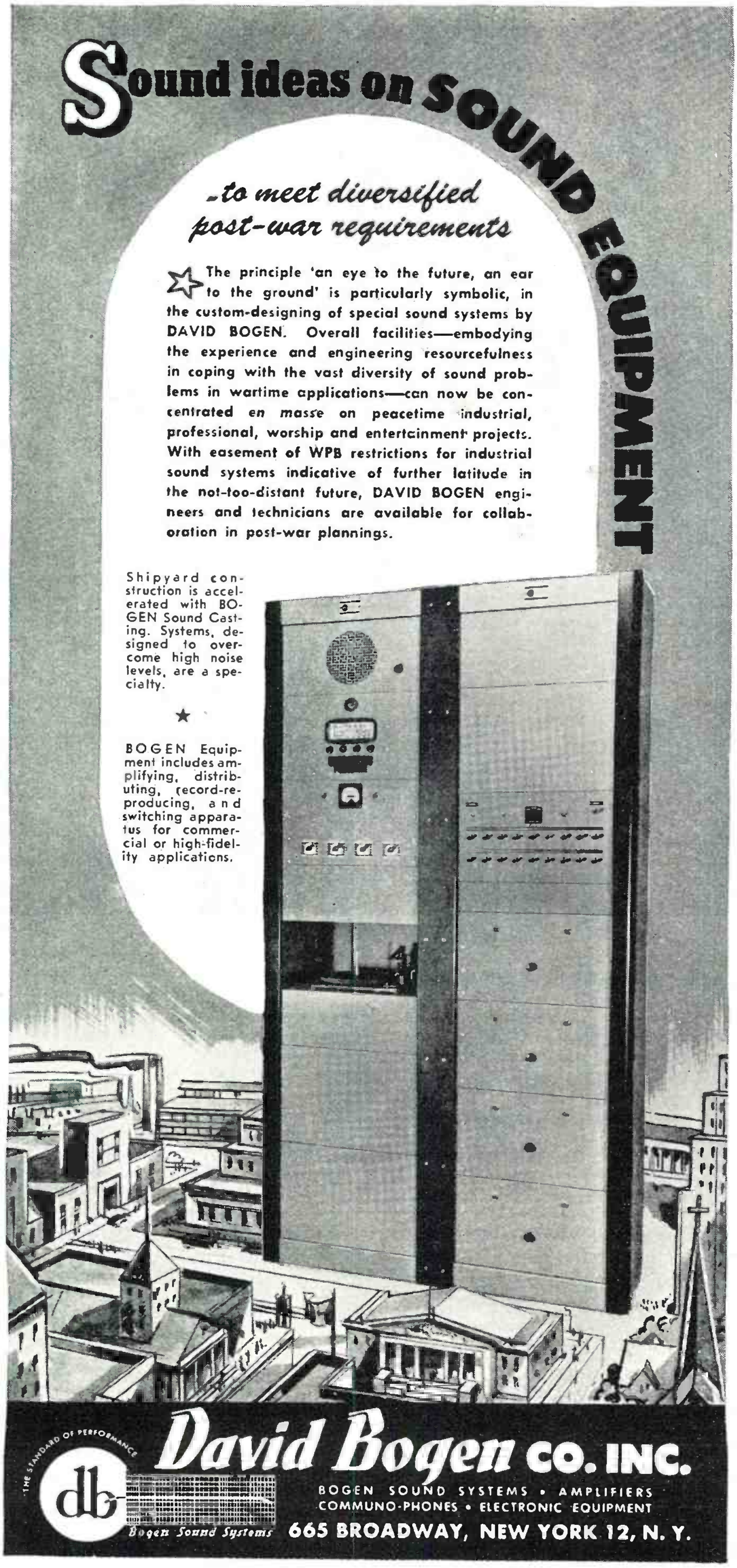


MODEL T-45
LIP MICROPHONE

Model T-45, illustrated at left, is the new Lip Microphone being manufactured by Universal for the U. S. Army Signal Corps. Shortly, these microphones will be available to priority users through local Radio Jobbers.

UNIVERSAL MICROPHONE COMPANY
INGLEWOOD, CALIFORNIA

FOREIGN DIVISION: 301 CLAY STREET, SAN FRANCISCO 11, CALIFORNIA ·· CANADIAN DIVISION: 560 KING STREET WEST, TORONTO 1, ONTARIO, CANADA



substance while ignoring vibrations in the air. Thus the apparatus will permit knocking against material in the debris to be heard even though an air raid be in progress.

The amplifier used with the apparatus may be a public address set or may be specially constructed for the purpose. If the first is employed the designer should bear in mind that a power of ten watts undistorted output will be required for efficient operation.

The current to operate the amplifier may be obtained from either of three sources, the mains, a converter, or batteries.

In the first case, the designer should bear in mind that long leads may be necessary to convey current to the apparatus, as bombs sometime put the electricity supply out of action for a considerable distance. It should be remembered that the mains in the same area may vary considerably. In my district, for instance, we have a.c. and d.c. If a.c. apparatus were connected to the d.c. mains the experience might be costly.

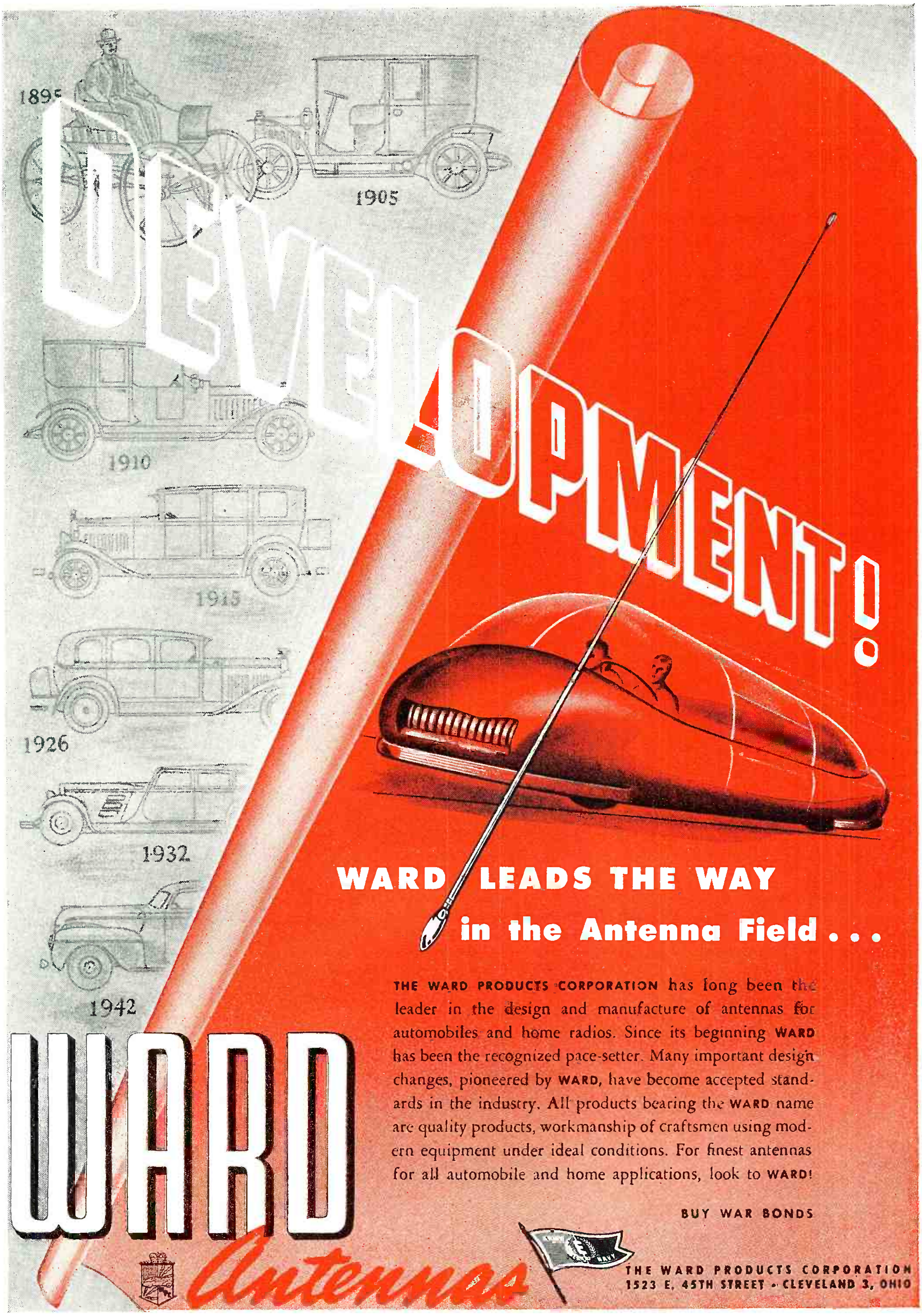
Without a doubt, the use of a rotary converter, or a vibrator (as used in auto-radios) is the best system. This ensures that the life saver be self contained and operated anywhere in city, town or country. Batteries also have that advantage although their bulk detracts from their advantages.

Before going further, I propose to say a few words about the operation of the apparatus. It is preferable that this be built into a box, trailer, or auto, and be connected-up ready for immediate operation. Thus, upon arriving at the scene of a raid (technically called an 'incident') it is only necessary to extend the microphone and locator leads, switch on the apparatus and get to work. The two directional microphones should be placed so that they are at different sides of the debris in which trapped persons are suspected of being buried. After placing the microphones in position, switch on one microphone and endeavor to locate sounds from amidst the wreckage. When a sound is heard take a note of the direction and place a white arrow pointing to it. Then switch on the second microphone and try to pick up the same sound from a different angle. When this is done you will be able to locate the position of the casualty by drawing two lines from the microphones to the sound. Where the two lines cross is where the casualty is buried.

The locator may be used in cases where no sound is picked up upon the directional microphones, or where external noises make the use of the latter impossible.

The apparatus had its value where ordinary bombing was concerned; it is proving of further value where flying bombs, known as V Planes or robots are involved. The bridge now has a flying squad to convey a life detector to incidents.

The robot bomb, a so-called secret weapon, was launched upon Britain


1895
1905
DEVELOPMENT!
1910
1915
1926
1932
1942
WARD LEADS THE WAY
in the Antenna Field . . .
THE WARD PRODUCTS CORPORATION has long been the leader in the design and manufacture of antennas for automobiles and home radios. Since its beginning WARD has been the recognized pace-setter. Many important design changes, pioneered by WARD, have become accepted standards in the industry. All products bearing the WARD name are quality products, workmanship of craftsmen using modern equipment under ideal conditions. For finest antennas for all automobile and home applications, look to WARD!
BUY WAR BONDS
WARD
Antennas
THE WARD PRODUCTS CORPORATION
1523 E. 45TH STREET • CLEVELAND 3, OHIO

after one of the longest "alerts" of the war. Since that occasion persons in the London and Southern England area have had numerous opportunities of seeing this latest novelty and, in some cases, of seeing the consequences of their "landing."

The flying bomb is designed to cause damage by blast, consequently it does not penetrate into the ground to any great extent. Indeed at several of the "landing grounds" of the flying bombs I have observed only a slight dent in the ground. The result is that the blast from the explosion spreads out over a considerable area. In open country the grass and bushes in the immediate vicinity are flattened to the ground, and in some cases uprooted. Trees may be split, but otherwise damage is slight. Anyone in the vicinity may be blown over or struck by flying branches or stones, but unless comparatively close they may well escape any injury.

On the other hand it is a different question where a bomb falls among houses. The blast takes the easiest route. This is frequently a window or door, or it may be a roof. After the blast there is the suction which tends to further damage buildings by its vacuum-like properties.

I have been much impressed by the similarity of the types of casualty found at each site of a crashing flying bomb. If houses are demolished there may be a few persons killed (Mr. Churchill in a speech declared that approximately one person was killed to each bomb launched against Britain). There may be one or two severe cases but frequently these are absent. Then there are the superficial injuries. These comprise cuts and bruises and are in some cases considerable. Few of these casualties require more than first aid treatment.

As can be seen, the use of the life detector can be very considerable in locating persons trapped through the landing of a flying bomb. Indeed, its value can be very great indeed, if it is placed in an automobile, or trailer, ready for immediate action, for a flying bomb may arrive without warning day or night.

A few details about this bomb may interest readers. It is approximately 25 feet long and has wings with a span of 16 feet. It is constructed of steel and contains about a ton of explosive in its nose. This part of the bomb is made of less stout metal than the rest

When the bomb was first launched against Britain it was thought in certain quarters that it was radio controlled. It has now definitely been ascertained that it is jet propelled.

A radio controlled object is guided by signals sent out from a station or stations, and upon given wavelengths.

It is no secret that the Allies have listeners searching the ether day and night, week in and week out, for any unusual sounds. Therefore it would only be a matter of time before the signals guiding the aircraft were picked up and deciphered. Counter

it's attention to details . . .

Human skill can't be scientifically tested. That's why it is always the unknown quantity in manufacturing. But experience is a reliable guide to measuring the true value of skill. In building C-D Capacitors, precision work is backed by the accumulated experience of conscientious men and women, some of whom have been with Cornell-Dubilier for nearly the whole of our 34 years of existence; others for five, ten and twenty years of loyal service.

To the human element in making C-D Capacitors are added the finest facilities—the careful selection of flawless materials. These, together with the expert workmanship of trained minds and skilled hands, have given Cornell-Dubilier a reputation for quality, for minute attention to every detail, and dependability since 1910. Cornell - Dubilier Electric Corporation, South Plainfield, New Jersey.

C-D PAPER TUBULAR CAPACITOR TYPE DT
Non-inductively wound, specially sealed and impregnated, small in size, with high safety factor. Type DT is uniform in electrical properties and has rigidly anchored wire leads. A specially-treated tube keeps out moisture.

CORNELL - DUBILIER CAPACITORS 1910 1944

MICA • DYKANOL • PAPER •
WET AND DRY ELECTROLYTICS

ALSO AT NEW BEDFORD, BROOKLINE, WORCESTER, MASS., PROVIDENCE, R. I.

signals could then be radiated. These might cause the bomb to crash, send it back to Germany, or result in its landing in a specified place.

Needless to say, the jet propelled bomb has not those defects, although it has others. Let us examine the bomb a bit closer.

The bomb is launched from specially constructed projectiles in occupied Europe, notably the Pas de Calais area. Its course is planned in advance and the bomb is kept to that course by means of an automatic pilot. If this automatic pilot is put out of action the machine will be diverted from its course, or may even crash prematurely.

There are other possibilities. The Nazis claim that they are able to ascertain where their "pets" crash by means of radio. The procedure used is probably the same as that employed when one of our aircraft is missing.

A transmission, we are told, is made from the bomb. It is apparently powerful enough to be heard in France. This signal is evidently picked up by two stations at a fair distance apart. By taking bearings on it the exact location of the robot may be ascertained. When the transmissions are no longer heard the senders know that the robot has gone to earth or, alternatively, that something has gone wrong with the mechanism.

It is my opinion that *if* such a system is used another door is opened by which it may be possible to destroy the bombs before they reach their target area.

Some years ago an explosion took place in an arsenal in Europe. At first experts could not find any reason for it. Then someone discovered that high frequency current induced in pieces of metal by a local high powered transmitter could cause a spark to jump between loosely bolted metal plates. Such a spark, it was thought, caused the explosion.

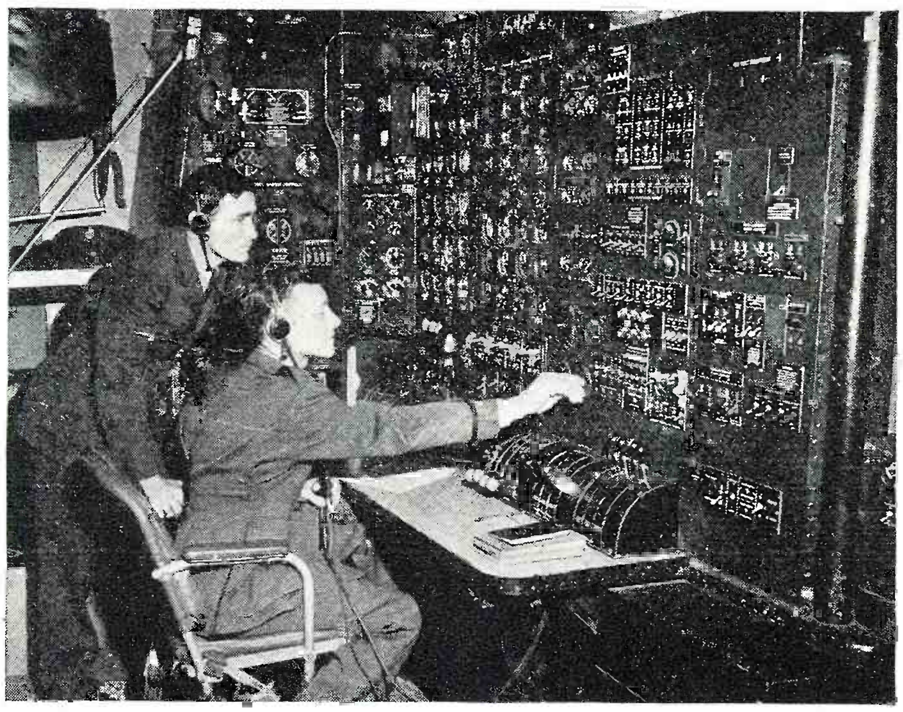
Now if we take a tuned circuit in which a sparking gap is included, we will find that if we tuned the circuit to the wavelength of a powerful station in the immediate vicinity a spark would jump the gap. Thus it is possible, I believe, to devise a means by which the tuned circuit in the flying bomb might be put to use in causing a spark to jump in the bomb and thus to set off the explosive.

But we will assume that the story of the radio transmitter in the bomb is untrue, as it may well be. I still believe that radio could be brought into use to satisfactorily combat the intruders.

As I remarked above, a current can be induced into metal. Further, if there are loose joints in a metal structure, a spark may well jump across the resultant gap. When a spark does that in the vicinity of a high explosive, well, other possibilities are great-

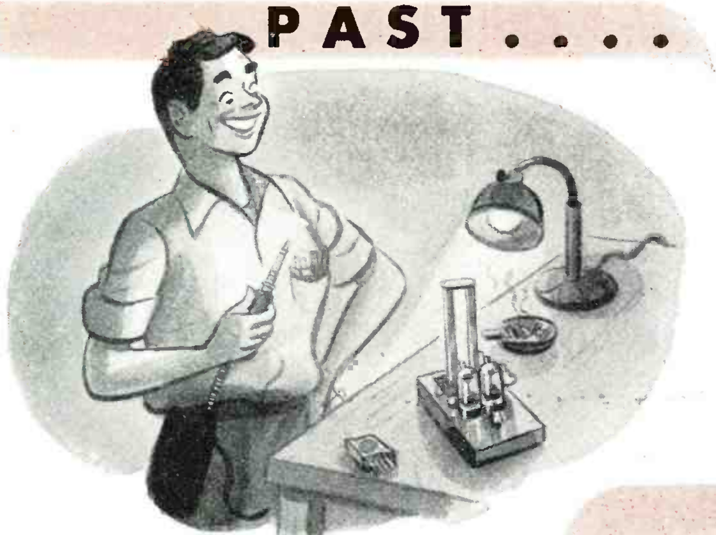
It would, I believe, be quite practical to erect a special balloon barrage and to connect it to radio apparatus so that a current be induced into bombs passing within its range. This idea may sound fantastic. That be as it may, it most certainly would be possible to so induce currents and, I believe, there may lie one solution to the premature destroying of Hitler's new bomb. —30—

Aviation Chief Mate Clovis Norwood (left) and Ensign Albert Geck operate the complex engineer's panel of the Navy's newest giant flying boat, Mars, which completed its first war mission early this year for the Naval Air Transport Service. The airship shattered all existing records for cargo transportation and over-water flight by carrying the heaviest load ever lifted by a plane: 148,500 pounds gross.



"Ham" Radio and HYTRON

PAST . . . .

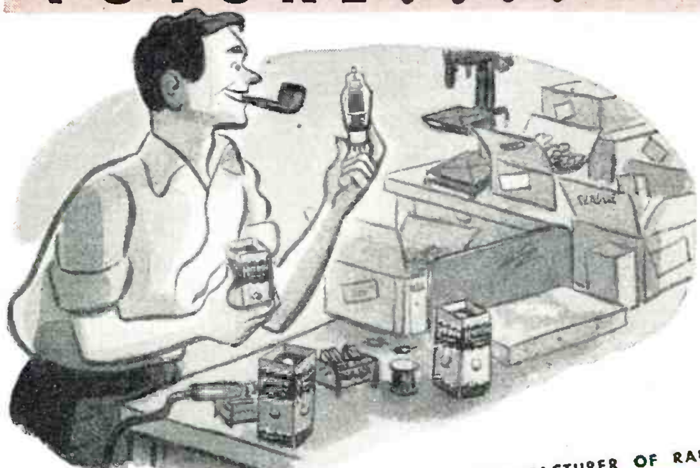


THE radio amateur trained himself during peace to be invaluable to the Nation during war. Specializing on tubes exclusively designed for ham radio, Hytron when war began was prepared for immediate and direct conversion to war production. Hytron transmitting and special purpose tubes proved by the ham were ideally suited—with little or no changes—to military applications. Years of practical experience made Army and Navy specialists of radio amateurs overnight. Peacetime tools of these same hams, Hytron tubes joined immediately this new fighting team.

. . . . PRESENT

HAMS with the Services in all parts of the world know the war job Hytron is doing. High-speed receiving tube techniques plus know-how derived from special purpose engineering of tubes for the amateur, make possible a flood of dependable Hytron radar and radio tubes to these fighting ex-hams and potential hams. Proud of winning the Army-Navy "E" for its performance on a huge production job, Hytron is also proud of its ham friends who are transforming innocent-appearing Hytron tubes into deadly weapons.

FUTURE . . . .



THERE should be no concern about adequate post-war amateur frequencies. Excellent wartime performance on far-flung battle fronts has made for ham radio many enthusiastic and influential friends. The ARRL reports that it looks forward with absolute confidence to the opening of new frontiers in expanded frequency ranges to be made available to the post-war amateur. Hosts of hams will return to their old friend, Hytron. For the more familiar lower frequency bands—the very high frequencies—or the new superhighs—their choice will be Hytron.

OLDEST EXCLUSIVE MANUFACTURER OF RADIO RECEIVING TUBES

HYTRON CORPORATION ELECTRONIC AND RADIO TUBES

SALEM AND NEWBURYPORT, MASS.

BUY ANOTHER WAR BOND

MATHEMATICS IN RADIO

By RUFUS P. TURNER
Consulting Engineer, RADIO NEWS

A review of the mathematical knowledge required to attain success in the various branches of radio

MATHEMATICS is in the forefront today. Formerly, all but a scant minority conceded this science unquestionably to be the dullest subject in any school curriculum and promptly abandoned it after stumbling through required courses. But the unprecedented war demands for mathematically-trained technicians have encouraged mastery of the subject by workers whose dislikes in the past have been pretty plainly expressed. Groups of new books promise to sugar-coat the entire subject—from arithmetic to calculus—for the man in the street. Scarcely a popular magazine now is without a slide rule ad. Advertising copywriters would have us believe that no citizen, male or female, can possibly go about his normal endeavors or make any advancement in the postwar world unless he has mastered the intricacies of higher mathematics.

The radioman is a particularly conspicuous prospect for a mathematical bill of goods. Several new mathematical textbooks have been written especially for him. Many of the courses offered in the larger towns for his benefit are strongly mathematical in texture. Indeed, we know of one resident course in *radio servicing*, conducted by a public school evening division, which was so unnecessarily mathematical as to discourage most of the students before the work was half through. These instances have caused some confusion among radio men, particularly among the younger set, and as they look around them they question the necessity of mathematics to their advancement.

The increasing frequency of such questions prompts us to outline briefly in this article the relationship of mathematics to the various branches of radio. It is not our aim to endanger the business of any individual whose purpose it is to teach mathematics. Our sole purpose is to point out *how much* and *what branches* of mathematics are essential to the various radio pursuits and thus to save the radio student and radio worker lost motion as well as inadequate preparation.

For the purpose of this discussion, we have separated all radio practitioners into the following groups: engineers, designers, operators, experimenters, and servicemen. These are, of course, broad classes, but it will be conceded that they are specific enough in their lines of demarcation to admit of group treatment with regard to mathematical requirements. The needs of each class will be described separately.

The Engineer and Mathematics

Radio engineering today is widely diversified and the conditions of its practice divergent. There are practicing engineers, whose work has been restricted to certain lines, who will declare that they have had no occasion since leaving college to apply any branch of mathematics higher than plane trigonometry. Some of these men have not seen the occasion; others have side-stepped the mettle-testing problems; still others have stuck to the time-wasting, roundabout methods of solution. In spite of the divergent conditions of practice, however, it must be admitted that the live-wire radio engineer, who is prepared for any eventuality, has mathematics in his tool-kit and can swim literal circles around the fellow who is not adept at the "arm-chair science of figures."

The successful practice of radio engineering presupposes a sound working knowledge of all branches of mathematics from elementary arithmetic to calculus. Any techniques the engineer may possess beyond calculus is additional fortification for the battles he is certain to have to wage in the field. In the mathematical lineup are all of those subjects encountered in grade school, high school, and college: arithmetic, algebra, plane and solid geometry, analytical geometry, plane and spherical trigonometry, vector analysis, differential and integral calculus, and differential equations. We question the value of *descriptive geometry* to the prospective radio engineer, except as an aid to mental stimulation.

The engineer must be able to hop agilely from the techniques of one branch of mathematics to another, as he solves his problems, and he must be able to handle the numerous processes with accuracy. His "mistake level" must be uncommonly low. All of this means that he must retain his knowledge of the entire field of mathematics—a feat made possible only by continual usage. An unused tool becomes rusty; knowledge not used is soon lost. Like a doctor preparing the right medicine, the engineer selects

"You said it was dead, didn't you?"

and uses the *proper* branch of mathematics for a particular problem. He does not cut and try laboriously with arithmetic, hacking and patching, piecing and piling until the answer works itself out, when an expert application of some other branch, say calculus, will give an answer forthwith. Nor does he have to resort to frequent uses of graphical methods, any more so than does an expert calculator have to resort to counting on his fingers.

To summarize, the radio engineer needs *all* mathematics, regardless of the branch of the field in which his major endeavor lies. Whether his concentration is upon tubes, capacitors, resistors, circuits, antennas, or what not, anything short of covering and mastering the entire field represents inadequate preparation. If he has been able to get along on less, it may safely be wagered that he has not applied the rapid methods and complete analysis afforded him by the higher branches of mathematics. This is a situation he cannot avoid. An engineering student, recently interviewed, asserted that the engineering courses are composed of many different subjects, "all mathematics in another form."

The Designer and Mathematics

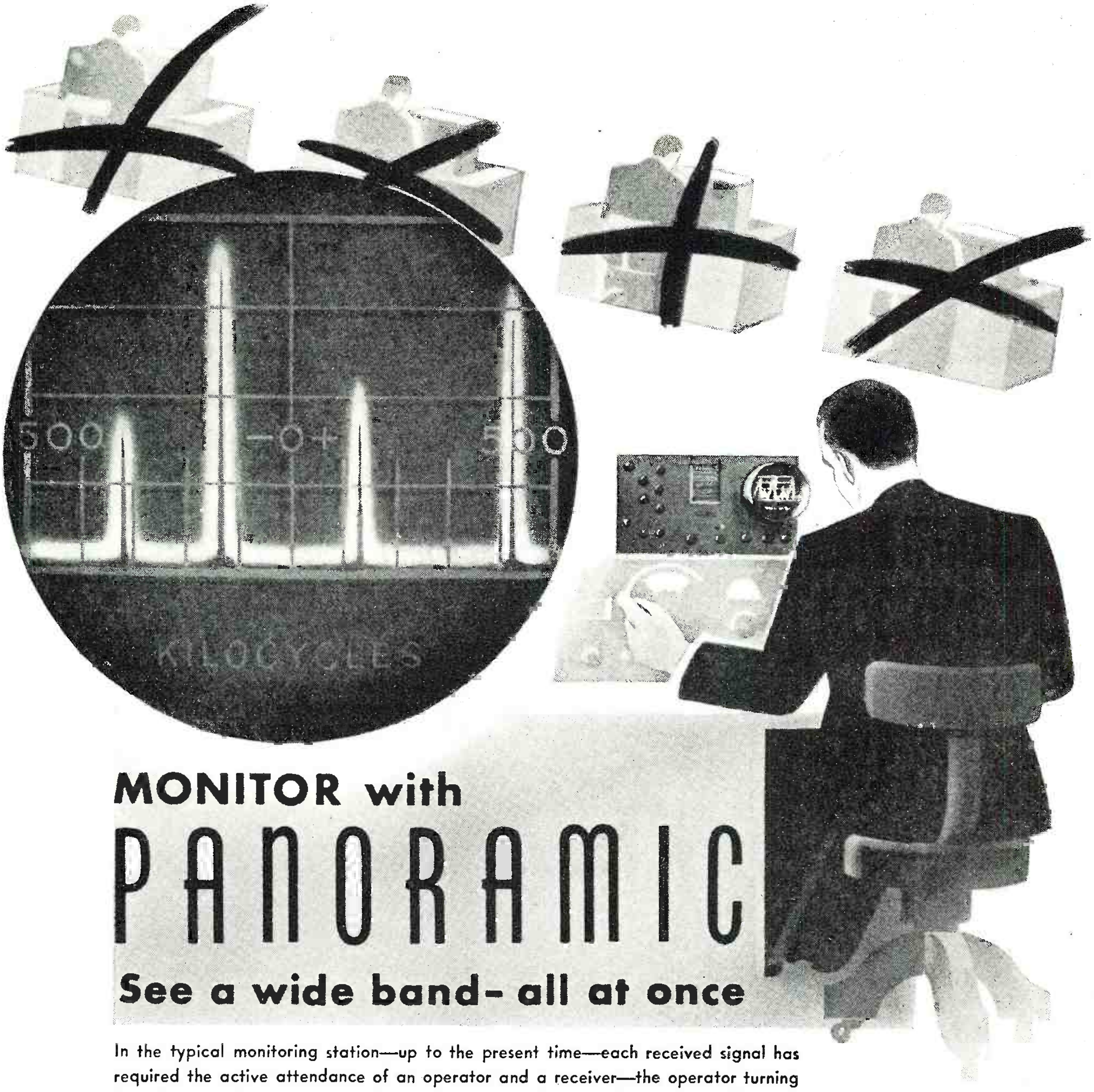
The designer, like the engineer, is taken by his work to the rock-bottom base of the science of radio. In order for the serious professional designer to hurdle the pitfalls he encounters in his regular pursuit of the art, he therefore needs the best mathematical background he can possibly acquire. Otherwise, he must work in close collaboration with an engineer so prepared. The designer is often an engineer, although he need not necessarily be one in fact. But it has been our observation that those successful designers who are not engineers by title do possess a complete store of engineering knowledge, however acquired, including full mathematical skill.

It is the business of the designer to be original. He, accordingly, must be able to get down to sources, to see through every device and operation "down to the mainspring." The worker who does not originate is far from creative effort and is a mere assembler of components and systems developed by the mathematically-trained technician. The designer is at the same time a worker of considerable ingenuity and mental alertness, both attributes which are whetted by mathematical endeavor.

The successful designer, like the engineer, needs all the mathematics he can possibly absorb; and through constant use of his mathematical skill, he must keep this tool sharpened.

The Experimenter and Mathematics

By *experimenter,* we mean the serious investigator, the researcher, who, by trying various processes, systems, or components with respect to other processes, systems, or components,



500
-0+
500
KILOCYCLES

adds to our store of knowledge and gives us new systems and devices. We do not mean the *radio tinkerer*, who we freely admit does occasionally hit upon an invention, but usually in the most uneconomic and unscientific manner. The legitimate experimenter plots his course and knows precisely what he is looking for, although he is alert for the unexpected as well. He does not idly and blindly shuffle along hoping to stumble upon the miracle of the century. He has a searching mind and an analytic sense; he knows how to put together the things he sees. He may have developed these mental traits through rigorous mathematical training.

The purposeful experimenter must have a good mathematical background, although it need not necessarily be as rigorous as that of the engineer. Some radio experimenters are engineers, although all engineers do not experiment. The experimenter who works in close association with an engineer, who supervises his work, seldom requires a mathematical background beyond plane trigonometry unless he is called upon to make more complex analyses and computations than are enabled by that much mathematical knowledge. The independent experimenter who is entirely on his own and must make his own conclusions, on the contrary, needs the mathematical preparation of an engineer.

The amateur experimenter is concerned solely with adding to his personal knowledge or with amusement derived from tinkering with scientific apparatus. Seldom does his interest in radio extend far beyond first principles. Usually, he has no industrial designs. He is in a unique position to determine the amount of mathematical skill he needs in his own case. When the amateur with common mathematical preparation (arithmetic, algebra, and geometry) runs against unanswered problems, he usually senses his need for the next branch of mathematics and usually satisfies himself with only the leading facts from that branch. Generally, the amateur radio experimenter requires no mathematical knowledge except that afforded by arithmetic and first-year algebra. To him, any further preparation is usually a luxury. His requirements will, of course, increase should he "graduate" into the class of serious experimenter.

The Operator and Mathematics

The *professional* radio operator, as such, needs no extensive mathematical background. His job is the operation and maintenance of radio transmitters, receivers, and monitors, and the design features of this equipment are generally not consequential to him unless he must make repairs in out of the way ports, or at odd hours. The knowledge normally required of him is more qualitative than quantitative, and he thus is able to get along on a more meager mathematical background. From his extensive knowledge of radio circuits and the conventional components employed in them, the radio operator is able to construct or to locate trouble in a wide variety of transmitters, receivers, and associated communication equipment.

To be sure, the operator's acquaintance with circuits and components and the reasons for their sizes, ratings, and employment in specific places may be enhanced by a broad mathematical background, but it is doubtful that the latter would make him a better operator. He may pass the Government professional operator's examinations, and build, test, and maintain a wide variety of communication equipment, radio, television, and facsimile, and do this job well with a minimum of mathematical equipment. The professional operator does not require mathematical knowledge and skill beyond arithmetic and algebra. He can get along with first principles of algebra, at that, and about all the trigonometry he requires is a knowledge of logarithms and of functions of the angle.

The professional operator does not have to be an engineer, and it is very doubtful that advanced engineering knowledge will improve his operating ability. Intimate acquaintance with the circuits and manner of operation of communications equipment will enable him to diagnose all troubles encountered during the operation of such equipment and to make all repairs and emergency replacements. Certain improvements to the instruments or the manner in which they are operated are likewise within his domain. Advanced mathematics is not prerequisite to these qualifications; and the operator's study program should not be burdened with this almost useless information which, while providing an asset from an engineering point of view, is about the equivalent of insisting that a bacteriological laboratory technician have an M.D. degree.

The *amateur* radio operator needs even less of a mathematical background than his professional associate in art. The amateur license examination is exceedingly simple to the radio student and, aside from the code test, presents little difficulty. The amateur operates his station primarily for reasons of personal enlightenment and a kind of scientific amusement. From this operation has come some noteworthy contributions to the progress of radio, but the writer feels that the amateur stepped out of character in these cases and became, even if temporarily, a serious experimenter or even an engineer.

There is absolutely no reason to sell the radio amateur, prospective or established, on advanced mathematics. He does not need this subject. His transmitters, receivers, and instruments are almost always built from standard designs which he finds in his magazines and textbooks. He gleans ideas for certain "personalized" changes in the circuits from his own acquaintance with circuits and constants commonly employed. He just is not concerned with fundamental design; and when he does fancy himself

ALLEN H. GARDNER, *President*
Colonial Radio Corp. . . .

"The public knows only part of the splendid job electronic engineers have done during the war, and of the marvelous accomplishments that have been made in radio communications, because of the extremely secret nature of most of the developments. One of the results which can be mentioned now is the . . .

"TREMENDOUS INCREASE IN NEW USES FOR MODERN, VERSATILE VIBRATOR POWER SUPPLIES"

Yes, Mr. Gardner, many fields, after the war, will find E-L Vibrator Power Supplies the key to a host of new improvements in their products and services. The transit industry, radio, aviation, railroad, marine, electrical and electronic are just a few of the fields in which E-L equipment will do many important jobs . . . The most significant new E-L development is the perfection of an electrical current division circuit between vibrator contacts. This has made possible an enormous increase in output capacity, to as much as 1500 watts at present!

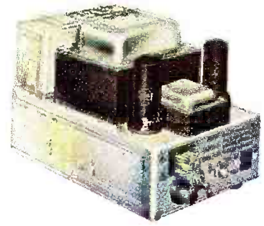
For the transit field, Electronic Laboratories offer four patented current conversion systems for fluorescent lighting in all types of vehicles. These systems will operate any type or size fluorescent lamp, either hot or cold cathode, as well as any number of lamps.

E-L is ready now to bring you the benefits of its tremendous wartime experience for two-way radio in planes, trains, transcontinental busses, boats and other fields . . . Multiple input and output units are available. Vibrator Power Supplies may be designed to supply any needed wave form. They are efficient and long-lived and economy is assured with the minimum of maintenance. E-L design engineering service will design a Vibrator Power Supply to meet specific requirements in size, weight and voltage.

E-L STANDARD POWER SUPPLY MODEL 619

This is a typical unit for mobile or portable applications with such equipment as 5 or 10 meter shortwave rigs. Model 619 allows you to operate from regular 115 volt AC power line and then switch easily to a 6 volt DC battery. Characteristics: Input voltage, 115 volts 60 cycle AC and 6 volts DC; Output voltage, 6.3 volts AC at 100 ma. and 300 volts DC at 100 ma.; Output power, 55 watts maximum.

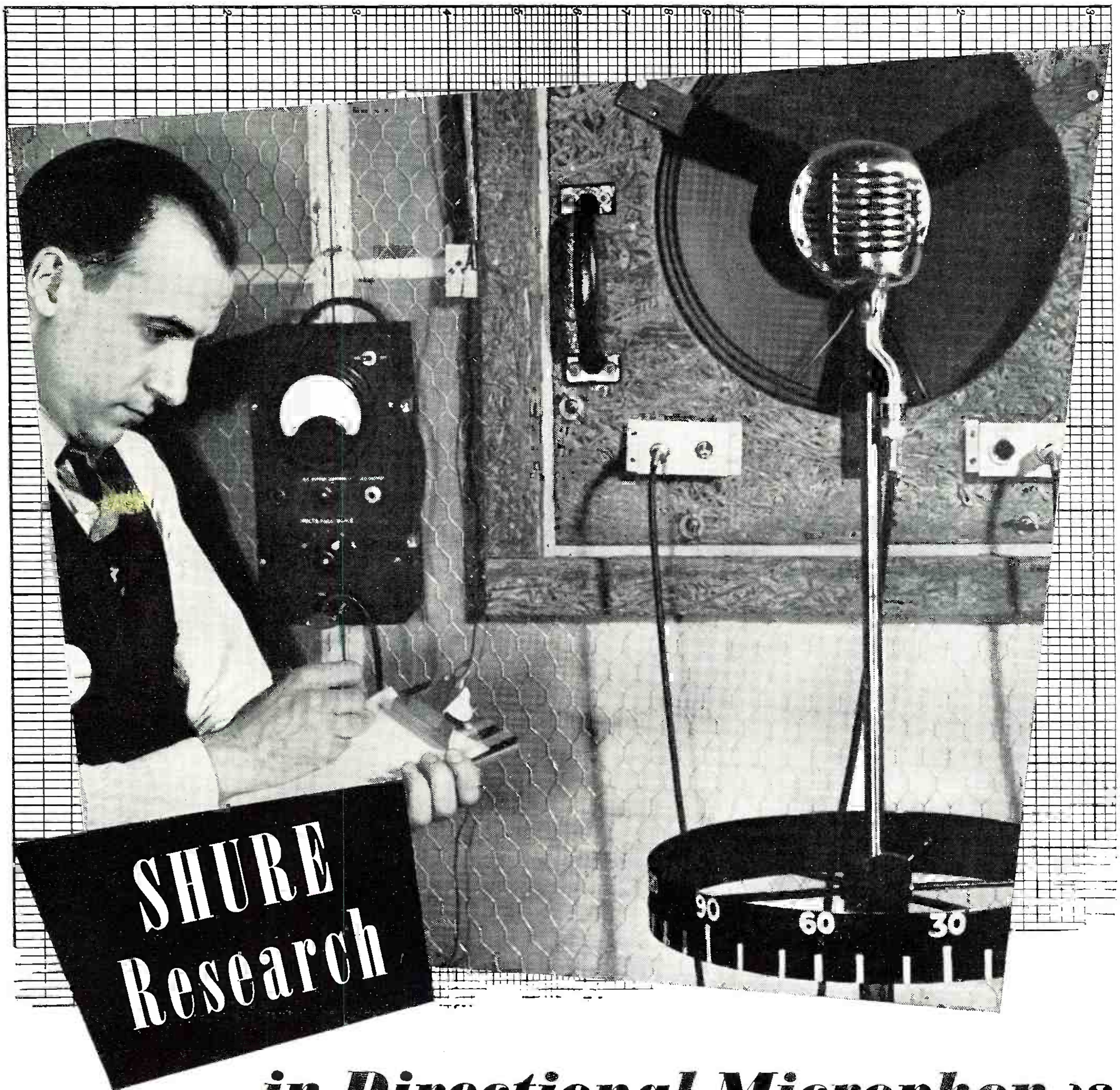
Dimensions: 9¾ x 5¾ x 6 inches. Weight: 14½ pounds



Write for further information of this and other power supply models with different inputs and outputs for a wide range of uses.

Electronic LABORATORIES INC.
INDIANAPOLIS

VIBRATOR POWER SUPPLIES FOR LIGHTING, COMMUNICATIONS, AND ELECTRIC MOTOR OPERATION • ELECTRIC, ELECTRONIC AND OTHER EQUIPMENT



. . . in Directional Microphones

It is not enough to design a Microphone that merely converts sound waves into electrical impulses. A Microphone, to be truly useful in modern broadcasting, should be discriminating enough to accept wanted sounds —and reject unwanted sounds. Shure Research was the first to develop a single unit uni-directional Microphone, both crystal and dynamic.

Shure Research is the reason why practically every major broadcasting station uses the Shure 556 Unidyne. Shure Research is your assurance of postwar microphone superiority.

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

ARMY E NAVY
SHURE
MICROPHONES

so concerned, he likes to build up his pipe-dream by a cut and try process. In this way, he derives much enjoyment from his activity. To introduce weighty mathematics into his hobby is to remove the enjoyment and exhilaration the amateur feels as he builds and operates his equipment. He is entirely satisfied to let the engineers design the equipment—he will build and use it, making those changes which appeal to him.

The Serviceman and Mathematics

The radio serviceman's job is to repair radio equipment, mainly home broadcast receivers. Like the radio operator, first-hand acquaintance with a large number of circuits and an up-to-date status with regard to the equipment on which he works are the serviceman's most invaluable assets. The reasons why the circuits operate and the methods of calculating size for replacement parts may be comprehended fully by the repairman without resorting to higher mathematics. To weigh a radio service course down with unrelated mathematics is ridiculous.

A good serviceman encounters no problems more complex than Ohm's Law, the computation of gain in decibels, or the calculation of a.c. and d.c. power. He accordingly *needs* only a sound foundation in arithmetic and some algebra. He can use a few trigonometric facts—such as the use of a log table, and use of trig function tables—but he does not need to know the entire science. All conversions he will be called upon to make, such as wavelength to frequency, microfarads to micromicrofarads, and the like, may be accomplished by simple arithmetic and indeed he will make substitutions in formulas which he either has memorized or will look up in his handbooks, so that little algebraic knowledge is required.

The normal course of radio servicing does not require the designing of new components or circuit arrangements. The repairman accordingly is not called upon to do the type of design work demanding a thoroughgoing knowledge of engineering mathematics. It is extremely misleading to prospective servicemen or to established servicemen who wish to improve themselves to present long mathematical treatments of repair topics. Such time is more profitably spent in classroom acquiring a more intimate acquaintance with the numerous modern radio and amplifier circuit arrangements and in more rapid methods of trouble shooting. It is perhaps most surprising to youngsters rejected from some of the new "double-differential" classes in radio servicing to learn that thousands of men are making livings at radio servicing throughout the country without knowing, or even caring, what the square of the sum of two numbers is equal to.

About the Slide Rule

The slide rule has come up for the lion's share of publicity since the war started. Time was when one or two outstanding manufacturers of drafting and surveying supplies were the chief sources of supply for these handy instruments. Today, however, several suppliers offer all manner of rules, starting at 25 cents in price, and recommend them for use by business men, students, housewives, mechanics, engineers, architects, etc.

Unquestionably, the slide rule is extremely useful for all forms of calculation except addition and subtraction, and we recommend its use to all radio men, whether in engineering or sub-professional work. The ability to manipulate the slide rule and interpret its indications with accuracy is a decided asset which pays large dividends in simplification and saved time.

The serious-minded radio man should obtain the best slide rule he can afford and devote himself diligently to its mastery. Like mathematics, knowledge of the slide rule will grow dim too unless used; and for this reason the rule, once employed, should be used in every suitable problem, the complex as well as the simple. There is a pronounced tendency to reserve the rule only for the humdrum calculations and to take pencil and paper for the mettle-testers. In this connection, Raymond W. Dull says in his book *Mathematics for Engineers:* "Although engineers use the slide rule more, perhaps, than any other class of men, we believe that the majority of engineers confine its use to the simplest kind of operations."

Summary

Mathematics is an exact science and is the life-blood of engineering. The domain of mathematics in radio embraces all of the branches of this applied science, but is less required by some branches than by others.

The radio engineer, designer, and serious experimenter require a thoroughgoing mathematical background embracing all branches from arithmetic through calculus. The engineer may well utilize any additional mathematical training beyond calculus, and the experimenter may be able to dispense with some of the higher branches (e. g., analytic geometry, calculus, and subjects beyond calculus) if he is not independently engaged.

The radio operator and radio serviceman require little mathematical equipment in the normal pursuit of their occupations. This is true likewise of the non-professional experimenter and the amateur radio operator. These classes of radioworkers will be adequately prepared by a good working knowledge of arithmetic and algebra, with enough knowledge of basic trigonometric facts to enable intelligent use of log and function tables.

The slide rule is an invaluable tool and ability to manipulate it an asset to each of the radio groups.

It is hoped that this explanation will help to quell the confusion arising in the minds of radio men who question the necessity of mathematics to their advancement.

—30—

Electron Microscopes
(*Continued from page* 43)

changing specimens is shown in Fig. 6. A scissor tong readily removes or inserts the specimen holder in the stage. The removable object chamber door is sealed by atmospheric pressure during operation. The standard specimen holder is designed to allow fine adjustment of the specimen-objective spacing so that maximum magnification can be obtained.

Fig. 12 shows the specimen holder used in making stereoscopic images. The holder, as shown, is ready for making one of a stereo pair of micrographs. The stereo holder is actuated by a special stereo door mechanism. By rotating the knurled knob of this door clockwise, the right-eye image of a stereo pair can be produced on the photographic plate. Full rotation counterclockwise produces the left-eye image. A mid-position of the stereo control knob permits regular micrographs to be produced. The stereoscopic images are produced by tilting the specimen with respect to the direction of the electron beam, and the total stereoscopic angle is eight degrees. All motions imparted to the specimen to produce stereoscopic images are made without removing the specimen, turning off the electron beam, or opening the column.

The cores or pole pieces of the objective and projector lenses are of a new demountable design which insures permanence of alignment, permits wide flexibility in choice of focal lengths, and allows for ease in servicing. Proper choice of pole piece material, and improved design of pole piece configuration have greatly increased direct magnifications attainable, while at the same time reducing distortion.

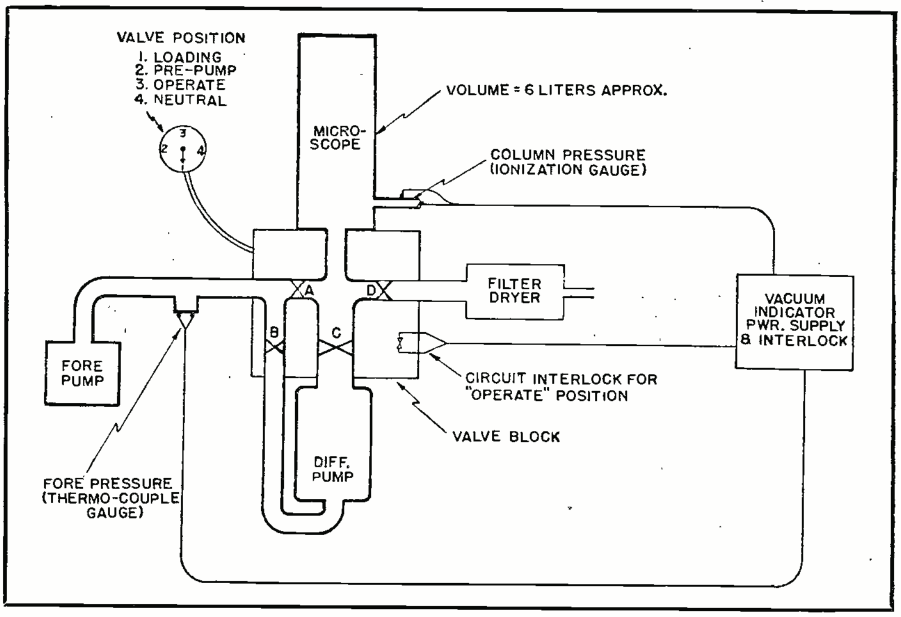


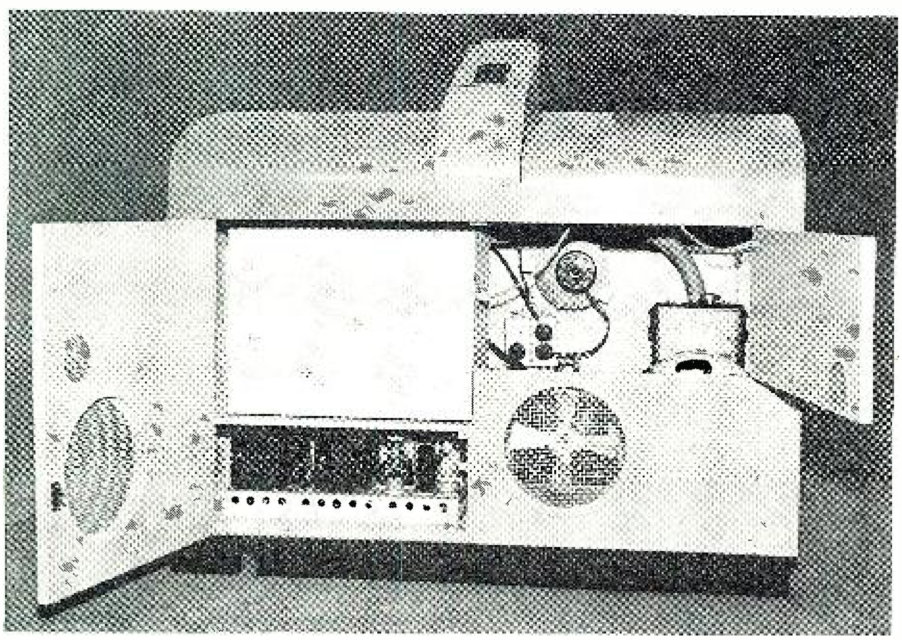
Fig. 11. Diagram of vacuum system used with the Universal Microscope.

A new design feature permits access to and removal of the objective and projector pole pieces without dismantling the column. A scissors arrangement enclosing a sylphon bellows can be removed from the section of the column which separates the objective and projector lenses, thereby exposing the pole pieces. On reinsertion, the spring preloading of the scissors sylphon automatically seals the column and the instrument is again ready for pumping and operation.

Another feature of the Universal Microscope is the inclusion of a clock with sweep second hand. The clock matches the valve position indicator and is of the luminous dial type.

The projector lens section of the column also includes a device for supporting specimens from which electron diffraction patterns may be obtained. This device will support materials for examination by either the transmission or reflection methods. The calibrated controls shown in Fig. 4 serve to orient reflection type specimens so that the proper angle exists between the electron beam and the crystal planes. The projector unit also includes a focusing lens for the diffraction patterns. Extra ports are provided in the projector unit for observation or for mounting special electrodes and various mechanical fixtures.

Fig. 10. Rear view of the Console Electron Microscope. At upper left, within compartment, is high-voltage unit which generates 30,000 volts; below is low-voltage chassis; and at right, mechanical forepump.

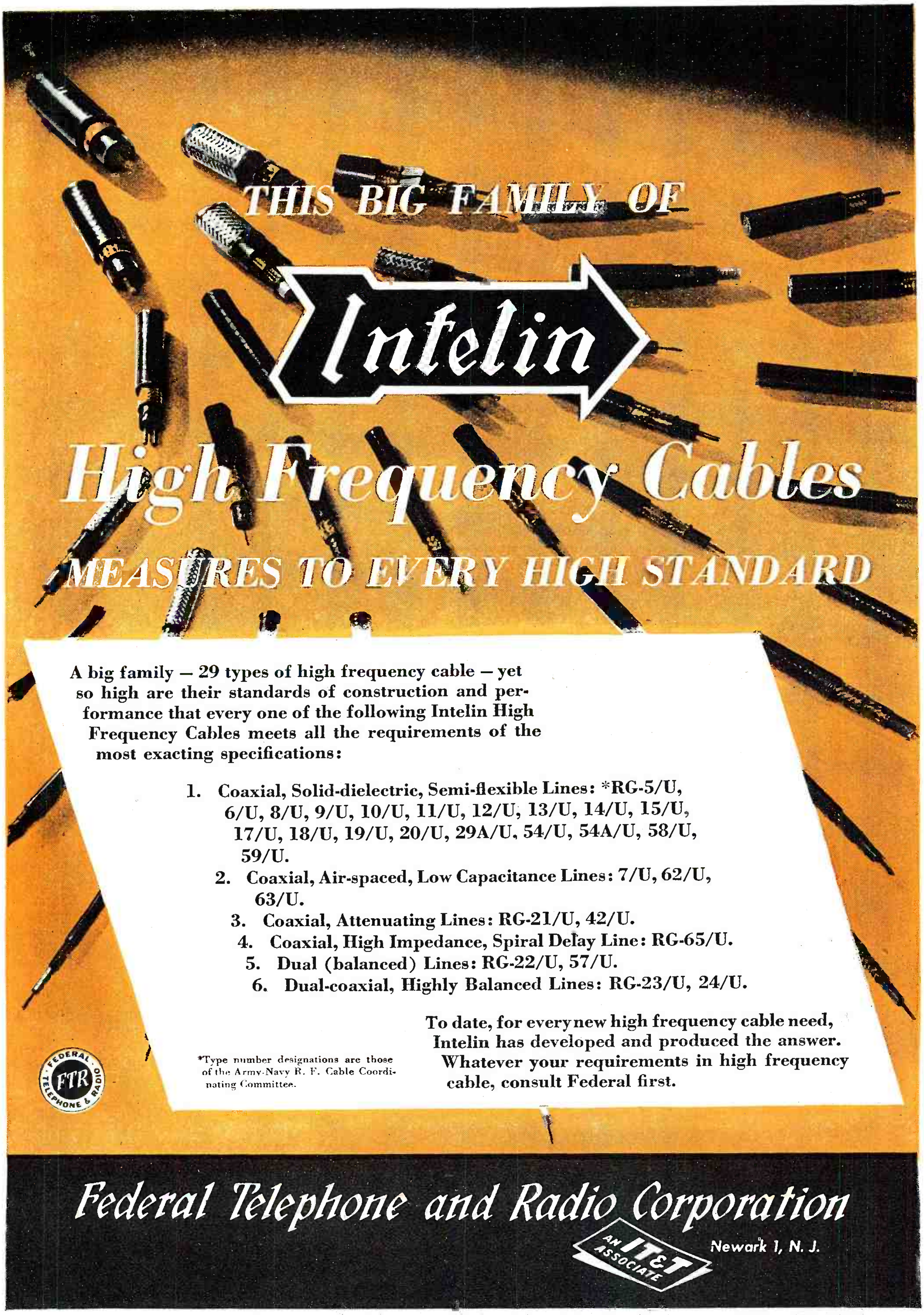


The viewing chamber is equipped with three large glass windows so that the fluorescent image screen can be viewed by several observers at once. The front window includes a flexibly mounted 3X magnifier which an operator can employ to assist in the focusing of images. Extraneous light is excluded from the viewing chamber during photography by two sliding doors.

The photographic chamber is mounted just below the viewing chamber. A close-up view of the camera cassette being inserted into the photographic chamber is given in Fig. 13. The light-tight cassette contains a 2" x 10" plate on which five 2" x 2" exposures can be made. The exposure sequence is controlled by step-by-step rotation of the knob shown in the center of Fig. 3. Exposure timing, in which the fluorescent viewing screen is used as the shutter, is accomplished by a standard camera cable release, also shown in Fig. 3. The use of a flexible exposure control effectively isolates the microscope from vibrations during photographic work.

The valve block and diffusion pump, which are located below the photographic chamber, complete the assembly of the column.

The control system of the Universal Microscope is assembled on a sloping panel. Again referring to Fig. 3, it will be seen that all mechanical and


THIS BIG FAMILY OF
Intelin
High Frequency Cables
MEASURES TO EVERY HIGH STANDARD
A big family — 29 types of high frequency cable — yet so high are their standards of construction and performance that every one of the following Intelin High Frequency Cables meets all the requirements of the most exacting specifications:
1. Coaxial, Solid-dielectric, Semi-flexible Lines: *RG-5/U, 6/U, 8/U, 9/U, 10/U, 11/U, 12/U, 13/U, 14/U, 15/U, 17/U, 18/U, 19/U, 20/U, 29A/U, 54/U, 54A/U, 58/U, 59/U.
2. Coaxial, Air-spaced, Low Capacitance Lines: 7/U, 62/U, 63/U.
3. Coaxial, Attenuating Lines: RG-21/U, 42/U.
4. Coaxial, High Impedance, Spiral Delay Line: RG-65/U.
5. Dual (balanced) Lines: RG-22/U, 57/U.
6. Dual-coaxial, Highly Balanced Lines: RG-23/U, 24/U.
*Type number designations are those of the Army-Navy R. F. Cable Coordinating Committee.
To date, for every new high frequency cable need, Intelin has developed and produced the answer. Whatever your requirements in high frequency cable, consult Federal first.
FEDERAL TELEPHONE & RADIO
FTR
Federal Telephone and Radio Corporation
AN IT&T ASSOCIATE
Newark 1, N. J.

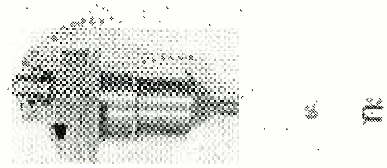


Fig. 12. Specimen holder for making stereoscopic micrographs.

electrical controls — specimen movement, intensity, magnification, focusing, power control, camera control, vacuum and circuit meters, are all within easy reach of the operator. A convenient switch which can be used to control room illumination is also provided on the control panel.

The housings of both these new microscopes were especially designed to fit the operating conditions for which they were intended. The Universal Microscope is intended for a fixed type of installation. The cabinet has been designed to occupy a minimum of floor space consistent with general allowable floor loading. The instrument may be mounted against a wall or free of any partitions. Power, water and fore pump connections can be made by way of floor trenching through the bottom of the cabinet, or they may be fed through the rear or right or left side of the lower section of the cabinet. The cabinet is designed to be self-ventilating so no fans or blowers are required. The fore pump and line voltage stabilizing transformer which are external accessories, can be installed in an adjacent room or other nearby convenient location.

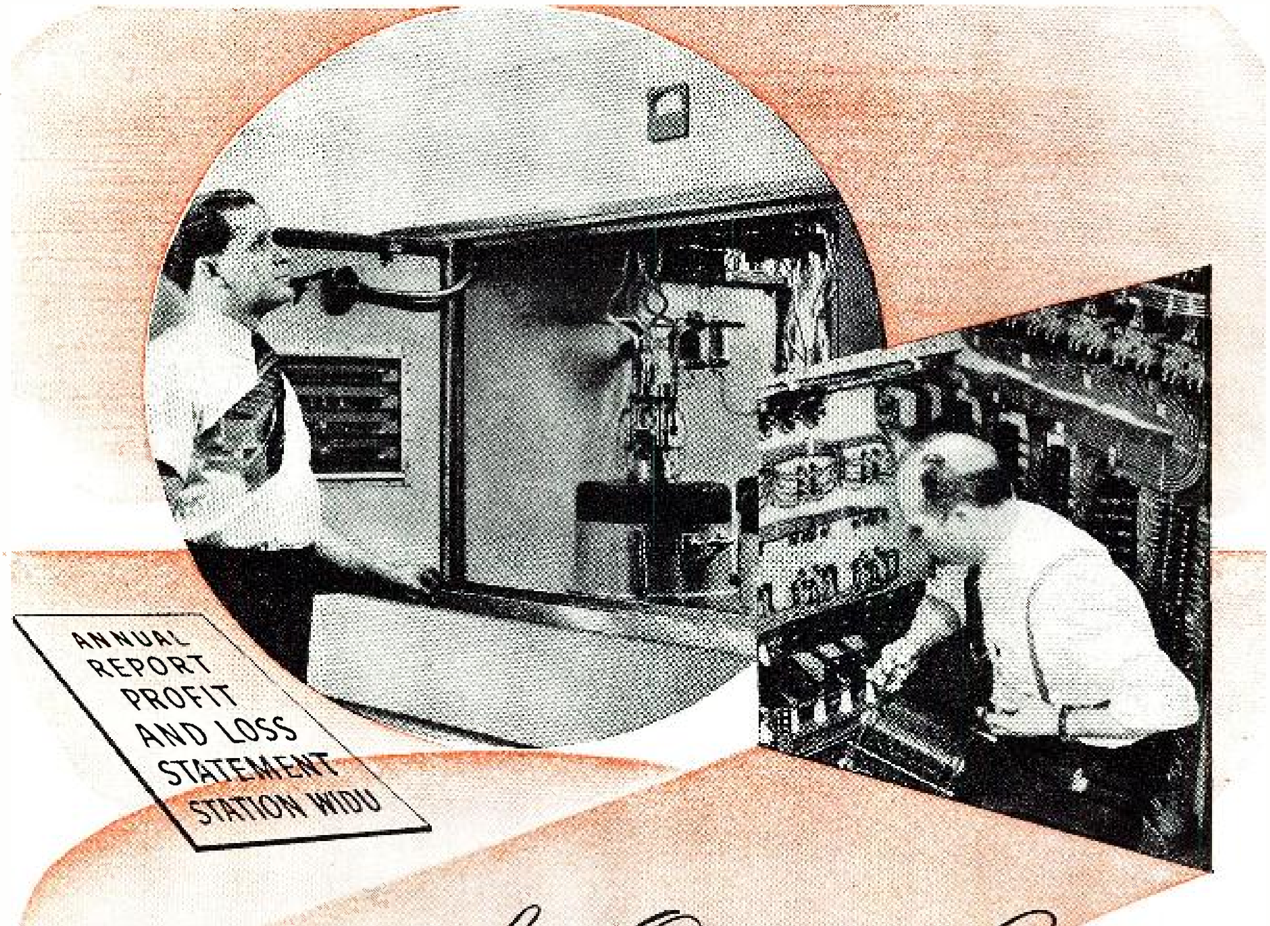
Reference to Fig. 14 will show that the valving system of the Console

(*Continued on page* 128)

Gallups Island

(*Continued from page* 30)

tion methods more effective was made some time ago at this Station and it has proved very effective. The radio engineering division is particularly rich in such "assists" and has employed every conceivable, useful aid to illustrate text material which is difficult to grasp because of its necessary abstractness. Visual aids have included strip films, motion pictures (both silent and talking), animated movies (made on the Station), slides, charts, drawings, and specially-made animated drawings. All radio theory instructors have made frequent use of demonstration equipment of all kinds to illustrate various radio and electrical principles. Large meters in working condition, cathode-ray oscilloscopes, cut-away models of electrical machinery and bread-board built-up radio equipment have been used profusely. Perhaps the most interesting development of demonstration equipment for *student* use has been the installation of benches in all theory lecture rooms and construction of working models of radio transmitters and



CONSIDER *Low Operating Cost*

WHEN YOU SELECT A NEW TRANSMITTER

In selecting a new transmitter, naturally you will take a good, hard look at operating costs. They have an embarrassing way of turning up every month where they *have* to be considered.

Westinghouse Transmitters are designed to keep operating costs at a very low minimum. For example:

1. Air-Cooled Tubes—featured by Westinghouse, eliminate the expense of water cooling. Air which cools the tubes can be used to heat the building.

2. Metal Plate Rectifiers—also featured by Westinghouse, seldom require replacement. Their life is practically unlimited.

3. Conservative Operation of All Tubes—results in long life and low upkeep cost.

4. Class C Operation—of all radio frequencies provides higher efficiencies and lower power consumption than any other type of circuit.

These are only a few of the advantages Westinghouse Transmitters offer. Others include: ***Simplicity of Control, Continuity of Operation, High Fidelity Signals, Ease of Maintenance.***

PLACE YOUR ORDER NOW
FOR YOUR POSTWAR TRANSMITTER

By placing your order today for a Westinghouse transmitter, you assure yourself of the fastest possible delivery following the lifting of wartime manufacturing restrictions. We are scheduling deliveries in the sequence in which orders are received. For details, write Westinghouse Electric & Mfg. Company, Dept. 1NB, P. O. Box 868, Pittsburgh 30, Pa.

J-08076

Westinghouse RADIO DIVISION

PLANTS IN 25 CITIES ... OFFICES EVERYWHERE

A M • E L E C T R O N I C S • F M

receivers with meters so that students can make adjustments and observe effects themselves. Several racks on which are mounted working radio instruments are also available for student experimentation. Display boards showing various radio instruments and devices are liberally distributed in all lecture rooms and laboratories. These opportunities offered to the trainee to learn by doing are in line with the best modern teaching methods and have been outstandingly successful at this training station.

In the Operations division trainees' code drills are held under conditions which simulate closely actual working conditions at sea. Static, background noise, and all the ills that the seagoing operator is heir to in his daily work are artificially introduced into code circuits and trainees required to copy messages through them. Students are assigned call letters to represent actual ships and they send and receive messages with their instructors who represent coastal stations. Again, the practical is emphasized.

All these things contribute in no small measure to reducing that inevitable period of adjustment when a dry-land sailor steps aboard his first ship. A Gallups Island man makes this adjustment quicker; he has the "know-how"; he needs only a pair of sea legs and a few watches at sea to justify the time and money that has been spent in training him.

But modern radio officers on merchant ships need to know more than how to operate their equipment, repair it, and send and receive messages. They usually travel in convoy. They must know all the ins and outs of communications in convoy, for upon them the master may be dependent for information which involves the safety of his ship. Radio officers must know blinker; they may be called upon in emergencies to use it. They must have more than a speaking acquaintance with semaphore and must be able to man an oar in a lifeboat if the necessity arises. To give them the necessary skill in these fundamentals, several periods each week throughout their 28 weeks course are devoted to seamanship, shipboard orientation, blinker, and semaphore.

When a trainee has acquired his license and has successfully passed all his school requirements he is assigned to one week's intensive instruction in wartime convoy procedure given by a naval officer at this Station. In this class he must learn all that is necessary for him to know about communication procedures, signals, confidential naval methods of handling ships in convoy, and everything that will permit his acting as liaison communication officer between his ships and convoy leader. In this course he is also taught the use of small radiotelephone transmitters which are used for convoy intership communication and has an opportunity to actually use these instruments under simulated conditions at sea.

Upon his passing his final polishing

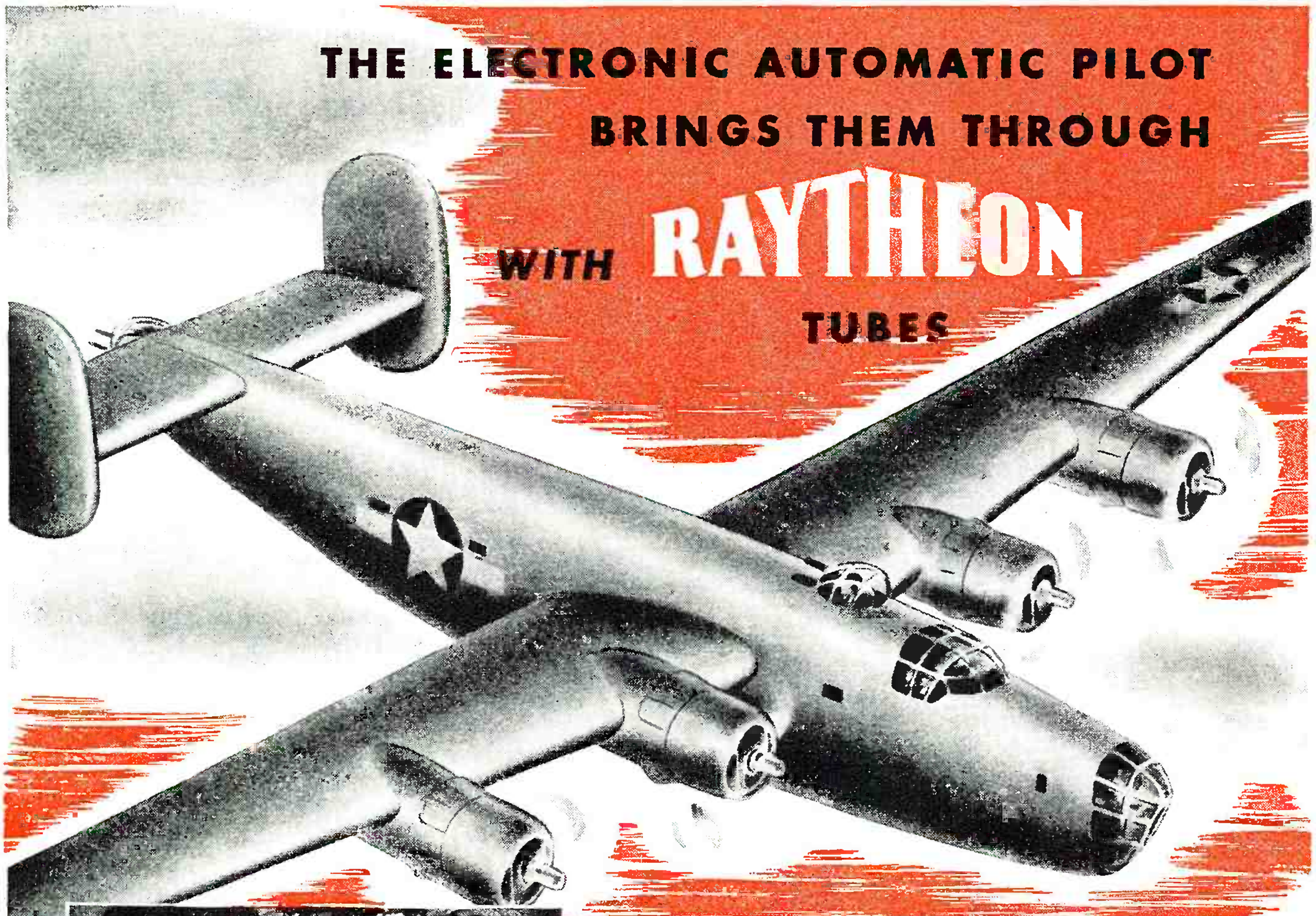
course, a trainee who has received a full second class radiotelegraph license is commissioned a radio electrician in the Maritime Service and released to the Recruitment and Manning Office to await assignment to a merchant ship. He is then on his own and can advance in rank to lieutenant, senior grade, in the Maritime Service by raising his license, putting in the required time at sea as an operator, and being employed on vessels which make him eligible for this rank.

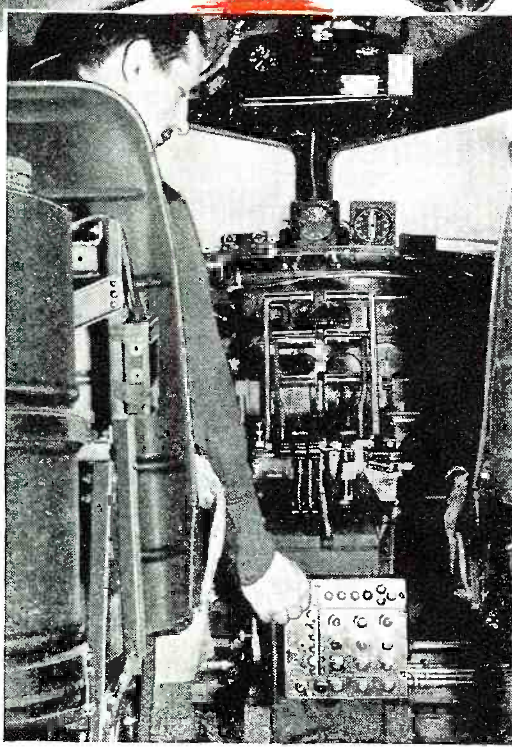
This, then, is the training Gallups Island men get for war. This Station and the Maritime Service are proud of these men. They, like the thousands of other men trained by the Service under the terrible urgency of war, have done their jobs and done them well. They are continuing to do them on widely scattered ships all over the world. They represent, as do all Maritime trained men, something new in the history of the American merchant marine. They are a part—a numerically small, but highly specialized end-product—of a planned, large-scale, intensive program involving the application of the best modern techniques of testing and classifications to interested, sincere men and then giving these men the knowledge and skills through intelligent training to fit them for jobs at sea. The idea of *training* large numbers of men for specific trades at sea is not a new one but the requirements of our merchant marine in war-time have given it an impetus never before considered practicable. Every Gallups Island man is regarded as a career man in the merchant marine. There is no doubt that many of these men will find employment in our post-war merchant fleet. In the training process this is kept in mind always: that these men will man the postwar American merchant fleets.

Although all activities on this Station are naturally centered around the training program, it is well recognized that other departments make contributions toward the finished product without which the training could not function.

Gallups Island, because of its location some seven miles out in Boston harbor, on the seaward side of the submarine net, enjoys an isolation that is both helpful and at the same time somewhat of a nuisance. The admitted advantage of freedom from the disturbing distractions of a large city are somewhat offset by the problem of supplying a Station of a thousand trainees and administrative personnel over a supply line about seven miles long. Several running boats and a large excursion type vessel, *The Calvert,* make several trips a day between India Wharf in the heart of Boston and the Station. Because of the intensive type of instruction and because of transportation difficulties, liberty—for both trainees and administrative personnel—is regarded as a precious privilege and eagerly looked forward to. Trainees ordinarily rate week-end liberty only, unless they attain a very high scholastic average in which case a Wednesday night liberty is awarded. Administrative personnel below chief stand duty every third night; CPO's and officers stand duty every fifth night and every fifth weekend, including Saturday and Sunday.

Gallups Island, named after Colonel Gallup who attained prominence in new England colonial life, was, before the Coast Guard took over in 1938, a Hub Public Health quarantine station. Immediately after taking over, the Coast Guard completely renovated most of the buildings and installed equipment to train Maritime enrollees as cooks and bakers and later as radio operators. The cooks and bakers school was subsequently abandoned and the Station became a radio school exclusively. When the Maritime Service assumed full control of the merchant marine training program for the War Shipping Administration in September, 1942, construction of new buildings and new facilities on this Station have proceeded at an accelerated rate. New barracks to house a vastly increased number of trainees and administrative men, new mess halls, new classrooms, an entirely new dock to accommodate the large Liberty boat, a new addition to the hospital equipped with the most complete and modern X-ray, surgical and medical equipment,—even a new incinerator—have all been constructed. Hundreds of feet of cement walks have been laid,





THE ELECTRONIC AUTOMATIC PILOT, pioneered and developed by Minneapolis-Honeywell, is one of the most significant advances made in aircraft science. Developed to keep bombers on a straight course in their bombing run, the electronic automatic pilot promises safer and more efficient flight for airlines . . . and, because this device must operate with complete reliability at all times, Minneapolis-Honeywell uses thousands of RAYTHEON tubes.

The special wartime experiences of Raytheon Manufacturing Company in devising and producing advanced electronic tubes for the war effort, means that you will be able to offer your customers the best tubes for all applications. Because you have the best tubes, you will have better customer good-will, faster turnover and greater profits.

Raytheon Manufacturing Company
RADIO RECEIVING TUBE DIVISION
Newton, Massachusetts • Los Angeles • New York • Chicago • Atlanta

All Four Raytheon Divisions Have Been Awarded Army-Navy "E" Plus Stars

RAYTHEON
High Fidelity
RADIO AND ELECTRONIC TUBES

DEVOTED TO RESEARCH AND MANUFACTURE OF TUBES FOR THE NEW ERA OF ELECTRONICS and drill field and its approaches macadamized, and new roads and driveways built. Good exterior building maintenance and intelligent landscaping have made Gallups Island not only one of the busiest, but also one of the most beautiful small islands in Boston harbor.

All recreational, social, athletic, and religious activities on the Station are centered in the magnificent new recreation hall. This building, the largest and most beautiful on the Station, is equipped with every facility to insure that trainees and administrative men on the Station have adequate means to relax from their work or studies. There is a large gymnasium and auditorium where motion pictures are shown several times a week, a unique sectional stage which can be rolled out to serve as a boxing ring or wrestling square, a balcony where administrative men and officers can see the movies, a reading room for CPO's, a reading room for trainees, a game room provided with ping-pong and billiard tables, and a canteen. A barber shop, tailor shop, and telephone booths round out the list of offices concentrated in this building. Social dances are occasionally held for trainees and administrative men with their guests in the auditorium.

The athletic program is necessarily a curtailed one. During the winter season an intramural basketball tournament gives officers, administrative men, and trainees a chance to get some much needed exercise. Boxing, apparatus work in gym, badminton, and ping-pong are also in progress. During the summer, regular daily morning calisthenics are held for all trainees on the drill field. Intramural softball games and softball games with army forts on adjoining islands are also scheduled with prizes going to winning teams. A recent rowing race held on National Maritime Day roused a great deal of rivalry amongst the trainees.

Religious activities on the Station are maintained and encouraged by two chaplains who hold regular Sunday services in the new recreation hall and are available for consultation in their offices in this building. For certain denominational religions, festival liberty is granted them to attend services in Boston.

The Superintendent of this Station, realizing that there is a difficult transition period for every trainee who comes to Gallups from another Maritime Station, has established a system of section advisors who serve as general guardians and buffers between the trainees and the administration. Each platoon when it arrives on the Station is assigned an officer to look after it, not only as a platoon but also as individuals. Any man who feels that he is not "getting a square deal," has a special favor or request to make; as, for example, for special liberty or leave, or has any personal or emotional problem, may talk this matter over with this officer and get his advice—although he is not required to accept it—before presenting his problem or request to Station administrative authorities. This gives the trainee a higher morale by bringing to his attention that his welfare is indeed the concern of the Station. The system, as it operates here, has worked out very well.

The Maritime Service is a flexible organization. It must be so; for this is war, and conditions and requirements change almost from day to day. So it has been on this Station. As new offensives have been launched by the Allies throughout the world, the demands upon merchant shipping and particularly American shipping have been stepped up. More ships mean more men and—more radio operators. The newly-established policy that all American merchant ships in the ocean-going trade carry three merchant marine radio operators has forced upon the Maritime Service the immediate necessity of turning out more men to handle the radio watch aboard ship than the maximum capacity of Gallups Island can accommodate. Therefore, the reduction of the present 28-week course to 20 weeks, and the setting up of a parallel station at Hoffman Island is now in progress. Both schools together, working on this curtailed course, are expected to be able to supply the expected demand for 2600 men per year qualified to stand a watch on the distress frequency at sea. Eventually, when this program is realized,

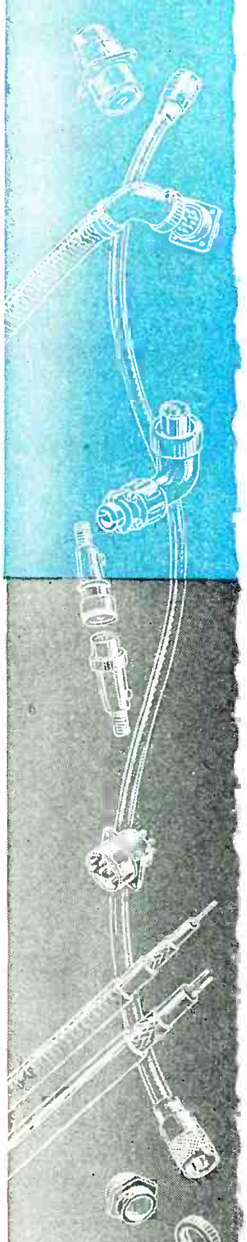
OVER 8,500 AMPHENOL PRODUCTS FOR ELECTRICAL TRANSMISSION

Save this—
For future reference.
For information you need now—
Use the Coupon.

If in your products you use electrical transmission equipment, there is in these Data Sheets information that you can use to advantage, if not today then on postwar products.

Amphenol equipment is used where the requirements are tough. There are Amphenol products for current of low or high frequency. Wherever you use electricity you need the best of equipment—Amphenol.

Use the coupon to send for the information you want



AN and 97 CONNECTORS
Where electrical connections must be positive and secure, where they must be made or broken quickly—as on aircraft, tanks or ships—these connectors are used. Made with from one to forty-eight contacts. On the coupon check **Section A.**

SPECIAL CONNECTORS
These are the special service connectors—explosion proof, moisture proof, thermo-coupling, grounding, instrument, special mounting, etc. Mark the coupon **Section A1.**

CONDUIT FITTINGS
Conduit couplings—straight, 45° and 90°, coupling nuts, ferrules, clamps, etc. Designed for secure connections. Properly finished to avoid abrasion of wire insulation. On coupon check **Section B.**

AIRCRAFT ELECTRICAL CONDUIT and CABLE ASSEMBLIES
Flexible metal and plastic conduit, cable assemblies, wiring harnesses, etc. Ample facilities for quantity production. On coupon check **Section B1.**

SPECIAL TOOLS
Conduit ferrule crimping machines, saw vises for cutting conduit and cable. Special tools for good work on this type of electrical equipment. Mark on the coupon **Section C.**

U. H. F. CABLES AND CONNECTORS
For ultra high frequency transmission—Amphenol low-loss cables and connectors—a complete line. This includes the full list of RG type cables. On coupon check **Section D.**

BRITISH CONNECTORS
In quality, type, range of size and application these are similar to Amphenol AN and 97—but built to specifications of the British Air Ministry. Mark the coupon **Section E.**

RADIO PARTS AND ACCESSORIES
For Radio, FM, Television, Electronic and Sound equipment—connectors, sockets, plugs, etc. Also special tools for wiring. On the coupon check **Section F.**

SYNTHETICS FOR ELECTRONICS AND INDUSTRY
The story of Amphenol's facilities for making plastic parts or products by compression or injection molding, extrusion or machining. On the coupon check **Section G.**

Depend upon **AMPHENOL** *Quality*

Connectors
Fittings
Conduit
Cable
Radio
Parts
Synthetics

AMERICAN PHENOLIC CORPORATION
1830 S. 54th Avenue, Chicago 50, Illinois

AMERICAN PHENOLIC CORPORATION "S"
1830 S. 54th Avenue, Chicago 50, Illinois

Please send me information and Data Sheets as checked below—without obligation.

☐ Section A	☐ Section B1	☐ Section E
☐ Section A1	☐ Section C	☐ Section F
☐ Section B	☐ Section D	☐ Section G

Signed ____________________

Company ____________________

Address ____________________

City and State ____________________

every ship flying the American flag and traveling the high seas will have a "round-the-clock" radio watch by qualified radiomen.

Perhaps the most fitting tribute to Gallups Island men who have gone down to the sea in ships to do their duty and their jobs is one which is applicable to all merchant seamen who have faced disaster and lost. This is engraved on the monument to men of this Station who have sacrificed their lives in the performance of duty. The dedicatory words are engraved on it and are a constant reminder and inspiration to men now in training at Gallups Island: *"By Their Deeds Measure Yours."*

—30—

Short Wave

(*Continued from page* 54)

a.m. CWT, Berlin is broadcasting the Latin American, United States, and Asia beams. The German portions of these services must be interchanged between them.

DJD, 11.77 mcs., DZD, 10.54, and DZB, 10.04, continue to pound in here (Chicago) on the United States beam from 4:50 until 6:00 p.m. CWT. The 6 o'clock news is heard excellently over DJD, but after this newsperiod the frequency loses much of its strength; by 7:00 p.m. CWT, it is barely audible. DZD and DZB remain fairly strong until about 8:00 p.m. CWT. After that time Berlin is not so easy to hear. DXJ, 7.24, and DXT, 7.27, are fairly strong from 8:00 p.m. CWT until midnight, but are bothered by bad atmospherics. DXP, 6.03, is strong and more free of atmospherics —but is QRM'd by a voice station on an adjacent frequency. DXB is almost completely smothered by ZC8, Rio de Janeiro, Brazil, on the same frequency, 9.61 mcs.

According to our information, all of the Berlin stations—except DXP and DXJ—sign off at 11:00 p.m. CWT.

DZE, 12.13, Berlin, has been heard with programs for Allied troops near 3:00 p.m. CWT, very strong, in addition to broadcasting the Latin American beam. (Prepared by Larry Gutter, Hallicrafters' monitor, Chicago.)

WEST COAST REPORT

August Balbi, Los Angeles, sends the following valuable report this month: (EWT)

The only reliable Moscow broadcast to the West Coast seems to be on 9.565 mcs. at 7:40 a.m. The new frequency of 15.750 mcs., heard at 7:40 a.m., noon, and 6:47 p.m. EWT daily, may bring West Coast listeners better reception from Moscow than the regular frequencies which have been employed in the past by the Soviets.

GRX, 9.69 mcs., 1:00 a.m. to 5:00 a.m. in Pacific Service, and GVZ, 9.64 mcs., 5:15 p.m. to 12:45 a.m., for North America, are London stations now being heard well on the Pacific Coast, along with other BBC transmitters previously reported.

The things we make are *Vital* to the war... do you want us to "slip you a few?"

We might--by a little fancy fenagling--slip you a few IRC wire wound Resistors and Controls. • But our conscience would bother us like all get out. • And we don't believe there is a single jobber or serviceman among you who--if he sat down and thought it out--would want us to. Every one of you has a relative or a friend or somebody out there fighting, and you wouldn't have us cheat him or them--not for a minute. • We imagine you can get some kind of wire wounds and controls from somebody at this time, but it just happens that ours are of a quality that Uncle Sam wants in a quantity that we can supply. In a way, we are stuck because we are so good, and we hope you'll be proud to be stuck with us. • With postwar business as the goal, there's bound to be a certain amount of off-side play. But we are not slipping anything over at the expense of our fighting boys who can't slip out of this war until it's over. • If our products are so good that Uncle Sam has to have them, they must be the kind that YOU will want for YOUR CUSTOMERS as soon as you can get them.

PREFERRED FOR PERFORMANCE • IRC • FIXED & VARIABLE RESISTORS •

INTERNATIONAL RESISTANCE CO.

401 N. BROAD ST. • PHILADELPHIA 8, PA.

AUSTRALIA — VLC6, Shepparton, Victoria, 9.615 mcs., is heard 5:00 to 6:00 a.m. EWT to the Philippine Islands; English news, 5:00 a.m. Also heard 9:00 to 9:30 a.m. in French to Asia, dual VLG2, 9.54 mcs. (Melbourne). VLC6 radiates in Thai to Thailand in dual with VLG2 between 9:30 and 10:00 a.m. VLC6 transmits to Asia in English, dual VLG, 9.58 mcs. (Melbourne) and VL19, 7.28 mcs. (Sydney), 10:15 to 10:45 a.m. VLC4, 15.315 mcs., is heard 11:00 to 11:20 p.m. to Australian Forces (weak). VLQ3, 9.66 mcs. (Brisbane), is heard 12:00 midnight to 3:15 a.m.; relays BBC at 2:00 a.m. (weak to fair). VLQ2, 7.215 mcs. (Brisbane), is heard 3:30 to 9:30 a.m. in Home Service; news, 4:00 and 7:00 a.m. VLG3, 11.71 mcs. (Melbourne), is used 11:00 to 11:45 a.m., beamed to West Coast along with VLC6, 9.615 mcs.

PHILIPPINES—PIRN, 15.32 mcs., in Manila, is heard 12:00 to 1:00 a.m. to West Coast; English news, 12:15 a.m. (very weak). On 9.64 mcs., PIRN is heard 3:00 to 9:30 a.m., with English news at 9:00 a.m.; also on 6.14 mcs., from 5:00 to 9:30 a.m., with news at 9:00 a.m.

INDIA—The "All India Radio" is heard as follows:

VUD, 11.76 mcs. (Delhi), 9:00 to 10:00 a.m. to Far East; English news, 9:30 a.m.; German news, 9:45 a.m. VUD4, 9.59 mcs. (Delhi), 9:00 to 11:30 a.m.; news, 10:50 a.m. (weak). VUM2, 7:27 mcs. (Madras), 9:00 to 11:30 a.m.; English news, 9:30, 10:50 a.m. and BBC news relay, 11:00 a.m. (fair). VUD3, 7.29 mcs. (Delhi), 9:00 to 10:30 a.m.; no English (fair). VUD2, 6.19 mcs. (Delhi), 10:30-11:35 a.m.; English news, 10:50 a.m.; BBC news relay, 11:00 a.m. (good). VUB2, 4.88 mcs. (Bombay), 9:00 to 11:00 a.m.; best from 10:00 to 10:30 a.m. (weak). VUC2, 4.84 mcs. (Calcutta), 9:00 to 11:00 a.m. (weak).

U. S. S. R.—To Europe on 11.63 mcs., 12:00 midnight to 2:00 a.m.; English news, 12:45 a.m.; broadcasts also in German and French (fair). Radio Moscow is heard (weak) on 15.11 mcs. in English from 6:47 to 7:15 p.m. to North America; news, 6:47 p.m. (New frequency of 15.75 mcs. is reported for 7:40 a.m. and 6:47 p.m. radiations.) The 9.565 mcs. frequency is best—7:40 a.m.

MANCHUKUO — Hsinking, 15.33 mcs., is heard 1:00 to 3:00 a.m.; English news, 1:30, 2:30 a.m.; messages from American prisoners-of-war interned at Mukden at 1:00 a.m. This station is "weak." The broadcast is directed to North America. Hsinking, on 6.125 mcs. and 5.71 mcs., is heard 4:00 to 11:00 a.m. in Home Service; English news, 9:30 a.m. (fair to good).

MALAYA—Shonan (Singapore), on 11.85 mcs. and 9.555 mcs., heard 6:00 a.m. to 12:15 p.m. at intervals; 6:00 to 6:30 a.m. to Australia; English news, 6:30, 10:30 a.m.; talk in English, 11:30 a.m.; some of their programs are beamed to India. The 11.85 mcs. frequency is weak; 9.555 mcs., good.

CHINA — Shanghai, German-controlled, best heard, 10:00 a.m. to noon; full schedule, 1:00 a.m. to noon; English news, 10:15, 11:15 a.m. Much of program consists of talks in German and Chinese.

JAPAN—Radio Tokyo, JZJ, 11.80 mcs., has been deleted on its 11:00 p.m. to 4:00 a.m. transmissions to the West Coast (September 1). JLT3, 15.225 mcs., JZK, 15.16 mcs., and JZU3, 11.897 mcs., are now in use from 11:00 p.m. to 4:00 a.m.; news, 11:40 a.m., 1:00, 2:00, 3:00 a.m.; German news in English, 12:30 and 1:00 a.m. daily. Reports of American prisoners-of-war in Germany, Saturday only, at 12:35 a.m.; also American prisoner-of-war reports during Honanuru Hour, 12:00 midnight to 12:30 a.m., and during each English news period (both morning and evening transmissions). JZK, 15.16 mcs., and JVW3, 11.725 mcs., heard 9:00 to 10:40 a.m. to East Coast, and 11:00 a.m. to 2:40 p.m. to West Coast.

* * *

SWISS TRANSMISSIONS

Swiss broadcasts to the Western Hemisphere are heard daily except Saturday, reports Larry Gutter, monitor for Hallicrafters. His compilation of complete broadcasts from Switzerland follows:

(Eastern War Time)

9:30 to 11:00 p.m.—Bern to the United States, on 7.38, 9.185, and 9.54 mcs. (The last has been announced as 9.539.)

Bern uses 9.185 and 10.36 mcs. to Latin America from 7:30 to 9:00 p.m. Spanish and Portuguese are languages employed.

There are no Bern Western Hemisphere transmissions on Saturdays.

(EDITOR'S NOTE: *We are reliably informed that a newscast in English is now radiated over HEO4 on 10.34 mcs. at 3:45 p.m. EWT.)*

* * *

REPORTS FROM READERS

(EWT unless otherwise indicated)

INDIANA—Mrs. John M. Hart, using a Hallicrafters Skyrider-Marine S-22-R (4 bands) and 16½-foot vertical antenna, reports:

11.725—Tokyo, noon to 1:00 p.m.; English news, 12:00 noon; good.

15.105—Tokyo, 6:15 to 6:45 p.m.; English news, 6:15 p.m.; good.

15.105—Tokyo, 7:30 p.m. with English news; good.

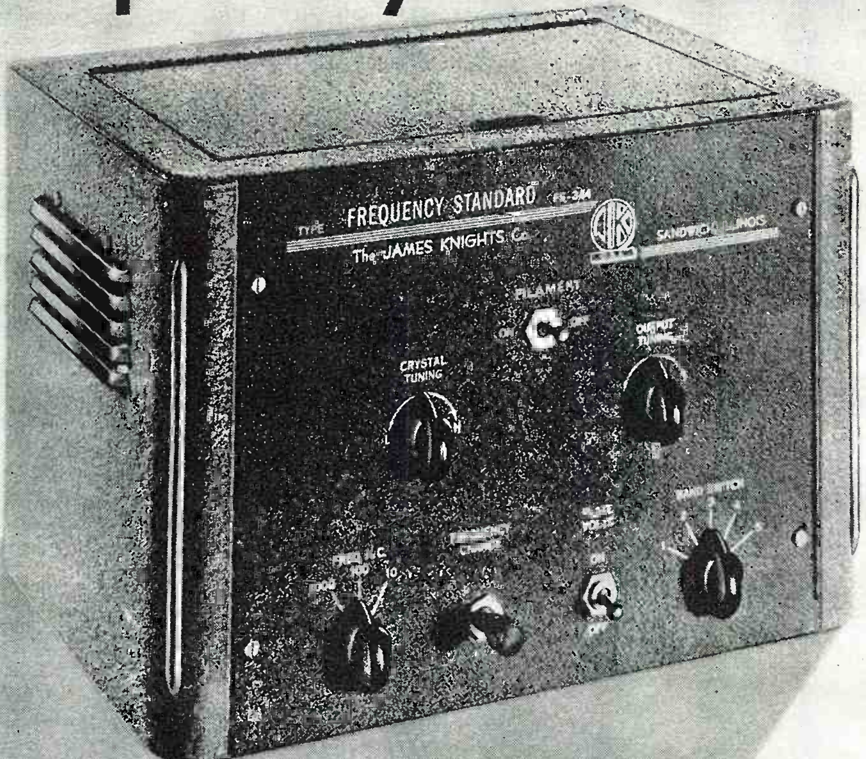
11.97—Brazzaville, 1:45 to 2:00 p.m.; English news, 1:45 p.m.; identified by playing of the French National Anthem; excellent. Also heard, 7:45 p.m. to 8:00 p.m., with English news at 7:45 p.m.; good.

11.645—Leopoldville, 8:30 p.m. to 9:30 p.m.; English news, 9:10 p.m.; good.

15.750 — Moscow — Heard at noon; identified by string music played on harp, followed by playing of Russian National Anthem, then the statement: *Death to the German Invaders!* Excellent.

You'll Want this New

JAMES KNIGHTS
"Crystal Controlled"
Frequency Standard



CRYSTALS

This is the ideal secondary frequency standard to check frequency of oscillators and transmitters, to calibrate and align receivers, etc. Can be used by the crystal manufacturer to check frequency standards for production. Useful many ways in the electronic laboratory or factory. Provides output up to 40 megacycles at 1,000, 100 and 10 kilocycle intervals. Complete cost only $59.50. Descriptive catalog sheet on request.

BUY WAR BONDS FOR VICTORY!

The JAMES KNIGHTS Co.
SANDWICH, ILLINOIS

CRYSTALS FOR THE CRITICAL

INDIANA — Fred Sawyer, Evansville, writes:

"In tuning across the short-wave bands about 11.65 mcs., or between COK and PRL-8, tuned in the Belgian National Radio at Leopoldville, Belgian Congo. It is now 6:00 p.m. CWT here and this station has been coming in very strongly for quite some time. From the past week's listening, they sign off around 8:10 to 8:30 p.m. CWT. Have a 1937 Sears Roebuck 10-tube regular home cabinet job and do not know the exact frequency. (It is 11.645 mcs.) Do not have a lot of time to listen but send regular reports to PRL-8 at Rio de Janeiro, however, and receive their programs pretty regularly."

ILLINOIS—From Bloomington, Illinois, William Shadid, says:

"Radio Berlin, 15.28 mcs., heard Q5R9 in morning until 8:45 a.m. CWT. News in English is at 8:30 CWT, followed by the names of five flyers shot down over the Reich. London always puts in an R-9 plus signal here—almost any hour of the day. FZI, Radio Brazzaville, 11.97 mcs., puts in a Q5R9 signal in the early evening. News in English is at 8:45 p.m. CWT. PRL-8, Rio de Janeiro, on 11.720 mcs., puts in a QT49 plus signal until closing down time at 10:00 p.m. CWT. CKRX, Winnipeg, Manitoba, Canada, 11.720 mcs., puts in a QSA5R7-9 signal all morning until about 1:00 p.m. CWT, when it starts to fade. Has a newscast at 12:30 p.m. CWT. I use a Howard 430 receiver and it is a fine set on all bands. I have a 150-foot end-fed Marconi antenna, 30 feet high, which has given excellent results."

RHODE ISLAND — From Greene, R. I., David Underwood sends this fine log: WRCA, New York, 11.893, 3:00 to 11.83, 7:00 a.m. to 5:15 p.m., excellent; 4:45 p.m., good; WCRC, New York, 11.83, 7:00 a.m. to 5:15 p.m., excellent; WLWO, 11.71, 2:45 to 5:15 p.m., excellent; KGEI, San Francisco, 11.79, 5:00 p.m. to 12:45 a.m., fair; London's North American Service, 5:15 p.m. to 12:45 a.m., is heard with excellent signals on GSC, 9.58, GRY, 9.60, GX, 9.69, GRH, 9.825, GRG, 11.68, and GSD, 11.75; HEO4, Bern, 10.34, is heard with excellent signal between 3:45 and 4:15 p.m. Other stations he lists include DXL7, Berlin, 11.885, good; PRF5, Rio de Janeiro, 9.50, poor; Leopoldville on 10.14, good; and VLG2, Melbourne, 9.548, fair.

OHIO—Robert Hoiermann, Alliance, writes:

"The hams in Peru, Paraguay, and Uruguay are still on the air. I have been hearing OA4D in Peru; CX3CN in Uruguay; and ZP6AC and ZP3BA in Paraguay. ZP1AA is also on the air, but I have been unable to hear him. The above mentioned hams operate in the 20-meter "fone" band, low end, and I hear them on Mondays, Wednesdays, and Fridays from 8:30 to about 9:00 p.m. EWT. Their signals are usually very weak, but they are copyable for the most part. Others have reported hearing hams in the 40-meter band, but I have been unable to hear any there. The stations listed have been on all through the war; but I have only heard the one station in Peru and the one station in Uruguay. I believe, however, that there are about a half dozen stations operating in Paraguay.

"An underground station that is interesting to listen to is "Deutscher Kurzwellen Sender Atlantik," operating in the 49-, 41-, and 31-meter bands; and in conjunction with "Soldaten Sender Calais" it operates on about 3 frequencies in the broadcast band. I have heard "DKSA," however, only on the 41- and 31-meter bands. It can be heard practically all afternoon and evening with pretty good signal strength on 9.76 mcs. My equipment consists of two Hallicrafters—SX-17 and SX-32—for short-wave listening; and a Scott Laureate for listening to FM. We listen to the SX-32 most of the time."

ARKANSAS — Don Phillips, Ashdown, Arkansas, reports Radio Tokyo comes in R-7 there at 11:15 p.m. The BBC is picked up R-8. Other stations he listens to include OQ2AA, COCQ, HCJB, XEWW, TGWA, WLWO, CJRO, WCEA, and the Berlin stations. Reception has been fairly good the past few months, he reports.

NEW JERSEY — Frank J. Barry, Perth Amboy, reports:

"All London, Berlin, and other European stations are heard here with excellent strength and regularity. OPL, Leopoldville, Belgian Congo, is heard every evening on 11.645 mcs.; usually a woman announces. This station signs off at 9:15 and at 9:28 resumes operation on 9.785 mcs., relaying the BBC from London. Both transmissions are R-9 plus. FZI, Brazzaville, 11.97 mcs., presents news for the U.S.A. and Canada at 7:25 p.m. EWT. R-9 signal. Radio Moscow, 15.105, broadcasts from 7:00 to 9:00 p.m.; very little English spoken. Signal is good but there's a lot of QRM on this frequency. VLC4, Melbourne, on 15.315, is heard regularly at 10:30 p.m., sometimes calling WNEW (New York). Signal is poor in this locality. All Pacific Coast stations as listed in RADIO NEWS are heard here with good strength and regularity. Tokyo on 15.105 has a very poor signal here in the evening. PRL8, Rio de Janeiro, 11.72 mcs., is heard until 10:30 p.m. with an excellent signal."

MISSISSIPPI—James D. Green, Engineering Department, WELO, Tupelo, sends us the following list of stations logged at WELO's listening post: GWC, London, 15.07, 11:30 a.m., S-3; GWE, London, 15.43, 7:30 a.m., S-3; GSB, London, 9.53, 8:00 a.m., S-3; JLG4, Tokyo, 15.105, 10:40 p.m., SO5; Berlin, 15.20, 6:00 p.m., S-5; Bern, 9.539, 9:30 p.m., S-9; HCJB, Quito, Ecuador, 12.445, 9:00 p.m., S-9. All London stations come in S-9 evenings. Melbourne (VLC4, 15.315) puts in a signal of S-9 evenings, too. We have

A Good Way To Avoid Complications...

STANDARDIZE on MALLORY Replacement Parts

★

No matter how carefully you do your work, the failure of an unknown replacement part will bring the customer storming back to your shop. Mallory approved Precision replacement parts will help you to avoid this loss of time, money and good will.

With time and manpower at such a premium, don't take chances with part failures. Standardize on Mallory volume controls, capacitors, vibrators, switches and resistors for all replacement installations... and play safe!

For years, thousands of service men have relied upon Mallory replacement parts to give trouble-free performance on every service job. Give your own work that extra margin of safety by specifying Mallory Parts from your distributor.

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.

Don't Forget—Government War Bonds

a Super-Pro at the station, working off a 200-foot tower.

WISCONSIN—Using an RCA T6-1 and a 45-foot rubber-covered, stranded antenna, Ed Truesdell, Milwaukee, reports hearing VLC6, Shepparton, Australia, 9.615 mcs., 6:15 to 8:50 a.m. EWT (fair). VLG, 9.58, and VL19, 7.28, at 10:15 to 10:55 a.m. EWT are reported as "very poor."

MICHIGAN—Howard Landry, Detroit, says: "Here in Detroit, daily reception from Berlin is "good," coming in best on 11.77 mcs. early in the evening, but fades gradually around 9:00 p.m., when I find it advisable to turn to the 49-meter band, where reception is much better late in the evening. Through the winter months, reception from Berlin in the 25-meter band (11.77) was excellent throughout the entire daily transmission (7:00 to 1:00 a.m. EWT) and I found it needless to change frequencies during the entire evening. At this time of year, however, Berlin comes in best in the 31- and 49-meter bands. "The German Overseas Service from Berlin" presents the news every hour daily, except Sunday, when the news is given at 9:00, 10:00, and 12:00 p.m. and 1:00 a.m. At 7:15 p.m. messages from prisoners-of-war are given on Monday, Tuesday, and Wednesday; and at 9:15 p.m. on Thursday and Friday. At 9:30 p.m. on Monday and Friday, the program "Calling Back Home" is presented with messages from American prisoners-of-war. This program lasts 30 minutes, and is repeated at 11:30 p.m. Commentaries from such personalities as "Mr. O. K.," "Robert H. Best," "Captain Duvair," "Paul Revere" and "VOX, The Voice of Common Sense," are often presented after the 7:00, 8:00 and 9:00 p.m. news broadcasts from Berlin.

"Radio Tokyo comes in occasionally at exactly 11.725, but reception of this station has been very poor since August 12. The news is given in English at 9:00, 10:00, 11:00 a.m. and 12:00 noon. followed by the names of American prisoners-of-war."

MISSOURI—Burnell Trasher, Moberly, reports:

"Have been hearing 'Radio Shonan,' Singapore, Federated Malay States, on 31.04 meters, 31 meter band (9.55 mcs.) with American beam 4:00 to 5:30 a.m. CWT. COK, Havana, Cuba, is heard 4:00 to 4:30 p.m. CWT on 11.66 mcs. Rio pounds in here on 11.72, 9:00 to 9:30 p.m. CWT. Berlin, 15.39 mcs., is heard with news 8:00 to 8:45 a.m. CWT and news in Spanish, 8:45 to 9:00 a.m. CWT.

* * *

ACKNOWLEDGMENTS

We appreciate the many valuable reports and letters from readers which we received this month. Space will not permit us listing them, but we do hope they'll keep coming. Thanks. Address: Kenneth R. Boord, c/o RADIO NEWS, 540 N. Michigan Avenue, Chicago, Illinois, U. S. A.

—30—

QTC
(Continued from page 51)

became of Roy Wren, last heard from when he was joining the Navy? T. G. Ferguson has not been heard from lately either. H. Morley is out with a cargo vessel and R. Woodward is also out on a freighter job. H. Moreshauser has taken out a dry cargo ship for a change from his previous tanker. B. Jones is getting a transfer from his present tankship.

ANDREW MacDONALD, ROU Baltimore, in a recent copy of the ROU news commented on "The Union Looks Ahead" in regard to postwar plans and brought out some "up-to-the-minute" points. "Postwar planning is in the news these days and it is as well that it should be, particularly if it impresses us with not only the need for planning but the need for planning on the part of government, business, labor; on the part of all of us. Being neither pollyannas nor prophets of gloom we do not look for the end of the war to bring an era of opulence and prosperity; neither do we expect an era of low wages, unemployment and economic depression. Undoubtedly, the readjustment period following the close of the war will be a difficult one but it need not be fatal nor even serious if we put our minds to some businesslike, common-sense planning now. It would indeed be a tragedy if by our own carelessness and laziness we fell victim to an economic debacle that would inevitably bring about the forfeiture of the freedom we are fighting a war to preserve." It's an article well worth reading; space does not permit us to give you the entire copy, however.

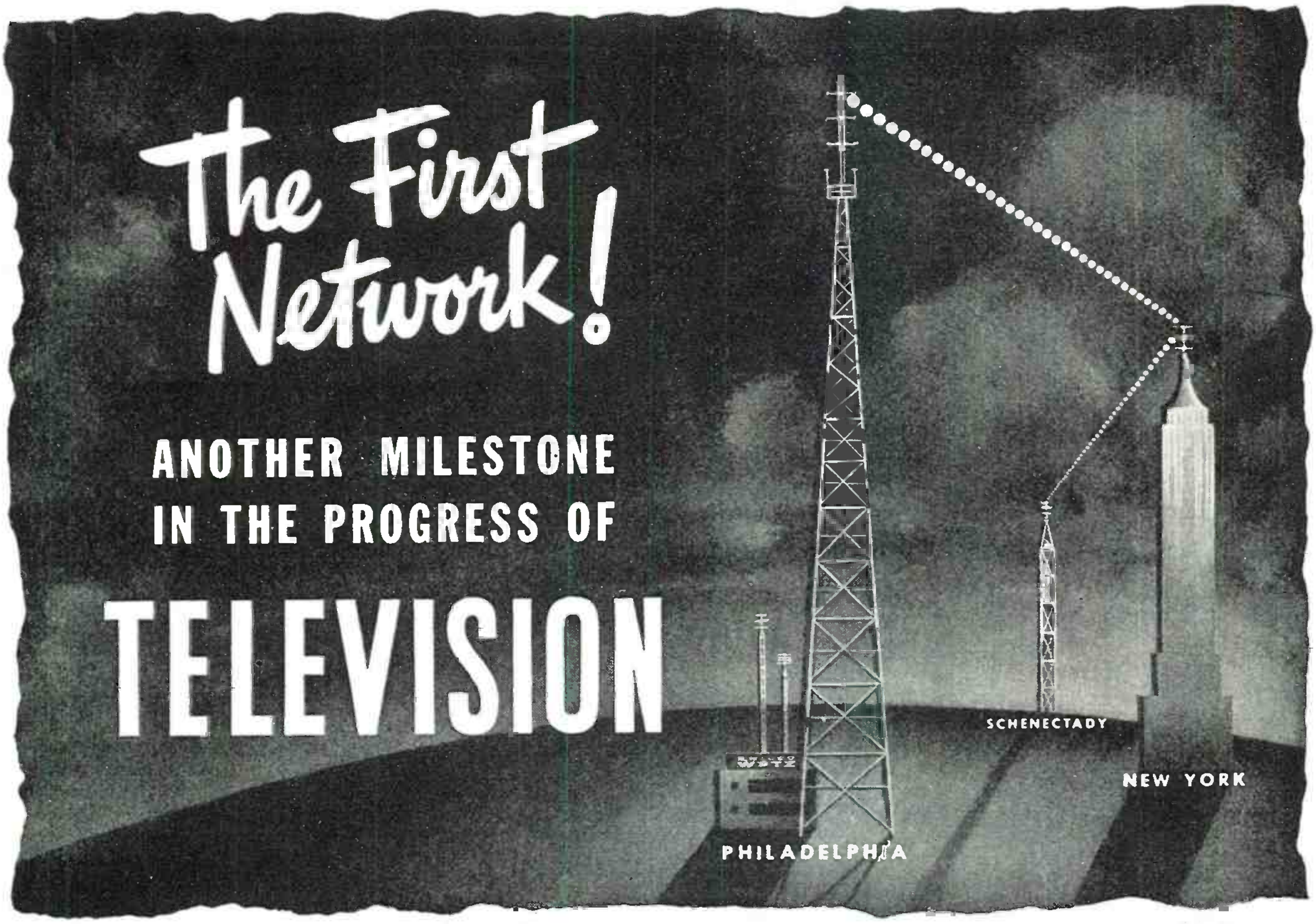
BONUSES were increased somewhat by WSA on the West Coast area it was announced recently.

Harry Morgan of ACA was in Detroit recently regarding negotiations with D and C Navigation for a new contract.

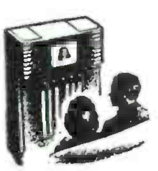
The National War Labor Board recently granted wage and "rate range" increases for the radio technicians at WCAU in Philadelphia. Contract changes and additions have been submitted to management of WIP for renewal of contract. ACA and KYW have withdrawn their dispute case before the NLRB and apparently settled their differences. Press Wireless and ACA also are getting around to an agreement. Announcers at WLIB and WFIL are getting new ACA-Management contracts.

NO WORD has been received from the boys aboard the new concrete cargo ships as yet. We wonder if their note will sound like the old "concrete mixers" of the good old days. U. S. Maritime Commission has a couple dozen ordered.

—30—



CHAIN television is here! With the recent dedication of the new Philco Relay Transmitter at Mt. Rose, N. J., the first Television Network, linking Philadelphia, New York and Schenectady, is in actual operation today. Now Philadelphians enjoy clear reception of programs from New York through their local Philco television station. Thus the first step has been taken through which millions will eventually witness events that take place thousands of miles away . . . *by television.*



HOW PHILCO RESEARCH SPEEDS THE ADVANCE OF TELEVISION

This first television network is an example of how Philco research is working to establish transmission principles which can extend chain television broadcasting from coast to coast. At the same time, Philco research is improving the clarity, sharpness and detail of the television picture . . . so that future television sets will have the greatest possible sales appeal. Thus in two ways . . . by helping to broaden the market for television, and by designing a more saleable product for that market . . . Philco leads toward the goal of television as tomorrow's "billion dollar industry."

Radio Hall of Fame Orchestra and Chorus.
Tune in Sundays, 6 P. M., E. W. T., Blue Network.

★

BACK THE ATTACK—BUY WAR BONDS

WITH PROGRAMS LIKE THESE, PHILCO TELEVISION STATION WPTZ HAS PIONEERED IN TELEVISION BROADCASTING

Since 1932, Philco has owned and operated its own television station, a rich laboratory of research and experience for television progress.

The Philco station has televised football, boxing, wrestling and other sports as well as news events direct from the scene of action.

Movies, variety acts, dramatic sketches, illustrated news talks and civic programs have been televised from the Philco studios.

PHILCO

THE OVERWHELMING LEADER IN RADIO FOR 12 STRAIGHT YEARS

Within the INDUSTRY

PHILCO CORPORATION, through its president, John Ballantyne, has announced the appointment of William Balderston to the post of vice-president in charge of operations and member of the Executive Committee.

Mr. Balderston who attended the University of Wisconsin, saw service in the last war with the Lafayette Division. From 1919 to 1930 he was vice-president and factory manager of the Ray-O-Vac Company of Madison, Wisconsin.

He has been affiliated with Philco since 1930 in various positions.

* * *

WESTINGHOUSE has made two new appointments of interest to the industry. The first concerns the naming of Stanley M. Johns to the post of manager of the company's Salt Lake City Office. Mr. Johns succeeds Frank E. Bodine as manager of this office, while Mr. Bodine will be in charge of the San Francisco territory.

Mr. C. S. Weber, manager of the Washington government office of the company, has announced the appointment of Richard M. Wilson as manager of the Marine Division.

Mr. Wilson joined the organization in 1936 and has been with the Westinghouse government office since 1938.

* * *

JACK C. WILSON, former senior administrative officer of the U. S. Signal Corps production field office in San Francisco, has been named Pacific District Manager for the Radio Division of Bendix Aviation Corporation. Mr. Wilson's territory will embrace all of California, Oregon, Washington, Arizona, Utah, Nevada, Idaho and Montana. The selection of distributors for this area will be made shortly.

* * *

ELECTRO-VOICE'S executives, Albert R. Kahn, president; R. E. Siekman, vice-president; and R. W. Augustine, production manager, have just returned from a tour of leading radio parts distributors in key cities in the East.

Their trip was for the purpose of planning dealer aids, catalog information and advertising material for the company's postwar sales and promotion campaigns. Electro-Voice manufactures various types of microphones.

* * *

ALLIED RADIO CORP. of Chicago, distributors of radio and electronic equipment, have been appointed a major authorized distributor for *Littelfuse, Inc.,* manufacturers of fuses, neon indicators, fuse-clips, mountings and accessories as well as the new "Signalette", panel type signal indicator and other circuit protection devices.

* * *

SOL W. BERK, manager of Lafayette Radio Corporation, stated recently that the position of the jobber in the post-war era will have changed materially for the better. The jobbers have proved to be an invaluable source of supply for hard-to-get items needed by manufacturers who were faced by a virtual stoppage of work because of the lack of experimental quantities of component parts. This service to industry has given the radio jobber a secure place in the distribution field.

* * *

ANSLEY RADIO CORPORATION has announced the names of the three first-prize winners in their recent contest to name their newly created monthly dealer magazine.

The name, Dynaforum, was chosen from those submitted by Ansley dealers and friends throughout the country. Because three persons sent in the same winning name, a first prize of a $50.00 war bond was sent to Mr. C. E. Busch of St. Louis, Mr. F. P. McMorrow of Cleveland and Mr. Edgar W. Neyholm of Minneapolis.

* * *

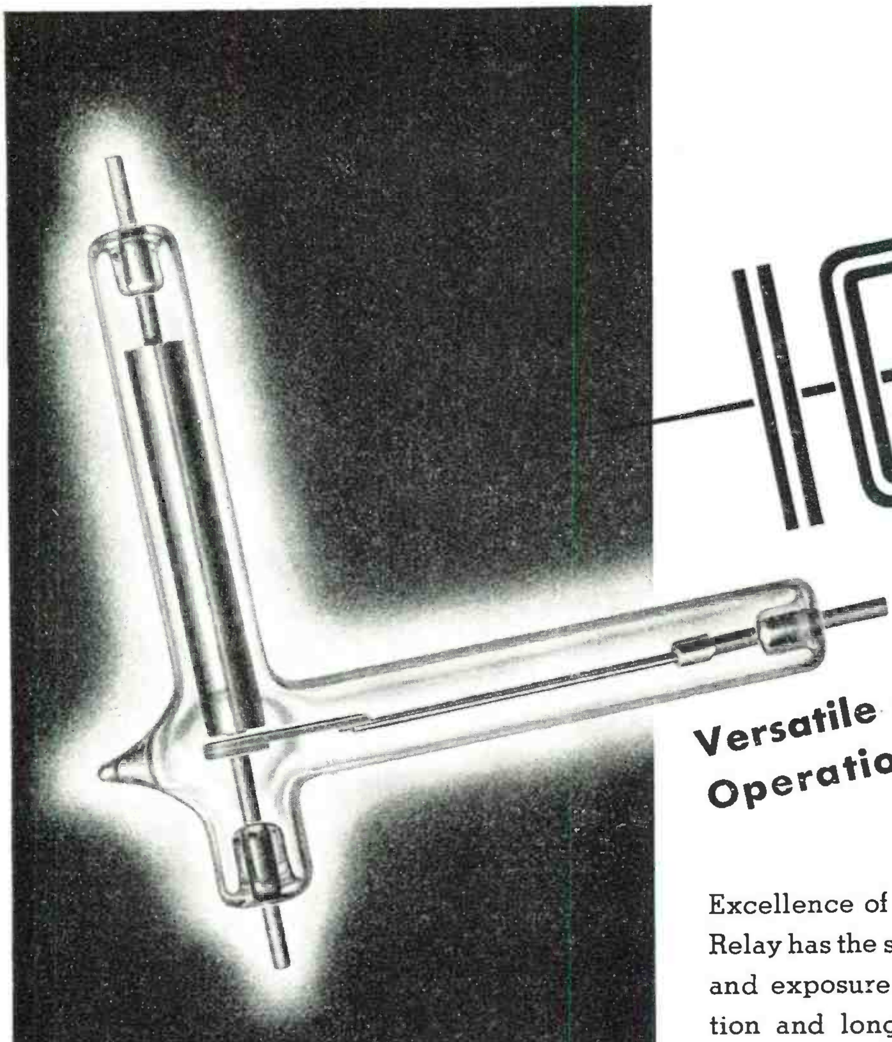
SHURE BROTHERS, manufacturers of microphones and phono-pickups, have appointed Walter and Harold Berggren as representatives for the Chicago area and Northern Indiana. The two are well-known as manufacturer's representatives in this area and will be able to offer manufacturers new Shure engineered equipment after the war.

* * *

FRED D. WILSON, sales manager for the commercial sound division of Operadio Mfg. Co., of St. Charles, Illinois, is completing an extensive trip throughout the West Coast and is currently visiting Operadio representatives and distributors in California. He is assisting West Coast representatives in providing war plants with plant broadcasting and interplant facilities.

* * *

ZENITH RADIO CORP. has appointed Walter H. Dyer to the post of manager of Zenith's auto radio division. His



I C E

VACUUM RELAYS are Rugged and Versatile . . . Give you Reliable Operation and Long Life

Insulation between open contacts, 20,000 volts peak R. F. or A. C. Contacts break 4 amperes. With suitable coil, requires approximately 4 watts actuating power. Contact D. C. resistance less than 0.05 ohms in either open or closed position.

Excellence of construction means this I. C. E. Relay has the strength to resist vibration, shock and exposure . . . resulting in reliable operation and long life. Versatility means that it can be used to do a score of different jobs for you. And of course . . . I. C. E. *precision engineering* is your assurance of correct adjustment to close tolerances. Large quantities of these I. C. E. vacuum relays are proving themselves on battlegrounds all over the world. We can give immediate delivery, in quantity, of these fine relays . . . your inquiries are invited.

I C E
ELECTRONIC TUBES

INDUSTRIAL & COMMERCIAL ELECTRONICS

BELMONT, CALIFORNIA

headquarters will be at the company main office in Chicago.

Mr. Dyer formerly held a similar position with RCA. He brings with him 15 years of automotive radio experience both from the engineering and sales standpoint.

* * *

JOAO B. AMARAL, president of the San Paulo Federation of Radio Societies, which consists of 43 broadcasting stations, arrived aboard the Brazil Clipper of the Pan-American World Airways to buy radio equipment for the Federation's stations.

While in this country he will also present a project to the office of the Coordinator of Inter-American Affairs for a U. S.-Brazilian exchange of men in every phase of the radio field. Later he will make a survey of the organization of American broadcasting companies.

* * *

PRESS WIRELESS has provided the first direct radio program transmission service from France to the United States for network rebroadcasting through its station PX, the mobile transmitter which has been sending news dispatches direct from near the battle lines since June 13.

A series of tests with the transmitter, under varying conditions over a period of time has convinced those sponsoring the service that the unit is adequate under normal conditions for programs which involve voice transmission across the Atlantic. PX has handled some two million words of traffic since June 13th.

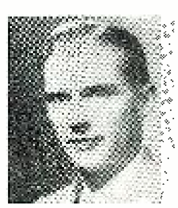
* * *

SUPREME PUBLICATIONS has announced their removal to new and larger quarters at 9 South Kedzie Avenue in Chicago.

According to Mr. M. N. Beitman, the offices of the company will occupy a section of the second floor of the building at that address while the warehouse and shipping facilities will be on the first floor.

* * *

PHILIP M. PRITCHARD, a member of the sales staff of Sylvania Products Inc. radio division, for the past eight years, has been promoted to Manager of Equipment Tube Sales for the East Central Division. Mr. Pritchard will make his headquarters at the company's office in New York City. He formerly was employed by RCA, and since coming to Sylvania has held various positions in the tube division.



* * *

RAULAND CORPORATION of Chicago has recently purchased the Phototube Division of the GM Laboratories, Inc. The product of this company, identified by the tradename "Visitron", is one of the pioneer phototubes in the industry.

The present acquisition of "Visitron", combined with that of the purchase, two years ago of the American rights to all patents and processes of the British-Gaumont electronic tubes, indicates the strong position which has been developed by the Rauland corporation in this electronic tube field.

* * *

ADMIRAL CORPORATION has appointed three more distributors to handle the complete line of Admiral's postwar products.

The Peaslee-Gaulbert Corporation of Atlanta, Georgia, and Jacksonville, Florida, will handle the company's product in these two cities. This company, which was established in 1867, has branches in eleven major cities throughout the South.

The Monroe Hardware Company of Monroe, Louisiana, will be the company's outlet in parts of Arkansas and Mississippi as well as Shreveport and Monroe, La.

The San Francisco area will be handled by the Kaemper-Barrett Company of that city. The company was an Admiral distributor before the war, thus the naming of this distributing organization is in the nature of a re-appointment. They maintain a branch in Oakland, California.

* * *

CARL W. ODELL has been named assistant manager of the Instrument Division of the Thomas A. Edison, Inc., of West Orange, N. J. The company is making preparation now to increase its aeronautical business. Mr. Odell was formerly with the Federal Telephone and Radio Corporation in the capacity of executive in the Direction Finder Division. Previous to that affiliation he was manager of the electronics plant of the Sperry Gyroscope Corporation.

* * *

LEAR AVIA INC. has announced a change in the corporate name to Lear, Incorporated. The change was effected preparatory to the company's entry into markets other than those in aviation equipment and aviation radio.

The company operates plants at Piqua, Ohio and Grand Rapids, Michigan. Research and development laboratories are maintained in Hollywood, California; Piqua, Ohio; and New York City.

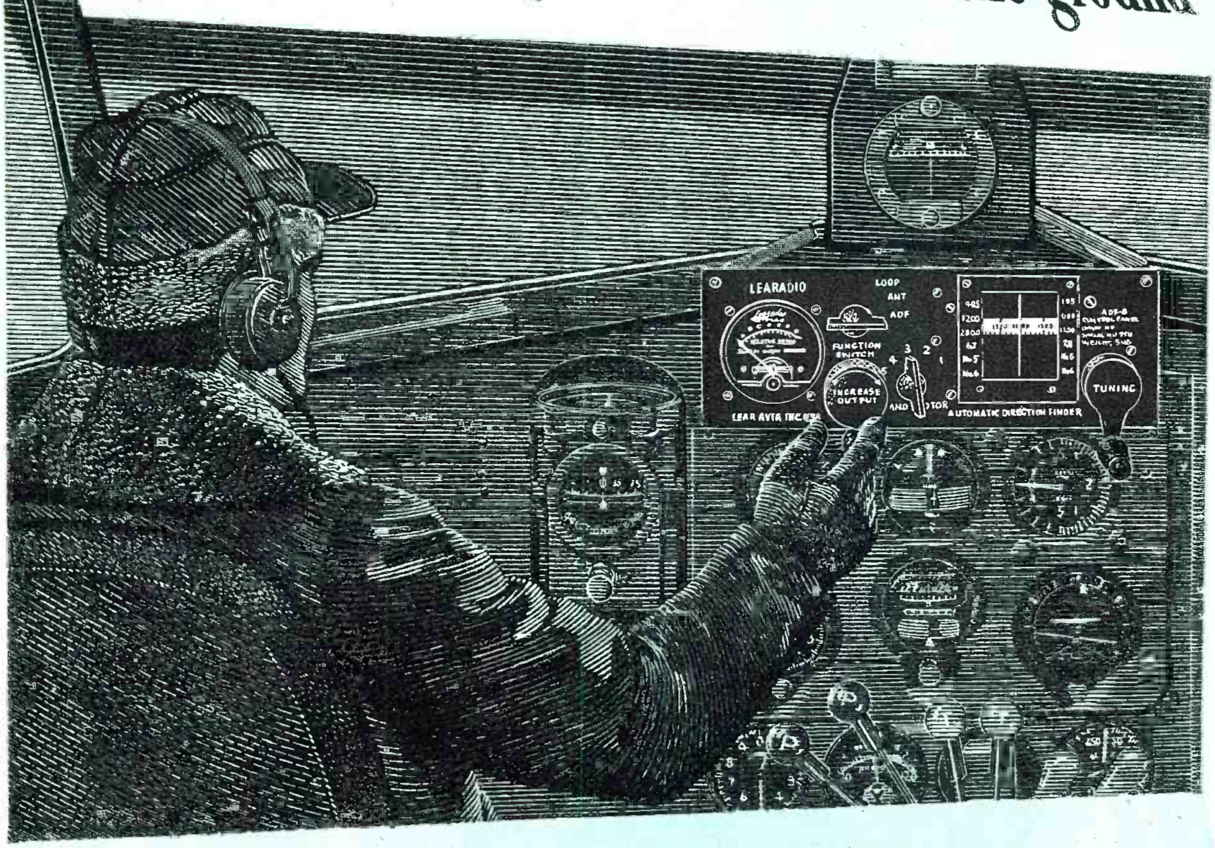
* * *

NATIONAL RADIO INSTITUTE celebrated its 30th anniversary with a luncheon on October 18th for its employees.

The institute has grown from a class of four resident students in 1914 to an organization employing a trained staff of over 150 and a student membership of over 20,000.

The entire staff attended the celebration including J. E. Smith, presi-

Two miles up—with an ear to the ground



Keeping posted high in the air is one secret of successful flying. The ground keeps track of the plane. The plane knows the weather, the course, and what it's like at the field.

Lear was among the very first to make aircraft radios—had gained an enviable reputation for fine radio and navigation instruments long before the war—was ready when war needs demanded greater and greater technical development.

Some of these developments can't even be mentioned now. They're too secret. Some are in the field of electric aircraft controls. Some will have no use outside of war.

But there are others that hold vast promise for everyone when peace returns.

With its war job done, Lear will turn its discoveries, its developments, the resources of its laboratories and plants toward adding new comforts, new conveniences, new pleasures to the lives of America's families.

PLANTS: Piqua, O., and Grand Rapids, Mich. BRANCHES AT: New York, Los Angeles, Chicago, Detroit, Cleveland.

LEAR INCORPORATED
PIQUA · OHIO

Formerly Lear Avia, Inc.

dent; E. R. Haas, vice-president; J. A. Dowie, chief instructor; and Joseph Kaufman, director of education. These men have been with the institute most of the past 30 years.

* * *

LENZ ELECTRIC COMPANY has just rounded out 40 years of service to the radio industry. The company, organized in 1904 by Mr. J. Mayo Lenz, began the manufacture of radio cords, cables and wire at their first factory located at 97 South Clinton Street in Chicago.

The tremendous growth of radio and telephone necessitated further expansion, so the company moved its plant to its present location at 1751 North Western Avenue in Chicago.

The company recently completed a three story annex to its main plant which will house the most up-to-date equipment for the application of various types of insulation.

The company is still under the active direction of J. Mayo Lenz, its president and founder.

* * *

T. F. WILLIAMS of the Williams Export Associates, Inc., 540 N. Michigan Ave., Chicago, has been named as export distributor for the Echophone Radio Company, manufacturers of radio and electronic products. Mr. Williams was formerly director of production for Philco Radio and Television Corporation of Great Britain and is well known in export trade circles. The company plans to expand its foreign trade at the end of the war.

* * *

EMERSON RADIO has announced the appointment of two new distributors in the South through their vice-president in charge of sales, Mr. Charles Robbins.

The Dixie Radio Supply Company of Columbia, South Carolina, will serve Columbia and contiguous territory under the guidance of P. J. Aylward, General Manager.

The second appointment is that of the James Supply Company of Chattanooga, Tenn., which will serve as an Emerson distributor in that territory.

* * *

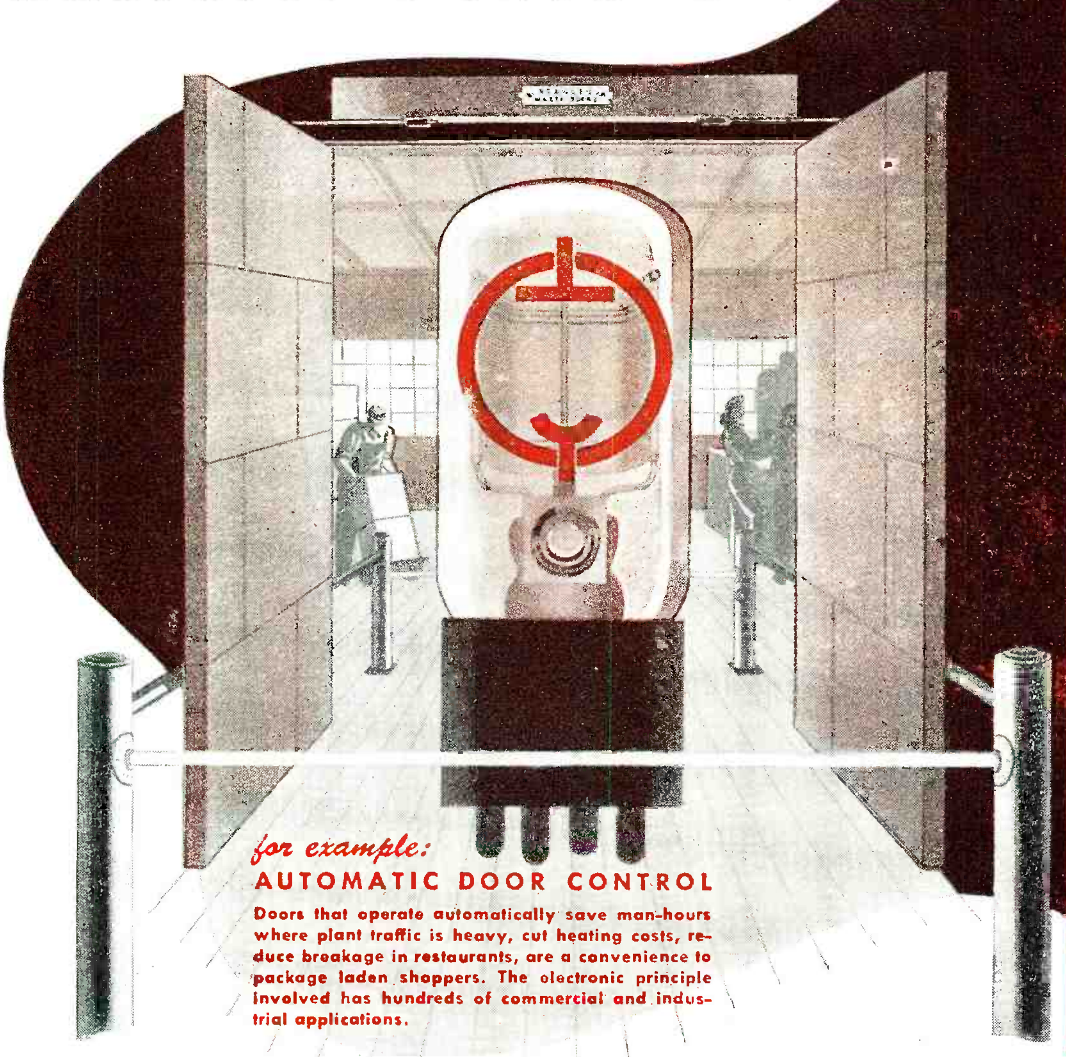
GENERAL ELECTRIC COMPANY has appointed two new representatives to their Southeastern District, representing the Electronics Department.

Mr. W. L. Fattig will be responsible for the sale of products of the Transmitter Division of the department in this district. His headquarters will be at the General Electric's Atlanta office.

Mr. T. B. Willard will be in charge of the company's tube products in the same district with headquarters in Atlanta. Prior to his new appointment, Mr. Willard was with the Apparatus Department of General Electric.

—30—

wherever a tube is used...



for example:

AUTOMATIC DOOR CONTROL

Doors that operate automatically save man-hours where plant traffic is heavy, cut heating costs, reduce breakage in restaurants, are a convenience to package laden shoppers. The electronic principle involved has hundreds of commercial and industrial applications.

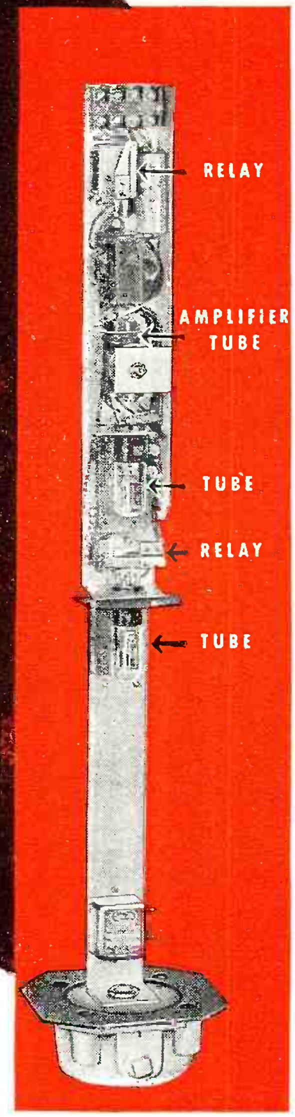


PHOTO-ELECTRIC DOOR CONTROL

Above unit manufactured by General Electric Co., is a part of STANLEY "MAGIC DOOR" CONTROLS.

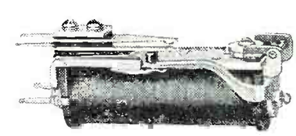
THERE'S A JOB FOR

Relays BY GUARDIAN

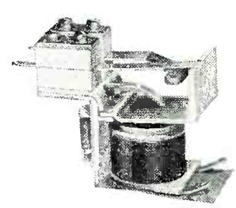
★ The "Magic Door" made by The Stanley Works of New Britain, Conn., uses a General Electric control unit which operates automatically at the approach of a pedestrian or vehicle. In this unit a beam of light focused on the cathode of a phototube causes a tiny current to flow. Enlarged through an amplifier tube this current operates a sensitive telephone type of relay such as the Guardian Series 405. Another phototube with an auxiliary relay, Guardian Series R-100, is employed to hold the doors open for anyone standing within the doorway.

The telephone type of relay is extremely sensitive and able to operate on the small current supplied through the electronic circuit. The auxiliary relay, Series R-100, is required to handle a greater current. It is a small, efficient relay having a contact capacity up to 1 KW at frequencies up to and including 28 megacycles. Contact combinations range up to double pole, double throw. Standard coils operate on 110 volts, 60 cycles, and draw approximately 7 V. A. Coils for other voltages are available. For further information write for Bulletin R-6.

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



Series 405 Telephone Type Relay



Series R-100 H. F. Relay

GUARDIAN ELECTRIC

1630-M W. WALNUT STREET CHICAGO 12, ILLINOIS

A COMPLETE LINE OF RELAYS SERVING AMERICAN WAR INDUSTRY

WORLDWIDE LOG OF SHORT-WAVE BROADCASTING STATIONS

(Continued from page 55)

9.525 GWJ LONDON, ENGLAND (BBC). To Southeastern Europe, Italy, Austria, 12:30 a.m.-6 p.m. To Holland, Belgium and Germany, 6-6:45 p.m. (ABSIE).

9.530 WGEO SCHENECTADY, N. Y. General Electric Company. Eastern South American beam, 5:30 p.m.-12 midnight (Spanish-Portuguese).

9.539 HE14 BERN, SWITZERLAND. To North America, 9:30-11 p.m. daily.

9.540 VE9AI EDMONTON, ALBERTA, CANADA. Reported as heard, 8:30 a.m. 12 midnight.

9.540 VLC5 SHEPPARTON, AUSTRALIA. Australian Broadcasting Corporation Beamed to Asia, 6:15-7:15 a.m. (Chinese, English, Malayan).

9.540 VLG2 MELBOURNE, AUSTRALIA. Australian Broadcasting Corporation. Beamed to Asia, 9:35-10 a.m. (Thai). Beamed to Asia, 9-9:35 a.m. (French).

9.550 GWB LONDON, ENGLAND (BBC). To Europe, Africa, Rio De Oro, and Canary Island, Scandinavia, 1 a.m.-5:30 p.m. To Rio de Oro and Canary Island, 2:15-4:15 p.m. To France, 5:45-6 p.m. (ABSIE) and 6-6:45 p.m.

9.555 —— SHONAN (SINGAPORE), MALAYA. 6 a.m.-2:15 p.m. (irregularly). News, 6 and 6:30 a.m.; sometimes, 11:30 a.m.

9.560 —— RADIO MOSCOW, MOSCOW U.S.S.R. Reported heard, 7:40-8:25 a.m.

9.565 —— RADIO MOSCOW, MOSCOW U.S.S.R. (Perhaps the same as 9.560 mcs. All-English program, 7:40-8:25 a.m. (News generally at start of transmission.) (Transmitter is reported to be at Komsomolsk.)

9.570 KWID SAN FRANCISCO, CALIFORNIA. Associated Broadcasters. (UNITED NETWORK.) Latin American beam, 8 p.m.-12:45 a.m. (Eng.). News or commentary every hour on the hour.

9.580 GSC LONDON, ENGLAND (BBC). North American Service, 5:15-10 p.m. To Iran, 12-12:30 p.m. (Persian). To Near East and Arabia, 12:45-2:15 p.m. (Arabic and Turkish). To Cyprus and Malta, 2:30-3:15 p.m To Near East and Arabia, 3:30-4:30 p.m. To Europe, 1-4 a.m. To Southeastern Europe, Near and Middle East, 4:30-5 p.m.

9.580 VLG MELBOURNE, AUSTRALIA Australian Broadcasting Corporation. Beamed to Western North America, 11-11:45 a.m. News, 11 a.m. Beamed to Asia, 10:15-10:45 a.m. (English).

9.590 VLI6 SYDNEY, AUSTRALIA. Australian Broadcasting Corporation. Beamed to Britain, 2:55-3:25 a.m. and 5:30-6 a.m.

9.590 WLWO CINCINNATI, OHIO. The Crosley Corporation. Latin American beam, 7 p.m.-12 midnight (Spanish-Portuguese).

9.600 GRY LONDON, ENGLAND (BBC). To Central and South Africa, 1:15-5 p.m. (African Service). To Central America, 6-9:30 p.m. (Latin American Service). To Southeastern Europe and Italy, 4 a.m.-9:30 a.m. To Europe, 5:45-6 a.m. (Special Clandestine Press).

9.606 ZRL JOHANNESBURG, SOUTH AFRICA. Schedule, 10-11:45 a.m.

9.610 DXB BERLIN, GERMANY. 5:50 p.m.-1:15 a.m. News, 9, 10, 11, and 12 p.m. and 1 a.m.

9.615 VLC6 SHEPPARTON, AUSTRALIA. Australian Broadcasting Corporation. Beamed to Eastern North America, 8-8:45 a.m. News, 8 a.m., occasionally at 8:45 a.m. Beamed to Western North America, 11-11:45 a.m. News, 11 a.m.

9.620 TIPG SAN JOSE, COSTA RICA. 8:30-11 a.m. and 8 p.m.-12:15 a.m.

9.625 GWO LONDON, ENGLAND (BBC). To West Africa and Gibraltar, 1:45-3:15 a.m. To Near and Middle East, 12:15-5:30 a.m. To Mexico, 7-10 p.m. (Radio Splendid). To Italy and Southeastern Europe, 10:30-11:30 a.m. (French). To Holland, Belgium, and Germany, 11:30 a.m.-6:45 p.m. (ABSIE).

9.630 CBFX MONTREAL, QUEBEC, CANADA. Broadcasts a program of fine marches daily from 8:30 to 9 a.m.

9.640 GVZ LONDON, ENGLAND (BBC). To Australia, 1-5 a.m. To Near East, 12:30-12:45 p.m. (Turkish). To Arabia, 12:45-2:15 p.m. (Turkish and Arabic). To Middle East, 2:30-3 p.m. (European Service). To Scandinavia, 5:15-6:45 p.m. (ABSIE). To Northern China, 9-9:45 a.m. (Eastern Languages).

9.646 XGOY CHUNGKING, CHINA. The Chinese International Broadcasting Station. "The Voice of China." Summer schedule: To East Asia and South Seas, 7:35-9:40 a.m. To North America, 9:45-11:40 a.m. To Europe, 11:45 a.m. 12:30 p.m. To East Asia and South Seas, 12:30-1:45 p.m. English news, 10, 11 a.m., 12 noon. English talk, 10:30-11 a.m.

9.660 GWP LONDON, ENGLAND (BBC). To Poland, 3-5:15 a.m. and 5:30-9:30 a.m. To Poland, 5:15-5:30 a.m. (Radio Polskie: For Polish Forces). To Near and Middle East, 1:45-2 p.m. To Poland, 10:30 a.m.-4:30 p.m.

9.660 LRX BUENOS AIRES, ARGENTINA. "Radio El Mundo." Heard with "excellent" signal at 8 p.m. Uses an "odd-sounding" chime, and announces, "Ella ERray Ekkes Radio El Mundo de Buenos Aires." Transmitter is located at San Fernando, and the station is owned and operated by Empress Editorial Haynes, Ltds., S.A. Also reported, 7-11 p.m.

9.660 XGOI SHANGHAI, CHINA. Home Service, 5-10 a.m

9.670 WNBI NEW YORK, N. Y. European beam, 4-7:30 a.m. and 3:45-5:15 p.m

9.670 WRCA NEW YORK, N. Y. Beamed to Brazil, 8-11:30 p.m. (Portuguese).

9.680 VLC2 SHEPPARTON, AUSTRALIA Australian Broadcasting Corporation. Beamed to North Asia, 3:30-4:30 a.m (Japanese).

9.680 XEQQ MEXICO CITY, MEXICO. Schedule, 9 a.m.-1 a.m.

9.690 GRX LONDON, ENGLAND (BBC). To North America, 5:15-10:15 p.m. To North Africa, 1-2:15 p.m. (Arabic and Turkish). To North and Northwestern

(Continued on page 140)

The chipped teacup of the PATRIOTIC Mrs. Jones

No matter who the guest—Mrs. Jones brings out her chipped teacup with no embarrassment. On the contrary, with a thrill of pride.

Not very pretty, that chip. But it bears witness to the fact that Mrs. Jones has her nation's welfare at heart.

Mrs. Jones has given up all unnecessary spending for the duration. By doing *without*—she is helping to fight inflation.

Maybe she doesn't know all the complicated theories about inflation. But she does know that her government has asked her *not to spend.*

So Mrs. Jones is making all the old things do . . . not only that teacup. She's wearing her clothes for another year—and another. She's not competing with her neighbors for merchandise of any sort.

And the dollars she's not spending now are safely put away (and earning interest) for the peacetime years ahead. *Then* those dollars will buy things that can't be had for any price today.

If we all are like Mrs. Jones, there will be no inflation with skyrocket prices. If we all are like her, dangerous Black Markets cannot exist.

A chipped teacup stands for all that . . . for a *sound, secure* U. S. A.

7 RULES FOR PATRIOTIC AMERICANS TO REMEMBER EVERY DAY

1. Buy only what you *absolutely need.* Make the article you have last longer by proper care. Avoid waste.

2. Pay no more than ceiling prices. Buy rationed goods only by exchanging stamps. (Rationing and ceiling prices are for *your protection.*)

3. Pay willingly any taxes that your country needs. (They are the cheapest way of paying for the war.)

4. Pay off your old debts—avoid making new ones.

5. Don't ask more money for the goods you sell or for the work you do. Higher prices come out of everybody's pocket—including *yours.*

6. Establish and maintain a savings account; maintain adequate life insurance.

7. Buy all the War Bonds you can—and hold 'em!

HELP US KEEP PRICES DOWN

Use it up . . . Wear it out . . . Make it do . . . Or do without

A United States War message prepared by the War Advertising Council; approved by the Office of War Information; and contributed by this magazine in cooperation with the Magazine Publishers of America.

Weather and War

(Continued from page 27)

variable resistor. Other humidity elements use chemically coated plastic strips across which the current flows. The resistance of the strip varies with changes in the surrounding humidity. Advantage is taken of the reduction of air pressure with increasing altitude by using the pressure diaphragm as the motivator for automatically switching in the temperature and humidity elements and reference resistances at regular intervals as the balloon rises.

Looking at Fig. 2 we see that, as the air pressure surrounding the instrument decreases, the pressure diaphragm gradually expands, moving the contact arm (shown schematically by an arrow) across a series of contacts. These contacts are so arranged that the temperature and humidity elements are alternately connected into the resistance-capacitance network of the modulating oscillator. Additional "check" or reference contacts are spaced at regular intervals across a commutator strip. These check contacts afford easy count of the other contacts (every 5th contact is a check) so that the pressure-height curve of the particular flight may be computed. The check contacts also provide a base line or reference value for evaluating the temperature and humidity contacts as explained in the following paragraphs on ground station procedure.

This entire mechanism, including pressure, temperature and humidity elements, transmitter and battery, is contained in a case not much larger than a shoe box. The entire unit weighs slightly over two pounds. The box is covered with foil or a white lacquer to reflect solar rays and prevent excessive heating in the upper atmosphere. The temperature and humidity elements are thermally shielded from effects of radiation and are well ventilated so that they represent free air conditions.

These instruments, like those described in earlier paragraphs, return to earth by parachute when the balloon bursts. A large percentage of them are eventually returned to the Weather Bureau by finders who are often attracted by the parachutes as they slowly float down. At one time a reward was offered for the return of each instrument. However, as the number in use increased and the excellent cooperation of the public in returning the instruments was demonstrated, it was found possible to discontinue the reward system. Nevertheless, the return of all instruments is desired since, by salvage of usable parts from returned radiosondes, it is possible to supply sufficient spare parts, instruments, and miscellaneous equipment to maintain and keep in operation approximately eight stations.

The ground equipment consists of a short-wave radio receiver (either superheterodyne or super-regenerative), dipole antenna with coaxial leads, electronic frequency unit, and recorder. The radiosonde transmits a carrier wave of 72.2 megacycles which is interrupted by alternate inclusion of the temperature and humidity resistors as explained in the foregoing. The fixed resistance of the radiosonde control circuit is the reference or base line used to compute the change and rate of change of the temperature and humidity. The frequency of interruption to the carrier waves varies with the resistance of the temperature and humidity elements and thus affords a measure of the change in those conditions.

The radio receiver amplifies the interrupted signal so that the number of pulses can be measured. An audio amplifier is employed which produces an alternating current of the same frequency as that of the interruptions to the carrier wave, which lies within the range of 0 to 200 cycles per second.

The alternating current is converted to direct current which is then fed to a recorder where the variations in the current are amplified to operate a recording mechanism. Two types of recorders are in rather general use, one is a potentiometer and the other a microammeter type.

In the potentiometer-type recorder a pen moves to a position on an unrolling sheet of record paper corresponding to a point on a slide-wire potentiometer where the unknown electromotive force of the electronic frequency unit's output is balanced by the known electromotive force of that point on the slide-wire. The pen thus makes a continuous trace on the moving sheet of paper, going back and forth as the various contacts are switched in. As long as one contact is maintained, the pen stays nearly in one place (moving only as the value of the element being measured changes) and a vertical or nearly vertical line is drawn on the sheet.

A sample of a potentiometer-type record sheet is shown in Fig. 1. A dotted line (not on the original record) has been drawn in to aid in following the changing conditions. Notes showing values of the data have been entered at selected levels.

The microammeter type is designed to measure the deflection of a microammeter in a time interval which represents 100 units on the chart. The deflection of the microammeter is proportional to the current output of the electronic frequency unit which permits it to be used as a measure of the resistance of the temperature or humidity element which, in turn, is a measure of the actual temperature and humidity. A light source and photoelectric cell assembly is geared to a printing cylinder in such fashion that every two seconds a dot is printed on a moving sheet of paper. These dots and the pointer of the microammeter correspond in position. The rows of dots indicate the values of temperature and humidity in a manner similar to the vertical lines drawn by the pen of the potentiometer-type recorder.

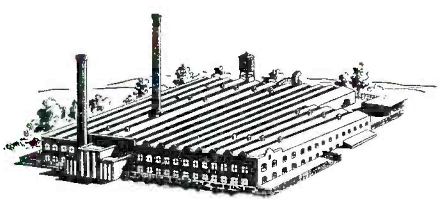
Radiosonde reports are collected twice a day from more than 60 places by the Weather Bureau and at many other points by the military services in various parts of the world. The information is condensed into a simple easily-read code and transmitted immediately by radio and teletype to all of the far-flung weather forecast centers where it is plotted by experienced crews and evaluated in terms of "weather to come" for the use of our fighting forces the world over.

—30—

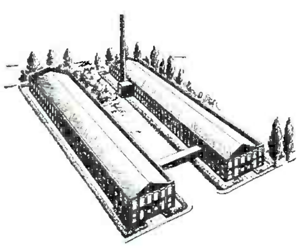
N CABINETS, TOO...

HERE FM WILL ALSO MEAN

FINEST MADE!



The vast Templetone plant at Mystic is now devoted entirely to our Woodworking division, and will concentrate all its facilities on the production of radio cabinets.



The new Templetone plant at New London, embracing 100,000 square feet of space, contains our radio and electronic divisions — now engaged 100% in producing vital war equipment.

Every Temple Radio will be housed in Temple-built furniture produced by Temple craftsmen in Temple's own furniture plant. During the impending lack of fine cabinetry following war's end, Temple will not have to depend upon outside sources for radio cabinets. Which means not only SURETY OF DELIVERY, but also exclusive distinction of design, not only directly supervised excellence of construction, but also wealth of selection—all additional reasons why it will pay YOU to "team up with Temple".

Temple RADIO

TEMPLETONE RADIO MFG. CORPORATION, NEW LONDON, CONN.

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

Licensed under Armstrong and RCA Patents

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.

WALL CHART

Visual aid material for use in aviation schools, aircraft plants, air depots, flying fields, purchasing and engineering departments is available from the *Cannon Electric Development Company.*

A new type K wall chart contains, in condensed form, practically all material on the K connectors. A total of 189 full-scale insert arrangements are listed. All inserts were tooled at the time of the issuance of the chart. Included on the chart are total contacts, identification numbers, wire and contact data and clearance.

Photographs of the basic K and RK assemblies with production and exploded views are included to aid the student or engineer in learning easily to identify various types of connectors.

Type K wall charts are available at no cost to all firms, individuals, and schools using *Cannon Electric* Products. The chart measures 38" × 50" and is printed on heavy buff colored paper.

Write direct to the *Cannon Electric Development Company,* 3209 Humboldt Street, Los Angeles, California.

PLASTICS CATALOGUE

The fabricating and laminating of plastics for use in various electronic applications is discussed in a new catalogue issued by the *Continental-Diamond Fibre Company.*

Special applications include bases for radio masts, and various component parts used in electronic equipment. Information as to the proper handling of this material is covered, including shearing and sawing, punching, drilling, milling, machining and reaming.

Technical data to aid the engineer in determining the adaptability of this material for specific applications is given in an article by J. A. Petko, research engineer for the company. Tolerances for various grades of materials are included to aid the design engineer.

Fuller details and copies of Bulletin FP43 will be forwarded to persons requesting them from *Continental-Diamond Fibre Company,* Newark, 49, Delaware.

AVAILABILITY LISTS

A free subscription to monthly availability lists is offered to industrial engineers and purchasing agents by *Walker-Jimieson,* radio and electronic distributors of 311 South Western Avenue, Chicago, 12, Illinois.

This monthly industrial availability booklet shows all items available on priority for immediate delivery from stock. In this way the current catalogue in the engineer's hands gives up-to-the-minute information on what items may be ordered without delayed deliveries.

Engineers and purchasing agents wishing to receive this booklet monthly may have their names included on the mailing list by writing to *Walker-Jimieson* and making the request.

PILOT LIGHT CATALOGUE

The *Gothard Manufacturing Company* has issued a new catalogue which describes their complete line of pilot light assemblies for panel board and instrument signaling.

Besides their complete line of standard assemblies, the company is in a position to engineer lamps for definite applications.

All the lamps and assemblies listed in the catalogue are Underwriters' Laboratory approved for safety operation.

Engineering details and complete specifications are included in the catalogue. For information other than that included in the catalogue, the company maintains a complete engineering service for tailoring the product to the application.

Copies of the catalogue may be obtained from the *Gothard Manufacturing Company,* 1300 Ninth Street, Springfield, Illinois.

RF COIL CATALOGUE

The *Stanwyck Winding Company* has issued a new catalogue on their line of r.f. coils and associated assemblies which is available to engineers and servicemen on request.

The catalogue covers the company's line of antenna coils, band expanding i.f., broadcast coils, composite i.f. and oscillator coils, as well as about thirty other items used in radar and television.

Beside the standard coils carried by the company, their engineering department is in a position to engineer special problems encountered by the radio manufacturer in meeting Signal Corps specifications.

Copies of this catalogue and other data are available by writing direct to *Stanwyck Winding Company,* Newburgh, New York.

RCA TELEVISION

The advance of television is described in popular form in a new booklet released by RCA.

In this booklet, the uses and various applications of "Radio Sight" are outlined along with some of the develop-

GREAT NEWS! SUPERIOR'S WELL-KNOWN

Model 710

VOLT—OHM—MILLIAMMETER

is now available for shipment within 10 days after receipt of order on priority of AA3 or better.

Sensitivity—

1,000 OHMS PER VOLT
ON BOTH A.C. AND D.C.!!

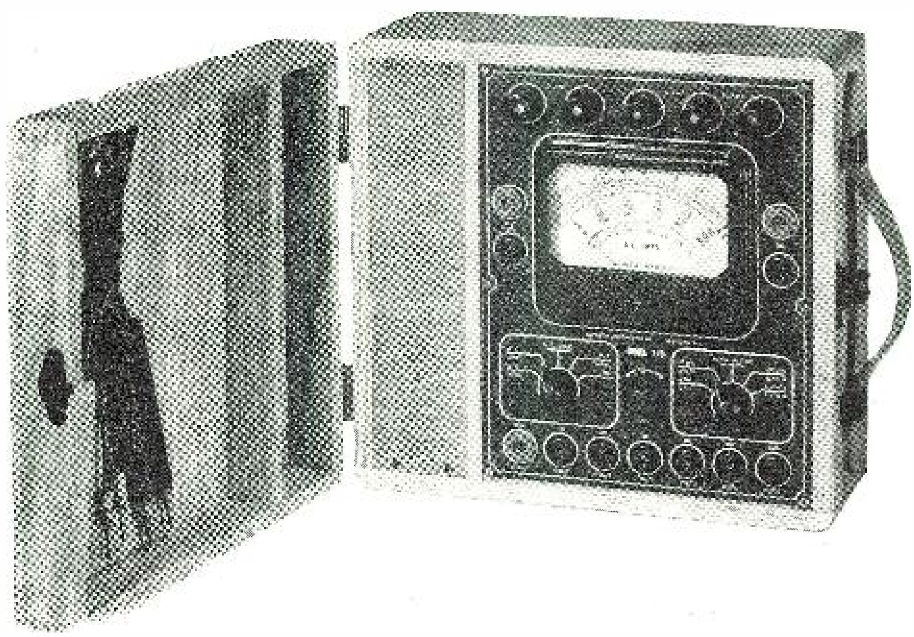
Measures:—

A.C. AND D.C. VOLTAGES UP TO—
1500 VOLTS

A.C. CURRENT UP TO—
3 AMPERES

D.C. CURRENT UP TO—
30 AMPERES

RESISTANCE UP TO—
10 MEGOHMS



Features:—

★ Uses New 4½" Square Rugged 0-400 Microampere Meter.
★ Direct Reading—All Calibrations Printed Directly on Meter Scale in Large Easy-to-Read Type.
★ Housed in Rugged Heavy Duty Portable Oak Cabinet.
★ Completely Self-Contained—No External Source of Current Required.

Designed and perfected in wartime to meet the exacting requirements of America's War Producers for a dependable volt-ohm-milliammeter, the Model 710 is being used by war plants engaged in the production of planes, ships, tanks, guns, etc.; also by various Army, Navy and other government agencies.

Specifications:—

6 D.C. VOLTAGE RANGES (1000 OHMS PER VOLT)
0 to 15/60/150/300/600/1500 Volts.

6 A.C. VOLTAGE RANGES (1000 OHMS PER VOLT)
0 to 15/60/150/300/600/1500 Volts.

7 D.C. CURRENT RANGES:
0 to 3/15/60/150 Milliamperes   0 to 3/15/30 Amperes.

A.C. CURRENT RANGE:
0 to 3 Amperes.

5 RESISTANCE RANGES:
0 to 1,000/10,000/100,000 Ohms.   0 to 1 Megohm   0 to 10 Megohms.

The MODEL 710 comes complete with cover, self-contained batteries, test leads and instructions. Size 6" x 10" x 10". Net weight 11 pounds. Price.................... **$34⁵⁰**

SUPERIOR INSTRUMENTS CO., Dept. R.N.
227 FULTON STREET   NEW YORK 7, N. Y.

ments which have helped to bring television a step nearer to perfection, the Iconoscope and Kinescope developed by Dr. V. K. Zworykin of the RCA Laboratories.

A possible television network is outlined in the booklet showing how a large percentage of the American people may some day have television in their homes.

The milestones of television are given in an interesting table covering the years from the discovery of selenium in 1817 to the present day developments in video.

A copy of the booklet will be forwarded without charge upon application to the Department of Information, *Radio Corporation of America*, 30 Rockefeller Plaza, New York, New York. Ask for the booklet entitled "Television."

SPRAGUE CATALOGUE

With new applications and new standards of performance on dry electrolytic condensers, the new Sprague Dry Electrolytic Catalogue No. 10 will prove of interest to engineers and purchasing agents.

This 28-page catalogue contains descriptions and engineering data on capacitors for salt air, reduced pressure, low and high temperature extremes, transients, r.f. impedance, sealing "shelf life" and many other special applications.

The catalogue has been streamlined to eliminate lengthy listings and a compact "size factor table" has been incorporated to give vital data in convenient form.

A copy of this catalogue will be forwarded upon request to *Sprague Electric Company*, formerly Sprague Specialties Company, North Adams, Mass. Please specify Dry Electrolytic Capacitor Catalogue No. 10.

JENSEN MONOGRAPH

The *Jensen Radio Manufacturing Company* of Chicago, Illinois has released the first in a series of technical monographs on the subject of loud speakers.

The first of these booklets is entitled "Loud Speaker Frequency Response Measurement" and explains how laboratory technicians can use measured frequency response as essential data in their development and design work. Equipment and methods are described.

The second of the series is "Impedance Matching and Power Distribution in Loud Speaker Systems."

Advanced material on the first book was carried in the April and May issues of RADIO NEWS. This booklet enlarges on the material treated in those issues and provides a reference book on the subject of loud speaker application and installation.

Each monograph is available at a charge of $.25 per copy. Copies of all issues are free on request to men of the Armed Services and to libraries and technical schools. Distribution is through radio jobbers and dealers or direct from the company, *Jensen Radio Manufacturing Company*, 6601 S. Laramie Avenue, Chicago 38, Illinois.

STROBOSCOPE

The *Universal Microphone Co.*, Inglewood, Cal., in re-issuing its edition of the Stroboscope has placed a half million of the device through its factory representatives to jobbers who, in turn, distribute them to retail dealers where radio-phono fans may secure them without charge. In cases where it is impossible to secure the Stroboscope from dealers, the factory will mail them direct upon request as long as the supply lasts.

The device, printed on heavy stock with a filing folder, determines turntable speed for reproduction of transcriptions and phonograph records, thus enabling reproduction with true pitch and tempo.

It works at 33⅓ or 78 r.p.m. under a light of 25. 50 or 60 cycles.

Universal, besides manufacturing various styles of microphones, before the war made many types of recorders. It has been announced that after the war they will again go on the market with recording components.

DRYING LAMPS

The near infrared process which has been used so successfully in the drying of paint on automobiles, is described in a new booklet distributed by the *Fostoria Pressed Steel Corporation*.

Increased use of this drying and dehydrating process is expected after the war in the manufacture of radio and electronic equipment at lower cost. The time formerly required for drying of enamels and protective coatings will be cut drastically and permit volume handling in smaller areas.

The manufacturer suggests several specific applications for the electrical industry including baking insulating coatings on generator and motor windings, baking finish on instruments and cases, preheating wire and cable before applying fabric covers and many other applications.

A copy of this booklet is available upon request to the *Fostoria Pressed Steel Corporation*, Fostoria, Ohio.

NEW JOHNSON CATALOG

A general products catalog listing most of the company's products has been released by the *E. F. Johnson Company* of Waseca, Minnesota.

The catalog which is known as the No. 968 contains engineering data and prices on variable condensers, plugs, jacks, inductors, chokes, terminals, tube sockets, couplings, antenna equipment and r.f. insulators.

Some of this equipment is presently available to nonpriority consumers within WPB regulations and other of the items listed are available on priority only.

Interested persons may obtain a copy of the catalog by writing *E. F. Johnson Company*, Waseca, Minnesota.

—30—

Now available to research laboratories and industrial electronics manufacturers

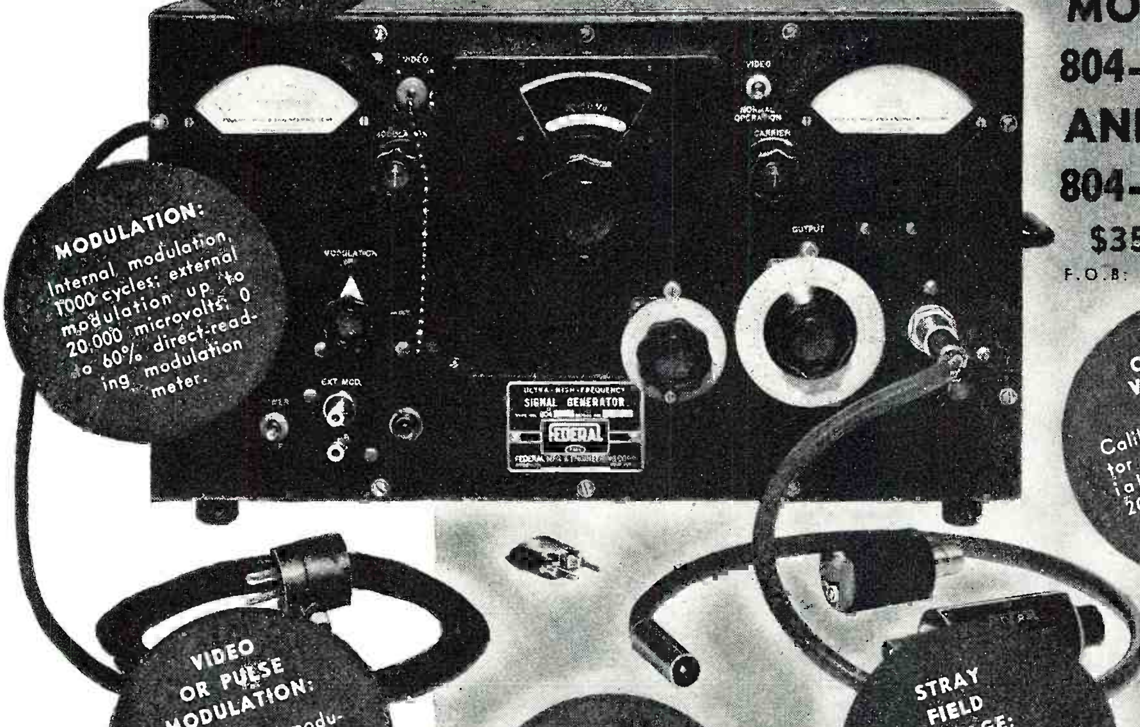
FEDERAL OF BROOKLYN

U.H.F. SIGNAL GENERATORS

MODELS 804-CS-1 AND 804-CS-2

$350.00

F.O.B. FACTORY



(Manufactured by arrangement with the General Radio Company of Cambridge, Massachusetts, and in accordance with their designs.)

Proof of the superiority of FEDERAL'S advanced manufacturing techniques and long-term experience in the field is found in this dramatic achievement. Difficult as the assignment was, we have successfully met all Army and Navy requirements for these precision laboratory instruments—thus permitting us to now make them available under priorities to research laboratories and manufacturers engaged in industrial electronics. Your inquiries will be given immediate attention.

ARMY E NAVY

FOR THE FOURTH TIME

KEEP BACKING THE ATTACK . . . . BUY MORE WAR BONDS

Federal Manufacturing and Engineering Corp.

Manufacturers of Federal Photographic Equipment and Federal Electronic Devices

BROOKLYN 5 NEW YORK

Recording FM Bursts
(*Continued from page 31*)

duration which seldom covers more than the time consumed by a single spoken word or one or two notes of music even though the FM station is located at a considerable distance from the observer. FCC engineers accordingly are recording reception from certain FM stations to determine the nature and extent of the interference.

Bursts were observed from the higher powered FM stations only. This may account for the failure of amateurs, experimenters and others to have reported this type of interference within this frequency range. The bursts normally are not observed from nearby FM stations, but since the steady ground wave signal is of sufficient strength to obscure them, they may even be observed in such instances by a system of pulsing or by a directional antenna which discriminates against the ground wave. At greater distances where the steady signal is absent or of low intensity, the bursts may be heard through the loudspeaker or may be recorded on the equipment previously described.

These bursts have been observed by both methods at distances up to 1400 miles from certain FM stations, but are neither so intense nor so numerous at the longer distances as they are at distances of 300 to 700 miles. Commission engineers have observed a systematic variation in a relative number of bursts which occur from hour to hour during the day. The highest number occur near sunrise while the fewest occur near sunset. These bursts may be related in some way to bursts of somewhat longer duration and with greater frequency of occurrence which have been reported by other engineers at frequencies below 20 megacycles.

The distances over which the FM bursts are received, as well as certain measurements of certain signal path length, indicate they are ionospheric in origin, just as are the bursts at the lower frequencies. There is also substantial agreement between the daily variations in the FM bursts and the lower frequency bursts which give further evidence that they are related and may perhaps be due to a common cause.

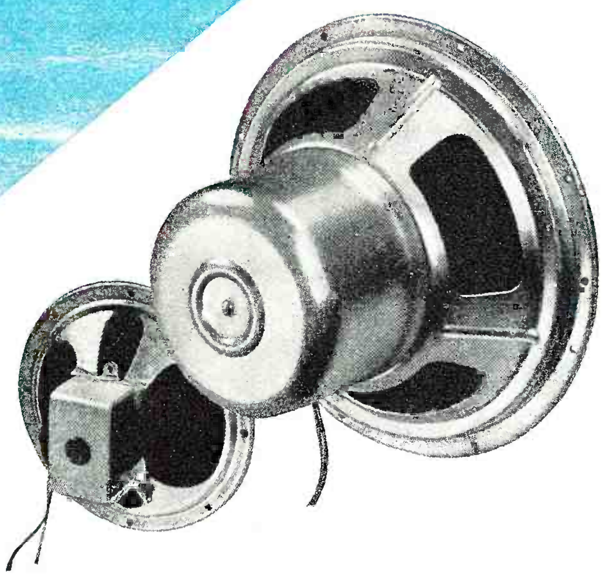
Certain television stations at 72 megacycles also have been observed and bursts have been discovered. However, insufficient data has been collected on these to make any determination of the relative amplitudes, frequencies of occurence, and durations as compared with the bursts in the FM band.

The engineers of the FCC are continuing their observations and it is hoped data will be obtained which may serve as a basis for approximating the amplitudes and numbers of the bursts to be expected at various distances from a transmitter at any given time. This determination involves not only a long-time measurement of burst amplitudes from FM stations, but measurements of the path lengths and directions of arrival of the signals in order to identify the medium causing the bursts.

In addition to the burst signal interference described above, there is another distinctly different kind of interference to very-high frequency reception which has been recognized for some years. It happens occasionally that a normally unheard station will come in with sufficient signal strength to operate a receiver satisfactorily for a considerable length of time. This may go on for many minutes or even hours. This effect, easily distinguishable from the burst phenomenon by its duration, can be produced by transmitters of low power. These have been known to produce a signal which was sufficiently strong to take control of a receiver tuned to a local station on the same frequency. For example, Commissioner Jett of the FCC often is able to listen to the Milwaukee FM transmitter at his home in Maryland. The cause of this phenomenon has been traced to abnormal "patchy" ionic densities in the lowest of ionospheric layers known as the "E" layer, and also known as "sporadic E transmission." Much data on this effect has been accumulated at lower frequencies, more is needed for the higher fre-

RADIO SPEAKERS

And Transformers



Consolidated Radio Products Co. has complete modern production and engineering facilities to supply the finest radio speakers available. Speakers can be furnished in the following ranges:

Dynamic Speakers from 2 inches to 18 inches

Permanent Magnet Speakers from 2 inches to 18 inches

Headsets

Consolidated Radio is also a nationally known manufacturer of small and medium transformers including Pulse Transformers, Solenoids and Search Coils.

Engineering service is available to design transformers and speakers for special applications, or to your specifications.

Electronic and Magnetic Devices

CONSOLIDATED RADIO

Products Company

350 W. ERIE ST., CHICAGO 10, ILL.

quency range of the spectrum and it is hoped that the present recording program of the Commission will help to supply the need. Both of these interference effects are being studied by the appropriate Panels of the Radio Technical Planning Board and with this cooperation and that of other interested organizations, it is believed that the Commission will find a satisfactory solution to the problems involved.

—30—

Practical Radio Course
(*Continued from page 53*)

gram. The second coil, L_1, tuned to the same resonant frequency as the normal grid-tuning coil L_2, adds selection to the desired signal. The three coils, as is evident from the illustration, are wound on the same form and are inductively coupled to each other. The capacitive-coupling between L_3 and coil L_2 serves to bring up the gain and sensitivity at the high frequencies so as to make them more uniform throughout the entire tuning range. Tuning capacitors C_1 and C_2 are ganged together and with the oscillator tuning capacitor (not shown), making a 3-gang tuning capacitor necessary for the receiver.

Since this arrangement provides two tuned circuits and a high degree of preselection it is quite satisfactory, even in receivers which employ a low i.f. value. The selectivity of the circuit is essentially dependent upon the mutual inductance of the coils and upon the frequency of the desired incoming signal; increasing either one *reduces* the selectivity. In a receiver which is to be fed by a short antenna, the mutual inductance usually is made quite large in order that a strong input signal to the mixer grid will be obtained.

An example of the adaptation of this simple band-pass preselector for use in 2-band superhets is illustrated in Fig. 5. This is the preselector used in many Motorola receivers and others which do not have an r.f. amplifier stage preceding the converter.

Signal is fed into the antenna primary coil, *P*, where it is inductively coupled to the secondary, L_1, of the antenna transformer. The secondary is tuned by the third section, C_3, of the 3-gang tuning capacitor (oscillator-tuning section not shown here)—its trimmer capacitor C_{11} is mounted directly on the gang capacitor since this section is used only on the BC band.

The secondary, L_1, is inductively coupled to another tuned secondary, L_2, which is tuned by section C_2 of the gang capacitor. This latter tuned circuit connects directly to the grid of the converter tube. Its trimmer C_{12} is in the circuit only on the broadcast band.

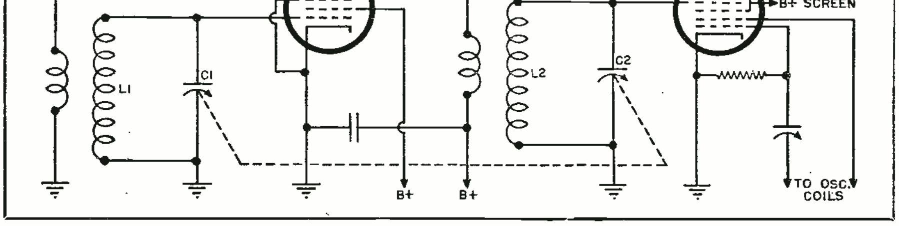
The dual tuned stages give additional selectivity on the broadcast band. On short wave, coils *P* L_1 and L_2 with their associated tuning capacitors are cut out of the circuit, and no intermediary tuned circuit is employed. The receiver then functions similarly to any other short-wave superhet receiver using a 2-gang tuning capacitor.

R.F. Amplifier Type of Preselector

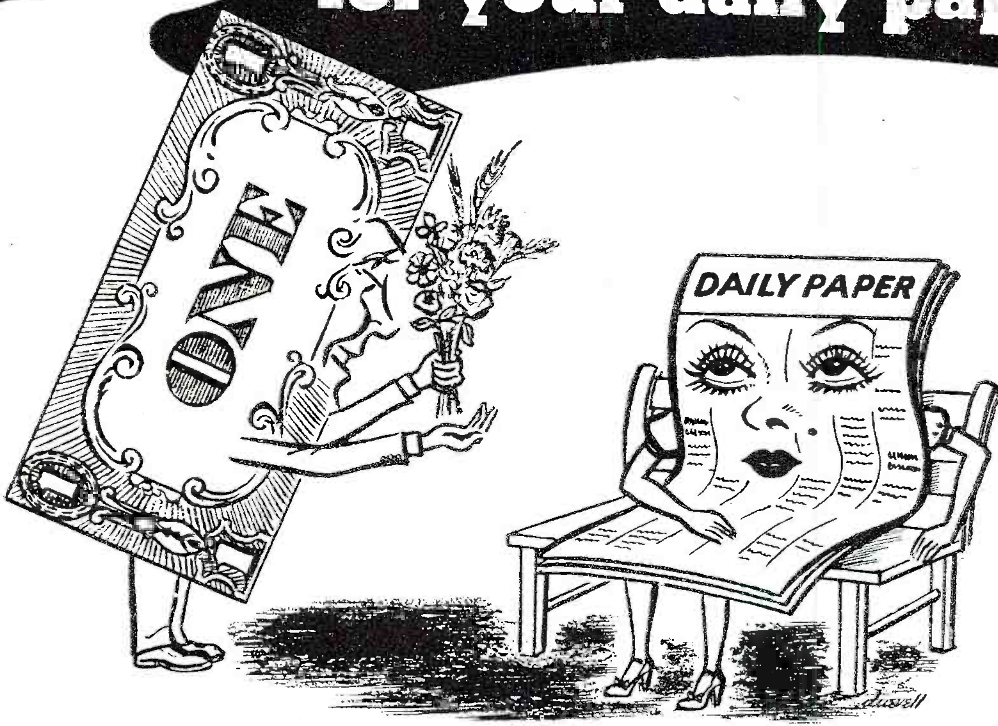
Although band-pass preselectors are quite effective in minimizing many of the spurious responses that are apt to occur in superheterodynes, they have one important disadvantage in that they appreciably reduce the strength of the desired signal. Of course this can be compensated for by stepping up the gain of the i.f. amplifier, but this is not always desirable. When it is done, the noise that is inherently caused by the frequency converter is not reduced, and consequently, the signal-to-noise ratio with the weak input-signal condition remains high. A more desirable solution lies in adding a stage or two of r.f. amplification *ahead* of the frequency converter in order to build up the strength of the weakened incoming signal so it will override any noise that is caused by the mixer or converter tube. The greater the strength of the signal applied to the converter tube with respect to the noise caused by the converter, the greater will be the signal-to-noise ratio. For example, measurements made on two 6-tube receivers having the same over-all sensitivity and the same tube complement (the difference being that one had two i.f. stages and no r.f. stage while the other had one r.f. stage and one i.f. stage) showed the receiver with the r.f. stage to have approximately three times better signal-to-noise ratio.

A simplified version of a preselector circuit which contains a stage of r.f. amplification to increase the signal

Fig. 6. Simplified form of a widely-used preselector circuit in which one stage of tuned radio-frequency amplification boosts the strength of the incoming signal before it reaches the frequency converter.



Would You Pay A WHOLE DOLLAR for your daily paper?



THAT man is here again! The guy who used to say "I can get it for you wholesale" now whispers: "I can get it for you WITHOUT RATION COUPONS . . ." The sad thing is that—he CAN. But, oh, what a price you pay!

You can't beat arithmetic. If there are ten refrigerators for sale and a hundred eager bidders for them, the seller is going to nick those ten buyers for *all the traffic will bear!* Then prices soar . . . the dollars that buy those refrigerators drop in value. Too few goods, too much money on the loose, connive to breed the worst of all national dangers: INFLATION. A 100-cent dollar sinks to 5c—or less—in buying power! Uncontrolled prices . . . *less* for your hard-earned money! A drop in the value of your savings account, of your insurance, of everything you own. Would you like to pay a whole dollar for your daily paper?

"Ration coupons?" Oh, nuts! "Ceiling prices?" "Listen, fella, I can get you what you want—for only a few dollars more . . ." Don't you believe him. He can't, *really!* You may not give up ration coupons THIS time, but you may have to give up MUCH more in the long run. The unhappy spiral of inflation can put every thing you want and need 'way beyond your price-reach! Don't let this happen to *you*—your neighbors, your entire nation. Instead, for a FAIR share at a FAIR price, take the Consumers' Pledge of Fair Play, and LIVE UP TO IT: "I will pay no more than ceiling prices; I will take no rationed goods without giving up ration coupons." DEFEAT the scourge of Inflation!

THE MARK OF EXCELLENCE

Here at Kenyon, we're proud to play our small role on the stage of a BIG war. That's why EVERY Kenyon transformer used by our fighting forces throughout the world reflects only the highest precision craftsmanship. Kenyon workers are doing their share—bringing Victory closer by turning out top quality transformers *uninterruptedly*—and as fast as possible!

KENYON TRANSFORMER CO., Inc. 840 BARRY STREET NEW YORK, U. S. A.

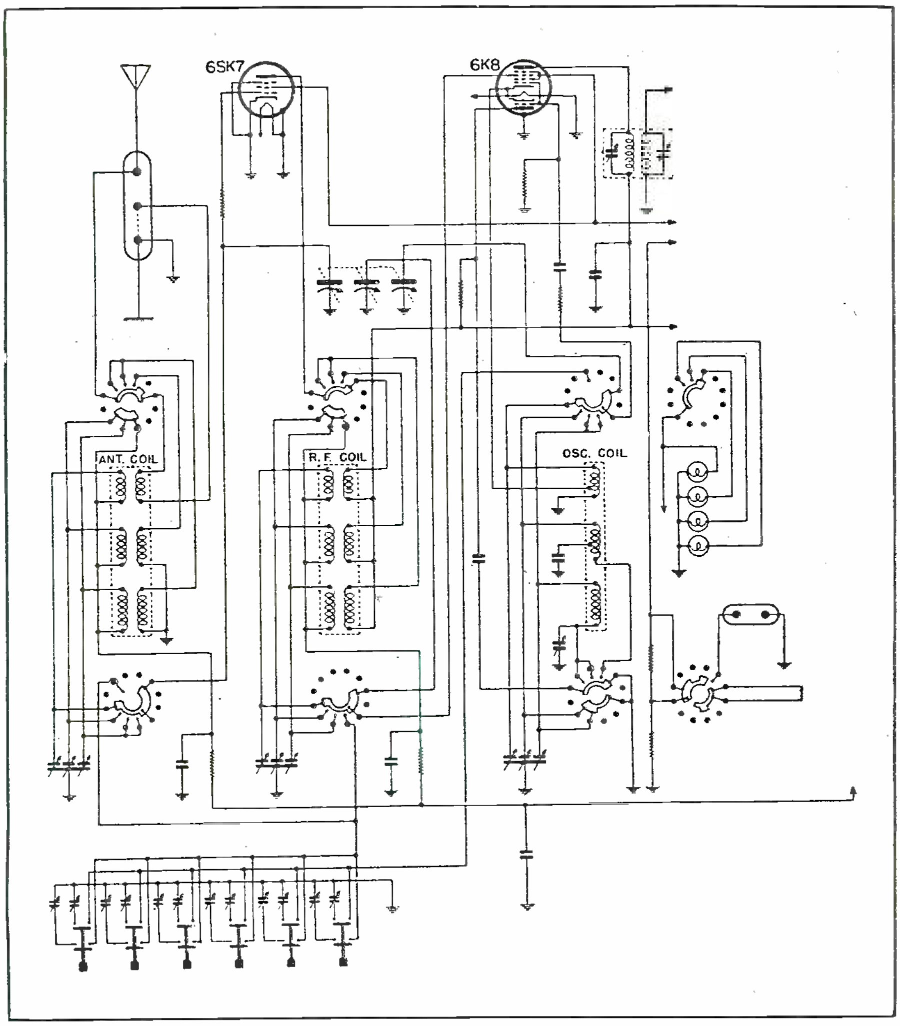


Fig. 7. Essentially the same simple preselector circuit (employing one stage of tuned radio-frequency amplification) as that shown in Fig. 6 is employed for each band of this three-band Sentinel push-button tuning receiver. Note that the broadcast and medium short-wave band primaries are grounded, while the highest frequency primary has been wired for connection to a doublet antenna.

strength at the input to the frequency converter tube is illustrated in Fig 6. The two tuning capacitors C_1 and C_2 are sections of the 3-gang tuning capacitor which also contains the oscillator-tuning section (not shown). For even greater image-frequency and other spurious response suppression the first tuned circuit L_1 C_1 is sometimes replaced by a band-pass resonant circuit of the form shown in Fig. 2 (which necessitates an additional section on the gang tuning capacitor), or by an image-suppression circuit like that shown in Fig. 3 (which does not require the additional tuning capacitor section).

A more complicated version of this same circuit as used in a Sentinel 3-band push-button tuning receiver is illustrated in Fig. 7. The broadcast and medium short-wave band primaries are grounded, while the highest frequency primary is arranged for a doublet antenna. The top switch is in two parts; one switches the antenna to the appropriate r.f. transformer primary; the other "shorts" the unused secondary coils to prevent absorption at certain resonant frequencies. The lower switch connects the grid of the r.f. amplifier tube to the correct secondary, or to the push-button tuner.

Use of Antenna Wave Trap for Eliminating Image Interference Caused by One Particular Station

Oftentimes a receiver is troubled only by image interference caused by one particular station. In such cases a simple tuned wave-trap may be connected in the antenna circuit as illustrated in the circuit of (*B*) in Fig. 1 (wave-trap L_t C_t shown dotted). The wave-trap is permanently tuned to the frequency of the interfering station by adjusting its trimmer capacitor C_t. (As we shall see in the next lesson of this series where such wave-traps will be discussed in greater detail, a similar trap can be inserted into the antenna lead of any receiver troubled by image interference, harmonic interference, code or beacon interference, etc., caused by one station.) In fact, many home receivers already contain such a built-in trap.

Difference Between Double-Spot Tuning and Image-Response Interference

The difference between double-spot tuning (repeat-point reception) and image-response interference is revealed by the difference in the spurious responses they produce. When double-spot tuning exists, a station signal will be heard at its correct dial setting and this *same* signal will be heard again (clearly) at a frequency setting which is twice the i.f. value *below* the correct setting. If, however, there happens to be *another* station broadcasting on this repeat-point frequency, *both* signals will be heard simultaneously—one interfering with the other. This is image-response interference, the second signal being the image-frequency signal.

(*To be continued*)

Saga of the Vacuum Tube
(*Continued from page 60*)

volts. The anode voltage used ranged from 18 to 44 volts and the anode current from a few tenths to 1 milliampere. The filament voltage was chosen so that the filaments could be heated by a two-cell lead storage battery without a rheostat. About 111,000 of these tubes were delivered to the Signal Corps in the early part of 1918.

The construction of this tube was later changed to use a cylindrical anode instead of the cup-shaped one, and this also resulted in an improvement in the operating characteristics. This improved tube was assigned the designation "VT-13" by the Signal Corps, while the Navy continued to use the former designation "CG-890." The VT-13 had a 3.25 mil tungsten filament approximately 1 inch long, mounted in the form of a V. The grid was of 7 mil tungsten wire wound as a helix, about .55 inch long, on a mandrel .155 inch in diameter, with a pitch of 20 turns per inch. The anode was of 5 mil sheet nickel, about ¼ inch in diameter and ½ inch long. About 3500 CG-890 tubes of both types were supplied to the Navy. A total of about 1100 of the VT-13 type was supplied to either the Army or the Navy.

The "Type T" Pliotron was used as a low-power oscillator for small radiotelegraph and telephone sets, chiefly by the Navy on submarine chasers and in aircraft transmitters. The Type T was first designated by the Signal Corps as the "VT-12," and this tube is shown in Fig. 161. This designation was used but a short time when changes were made in the filament design to increase the life of the tube. The revised design was assigned the designation "VT-14" by the Signal Corps and "CG-1162" by the Navy. The bulb was similar to that used for the TB-1. The filament was a helix of 4.05 mil tungsten wire, with a total length of about 2 inches. It was supported by a molybdenum wire extending upward from the press. Concentric with the filament was a helical grid of 7 mil tungsten wire wound with an inside diameter of .130 inch and a pitch of 10 turns per inch. The length of the grid wire was about 3⅜ inches, making a helix about 11/32 inch long. The anode was a cylinder of molybdenum 5 mils thick, with an inside diameter of 9/32 inch and a length of ⅝ inch. The filament normally consumed about 7.5 volts at a current of 1.75 amperes. The normal anode voltage was about 350 volts, and the anode current about 40 milliamperes. The power output when the tube was used as an oscillator was about 5 watts. It is interesting to note that many of these tubes were used by amateurs as Barkhausen oscillators in the earlier days of amateur activity at ultra-high frequencies, after they had appeared on the salvage market.

The "Type U" Pliotron was the first of the General Electric "50-watters," and the prototype of the RCA UV-203. It was designated "CG-1144" by the Navy, and "VT-18" by the Signal Corps, and is shown in Fig. 162. It had a cylindrical bulb about 2 inches in diameter and 6 inches long. The filament consisted of a tungsten wire, 10.1 mils in diameter and having a total length of 3⅞ inches. It was helical in shape, ⅛ inch inside diameter, with a pitch of 20 turns per inch. The filament was placed inside a grid helix and supported by a molybdenum rod passing up the axis of the helix. The grid was of 5 mil molybdenum wire helically wound on a .200 inch mandrel with a pitch of 20 turns per inch and a length of ⅞ inch. The grid was supported by two molybdenum wires electrically welded along the sides of the helix. The anode was of 5 mil sheet molybdenum bent in such a way as to form a cylinder ½ inch in diameter and 1⅛ inches long, having four fins extending ⅜ inch out from it. These fins were intended to increase the radiating surface of the anode, thereby increasing the permissible anode dissipation. This tube operated with a filament current of 6.5 amperes at 10 volts. The normal anode voltage was 750-1000 and anode current 150-200 milliamperes. As a high-frequency oscillator this tube would put out about 50 watts.

This tube was a later development than the other Pliotrons, but was used to a considerable extent by the Navy in seaplane transmitters. About 1200 were supplied to the Navy and 200 to the Army.

The largest of the early Pliotrons was the "Type P," shown in Fig. 163. This was known to the Navy as the "CG-916" and to the Signal Corps as the "VT-10," and was the forerunner of the RCA UV-205. The bulb was about 5 inches in diameter. The filament was W-shaped, of 7 mil tungsten wire, with a total length of 6¼ inches. It operated with 3.6 amperes at a voltage of 13-19 volts. Surrounding the filament was a grid of 3 mil tungsten wirewound on a rectangular form of tungsten or molybdenum. The pitch of the grid was 30 turns per inch, and it was spaced .090 inch from the filament. The anode consisted of two rectangular plates of 25 mil thick tungsten. These were 2 by 2⅜ inches in size, set parallel and ½ inch apart. The anode voltage was normally 1500-2000 volts and the anode current 150-

STATEWIDE PROTECTION

by Motorola F-M Radio

HOW TO GET IT

If your community can show a vital public or military need for a Police Radiotelephone System, simply file your application for allotment using WPB form 541. For full information on how to get yours, write or phone and our Motorola Field Engineer will get you started at once. There is no obligation involved.

Alabama joins the growing list of States provided with the efficiency of a Motorola F-M Police Radiotelephone System. Nineteen strategically located Central Headquarter Stations equipped with three-way radio put State Police Authorities in constant touch with the 115 three-way radio patrol cars on Alabama's highways. All parts of the State are blanketed; State police forces are mobilized instantly; needless cruising is cut to a minimum; man power is conserved. Motorola designed, built, installed and services the entire system.

ARMY E NAVY

Write or phone for full information today

GALVIN MFG. CORPORATION · CHICAGO 51

200 milliamperes. As an oscillator it delivered about 250 watts, and was used by the Navy in seaplanes and flying boats.

There were other tubes made in limited quantities during this period. One of these was the VT-16, which was being worked on at the time of the Armistice in 1918, and which differed only in minor details from the VT-14. Two other interesting tubes made by General Electric are shown in Figs. 164 and 165. That shown in Fig. 164 is a small Kenotron made in the General Electric Research Laboratory in 1916 or 1917. The cone-shaped anode, which is of molybdenum, fits closely around the filament in order to minimize the voltage drop in the tube. This tube was used to furnish high-voltage d.c. for some of the early experiments which led to broadcast transmitters.

The Pliotron shown in Fig. 165 might almost be considered the first "variable mu" tube. The filament and grid were coaxial helices. The anode was conical, hence the ratio of grid-filament distance to plate-filament distance varied at different points along their common axis. This tube was made about 1919, but only on an experimental basis.

To tube collectors who wish to identify the place of manufacture of specimens of these tubes, the following may be of interest. Many of these earlier General Electric tubes have hand written markings on the press, such as "H-6," "G-25," and the like. Those with the letter "H" were made at the Harrison Lamp Works and those marked "G" were made at Nela Park. The numbers following the letter designation are lot numbers.

When the vacuum tubes made for the Armed Forces by the General Electric Company are compared with those made by the Western Electric Company one fact stands out in a startling manner. Tubes made by these two companies for identical purposes were totally different in appearance, materials, and structure, *yet were interchangeable in use.* As an illustration, let the reader compare the VT-11 described above with the VT-1 made by the Western Electric Company and described in a previous article. Both are shown in Fig. 166. No more forcible illustration could be made to bring out the point that each company brought to the field of development of this new device its own peculiar background of experience, gained through trying to solve its own problems in other fields.

The scientists of these two companies, seeking answers to the same questions had, because of experience, taken different paths but arrived at a common designation.

References

192. *Langmuir, Irving—"The Effect of Space Charge and Residual Gases on Thermionic Currents in High Vacuum." Physical Review,* 2nd Series, Vol. 2, 1913, pp. 450-486. *See also Science Abstracts, A, No.* 725, 1914.

193. *Child, C. D.—"Discharge from Hot Calcium Oxide." Physical Review,* Vol. 32, No. 5, *May,* 1911, *pp.* 492-511.

194. *Lilienfeld, J. E.—"Die Elektrizitätsleitung im extremen Vakuum." Annalen der Physik,* 4th *Series, Vol.* 32, *No.* 9, 1910, *pp.* 673-738.

195. *Langmuir, Irving — "Thermionenströme in hohen Vakuum. I. Wirkung der Raumladung." Physikalische Zeitschrift. Vol.* 15, *No.* 7, *April,* 1914, *pp.* 348-353.

196. *Langmuir, Irving — "Thermionenströme in hohen Vakuum. II. Die Elektronenemission seitens des Wolframs und die Wirkung von Gasresten." Phys. Zeit., Vol.* 15, *No.* 10, *May* 15, 1914, *pp.* 516-526.

197. *Dushman, Saul—"A New Device for Rectifying High Tension Alternating Currents—The Kenotron." General Electric Review, Vol.* 18, *No.* 3, *March,* 1915, *pp.* 156-165. See also *Physical Review, Vol.* 5, *April,* 1915, *p.* 339.

198. *Langmuir, Irving—"The Pure Electron Discharge and Its Applications in Radio Telegraphy and Telephony." Proc. I. R. E., Vol.* 3, 1915, *pp.* 261-293.

199. *Hull, Albert W.—"Negative Resistance." Physical Review,* 2nd *Series, Vol.* 7, *No.* 1, *January,* 1916, *pp.* 141-143. *Abstract of paper presented at a meeting of American Physical Society in New York, October* 30, 1915.

200. *Hull, Albert W.—"The Dynatron—A Vacuum Tube Possessing Negative Resistance." Proc. I. R. E., Vol.* 6. *No.* 1. *February,* 1918, *pp.* 5-35.

201. *Hull, Albert W.—"The Effect of Uniform Magnetic Field on the Motion of Electrons between Coaxial Cylinders." Physical Review,* 2nd *Series, Vol.* 18. *No.* 1. *July.* 1921, *pp.* 31-57.

202. *Hull, Albert W.—"The Magnetron." Journal A. I. E. E., Vol.* 40, *September,* 1921, *pp.* 715-723.

CAPTIONS FOR ILLUSTRATIONS

Fig. 155. Pliotron Amplifier, using 30 "Type P" Pliotrons, used to modulate the 200 kw. Alexanderson alternator at New Brunswick in 1919. Photograph courtesy General Electric Company.

Fig. 156. Hull's Dynatron. Reproduced from Proc. I.R.E., 1918.

Fig. 157. Hull's Pliodynatron. Reproduced from Proc. I.R.E., 1918.

Fig. 158. Kenotron TB-1. Photograph courtesy Bell Telephone Laboratories.

Fig. 159. Wind-driven generator, showing TB-1 tube in mounting. Photograph courtesy Bell Telephone Laboratories.

Fig. 160. General Electric "Type G" Pliotron (VT-11, early CG-890). Left—completed tube. Center—filament and grid assembly. Right—complete assembly on stem. Photograph courtesy General Electric Company.

Fig. 161. General Electric "Type T" Pliotron, VT-12.

Fig. 162. General Electric "Type U" Pliotron (CG-1144, VT-18). Photograph courtesy Bell Telephone Laboratories.

Fig. 163. General Electric "Type P" Pliotron (CG-916 or VT-10). Photograph courtesy Bell Telephone Laboratories.

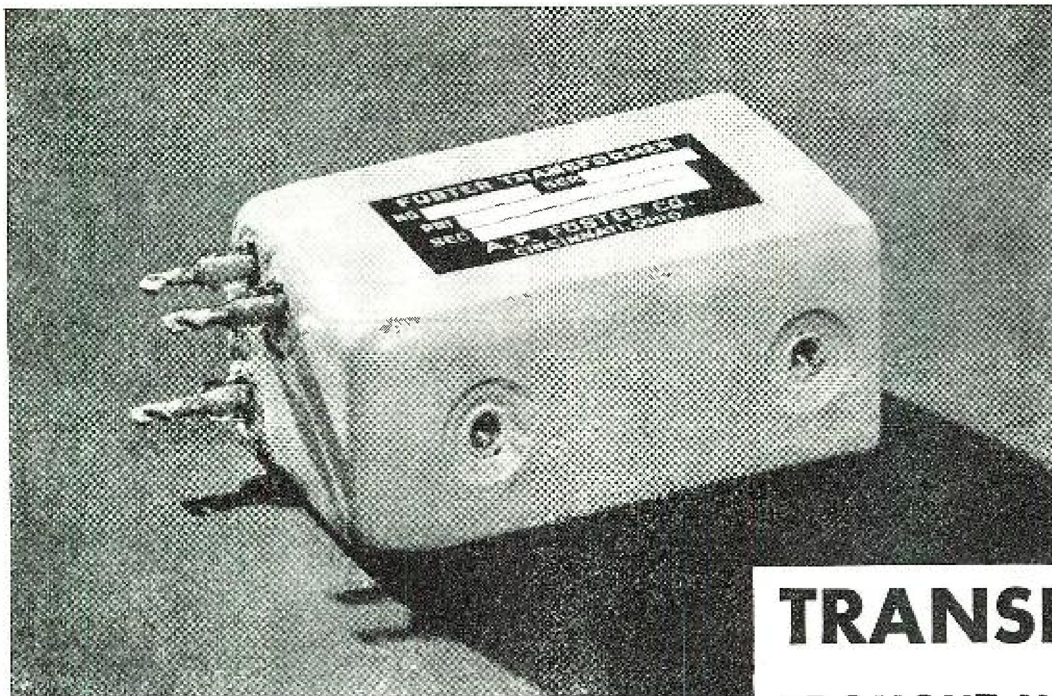
Fig. 164. Small Kenotron with Edison medium screw base and conical anode. Used about 1917.

Fig. 165. Small receiving type Pliotron with helical grid and filament and conical anode. Made about 1919.

Fig. 166. Left—Western Electric VT-1. Right—General Electric VT-11. These tubes were interchangeable in use. Photograph courtesy Bell Telephone Laboratories.

(To be con't in January Issue)

RE DESIGNED "TO ORDER



TRANSFORMER

BROUGHT UP TO PAR BY

FOSTER

Some weeks ago a manufacturer brought this unit, as then being supplied to him, to Foster Engineers for examination. Performance of the original model of this transformer had failed to meet a certain high standard of minimum inductance and maximum resistance. Foster re-designed it, met the exacting specifications, somewhat reduced its over-all dimensions, yet kept the new Foster model interchangeable with the old—no costly changes were required in the product of which this transformer is a part.

It is another example of Foster skill and experience in designing and building transformers for specific requirements that will be of great value in the post-war world of electronic equipment. Our experience covers close tolerance vibrator transformers, output transformers, microphone transformers, saturable reactors, power transformers, audio filters and reactors . . . designed and custom-built to the most exacting individual requirements.

SPECIALISTS IN BUILDING TRANSFORMERS SINCE 1938

A. P. FOSTER COMPANY

TRANSFORMER ENGINEERS & MANUFACTURERS

719 WYOMING AVENUE, LOCKLAND 15, OHIO

Electron Microscopes
(Continued from page 88)

Microscope is practically identical in operation to that of the Universal Microscope. Only a few features have been omitted, such as the fore pressure indicator, the "neutral" position of the valving, and the automatic pressure controlled circuits. No valve position indicator is required as the valve crank moves one and one-third revolutions per position and valve positioning is easily indicated by suitable markings on the side of the microscope hood, each marking spaced 120° from its neighbor.

The small volume of the Console Microscope together with its compact, efficient pumps allow the column to be pumped from atmospheric to operating pressure in slightly over one minute.

The Console Microscope employs only fourteen vacuum tubes which are mounted on two convenient chasses—a high-voltage unit, completely self-

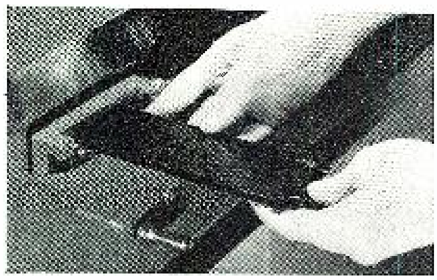


Fig. 13. Photographic plate in light-tight cassette, being placed in machine.

contained, and a low-voltage unit. Both of these chasses can be disconnected and removed from their respective pockets at the rear of the console for service or examination. The high-voltage unit develops thirty kilovolts for the electron beam. Complete operator protection from high voltage

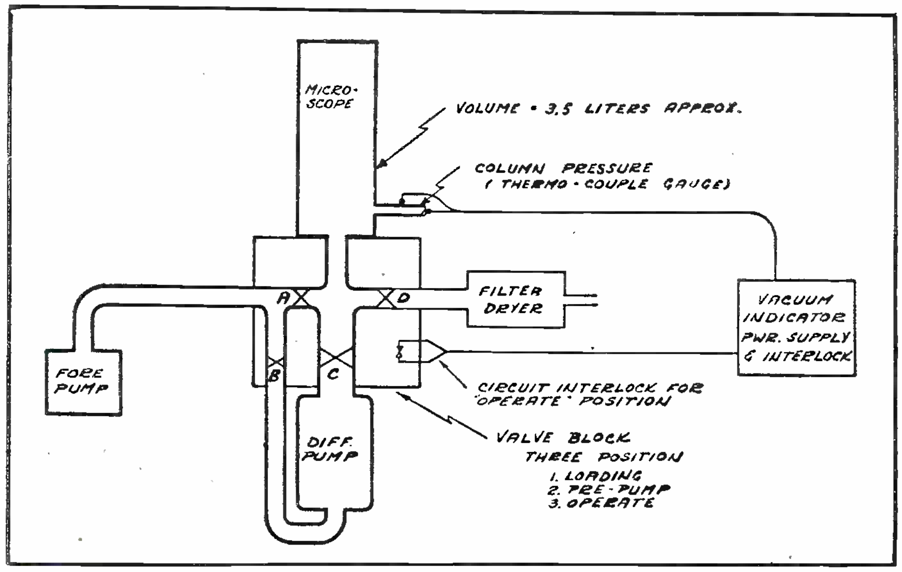


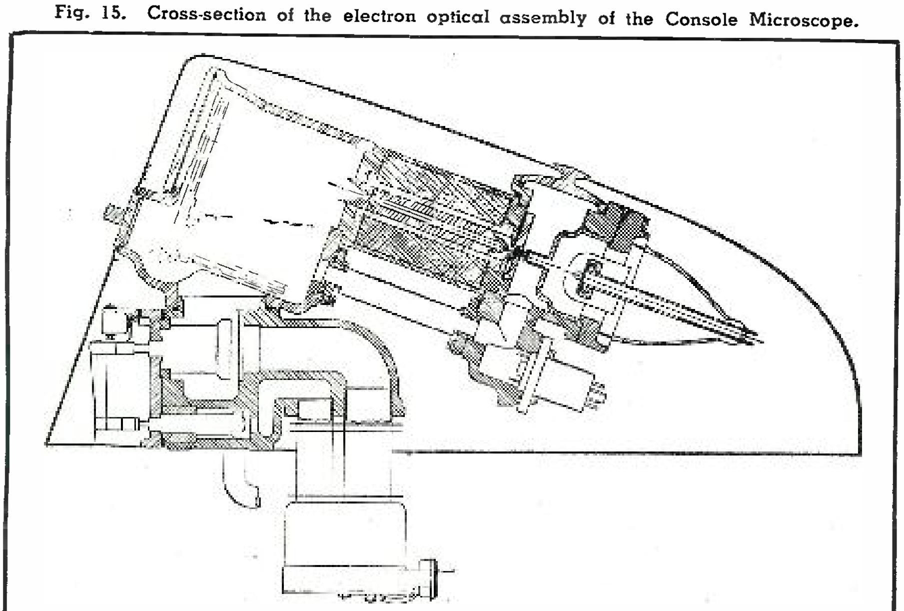
Fig. 14. Mechanical arrangement of vacuum system used in the Console unit.

and X-rays is provided in both new instruments. Both instruments employ only standard, preferred type vacuum tubes for all electronic circuits.

Mechanically the new microscope columns are greatly simplified. Clamping rings, gaskets, sylphon bellows, etc., which are essential parts of demountable and adjustable vacuum systems, have been reduced to a practical minimum. Whereas the type EMB Microscope employed 22 sylphon bellows, the Universal Model uses seven and the Console Model only three. Most of the sylphon bellows were eliminated by design simplification but in certain cases, bellows have been replaced by a recently developed type of rubber seal. These new rubber seals permit rotary or reciprocating motion within the evacuated chambers and render months of continuous service without attention.

The electron optical system of the new Console Microscope consists of four main sections held in accurate

Fig. 15. Cross-section of the electron optical assembly of the Console Microscope.



alignment by mechanical pilots. The removal of only seven screws will permit complete dismantling of the column. The column itself is supported entirely by the valve block which in turn is rigidly mounted on top of the desk. The column is tilted at an angle of about 22° with respect to the desk top so that the viewing screen is brought to a convenient, comfortable position for the operator. Like the Universal Microscope, the column of the Console Model is a complete rigid assembly of the electron optical and vacuum systems.

The viewing chamber, which mounts directly on the valve block, includes the complete camera mechanism. The viewing chamber is also the supporting member for the remaining elements of the electron optical system, which are, in order: the lens unit, the object chamber, and the electron gun. (Fig. 15).

The viewing screen is a plate-glass window coated with a suitable fluorescent material and is large enough to allow examination of a field about three inches in diameter. An opaque marked boundary on the screen identifies that part of the field which will be included on the photographic plate. A 3X lens is conveniently located in front of the viewing screen to assist focusing adjustments.

Access to the photographic chamber is made through a port just below the viewing screen. A cassette similar to that employed in the Universal Microscope, but holding a 2" x 2" lantern slide plate, is inserted into the photographic carriage. The carriage automatically grips the cassette and allows the light-tight cassette cover to be removed. After a suitable field has been chosen and framed in the boundary area of the fluorescent screen, an exposure is made by rotating the camera control handle. A 90° rotation places the camera carriage and cassette in between the electron beam and the fluorescent screen. A further rotation of about 90° opens the cassette and allows the electron beam to impinge

directly on the photographic plate. The carriage is restored to its normal position by rotating it in the opposite direction. The carriage itself provides shielding against extraneous light during exposures.

The lens unit consists of two lenses in one: objective and projector. The magnetic circuit is arranged so that one winding provides magnetizing flux for the two pole pieces which are in series magnetically. This novel arrangement simplifies circuits and components. From an electrical viewpoint whatever current is required to obtain focus for the objective lens becomes the actual current available for the projector lens. The projector lens has been designed so that the required magnification is obtained.

The removal of two screws holding the viewing screen permits access to the pole piece assembly for cleaning. By removing a small insert, forming a part of the projector pole piece, a ten to one reduction in magnification can be obtained. The entire pole piece assembly is of the demountable design, previously described for the Universal Microscope.

The object chamber of the Console Microscope contains a ball bearing stage whose design is similar to the counterpart in its larger companion, the Universal Microscope.

The electron gun includes the condensing lens or illumination control. In this case the condenser consists of an electrostatic element or grid whose potential can be varied to change electron flow and thereby provide uniform intensity control throughout the required range. Since the electron gun filament and condenser are prealigned at assembly, no adjustment is necessary during operation other than to aim the gun occasionally to obtain maximum illumination. The electron gun filament is the same as that used on the Universal Microscope. Filament replacement in the case of either microscope is a matter of only a few minutes, and average filament life is from seventy to one hundred hours.

The control system of the Console Microscope also is designed for operator comfort and convenience. Specimen movement, focusing, intensity and circuit metering are all within easy reach on the two control panels situated on either side of the column. By means of a selecting switch one meter is made to indicate, successively, all major circuit conditions as well as the pressure within the microscope column. The compartment at the end of the right-hand control panel contains the fuses for the major electrical circuits while the compartment in the left-hand control panel provides storage space for spare parts or small accessories.

The Console Model has been designed for semiportable usage. The desk type construction, whose dimensions allow clear passage through a standard thirty inch door, fulfills the requirements of occasional mobility. The Console desk provides a housing for the fore pump as well as all other components (Fig. 10) except the line voltage stabilizer which can be wall-mounted or housed at any nearby convenient location. The only external connections to the desk are the power lines associated with the stabilizer. The fore pump is mounted on a specially-designed shock absorber which prevents any vibrations from reaching the desk and microscope proper. Considerable storage space is provided by the shelving built into the compartments at the right and left of the knee-hole of the desk. Hinged doors at the back of the desk allow access to the fore pump and electrical system.

Both the Universal and Console models of the Electron Microscope can be operated from standard socket power, 115 volts a.c. The Universal models use 1500 watts and the Console Model 1000 watts. Both instruments have vacuum systems which pump their respective columns to better than 0.1-μ of Hg.

The Universal Microscope has a direct magnification range of from 100 to 22,000 diameters, adjustable in forty steps. The Console Model provides two direct magnifications of 500 or 5000 diameters. The photographic negatives produced by either microscope must be photographically enlarged to reveal all the detail present. Enlargements giving total magnifications up to greater than 100,000 diameters may frequently be made.

Electron Microscopes have been found to be of extreme value in a large number of fields. Each year brings new discoveries and extends the list of applications. Instrument design and new developments will and must keep pace with this new science—the science of electron microscopy.

—30—

SERVICE HINT

WARREN J. DOUGHERTY, a serviceman of Kinkaid, Kansas, has called to our attention one of the factors most overlooked when replacing G-type tubes with the more newly-designed GT tubes. Invariably these GT tubes, with metal base, have their No. 1 pin grounded. Inasmuch as many manufacturers use all available socket pins for common tie-points, considerable damage may be caused when grounding the No. 1 pin. A particular case is the RCA Model BT-42 which was originally equipped with G-type tubes. When changing to GT tubes with metal base, the condenser, C16, 400-μfd. condenser and 1-megohm resister, R7, in the plate circuit of the 1H5 should be disconnected from the No. 1 pin of the 1N5 tube socket, as in this particular case, it was used as a common terminal connector. The metal base occasionally will short out the plate voltage from the 1H5 tube, resulting in a nonoperating receiver.

—30—

Spot News
(*Continued from page* 18)

braska (Omaha), WOW; New Jersey (Newark), Bremer Broadcasting Co.; New Mexico (Albuquerque), Albuquerque Broadcasting Co.; New York (Rochester), Stromberg-Carlson; (Buffalo), WEBR, and (White Plains), Westchester Broadcasting Co.; Oklahoma (Oklahoma City), WKY Radiophone Co.; Pennsylvania (Pittsburg), Westinghouse; Rhode Island (Providence), E. Anthony & Sons; Tennessee (Nashville), J. W. Birdwell; Utah (Salt Lake City), Utah Broadcasting; Virginia (Richmond), Havens & Martin; Washington (Spokane), Louis Wasmer, and Wisconsin (Milwaukee), WTMJ.

It appears as if a lively television service awaits the public in the post-war era.

A STUDY OF THE SURPLUS PROBLEM has revealed many interesting facts, one of which is particularly startling. It concerns the manufacture of home receiving sets using surplus stock of automobile sets made in 1942. It was generally believed that all manufacturing of receivers had ceased. Now it appears, however, as if manufacture or "conversion into home receiving sets" as a WPB spokesman called it, has been permitted. The manufacturer who "converted" these receivers was located in Chicago and received permission to do so last year. Large space advertisements in Chicago papers announcing these receivers prompted the search for authorization to construct them. A WPB spokesman admitted, upon inquiry, that such "conversion" had been allowed. How extensive this "conversion" practice has been is not known at this writing. It appears as if it has been quite limited. Undoubtedly, however, other manufacturers will be soon requesting permission to practice "conversion." The results of their inquiries should be quite interesting.

The jobber front has also seen an interesting surplus situation arise. Some weeks ago a regulation governing sales of electronic parts and equipment in excess and idle stocks was issued. Many jobbers assumed that this regulation lifted all barriers and provided an opportunity to sell as the traffic warranted. This, of course, was not the case since priority ratings were required for these sales. Accordingly, Ray C. Ellis, director of the WPB Radio and Radar Division issued a clarifying statement explaining the amendment and what restrictions it eliminated. Mr. Ellis said that the amendment lifted prohibition against special sales of excess and idle stocks on list B to wholesale dealers. Thus wholesale dealers may buy excess and idle stocks if rated AA-5 or better, but it does not give them the rating for that purpose. Wholesalers may use ratings which they have obtained otherwise and are legally entitled to apply or extend under WPB regulations.

The surplus situation is receiving special attention from an RMA unit, too. The group concerned with surpluses met in New York recently. Ray C. Ellis and Samuel Drucker, in charge of war surplus problems under Mr. Ellis, spoke to the members explaining the problems and their possible solutions.

Obsolete equipment remains one of the gravest problems in the surplus situation. The FCC is naturally very much concerned with the disposal of mobile transmitting equipment and particularly the walkie-talkies. Falling into the hands of the underworld element, such equipment would be used for many illegal forms of transmission. It is entirely possible therefore that this equipment may be either kept off the market entirely or allotted very carefully to such industries as buses, taxicabs, trucks, and medical. Of course, there will be the problem of frequency distribution. It is well known that there are not too many frequencies available and whether or not any channels can be spared for this type of work it is difficult to predict.

A surplus plan has also been initiated in England. In this plan distribution and price will be controlled, while the release of stocks will be gradual. There will be no flooding of the market according to officials who prepared the proposal. Distributors of this surplus merchandise will include manufacturers and dealers normally handling the equivalent type of merchandise. The proposal indicates, too, that profiteering on the part of distributors will not prevail. No definite date as to the introduction of the plan has been set yet. It is generally believed that modified versions of the procedure have been applied during the past months, and shortly after the first of the year the present plan may be put into full operation.

THE STREET CAR SYSTEM IN WASHINGTON, D.C. will soon have an emergency radio link in operation. A license to install such a system was recently granted to the Capital Transit Company, who will install this equipment in thirty mobile units. These mobile units will consist of emergency trucks, supervisors' and inspectors' automobiles.

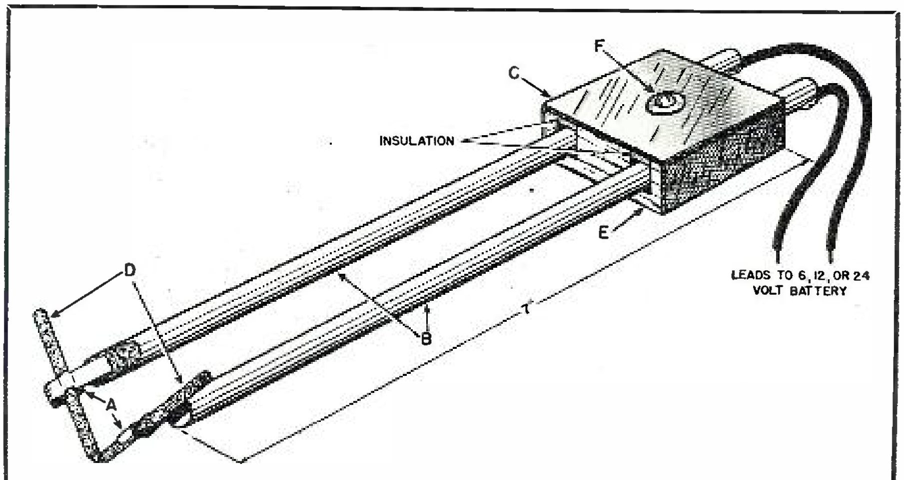
THE DESIGN OF THE FIRST BRITISH civilian wartime receiver was recently disclosed. The receiver

Another "G.I." Soldering Iron

THE problems that one G.I. radio technician met in attempting to service radio receivers with only the parts available were described by Walter Fernald in his article "G.I. Radio Servicing", which appeared in the May, 1944 issue of Radio News. Since that time, an influx of comments, suggestions, and new ideas has been received with reference to the solutions presented in the article.

One of the best of the new ideas was grooved to hold the copper tubing; old flashlight carbon rods (D); and a machine screw (F) to hold the cover and wood spacer block together.

It is necessary to use tape, or other insulating material, on the metal cover, on the side next to the copper tubing. The tubing should not be even with the top of the wood spacer block, as the metal cover with the insulating material underneath holds the tubing in place and by loosening the machine



received from Cpl. Frank K. Brockwell of Camp Polk, Louisiana for another type of soldering iron. This portable iron can be used with only one hand and will work on a 6, 12, or 24-volt battery. It will solder any size wire and can be made of any scrap material available.

The diagram shown gives the simple layout of the iron. It consists of 2 small metal spring clamps, battery clips, etc. (A); 5/16" copper tubing (B); a metal cover (C) with wood spacer block (E) screw, the two pieces of tubing can be rotated for the correct angle for the carbon rods. The small clips that hold the carbon rods can be soldered to the tubing, as the tubing never gets hot!

This iron should come in handy as a gadget for any radioman who cannot obtain a standard soldering iron. At any rate, it is another good servicing suggestion and any other ideas that might be of value to servicemen will be more than welcome. The Ed.

uses four tubes. The first is a triode-heptode type similar to our 6J8G; the second is an r.f. pentode and this is followed by an a.f. pentode. The rectifier is a heater type. Fixed and variable iron-core i.f. transformers are used. Receivers are for a.c. About 42 manufacturers are expected to start producing these civilian receivers. A battery model will be announced soon, too.

A CANADIAN RTPB may be placed in operation soon. The controller of radio of the Department of Transport, Walter A. Rush, met with members of the industry and other government bodies recently to discuss the possibility of organizing a board which would be similar to the U.S. board with its 13 panels. The procedure of calling for volunteers from the various engineering societies, broadcast stations, and industry itself, adopted in the United States, will probably be followed in Canada.

THE AVALANCH OF FM INTEREST at the recent war conference prompted many to inquire as to whether FM was to become a feature of NAB promotion, and allied to the FMBI (Frequency Modulation Broadcasters, Inc.). Spokesmen of NAB pointed out that their organization is one concerned with all broadcast services and accordingly FM, television and other new radio develop-

(*Continued on page* 148)

Servicemen's Meter

(*Continued from page* 50)

tions are complete, cover the dial with a disc of thin sheet celluloid.

Assume the meter is all wired and ready to calibrate, plug into a 110-volt socket, turn on S_3 and allow the VTVM to warm up for five or ten minutes. Short the grid of the input tube to chassis and turn S_1 to low-volts position. Turn R_6 so that the slider is nearest ground potential; that is, at junction of R_3, R_5, and R_6. This is the dial position for lowest voltage reading. Now set R_5, the zero adjust, until the shadow in the 6E5 tube almost closes. Leave a thin hairline shadow, as this is the easiest to adjust for when taking readings.

If a positive d.c. or an a.c. voltage be applied to the grid of V1, the shadow angle of V2 will open up and by turning R_6 up from its original position, a bucking voltage is applied across R_1, and the shadow returns to its zero setting if the bucking voltage equals the increase in voltage across R_1. Turning R_6 too far causes the shadow to overlap. If more than 9 volts are applied to V1, the maximum setting of R_6 will not close the shadow and S_1 must be set to the high-volts position and R_7 adjusted to close the eye. If a high voltage be applied to V1 the target of V2 will darken somewhat until R_6 or R_7 be adjusted to proper bucking voltage, whereupon the target will resume its original brightness. If R_7 is turned to its maximum position and the eye will not close, it indicates over-voltage on V1.

To calibrate the VTVM, a multi-range a.c. and d.c. meter is required. For d.c. use a stable power supply or "B" batteries and a high resistance potentiometer for a voltage divider. Connect the end terminals of the potentiometer across the supply, and the d.c. voltmeter across the negative and the slider of the potentiometer. Connect the ground post of the VTVM to the negative of the supply and the grid of V1 to the slider of the potentiometer or to the positive terminal on the d.c. meter, whichever is more convenient. See Fig. 2. When taking readings from the d.c. meter use the range which will place the reading near the center of the meter scale, as the moving-coil meters are most accurate in the center third portion of their scale. Suppose the d.c. meter reads 3.7 volts. With S_1 on low-volts position, turn R_6 until the eye returns to zero setting. Now, with a pin or sharp pencil, make a slight mark on the dial. Do this by sticking the pin through the appropriate hole drilled in the celluloid pointer. Print in the mark or numeral for 3.7 with india ink; and with a ruling pen draw a short line through the mark made by the pin. In like manner calibrate the full low- and high-volt d.c. scales, with the exception of the part below 1 volt. From here on down use the voltage divider R_{11} and R_{15}; this will divide the voltage by 10. This is the best way of calibrating the lowest ranges if you do not have a meter that reads ½ or 1 volt full scale. Connect the potentiometer arm and meter across the d.c. jack and ground, and the input lead from V1 to the probe jack.

For calibrating the a.c. scales the procedure is about the same as the d.c. except that you use some variable source of a.c. in place of the d.c. power supply. A tube checker makes an ideal source of voltage from 1.5 to 117. Solder two leads to the filament prongs of an old tube base, plug into the checker and connect the leads to the same potentiometer as used in the d.c. calibrations. On the lowest ranges use the VTVM voltage divider as above. If you do not have a tube checker around the house, a toy train transformer can be used with an old output transformer to give a wide range of a.c. voltages.

To calibrate the ohms scale set S_1 on the center position and, in the ohms-capacity section, plug the probe (or a lead from grid of V1) into the jack marked "PROBE." Set S_2 at the Rx1 position. Across J_1 and J_2 connect known values of resistance and adjust dial until the eye returns to zero. Mark and letter in the dial as in making the voltage calibrations. On the Rx1 range, the ohms read from 1 ohm to 10,000 ohms; and on the next range the above values are multiplied by 10. If you have a decade box of precision noninductive resistors available you can calibrate your ohms scale with a very good degree of accuracy, and you can add a scale for rough impedance measurements by setting S_1 at the left-hand (capacity) position and calibrate as for ohms resistance. To calibrate the capacity scale, use the same switch settings as for impedance calibrations and insert various known values of capacity across J_1 and J_2. (Note: the capacity section is not to be used with electrolytic condensers.) If you do not have a decade box or any calibrated condensers, gather up some carbon resistors and paper dielectric condensers and head for the nearest telephone company. They usually have a high precision resistance and capacity bridge on their test board and you can probably persuade the engineers to measure your R's and C's for you. By various combinations of series and parallel connections you can secure sufficient calibration points. When using the ohms or capacity section to measure unknowns, use the setting of S_2 which will give a shadow angle of about 45 degrees on the 6E5 tube. Whenever possible, avoid a switch setting that gives an extremely wide or extremely narrow shadow because the greatest accuracy is obtainable when the angle is approximately 45 degrees. When measuring ohms on the two highest ranges be sure to use a shielded test lead in J_1. And when measuring capacity on these same two ranges use the shortest leads possible. The best method is to fasten alligator clips to phone tips by soldering them together. Make up two of these and use one each in J_1 and J_2. These same clips are preferable to a test lead when measuring extremely high resistance.

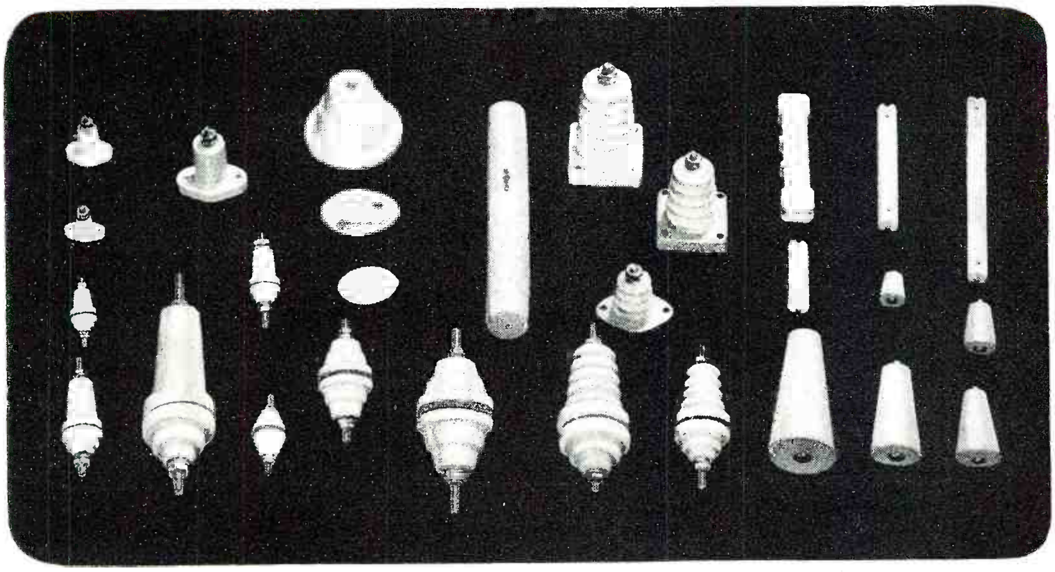
If the range of external voltages to be measured is beyond 113 volts a.c. or 170 volts d.c., plug the probe into the "PROBE" jack of the voltage-divider and plug a test lead into the a.c. or d.c. jack of the voltage-divider as desired. This extends the range by a factor of 10. Of course, when using the voltage-divider, connect the ground post of the VTVM to the ground of the unit being tested. To measure negative voltages up to 9 volts, plug a test lead into the ohms jack J_2 and set S_1 to the center position. Connect the test lead to ground of the unit being tested and the probe to the negative side. This makes the unknown 9 volts positive with respect to the probe, and the negative voltage equals the dial reading subtracted from 9. Current can be measured by inserting the probe into the "PROBE" jack of the ohms section, and the current to be measured across J_1 and ground so that the current flows through R_8 or R_9, etc. Adjust S_2 for a visible shadow on the 6E5, using the lowest resistance setting of the switch that you can use and still have a readable shadow on the eye. By reading the voltage on the dial and knowing the resistance which S_2 connects to, the current can be computed by Ohm's Law. A separate scale can be calibrated for current but this is hardly necessary since the divisor, R_8 or R_9, etc. is always a power of ten and the computations can be made mentally. Suppose that the dial reads 1 volt and S_2 is set at Rx1. That means that the current being measured sets up a drop of 1 volt across 100 ohms and since I equals E/R, I equals 1/00, or 0.01 ampere. It is best to connect the ground post of the VTVM to the ground of the unit being tested and measure the current at its return to ground by connecting it to J_1. Otherwise the whole VTVM will be above ground, which may unbalance a sensitive circuit or be dangerous if measuring the current in a high-voltage circuit.

In constructing the VTVM no elaborate precautions need be taken and extensive shielding is not necessary. Only see that the resistors and wiring of the multiplier and ohms section are not in the magnetic field of any transformer or choke. In case of doubt shield these sections. It is best to mount J_1, and J_2, and the "PROBE" jacks on the metallic front panel of the chassis, and the related parts connected to these jacks by short leads. The construction of this VTVM would make a good project for beginners' radio classes where the mortality rate of conventional meters runs rather high. Besides that, it will furnish good instruction in the cathode-follower type of circuits which are becoming increasingly popular with the designers of high-grade audio equipment.

-30-

Insulators

BY ENGINEERS



Johnson Radio Engineers have been specialists in insulator design for radio frequencies for almost a quarter of a century. Shapes to provide strength for strains and stresses—reinforced mounting holes and carefully designed mountings—high internal resistance to radio frequency voltage—long leakage path—careful treatment to present a surface that will not collect dirt and foreign matter—quality hardware, not punched nuts and poorly formed parts—materials selected for their radio frequency characteristics, not the "flower pot" variety of ceramics.

To Johnson Engineers an insulator is a piece of radio apparatus and given the same careful attention in design and production. As a result you can't buy a better insulator than Johnson. Send your next insulator problem to Johnson for recommendations and quotations. No obligation.

Ask for Catalog 968Z.

ANTENNAS

CONDENSERS

TUBE SOCKETS

PLUGS & JACKS

INSULATORS

INDUCTORS

BROADCAST EQUIPMENT

CONCENTRIC LINE

ARMY NAVY

JOHNSON

a famous name in Radio

E. F. JOHNSON CO.
Waseca, Minnesota

LETTERS FROM OUR READERS

SCREWDRIVER MECHANICS VS. LICENSEES

"AS FOR "screwdriver mechanics," that's the way most of the servicemen got started, and even you, Mr. Berger, must have puttered around a little, at least at first. If 'SM's' can't repair, what loss is it to you; the radio comes to you and you can collect a nice fee for fixing it up like new.

"But what I really think is this: Let the beginner be, for if, just as it is with a 'legitimate' radio service, you can't do a good job, you lose a customer, and he never comes back. But if you license the serviceman, you stop the beginner from buying radio material, therefore, his knowledge stops, because no matter how much theory he has in his head, you put him in front of a radio to repair and he is stumped. So, if you license, you stop future repairmen who will take your place someday.

"I do agree with Mr. Berger about the manufacturer, it would help a lot when you are in a hurry."

LEROY F. WILLOUGHBY,
Radio-Telephone 1st,
Northwest Radio, Detroit,
Michigan.

"MY ANSWER is that I am 'agin' it for two reasons, the first is that I consider it to be darn poor sportsmanship to try to force people to deal with me and my gang if they would rather not. The other reason is that it will neither work nor do any good to anyone excepting to the one who collects the license money.

". . . Visit ten radio shops. Notice the difference in equipment, prices, training and workmanship. None of this would be changed in the least by licensing, so where is there anything to gain? More than twenty years in radio servicing and more than fifty thousand repairs have convinced me that if one treats his public right by doing good work as promptly as possible, he will eat quite regularly and even have to worry about the income tax.

"And isn't it much better to have the work come to us because the people want us to do it than to tell them they must bring it to us because we have a license?

"Let's worry more about the work we do, than about the work we think some screwdriver mechanic is getting."

CHARLES PILGRIM,
Aitkin, Minnesota.

"AT THE end of the letter from Mr. Berger of New Jersey you asked the readers what they thought of his suggestions to eliminate the so called 'screwdriver mechanics' from radio repairing.

"Could it be that Mr. Berger has some deeper motive? Could it be that some time in the not-too-faraway future the army will release thousands of penniless radio technicians who will jeopardize Mr. Berger's gravy train?

"Yes, it would be nice for some if all these men were controlled by licensing only the shops financially able to purchase expensive test equipment, but I think those few would do better by their country if they were to suggest some legislation to help postwar rehabilitation instead of hindering it.

"We army technicians have to work with a minimum of equipment and know that it does not take a room full of gadgets to repair the radios the average repair shop operator is faced with.

"Let's keep this the free country that we are fighting for and let the public decide whether the 'screwdriver mechanic' is capable or not."

CPL. DARREL S. KNOX,
Signal Corps.

"I HAVE advocated Federal Licensing of Radio Servicemen for the past four years and have fought for it in spite of opposition. I believe that it and only it will clean up the sorry mess we find ourselves in.

"In Philadelphia, as in other cities, we have hundreds of gyps, thieves, or whatever you wish to call them, who are preying on the general public and nothing is being done about it.

"They have no regard for honesty whatever, charge for parts never installed and worst of all, in spite of the outrageous prices charged, the radios are often in worse shape after their 'repair' than they were originally. Radio is a highly technical item and one which the public does not understand so they swallow the diagnosis of these "saw and hatchet" men and pay what they demand. This definitely should be stopped and it should be done by the radio industry itself. The Better Business Bureaus don't seem to find time to prosecute these thieves but allow them to continue after a complaint has been adjusted. I know of three outfits here that have stacks of complaints against them yet the newspapers still accept their lying advertisements knowing full well that they are clipping hundreds of their readers whom the papers are supposed to protect from dishonest businessmen. If these men had to take a Federal Examination along the same lines as they now give to radio operators, in which they could not "fenagle" their way through unless they really knew their stuff, it would force them out of business and leave the field open for those who can do a good repair job and honestly charge a reasonable fee for their work. In addition, I have suggested that all of the better class

PLAN YOUR PLANT DRIVE NOW!

Good organization will be needed to sell the 6th. The task of raising the huge sum required will be the most difficult ever asked of Industry. As each new military success brings us closer to Victory, the public naturally will feel that the urgency of war financing is lessened—whereas it isn't. So organize now to prevent a letdown on the home-front from causing a letdown on the fighting front. Build your plant's payroll campaign around this fighting 8-Point Plan. You don't have to wait for the official Drive to start—swing into action NOW!

1 BOND COMMITTEE—Appoint a 6th War Loan Bond Committee from labor, management and each representative group of the firm.

2 TEAM CAPTAINS—Select a team captain, for each 10 workers, from men and women on the payroll—but not in a supervisory capacity. Returned veterans make most effective captains.

3 QUOTA—Set a quota for each department and each employee.

4 MEETING OF CAPTAINS—Give a powerful presentation of the importance of the work assigned to them. Instruct them in sales procedure. Have them carefully study the Treasury Booklet, *Getting the Order*.

5 ASSIGNMENTS—Assign responsibilities for:
- (a) *Music, speeches and announcements of the opening rally.*
- (b) *Pre-drive letter to employees from management and labor.*
- (c) *Competitive progress boards.*
- (d) *Meeting schedules, etc.*

6 CARD FOR EACH WORKER—Dignify each personal approach with a pledge, order, or authorization card made out in the name of each worker. Provide for a cash purchase or installment pledge. Instruct each captain to put a pencil notation on the card to indicate the subscription he expects to solicit from each worker.

7 RESOLICITATION—People don't mind being asked to buy more than once. Resolicit each employee toward the end of the drive in a fast mop-up campaign. Call upon your State Payroll Chairman; he's ready with a fully detailed plan—NOW!

8 ADVERTISE THE DRIVE—Use all possible space in the regular media you employ to tell the War Bond story.

The Treasury Department acknowledges with appreciation the publication of this message by

ZIFF-DAVIS PUBLISHING COMPANY

This is an official U. S. Treasury advertisement prepared under the auspices of Treasury Department and War Advertising Council of servicemen should join the Institute of Radio Engineers as Associate members and when a representative number are in, that a separate section be formed in which they would hold their own meetings and yet have access to the general meetings of the IRE.

In this manner they would improve their standing intellectually and gain a professional status. I discussed this with Dr. Wheeler when he was president of the IRE and he is in accord.

. . . "I would like to see more comments on the plan from your readers and think that editorial comment might bring them out in quantity."

Richard G. Devaney,
Philadelphia, Pa.

It would seem that Mr. Berger's snowball has reached avalanche proportions. Editorial comment on the letters received does not seem to be necessary to get our readers to send us their ideas on this subject. If you are interested, please drop us a line.

* * *

A SOLDIER'S REQUEST

"WE ARE a group of boys, about 700 of us, at Camp Edwards, Massachusetts. We wonder if any of your readers would be kind enough to donate a television receiver to us. You see, three-fourths of us are overseas veterans who have been hurt or have come back on rotation. There is not much for us to do and less in the winter. I have just come out of a hospital where we had some television sets given to us. I know how to set one up and how to operate it as I have done that kind of work in civilian life.

"Thank you from all of us and myself."

Pvt. Robert B. Blauvelt No. 32769428,
SCU 1137 Headquarters Company,
Camp Edwards, Massachusetts.

Here is a real chance to lend a helping hand, readers. If you have any suggestions, please write directly to Pvt. Blauvelt at Camp Edwards.

* * *

ANNIVERSARY ISSUE

"CONGRATULATIONS on your article on Amateur Radio Progress in the July issue of Radio News. It's a great idea to keep the accomplishments of Ham Radio in the public eye in preparation for that day of reckoning when frequencies are re-allocated. Thanks, too, for the pictures of your rig and its development through the years.

"Most of us today spend all our time fighting this war, but many others like myself still find time to mull over ideas for the postwar rig and even get down to actual design data. In this respect, the ideas you have developed and improved in your rigs would probably be of great interest. Such items as how to design the panel for convenient operating, remote control problems and safety interlock precautions, necessary in medium and high power rigs. Also the gauge of metal you found best to work on, and numerous other problems that arise when we convert a paper and pencil rig to the real thing. Many of us can lick the design problems as far as the basic transmitter circuits are concerned (those who cannot copy) but I've found that what really counts is the way we put the monster together. It is the certain 'know how' gained by years of building that newcomers like myself (since 1938) are missing out during this war. The only way to come out on top after the war would seem to be to rely on you old timers and draw on your experience. What say, can you help us?"

Ensign Douglas Laster,
Radio Material Office,
Key West, Florida.

All right, old timers, how about passing your knowledge around for the "newcomers."

* * *

PHILCO VS. RCA

"RCA will be very unhappy when they see you calling one of their chasses a Philco on page 54, Fig. 2 of the July issue of Radio News."

John T. Hesse,
Hamden, Conn.

"IN REGARD to Fig. 2 on page 54, of your July, 1944, issue of Radio News, I wish to call your attention to a rather grave error. The title under this picture refers to the set as being one of Philco's receivers. The set is actually one of RCA's receivers. Who are you trying to advertise anyway? Next time be more careful. Shame!"

Pvt. Walter T. Selsted,
Signal Corps.

"JUST a line to say that Louis Piazza is really going to town, (see Radio News, July 1944, the caption says Philco) for he doesn't seem to be over half finished with his job and already the chassis has been converted from a Philco to what looks very much like an RCA chassis to me. Don't you think that is carrying 'conversion' to extremes or can we expect such as this before we see any more 12SA7's, 1H5's, etc. Anyway as long as Mr. Piazza is in Philadelphia maybe there is some excuse for Philco horning in."

Pace's Radio Service,
Vicksburg, Miss.

Thanks to all those observant readers who called this "slip" to our attention. Sorry we couldn't print all your letters, due to lack of space.

—30—

MILLIONTH CRYSTAL

THE one-millionth "Type X" crystal for the Army Signal Corps has been completed by RCA's Victor Crystal Division in Camden, New Jersey.

The accomplishment was announced by H. E. LeRoy, Camden Works Manager, in a ceremony carried over the plant's internal broadcasting system when the millionth crystal, in a gold-plated container, was presented to Col. Eugene V. Elder, commanding officer of the Philadelphia Signal Corps Procurement District. —30—

THERE IS NOTHING TO DO ABOUT A WAR EXCEPT WIN IT!

The purpose of this advertisement is NOT to brag about Thordarson's part in the war effort. While patriotism in a person or company may be something to be proud of, our own feeling is that it should not be exploited. Expressing patriotism in America is not even a duty; rather, it is a privilege . . . happily one that is understood and appreciated by the majority.

That is why, for nearly 3 years, Thordarson has talked little about the war and war production . . . except to make the bare statement that we were busy supplying materials for the armed forces.

Regardless of all this, we do think the time is now propitious to give a few more details as to what we are thinking and doing.

When war came, we were one of the first companies to be chosen for front-line production duty. The need was urgent . . . the demands were great. As Americans, we were glad wholeheartedly to tackle the job assigned to us.

Early and late . . . day and night . . . Sundays and holidays, we have continued to devote all of our efforts, 100% to winning the war. We have kept "eyes front" on this one task. We have had to forget, for the moment, personal considerations of "good business" . . . on occasion we have even had to turn down old and good friends who needed this or that which, under ordinary conditions, we would have been tickled to death to supply.

The time will come . . . it's coming shortly, we feel . . . when we again can think first and foremost of supplying civilian needs. That will be a far happier day for us than it could possibly be for you, no matter how much you have needed material you were unable to secure.

But meantime, the war goes on . . . and we, in our small way, must continue to stand guard at our appointed post until the "at ease" command is given. As we said in the beginning: THERE IS NOTHING TO DO ABOUT A WAR EXCEPT *WIN* IT!

THORDARSON

TRANSFORMER DIVISION
THORDARSON ELECTRIC MFG. CO.
500 WEST HURON STREET, CHICAGO, ILL.

Transformer Specialists Since 1895

. . ORIGINATORS OF TRU-FIDELITY AMPLIFIERS

WORLDWIDE LOG OF SHORT-WAVE BROADCASTING STATIONS

(Continued from page 110)

Africa, 3:30-4:30 p.m. (Arabic). To Southeastern Europe and Italy, 1-3:30 a.m. To Spain, Portugal, and Northeast Africa, 2:30-3:15 p.m.

9.690 JIE2 TAIHUKO, TAIWAN. Heard 9:30-11 a.m. English news, 9:30 a.m.

9.700 WRUS BOSTON, MASSACHUSETTS. Worldwide Broadcasting Corporation. Central American beam, 7:30 p.m.-2 a.m (Spanish-Portuguese).

9.730 XGOA CHUNGKING, CHINA. The Central Broadcasting Station. 1:30-2:40 a.m. and 6:30-10 a.m. News, 10 a.m.

9.740 CSW7 LISBON, PORTUGAL. North American beam, 8-9 p.m. (Portuguese). Identification at close—bells that sound much like Big Ben, followed by single gong.

9.750 WKLJ NEW YORK, N. Y. European beam, 3:30-3:45 p.m.

9.760 —— "DEUTSCHER KURZWELLENSENDER ATLANTIK" (RADIO ATLANTIC), clandestine, heard from about 8 p.m. to 1 a.m. All of transmission is in German. News, 8:30 p.m. Program begins with "Achtung, Achtung." This station is reported to be somewhere in "Fortress Europa," and is coming in loudly in the evenings on this frequency, and occasionally near 6.22 megacycles. This station on July 20 broadcast the first news of the revolt against Nazism within Germany. With the Soviet tidal wave rolling westward, "Atlantiksender" (as it sometimes announces) has lately been playing with emphasis the little German ditty, "When Jerry Comes Marching Home." Also heard afternoons, after 12:30 p.m., in German, with U. S. music being played.

9.783 RNB "RADIO NATIONAL BELGE," LEOPOLDVILLE, BELGIAN CONGO. (Also reported as 9.785.) Relays the BBC's North American Service from 9:30 p.m. to 12:45 a.m., with BBC news at 10:45 p.m. and 12:30 a.m.

9.825 GRH LONDON, ENGLAND (BBC). North American Service, 5:15 p.m.-12:45 a.m. To New Zealand and Pacific Area, 1-5 a.m. (Pacific Service). To Near East and East Africa, 3-5 p.m. To West Africa, 3:30-5 p.m.

9.835 —— HUNGARIAN NATIONS RADIO. Heard, 6:15-6:28 p.m. and 7:15-7:28 p.m.

9.864 CR7BE LOURENCO MARQUES, MOZAMBIQUE. Heard each Thursday and Friday, 4-5 p.m.

9.870 —— RADIO PRAHAVA (clandestine station). Heard 5-5:08 p.m. and 6-6:08 p.m.

9.890 KROJ ARMED FORCES RADIO, LOS ANGELES, CALIF. To American forces abroad, 4 a.m.-2 p.m.

9.930 —— "SOLDATENSENDER MITTELMEER," ATHENS, GREECE. Heard on East Coast, 2-7 p.m. Has American music, speech is in German.

10.005 —— "VOICE OF FREE ARABS." Heard, 2:15-2:33 p.m.

10.042 DZB BERLIN, GERMANY. Full schedule not known, but heard at 5:45 p.m., probably carries North American Service from Berlin, 5:50-midnight.

10.050 SUV CAIRO, EGYPT. Heard irregularly, 7-9 p.m. Calls New York with spot relays for the national networks in that city.

10.280 XGAP PEIPING, CHINA. Heard, 9-11:50 a.m. (Home Service). Frequency also is reported as 10.250.

10.335 ZFD ST. GEORGE, BERMUDA. Reported heard almost every morning at 9 a.m., calling WNB.

10.338 HEO4 BERN, SWITZERLAND. Heard beamed to South America, 7:30-9 p.m. English program to America 3:45-4:15 p.m.

10.540 DZD BERLIN, GERMANY. 5:50-midnight, News, 9, 10, 11 p.m.

10.780 SDB2 STOCKHOLM, SWEDEN. Heard irregularly at 12 p.m.

11.040 CSW6 LISBON, PORTUGAL. Heard in Portuguese, 4-5 p.m. Also reported from 2-7:45 p.m.

11.090 —— PONTA DELGADA, AZORES. Heard, 2-3 p.m.

11.410 —— RADIO DAKAR, DAKAR, FRENCH WEST AFRICA. Heard, 4-5 p.m. in French.

11.445 —— RADIO MOSCOW, MOSCOW, U.S.S.R. All-English program, 7:40-8:25 a.m. daily. (News generally is given at start of transmission.)

11.470 —— "VOICE OF FREE INDIA." Heard, 11:35 a.m.-12:05 p.m. in English. News, 11:35 a.m. Sometimes heard from 10 a.m. to 12:05 p.m.

11.535 DZA BERLIN, GERMANY. Has been heard at 12:41 p.m. with prisoner-of-war messages.

11.623 COK HAVANA, CUBA. Noon to midnight. (Verification gives frequency as 11.570 mcs.) News in English, 9 p.m.

11.630 —— HUNGARIAN NATIONS RADIO. Heard, 8:15-8:30 a.m.

11.645 RNB LEOPOLDVILLE, BELGIAN CONGO. Is now back on this frequency; heard in German, 12:30-12:45 p.m.; French at 12:45 p.m. Full schedule not known. News at 8:30 and 9:10 p.m. (English). (Frequency also reported as 11.645 mcs.)

11.650 XGOK CANTON, CHINA. Home Service, 5:30-9:30 a.m.

11.675 DHK PODIEBRAD, BOHEMIA (CZECHOSLOVAKIA). Presumed to be relaying Berlin in Pacific Service at 8:15 a.m. in English, in paralled with DJL on 15.11 mcs. Full schedule not known.

11.680 GRG LONDON, ENGLAND (BBC). To Iraq and Iran, 1:30-4 a.m. and 10 a.m.-1:45 p.m. To North America, 6:15-7:15 a.m. and 5-8 p.m. To Near and Middle East and Italy, 5-5:30 a.m. (Hindustani or English). To North America, 4:15-5 p.m. To Near East, 5:30-5:45 a.m. (Arabic and Turkish).

11.695 XGRS SHANGHAI, CHINA. Heard from 7:15 to 8:20 a.m. English news, 7:15 and 7:40 a.m. Prisoner-of-war messages, 7:50 a.m. (Also reported as heard 4 a.m.-12 noon, with news at 10:15 and 11:15 a.m.

(To be continued)

Versatile Gadget

(*Continued from page 47*)

known load, such as a 50 or 100-watt soldering iron, should be noted carefully. A fairly close approximation of the load under test can be had from the brilliance of the lamp. When a series lamp is used in this manner, the load being observed would not be operating at its full load capacity.

If a 50 to 100-watt receiver were to be connected using a 200-watt lamp in series, this lamp would glow dimly. If the lamp would light up to full brilliancy, it would immediately indicate that the receiver is drawing a considerable overload.

A 100-watt lamp is sensitive to changes in receiver "B" current. In one case an old set was plugged in for a preliminary test. When the tone-control knob was operated, the lamp showed changes in brilliancy. This at once suggested a varying drain on the "B" supply, possibly a shorted condenser in series with a rheostat. An ohmmeter revealed that the .25-μfd. condenser connected between the output plate and ground through a 10,000-ohm control provided a solid d.c. continuity.

With a.c.-d.c. sets the change in brilliancy of the lamp may be noted as the tubes warm up. Normal operation shows this characteristic change.

Such a preliminary test, with a 50-watt lamp, is a procedure highly recommended in these times. It protects tubes and other parts from serious overload and gives information not readily obtainable in other ways. A dead short would blow up a wattmeter but cannot harm the lamp.

Moreover, the receiver may be left on test through a lamp of proper size. Any serious change in loading, any breakdown of a rectifier tube, can be discovered when it happens. This is a double-utility test, protecting the receiver and indicating the trouble.

Continuity

Sometimes a cut-out in a cord is difficult to locate. With the series lamp, it's easy. Just plug in the cord, see that the lamp glows, then shake or twist the cord until the lamp flickers or goes out. The break can be found without trouble.

For testing continuity of high impedance coils a smaller lamp should be used. A 7½-watt lamp will show a bright glow through a Telechron motor coil whose 60-cycle impedance is about 3000 ohms.

Since the full rated current of this small lamp is only .062 ampere, it may be used for testing continuity of tube filaments.

Switches and relay contacts may be tested under load. Trouble is instantly indicated by the lamp. When testing contacts with this circuit, it must be remembered that full line voltage appears across the gap when the contacts open. Sparking may occur if this voltage is several times higher than the voltage for which the relay was designed.

Voltage Reduction

Old timers will remember that in the days of d.c. distribution, a standard way of reducing voltage was by means of series lamps. Today the same principle is employed in a.c.-d.c. radio receivers to reduce the line voltage to the value required by the series filaments. Voltmeter multipliers are usually series resistors.

The series lamp may be used to reduce the voltage applied to any load. The lamp acts as a voltage-dropping resistor. Voltage control is obtained by changing the size of the lamp. Here is a control that can not be damaged even if the load wires are short-circuited.

It will be understood that the voltage drop depends upon two factors; namely, the rating of the lamp and the current taken by the load. Of course, in effect this is simply another application of current limiting.

Short Circuits

Nothing simpler than the "series-lamp test" could be devised for locating short circuits. The lamp will glow brilliantly until the short is removed. The lamp must be large enough so that it will not light up brightly on the normal load. If the trouble is intermittent, the lamp will indicate when it occurs.

A useful trick, not commonly known, is to substitute a lamp for a blown fuse in the house cut-out box. With all load removed from that branch, the lamp should not glow. If a short or ground remains on the line, the lamp will light up to full brilliancy. This is a much better procedure than watching the fuses blow out as fast as they are screwed in.

The series lamp is a genuinely important and versatile gadget. No other device gives so much for so little.

—30—

Power Supplies

(*Continued from page* 40)

sufficient, then several may be placed in parallel. Experimentally, the amount of wattage being dissipated in the tube may be determined by connecting it into the circuit and measuring the voltage dropped across it. This figure, multiplied by the current through the tube, gives the wattage in the tube. The foregoing generally must be done because the desired information is not obtainable from tube manufacturers.

For the feedback tube, a sharp cut-off pentode is desirable, this giving better and more clear-cut control than the remote cut-off pentodes. A glance through the tube manual will reveal several suitable tubes. The pentode, however, is not the only possible tube. This was made clear in two of the commercial circuits just examined. Here duo-triodes were used quite successfully. The main purpose of the feedback amplifier is to have large variations in plate current from small changes in grid voltages. The greater this action, the more sensitive the circuit will be to output voltage variations. The amplifier (or amplifiers) does not contain any condenser coupling, this automatically reducing low-frequency changes from having the effect they should have. Direct coupling is used throughout.

The remaining problem of designing

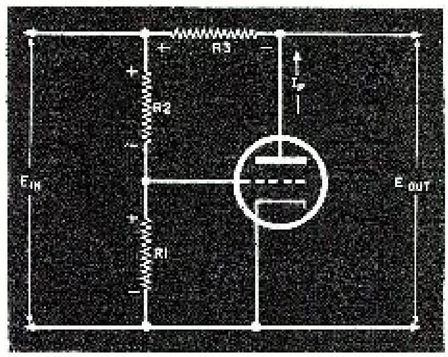


Fig. 6. A vacuum-tube voltage regulator circuit using the Gm of the tube as its basis of operation.

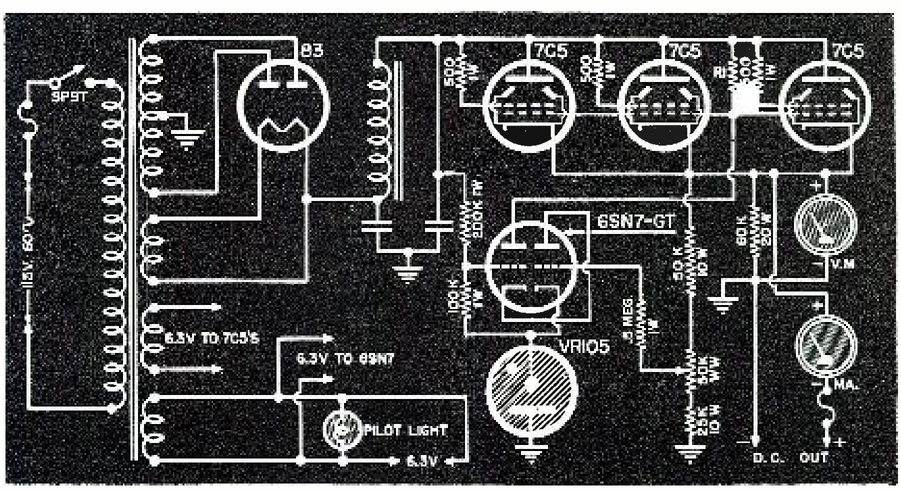
R_2, R_3, and R_4 is decided in the following manner. E_g, that portion of the output voltage applied to the grid of the 6J7, is related to E_{out} by this simple equation:

$$\frac{R_4 + R_x}{R_2 + R_3 + R_4} E_g = E_{out}$$

where: R_x is the bottom portion of R_3 between the center arm and R_4. This voltage, when subtracted from the 105 volts of the VR tube, gives the actual voltage on the grid of the 6J7. Generally, this value is such as to keep the grid negative with respect to the cathode. In the present case, this would mean that E_g would have a value less than the VR's 105 volts. A characteristic chart of the tube used will indicate quickly the amount of variation desirable. From this value, the proportion that R_3 will be of the total resistance of R_2 plus R_3 plus R_4 can be easily computed. R_2 and R_4 are placed on either side of R_3 to insure that the voltage applied to the 6J7 will be below a certain maximum value and above a certain minimum.

When actually constructed, these units are rather large in size. A roomy chassis will insure good ventilation with adequate space between components, especially transformers and power chokes. A well-designed panel, such as shown in the photograph will aid the operator to quickly reach the controls easily and safely. Any radio

Fig. 7. Power supply manufactured by Technical Apparatus Co. employs a double triode to amplify input and output variations. Unit supplies 200-400 volts d.c. at 40 watts.




TURNER
MICROPHONES
Partners in Performance
SOUNDSCRIBER
TRADE MARK
SOUND IN AN ENVELOPE
PRESTO
MODEL "K" RECORDER
GENERAL ELECTRIC
MODEL 50A RECORDER
TURNER
211 DYNAMIC
BROADCAST TYPE
Utilizing a new type magnet structure and acoustic network, Turner 211 extends the high frequency range and raises the extreme lows from 2 to 4 decibels – to compensate for overall deficiencies in loud speaker systems. Unique diaphragm structure results in extremely low harmonic and phase distortion without sacrificing high output level. A reliable unit for use in war plants, P. A. Systems and broadcast studios.
Leading designers and builders of rugged electronic recording devices ally their products with TURNER applications for sure-fire performance under varying acoustic and climatic conditions. Today these recorders play an important role in essential war communication activities. In the world tomorrow, they will open new horizons in the fields of radio, entertainment, education and business.
It's time to Turn to Turner for suggestions and applications in your electronic developments. The clear crisp reproduction of any sound — the rugged construction, accurate response, professional appearance and maximum performance of Turner Microphones give them a prominent position in any microphone discussion. While orders are being filled currently for those whose needs meet priority requirements, Turner invites your inquiry for collaboration with post-war developments.
TURNER — Pioneers in the Communications Field
Write for your Free copy of Turner's Illustrated Catalog
The TURNER Company
CEDAR RAPIDS, IOWA
Crystals Licensed Under Patents of the Brush Development Company

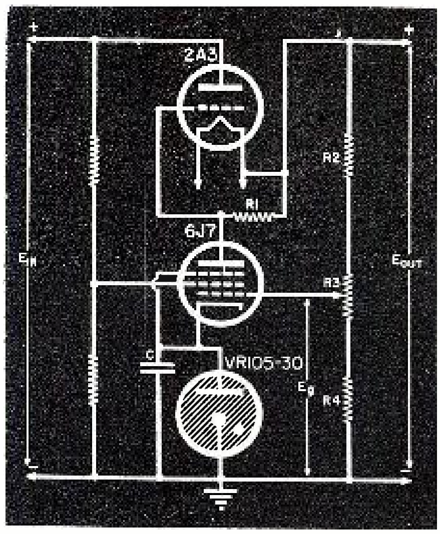


Fig. 8. Improved voltage regulator employing the same basic circuit as Fig. 2.

manufacturer will confirm the fact that good layout is just as important as circuit design, and it is always given a great deal of thought. Note that even fuses are placed on the panel, each possible of quick replacement. For the man who uses these units every day, these little considerations may determine the choice of one unit over another.

—30—

Signal Tracing

(*Continued from page* 34)

envelope. The elements of each may be identified with the aid of a tube manual.)

(3) Absence of oscillator voltage. (See G—Oscillator.)

(4) I.f. transformer tuned to wrong frequency.

(5) Oscillator working at wrong frequency.

(6) Defective i.f. transformer.

G—Oscillator

Having followed the signal thus far and having seen it well on its way in the primary of the i.f. transformer, we might figuratively stand aside for a little while and with our inward eye observe other signals as they pass after they are tuned in. "We're all intermediate now!" would be a good slogan for radio signals in this part of the circuit.

Now the chief agent in "creating all signals equal" is the local oscillator. It generates an unmodulated wave of just the right frequency to combine with the incoming signal so that the difference is always that to which the i.f. channel is tuned. Furthermore, when the weak incoming signal joins with the strong oscillator voltage, the union produces an i.f. signal that is the difference of the two. So, the offspring has a new identity and a far greater strength but it never loses the character, the *modulation,* of the signal.

The oscillator itself is a highly important component, not only in the receiver but in the broadcasting station also. Before the invention of the vacuum tube, the generation of high-frequency waves presented a serious problem. At one time, huge rotating alternators were used. Now the 50 kw. output of a powerful broadcasting station is initiated and controlled by a small glass tube that can be tucked into a man's pocket.

Fundamentally the oscillator is an amplifier excited by its own output. It consists of an ordinary vacuum tube containing plate, grid, and cathode. The associated circuit of coils and condensers comprise a resonant circuit capable of vibrating or oscillating electrically. The energy is supplied by the local battery or *"B"*-supply.

With the proper testing equipment it is easy to determine whether the circuit is oscillating and at what frequency. Since the output is unmodulated it can not be detected with an audio tracer. However, sudden or sharp changes in output (or in plate current) can be heard. With the probe at G, a click should be heard when the oscillator condenser plates are shorted with a small screwdriver and again when the short is removed.

In the 7A8 tube of Fig. 4, the cathode, grid No. 1, and grid No. 2 are the oscillator cathode, grid, and plate, respectively. The plate voltage may be measured directly. Control grid voltage will show negative *if the tube is oscillating.*

H—Grid of I.F. Tube

Signal should be heard with about the same strength as at E.

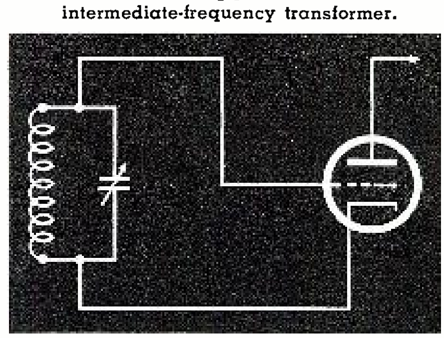
The function of the i.f. transformer is not to produce voltage gain but to provide (1) a tuned plate load for the preceding tube, (2) a tuned grid circuit for the following tube, and (3) a tuned coupling impedance between the tubes.

The primary side is a parallel resonant circuit tuned to the desired fixed intermediate frequency. Taking the plate circuit alone we have Fig. 5.

Considering the tube as an a.c. generator of internal resistance r_p we may redraw the diagram as shown in Fig. 6.

Plainly, the a.c. voltage generated by the tube is applied to the resonant elements in *parallel.* For this connection the impedance of the resonant circuit is a maximum at the resonant frequency. Since the total voltage is divided between r_p and the load impe-

Fig. 8. Secondary portion of a tuned intermediate-frequency transformer.



dance, the voltage across the load is a maximum when the load impedance is a maximum. For this reason the voltage across the primary is greatest at resonance.

The tuned secondary may be represented as shown in Fig. 8.

Since the e.m.f. "source" is the induced voltage in the secondary coil, the equivalent circuit of Fig 9 may be used.

Plainly, the resonant elements are in series with the source. Maximum voltage occurs across the condenser at (or very near) the resonant frequency.

In the i.f. transformer, the primary and secondary are coupled together through mutual inductance, so a voltage applied at the primary terminals reappears at the secondary terminals. In the usual circuit the voltage ratio between input and output is seldom greater than one.

The main function of this transformer is to pass a narrow band of desired frequencies and to reject all others. Rejection occurs because the combination of tubes and tuned transformer *will not amplify the undesired frequencies.*

If the i.f. channel is tuned to 455 kc. and has a bandwidth of 10 kc., the lowest frequency is 450 kc. and the highest, 460 kc. These extremes correspond to a ratio of 46/45 or 1.02. In music a ratio of 2 to 1 is an octave. The ratio of a semitone is equal to the twelfth root of 2, or 1.06. The width of the i.f. response is thus seen to be much less than a half tone.

When it is remembered that some audio transformers will pass frequencies from 20 to 20,000 cycles, or about *ten octaves,* it is evident that the response of the i.f. channel is confined to a *very narrow band* of frequencies.

Broadcast frequencies extend from about 550 kc. to 1600 kc. The ratio between these extremes is roughly 1 to 3. This is an octave plus a fifth, a total of 19 semitones.

When this frequency range is divided into 10 kc. bands it yields a total of 105 channels.

The piano tuner has trouble enough to divide the interval of a twelfth into 19 equal parts. Yet the results are coarse compared with the tuning of a superheterodyne, which can slice the same interval into 105 pieces, adjoining but not overlapping!

J—Plate of I.F. Tube

Signal should be heard with increased strength.

Gain, 20 to 100 times. This depends upon receiver design and upon the a.v.c. voltage.

At this point, only the i.f. signal should be found. The tuned i.f. transformer has rejected all other frequencies and the tube is simply amplifying the input presented at the grid.

Trouble

If the signal appears at the grid and not at the plate, the tube is not working. Possible causes are:

(1) Defective tube.
(2) Wrong voltages or no plate voltage.
(3) Mistuned or defective i.f. transformer on the plate side.

L—Plate of Diode Detector

Signal should be heard as at J.

The signal is still at intermediate frequency but the wave train is about to undergo demodulation in the diode.

Trouble

Failure of a signal at this point can usually be ascribed to a defect in the i.f. transformer.

N—Diode Load Resistor

Signal should be heard.

By the magic of demodulation the signal is now at audio frequency.

The high-frequency wave has done its work of *carrying* the message and has been dismissed. Only the original modulating frequency (voice or music) should remain.

A detailed discussion of demodulation is beyond the scope of this paper but may be found in any good textbook. Successful signal tracing is first of all a matter of the understanding. The hand that moves the probe must be guided by an intelligence that knows the function of each part and its relation to every other part.

The demodulator or detector is simply a rectifying device that passes the postive half of the high-frequency wave but gives poor conduction on the negative half. By means of filters, these positive pulses are joined to form the original modulating wave.

For purposes of signal tracing, adequate knowledge of the detector circuit can be obtained from a study of the functional diagram given in Fig. 7.

O—Grid of First Audio

Signal strength depends on setting of volume control.

Possible trouble is defective volume control or failure of coupling condenser.

P—Plate of First Audio

Signal should be heard with normal gain of about 30 times.

Failure of the signal to appear at P indicates that the tube is not working. Trouble may be located in the manner already outlined.

Q—Grid of Output Tube

Signal should have same level as at P.

A critical component and very common source of trouble is the coupling condenser. It is extremely important that this condenser have low d.c. leakage in order to keep the plate voltage off the grid of the output tube.

R—Plate of Output Tube

Here the signal should reach its highest level. A gain of 10 to 20 is normal for pentodes and 2 to 5 for triodes.

The a.c. plate current creates a strong field around (glass) tubes and the plate wiring, including the output transformer. Thus, the signal may be heard when the probe is merely brought near to these parts.

Trouble

In this part of the circuit, trouble is easily located. The components are

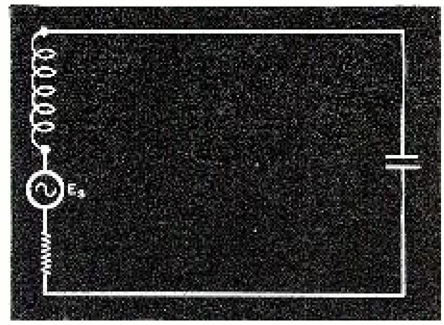


Fig. 9. Equivalent circuit of Fig. 8.

simple and the input signal is at a high level. No signal at R may indicate a defective tube, wrong voltages, open output transformer primary, break in wiring, or failure of some other component. Voltage and continuity tests give the answer quickly.

S—Secondary of Output Transformer

Signal should be reduced in strength by reason of the step-down ratio of the transformer.

The only remaining component is the speaker.

"Signal tracing" may end here and yield to elementary trouble-shooting.

Hum

Hum may be regarded as an unwanted signal and may be analyzed and located by signal-tracing methods.

In the ordinary receiver operating on a.c., the hum frequencies may be either 60 or 120 cycles. The oscilloscope is an important aid in determining the frequency.

Line frequency (60 cycles) may be introduced through direct pickup by a grid circuit, through leakage in a tube, or by reason of emission from a heater.

Ripple frequency (120 cycles) occurs in the "B"-supply. It is strong at W (Fig. 4), negligible at V, and practically zero at the output side of any filter beyond this point. Screen-grid

INVENTOR OF TELEVISION SEES FASTER PHOTO TRANSMISSION

JOHN BAIRD, inventor of television, demonstrated to British correspondents in England recently, an instrument which "makes an international newspaper seem probable."

"A whole newspaper could be transmitted about the world in a matter of seconds," he added, showing the instrument with which he expects to make television facsimile the communication means of the future.

Baird plans to revolutionize wireless telegraphy by flashing complete typewritten pages at the rate of 25 a second anywhere in the world. The present rate, used largely for pictures, is one page every six to 10 minutes.

Today, messages written in London to be wirelessed overseas have to be changed letter by letter into electrical impulses which are broadcast and then translated into letters again at the receiving end.

Mr. Baird intends to increase the speed of phototelegraphy (sending pictures by radio) some 15,000 times, and proposes to radio not only pictures, but plans and messages. Blueprints, charts, machine and architectural drawings, newspapers and whole books could be radioed in a matter of seconds.

At the moment, Mr. Baird is working on the elimination of the only serious difficulty—the new system would have to be operated on ultra-short waves and will travel only comparatively short distances.

Ultra-short waves travel like light waves and cannot go through or over mountains and high buildings.

These limitations mean that at the moment Mr. Baird's new telegraphy could be used only over comparatively short distances of land or sea. By having equipment to pickup and relay the impulses on every 50 miles of the route, however, messages and pictures could be sent at the new rate of 25 seconds from, say, London to Rome.

At the moment there is no means of trans-Atlantic transmission, but Mr. Baird is convinced these difficulties will be overcome eventually.

—30—

circuits should be exceptionally well filtered since a hum on this grid will be amplified by the tube.

By means of signal tracing, hum levels can be compared and the source of excessive hum may be quickly located.

C-F-K-V—Screen Grids

The signal should *not* be heard at any of these points.

The function of a screen-grid is twofold:

(1) To shield other electrodes.

(2) To influence the operating characteristics of the tube.

By reason of its shielding effect the screen-grid prevents interaction between plate and grid. As far as a.c. is concerned, the screen is grounded through the screen by-pass condenser. Normally no a.c. or signal voltage should appear on the screen.

The d.c. voltages can be checked with a voltmeter.

Trouble

Signal or hum usually indicates insufficient by-passing, open paper condenser, or dried-out electrolytic.

Condensers

Aside from tube failures, the most common receiver troubles are those involving condensers. A tabulation according to *function* will be helpful.

Filter

(a) Power supply frequency. Removes the a.c. ripple from the "B"-supply.

(b) Audio frequency. Removes unwanted audio signal, as from a.v.c. line.

(c) Radio frequency. Removes unwanted r.f. carrier, as in demodulator circuit.

(d) Tone control. Reduces high-frequency response in order to produce apparent accentuation of bass.

(e) High audio frequency. Removes extremely high audio frequencies to reduce distortion. Used in plate circuit of pentode output tube.

By-pass

Provides a low-impedance path so that the a.c. may go *around* or *pass by* a resistor.

The condenser is intended to present practically zero impedance *at the frequency to be by-passed.* Therefore the by-passed signal will not set up a voltage drop across the condenser.

Example: Cathode by-pass condenser.

Usually the capacity of a by-pass condenser is a clue to its function. When its position in the circuit is known, its function should not be in doubt.

Blocking

Keeps d.c. voltage out, while passing a.c. (within a stage).

Coupling

Transfers signal or a.c. energy between stages. Also blocks d.c.

Decoupling

Absorbs or by-passes signal. Prevents signal in one stage from affecting *preceding* stages.

Tuning

Establishes circuit resonance at desired frequency.

Distortion

In the absence of proper testing equipment, distortion can become a problem whose solution requires somewhat aimless substitution of tubes and parts until the defective component is found. With signal-tracing equipment, the signal can be followed until the distortion appears. The offending stage is thus located immediately.

Distortion may occur in almost any tube but usually is confined to the stages working at relatively high levels, such as the detector and audio tubes. A broadcast signal is required when the tracing is done by ear. When an oscilloscope is available a sine wave tone should be used. Although the 'scope locates the stage indisputably, a good ear seldom requires such corroboration.

Probable causes of distortion:

(1) Defective tubes.

(2) Leaky coupling condensers.

(3) Open condenser in plate circuit of pentode output.

(4) At high signal levels, a.v.c. voltages too high.

(5) Improper tube voltages.

(6) Overloading of tubes.

(7) Rectification where undesired.

(8) Regeneration.

(9) Hum voltage impressed on signal.
(10) Excessive selectivity.
(11) Defective speaker.

Noise

Noise is a signal definitely not wanted. Simple tests will show whether the source is internal or external to the receiver. If the noise is generated within the receiver, signal tracing can locate it.

Conclusion

It has been amply demonstrated that signal tracing can follow a signal from its first feeble flutter on the antenna to its final full force at the speaker. Signal tracing can determine whether the signal remains within the prescribed channels as a well-behaved signal should or whether it goes out of bounds. Signal tracing can track down unwanted signal voltages and aid in their elimination.

Rather, it is the radioman that does all this. The hand that moves the probe must be guided by an intelligence that knows the function of each part and its relation to every other part.

Signal tracing is a happy union of ingenious instrumentation with high intelligence.

-30-

Spot News

(*Continued from page* 133)

ments are really only sections of the broadcast art. The NAB officials cited that it is therefore as important to be as interested in FM and television as any other medium of transmission.

It was believed that the FMBI might join hands with the NAB. However FMBI officials did not seem to approve of such a plan. They believe that their separate organization is in a better position to promote the FM art. There is every belief, however, that a spirit of coordinated effort will prevail.

The FM broadcasters have announced, incidentally, that they will hold their annual meeting at the Hotel Commodore in New York City, during the week of January 27, 1945.

Personals . . .

Henry F. Wilson has left his post as senior electrical engineer, with the Procurement and Distribution Service, office of the Chief Signal Officer, to re-enter a distributing service. . . . **Leon A. Adelman** is now an advisory sales manager of the Clarostat Manufacturing Co. Mr. Adelman will also act as a New York metropolitan sales representative. . . . **Jack F. Crossin** was recently appointed sales director of Hamilton Radio Corp. . . . **Charles H. McGee Sr.**, has resigned his WPB post to return to private industry as a manufacturers' representative. His new offices are in the Carry Building, 927 Fifteenth Street, N. W., Washington, D.C. . . . **Clarence Radius** is conducting a fifty-week course in technical television for the engineers of the Central Division of NBC, Chicago. . . . **J. R. Duncan** is now with WLW as chief television engineer. . . . **Samuel Ruben**, inventor of the Mallory dry battery, ceramic coated resistor and other important radio items, was recently awarded a Certificate of Appreciation for his extraordinary contributions to the war effort. . . . **John H. Miller** has become chief electrical engineer of Weston Electrical Instrument Corp. **F. X. Lamb** becomes assistant chief electrical engineer and **Carl M. Lederer** is now assistant director of research. **W. N. Goodwin Jr.** relinquishes his post as chief engineer but retains his present title of director of research. . . . **Allen B. DuMont** was recently honored by the Rensselaer Polytechnic Institute with the honorary degree of Doctor of Engineering. . . . **Professor E. A. Hertzler**, formerly of Pratt Institute, is now director of war research at United Electronics Co. . . . It's now **Brigadier General C. O. Bickelhaupt**. General Bickelhaupt is Commanding Officer of the Eastern Signal Corps Unit Training Center at Fort Monmouth, N. J. The General in civilian life is vice president of American Telephone & Telegraph Co. . . . **Charles E. Wilson** who recently resigned as vice chairman of WPB has returned to his post as president of General Electric Co. . . . **John S. Timmons** has returned to the Philco Corp. at Philadelphia, after a stay of almost two years with the WPB as deputy director of the Radio and Radar Division. Mr. Timmons was directly associated with Ray C. Ellis, Radio and Radar director.

-30-

Avoiding Radio Interference from Fluorescent Lighting Installations

A FORM of radio interference which is fairly common but which may not have been met by some of our readers, is that from fluorescent lights. In view of the increasing number of these lamp installations, a resumé should prove of timely interest.

The extent to which fluorescent lamps disturb radio reception is dependent upon a number of factors, among which are the strength of the desired signal, and the type of receiver antenna. The strength of the signal depends upon the transmitter power of the station being received and the distance between the station transmitter and receiver. Obviously, the stronger the station signal, the less objectionable a given radio noise becomes.

Radio disturbances from fluorescent lamps reach radio receivers by (1) direct radiation, (2) by radiation from connecting supply lines, and (3) by conduction along supply lines. Unless the conventional radio receiver antenna or lead-in is located within a few feet of the lamp, direct radiation is not serious, although radio receivers using internal loops may require greater separation from the lamp fixture. Usually the radiation from and conduction along supply lines are the most important factors. In order to minimize the effects produced by these forms of radio noise propagation, filters must be installed at the lamp terminals.

Some manufacturers incorporate a small capacitor in the starting mechanism of their units. When properly located in the circuit, this capacitor reduces radio noise to some extent. In a great many instances, however, additional measures must be taken to suppress radio noise. Filters are available commercially for this purpose, one type being termed a "capacitive type filter," which is the simplest and most inexpensive type. There are cases, however, where this type of filter does not give sufficient reduction in radio noise, thus a combined capacitive and inductive filter must be used to attain the maximum degree of suppression.

In general, it will be necessary to filter each lamp or group of lamps in one fixture, since it is essential that the filter be located directly at the fixture terminals. In making a filter installation, it will be noted that one terminal or lead is to be connected to ground. Ground in this case means the metal frame of the lamp fixture and not a water pipe or other actual ground. If, in addition to the so-called ground connection to the metal fixture, an actual ground connection is desired, this may be made providing the "ground" terminal of the filter is connected to the metal fixture with a very short lead.

In the case of small table or desk type lamps, there may not be sufficient room in the base to install a commercial filter. In such cases small short path tubular capacitors, installed in the base, will usually provide ample suppression. Capacitors suitable for this purpose are readily available at radio parts stores. The capacitor should be of reliable manufacture and have a 600 v. d.c. continuous rating. Such installations should be made only by competent persons.

—30—

★ INDUSTRIAL ★ MAN-POWER BUREAU

"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."

Let's Talk Shop

(*Continued from page* 35)

of the problems which must be faced in the postwar world. One of the greatest problems will be the re-entry into the service field by men who have left for other activities during the war and the entry into the field of a large number of men who have been trained in some form of radio by the government and who now wish to make this their life's work. Competition will be very keen since the government has embarked on a program to train returning servicemen in any field they desire to enter. Many of these men will want to enter the radio and electronic field. As war veterans they are entitled to, and will receive government aid and schooling. In some cases the government will even advance money for them to establish their own businesses. The wise serviceman who is now established will do well to take these facts into consideration in any future plans he may make.

Do not be misled by stories you may have heard about the great number of servicemen who will be needed in the field for the maintenance and repair of industrial electronic equipment. There will be many needed but they will not all come from the ranks of existing servicemen. Many plants have already made connections with

PHOTO CREDITS

Page	Credit
25 (top)	USWB-AAF Photographic Library
25 (right), 26, 27	USWB
28, 29, 30	U. S. Maritime Service
31	Black Box Studios
32, 48	Frank Ross, Staff Photographer
36, 37	North American Philips Co., Inc.
38	Technical Apparatus Co.
41, 42, 43, 86, 88, 128	RCA
45	Shure Brothers
76	Acme

men who do this work in their own communities. Some intend, as soon as the rush of the war is over, to take junior engineers or laboratory assistants from their own personnel to do this work. These men will be maintained on the payroll as the serviceman for a particular plant. The independent or outside serviceman may have very little opportunity to get into this market. A suggestion is made that if this type of work is desired, contacts be made now with the local plants in order that a peacetime connection be established.

On the bright side of the picture, which will have a distinct bearing on the future of the serviceman is, of course, the widespread use of such services as television, frequency modulation, facsimile, etc. Television, for example, is now ready for the public and a large number of responsible manufacturing firms will embark on the sale of television receivers to the public immediately after the war ends and as soon as material and manpower is available. Television, by its very nature, cannot be sold and installed as is the ordinary radio receiver. The antenna of a television receiver must be planned carefully and scientifically installed. The haphazard methods of installing radio receivers used in the past will not work in the case of television receivers. Forward-looking servicemen will recognize an opportunity here to set themselves up as installation experts for dealers and certainly should now begin to make dealer contacts with those dealers who will sell recognized brands of television after the war.

In the case of frequency-modulated radio receivers the serviceman will have to reorient himself, taking into consideration that receivers of this type will require much more accurate and efficient servicing than has been required heretofore on ordinary AM receivers. New service techniques and bench methods should be studied now. All necessary testing and labor-saving devices which are available should be included in the budget for expansion immediately after such equipment becomes available.

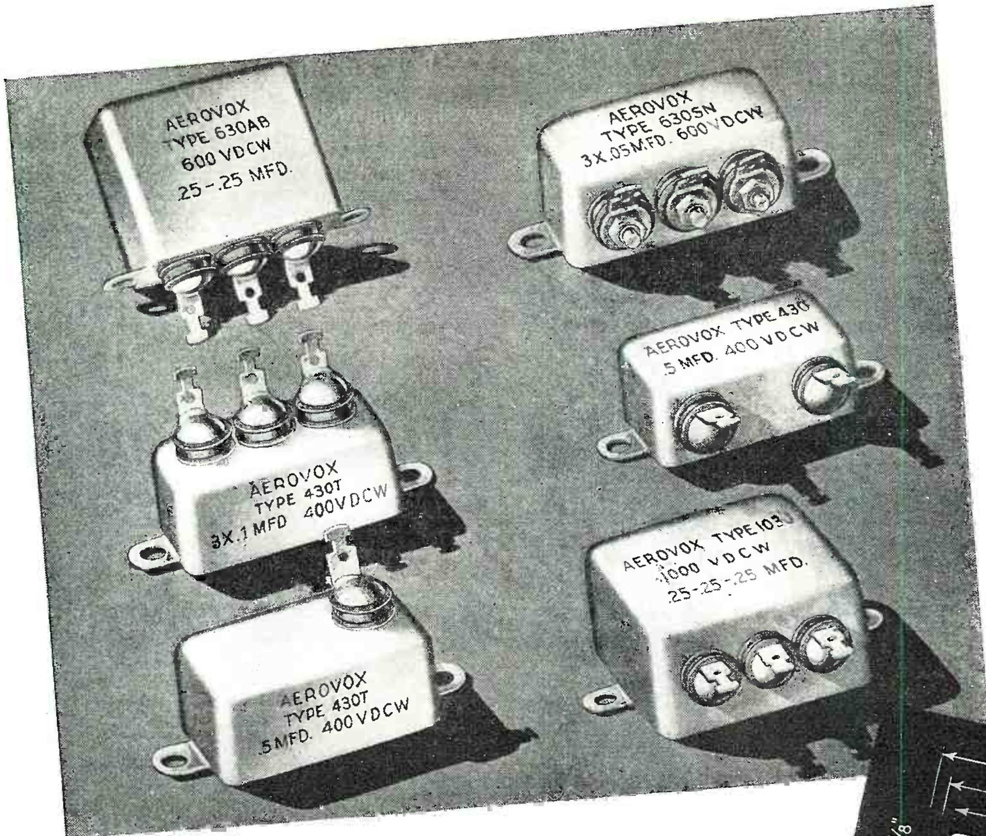
From the above remarks, it can be seen that the serviceman is not in an unfavorable position. Despite all the receivers he may have piled up in his shop waiting for repairs, despite all of the promises which have been made by various factors in the field, the serviceman who survives in the postwar period will be the serviceman who decides to be a *business* man and to apply thorough time-tested methods of operation.

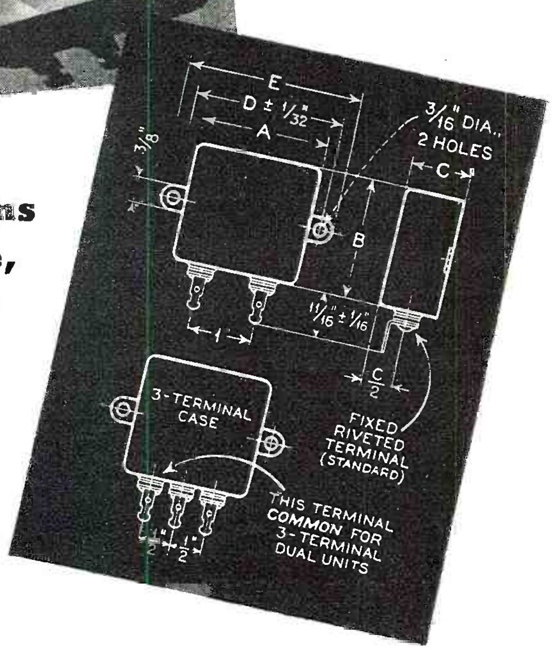
The above discussion has barely scratched the surface of these all-important problems which face the radio serviceman. Future monthly articles will cover in detail many of the individual problems. Readers are invited to write directly to the author expressing their ideas which may be included in future articles.

—30—

INDEX OF *Advertisers* Nov. 1944

COMPANY	AGENCY	PAGE No.
Aerovox Corporation	Austin C. Lescarboura & Staff	155
Alliance Manufacturing Company	Campbell-Sanford Adv. Co.	96
Allied Radio Corporation	Henry H. Teplitz Advertising Agency	60, 150
Allied Radionics Agency		148
Allmetal Screw Products Co	Arthur Kleinwald	112
American Condenser Co	Michael F. Mayger, Advertising	131
American Phenolic Corporation	Evans Associates, Inc	95
Audak Company	Hart Lehman Advertising	8
Audel, Publishers	Grant & Wadsworth, Inc	144
Barker & Williamson	Harry P. Bridge Co., Advertising	74
Best Vibrator Company		144
Bliley Electric Company	Hardy Advertising	102
Bogen Company, Inc., David	Shappe-Wilkes, Inc	72
Bogue Electric Company		151
Burgess Battery Co	Howard H. Monk and Associates	94
Burstein-Applebee Company	Frank C. Whalen Adv. Co	124
Candler System Co	Van de Mark Advertising, Inc	138
Capitol Radio Engineering Institute	Henry J. Kaufman Advertising	66
Centralab	Gustav Marx Adv. Agency	98
Commercial Radio Institute		144
Connecticut Telephone & Elec. Div.	Wilson & Haight, Inc., Adv.	20
Consolidated Radio Products Co	Burton Browne Advertising	119
Continental-Diamond Fibre Co	Harry P. Bridge Co., Advertising	140
Cornell Dubilier Electric Corp	Reiss Advertising	75
Cornish Wire Company, Inc	Hart Lehman Advertising	130
Coyne Electrical School	Phil Gordon Agency, The	145
Coyne Electrical School	McJunkin Adv. Co	136, 138, 153
Crowe Name Plate & Mfg. Co		123
Davies, Harry, Molding Co		142
DeForest's Training, Inc	MacDonald-Cook Co	15
DeJur Amsco Corporation	Shappe-Wilkes, Inc	152
Delco Radio Div., General Motors	Campbell-Ewald Company	67
Drake, Frederick J. & Co	A. B. Wilder, Inc	124
Echophone Radio Company	Burton Browne Advertising	23
Editors and Engineers		148
Eicor, Incorporated	Henry H. Teplitz Adv. Agency	80
Electronic Laboratories, Inc	Burton Browne Advertising	83
Electro-Motive Mfg. Co	Cory Snow, Inc	148
Electro-Voice Corp	Shappe-Wilkes, Inc	10
Fada Radio and Electric Co., Inc	Sternfield-Godley, Inc	7, 144
Fawcett Publications	Hill Advertising, Inc	146
Federal Manufacturing & Engineering Corp	Shappe-Wilkes, Inc	117
Federal Telephone & Radio Corp	Commerce Adv. Agency	69, 87, 150
Foster, A. P., Company	Gotham Advertising Co., Inc	127
Freed Transformer Co		85
Galvin Mfg. Corporation (Motorola)	Gourfain-Cobb Adv. Agency	125
General Cement Manufacturing Co	Turner Advertising Agency	118
General Electric Company	N. W. Ayer & Son, Inc	19
General Test Equipment Co	Suzanne Hayman, Advertising	136
Gothard Manufacturing Co	Merchandising Advertisers	110
Greenlee Tool Company	Howard H. Monk and Associates	132
Guardian Electric Mfg. Co	Kennedy & Company	109
Hallicrafters Company, The	Burton Browne Advertising	5, Back Cover
Hammarlund Mfg. Co., Inc., The	Roeding & Arnold, Inc	24, 150
Harvey Radio Co	Shappe-Wilkes, Inc	108
Howard Manufacturing Corp	Bozell and Jacobs	147
Hytron Corporation	Henry A. Loudon Advertising	78
Illinois Condenser Co	Sander Rodkin Adv. Agency	136
Industrial & Commercial Electronics	Garfield & Guild Advertising	105
International Detrola Corp	Zimmer-Keller, Inc	21
International Resistance Co	Lavenson Bureau	97
Islip Radio Mfg. Corp	Kotula Company	131
Jensen Radio Mfg. Company	Burton Browne Advertising	6
Johnson, E. F., Co	David, Inc	135
Kato Engineering Co		134
Kenyon Transformer Co., Inc	Jasper, Lynch & Fishel, Inc	121
Knights, James Co., The	Turner Advertising Agency	99
Lafayette Radio Corporation	Shappe-Wilkes, Inc	88
Lake Radio Sales Co	Sander Rodkin Adv. Agency	114
Lear Avia, Inc	Arthur Kudner, Inc	107
...ab Products		124
...ring School	Buchanan, Thomas Adv. Co	142
McElroy Mfg. Corp	Shappe-Wilkes, Inc	142
McGee Radio & Electric Co	Clyde H. Smith Advertising Co	148
McGraw-Hill Book Co		126
Mallory, P. R. & Co., Inc	Aitkin-Kynett Co., Adv	101
Meck, John Industries	Western Advertising Agency	141
Merit Coil & Transformer Corp	Ross Llewellyn, Inc	100
Micamold Radio Corp	Equity Advertising Agency	150
Millen, James Mfg. Co., Inc	James Millen, Inc	12
Miles Reproducer Co., Inc	Altomari Advertising Agency	146
Murdock, Wm. J. Co	John A. Smith & Staff	62
National Company, Inc	Graydon Smith, Advertising	61
National Electronic Supply		76
National Radio Institute	Van Sant, Dugdale & Co	3
National Schools	Mayers Company, The	91, 152
National Union Radio Corporation	Hutchins Adv. Co., Inc	65, 151
Nelson Co	A. N. Baker Advertising Agency	126
Newcomb Audio Products Co	Dozier Graham Eastman Adv	138
Ohmite Manufacturing Co	Henry H. Teplitz Adv. Agency	59
Olson Radio Warehouse	Jessop Advertising Agency	132
Onan, D. W. & Sons	Pioneer Advertising Company	122
Panoramic Radio Corporation	Shappe-Wilkes, Inc	81
Park Metalware Company	Melvin F. Hall Adv. Agy., Inc	118
Philco Corporation	Hutchins Advertising Co	103
Radio & Technical Division of Murray Hill Books, Inc	Harry P. Bridge Co., Adv.	110, 114, 116, 120, 140, 142, 149
R.C.A. Communications, Inc	Albert Frank-Guenther Law, Inc	152
RCA Institutes, Inc		140
Radio Corporation of America—RCA Victor Division	Kenyon & Eckhardt, Inc.	Second Cover, 17
Radio Merchandise Sales	Daniel de Koven, Advertising	90
Radio Parts Co	Sidney S. Lovitt	104
Radio Tube Service Co., Inc	Daniel de Koven, Advertising	82
Radolek Company	Turner Advertising Agency	153
Raytheon Manufacturing Co	Burton Browne Advertising	93
R B M Manufacturing Co		152
Rider, John F., Publisher, Inc	Lansford F. King	92
Runzel Cord & Wire Company	Duane Wanamaker Adv	3rd Cover
Sauereisen Cements Co		153
Shure Brothers	Henry H. Teplitz Adv. Agency	84
Snyder Mfg. Co	Philip Klein Adv. Agency	96
Sperry Gyroscope Co., Inc	Young & Rubicam, Inc	13
Sperry Gyroscope Co., Inc	Equity Advertising Agency	151
Sprague Products Co	Harry P. Bridge Co., Adv	63
Sprayberry Academy of Radio	Harry P. Bridge Co., Adv	77
Standard Transformer Corp	Burnet-Kuhn Advertising Co	68
Stanwyck Winding Co	Franklin Advertising Service	134
Stevens Walden, Inc	Howard-Wesson Co	14
Studio Service Company		153
Superior Instruments Co	Loewy Advertising Agency	115
Supreme Instruments Corp	O'Callaghan Adv. Agency, Inc	18
Supreme Publications	Henry H. Teplitz Adv. Agency	133
Sylvania Electric Products Inc	Arthur Kudner, Inc	16
Tavella Sales Co	Reuben Barkow	126
Teleplex Company	Terrill Belknap Marsch Associates	146
Templetone Radio Mfg. Corp	Peck Advertising Agency	113
Thordarson Electric Mfg. Co	Duane Wanamaker Advertising	139
Tobe Deutschmann Corp	Franklin Bruck Adv. Corp	156
Triplett Electrical Instrument Co	Western Advertising Agency	22
Tri-State College	Clem J. Steigmeyer	140
Turner Company, The	W. D. Lyon Co	143
United Transformer Co	Shappe-Wilkes, Inc	11
Universal Microphone Co	Ralph L. Power, Ph. D.	71
Valparaiso Technical Institute	Smith, Benson & McClure, Inc	130, 148
Vaughn Cabinet Co	Paul Grant, Advertising	116
Wallace, Wm. T., Mfg. Co	Michael F. Mayger, Adv	108
Ward Leonard Electric Co	E. M. Freystadt Asso., Inc	9
Ward Products Corporation	Burton Browne Advertising	73
Warwick Manufacturing Corp	Agency Service Corporation	129
Western Electric Co	Deutsch & Shea	150
Westinghouse Electric & Mfg. Co	Fuller & Smith & Ross, Inc	89, 151
Wholesale Radio Laboratories	Allen & Reynolds	106





Meeting the severe operating conditions encountered in military, aircraft, police, broadcast, P-A and other equipment . . .

HYVOL "BATHTUB" *Capacitors*

● These drawn-container units are designed for applications requiring compact, extra-quality capacitors. Aerovox Type 30 capacitors are specified for equipment that must undergo severe-service operating conditions, more particularly in military, aircraft, police, broadcast, public-address, and other classes of communications equipment, as well as in electronic assemblies operating hour after hour. These "bathtubs" are standard capacitors in Government radio and electronic equipment.

Type 30 is Hyvol impregnated and filled. Type 30M is mineral-oil impregnated and filled. One-piece drawn metal case with soldered bottom plate. Terminals are constructed with the Aerovox-originated "double-rubber" bakelite insulators permanently riveted to the case, making a sturdy, *absolutely* immersion-proof assembly. Terminals on side, top, bottom or ends to suit mounting and wiring requirements.

In 400, 600 and 1000 v. D.C.W. Choice of capacitances. Single, dual and triple sections.

● **Write for descriptive literature and listings.**

AEROVOX *Capacitors*

INDIVIDUALLY TESTED

AEROVOX CORPORATION, NEW BEDFORD, MASS., U. S. A. — SALES OFFICES IN ALL PRINCIPAL CITIES

Export: 13 E. 40 ST., NEW YORK 16, N. Y. • Cable: 'ARLAB' • In Canada: AEROVOX CANADA LTD., HAMILTON, ONT.

OLD FAITHFUL GEYSER, Yellowstone National Park. Geologists believe it began erupting before the last glaciation, about a million years ago. Within record, Old Faithful has erupted continuously at about 65-minute intervals, spouting a column of water 95—130 feet high for 4½ minutes.

STILL GOING STRONG

LONG, UNINTERRUPTED service under all operating conditions is the characteristic you want most in a capacitor. Tobe Capacitors serve so well and so long because every step in their manufacture is checked and cross-checked by rigid inspections. Constant improvement through constant research is the promise performed by Tobe engineers. An example is the Tobe TRS Capacitor, shown below, a skillfully designed transmitting condenser. Why not call on Tobe for prompt, specialized help on *all* your capacitor problems?

TRS 605,
5 mfd. 600 volts
SIZE—
Overall height 5″
CONTAINER—
1-3/16″x 2-1/2″x 4″
Dimensions of other TRS models on request.

SPECIFICATIONS FOR TRS CAPACITORS

CAPACITY . . . . .1 to 20 mfd.

WORKING VOLTAGE . . . 600 volts DC to 6,000 volts DC.

SHUNT RESISTANCE . . . 6,000 megohms per mfd.

RESISTANCE, Terminal to Case . . 10,000 megohms minimum:

POWER FACTOR . . . .002 to .005

VOLTAGE TEST Terminal to Case 2,500 VDC for 600 volt condenser.

Capacitor unit tested at 2 times rated voltage.

Universal (wrap around) L or foot type and screw Spade-lug mounting brackets can be supplied.

TOBE DEUTSCHMANN CORP.
TOBE
CANTON · MASSACHUSETTS

A small part in Victory today . . .
A BIG PART IN INDUSTRY TOMORROW

Printed in U.S.A.


READY ON D DAY...
WE'LL BE
READY
ON V DAY!
Runzel
CORDS · WIRES · CABLES
WHAT ARE YOUR REQUIREMENTS?
RUNZEL CORD & WIRE CO.
4723-31 MONTROSE AVENUE • CHICAGO 41

KE MONEY FROM HOME

$200.00 each Month for Prize Winning Letters!

$200.00 in prizes every month....

$100.00 first prize, $50.00 second prize, $25.00 third prize, $15.00 fourth prize, $10.00 fifth prize, plus $1.00 for every letter received.

Here we go again. Another great Hallicrafters letter contest for service men. Wherever you are, whenever you see this announcement, drop us a line. Write and tell us your first hand experience with *all* types of radio communications built by Hallicrafters, including the famous SCR-299.

It's just like money from home! Write today to get your share. Tell us your story in your own way. You can't lose and you *can* win as high as $100.00.

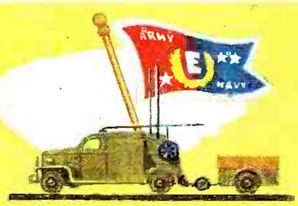
Rules for the Contest

Hallicrafters will give $200.00 for the best letters received during each of the six months of September, October, November, December, 1944, January, and February, 1945. (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.

Open to service men around the world. Monthly winners will be notified immediately upon judging and payment will be made as soon as possible.

Service men all over the world are learning that the name "Hallicrafters" stands for quality in radio equipment. There's a great and exciting future ahead for short wave enthusiasts. In peace time Hallicrafters will continue to build "the radio man's radio" and that means the best that can be made. There will be a set for you in our postwar line.



BUY A WAR BOND TODAY!

hallicrafters RADIO

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