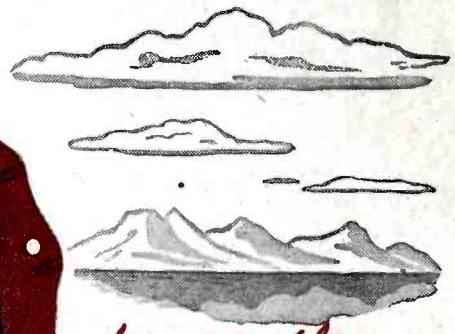
RADIO NEWS

Special Features on

TELEVISION

JANUARY
1945
35c
In Canada 40c

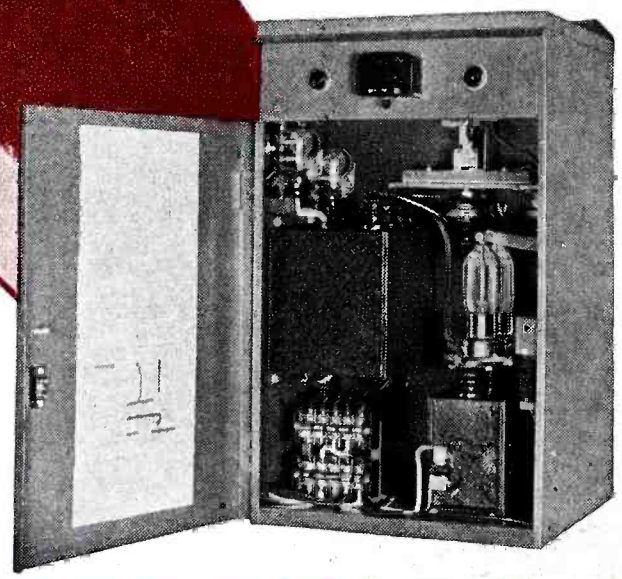
wherever a tube is used...



for example:

ELECTRONIC AIR CLEANING

Smoke, dust, and soot particles 100 times smaller than the eye can see are drawn out of the air electronically by an ingenious arrangement of positively and negatively charged plates. This device facilitates precision manufacturing of delicate instruments, guarantees purity and sanitation in food processing, promotes health and cleanliness in restaurants and hospitals.



POWER PACK

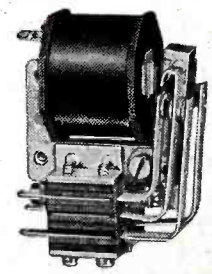
THERE'S A JOB FOR *Relays* BY GUARDIAN

Electronic air cleaners ionize dust particles and collect these particles on a series of positive and negative plates called "Collector Cells" which are arranged in a venetian blind fashion. Rectifier tubes in a power pack change the a-c secondary voltage into pulsating d-c voltage. This d-c voltage is smoothed out by a capacitor and charges the Ionizer and Collector cells.

Relays are built into the power pack to protect it against short circuits or other irregularities in circuit operation. Typical of such relays is the Guardian Series 40 a-c relay which has a laminated armature and field piece.

The Series 40 is well fitted for use in power packs such as illustrated, because it is designed to handle a maximum of control in minimum space. It has a switch capacity of double pole, double throw with 12½ ampere contacts (rated at 110 volts, 60 cycles, non-inductive load). Coils are available for standard voltages up to 220 volts, 60 cycles. Normal power requirements are 9 V. A.

For details on this and other Relays by Guardian write for General Relay Bulletin.



Series 40 A C. Relay

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.

GUARDIAN ELECTRIC

1630-A W. WALNUT STREET CHICAGO 12, ILLINOIS

A COMPLETE LINE OF RELAYS SERVING AMERICAN WAR INDUSTRY

I WILL SEND A SAMPLE LESSON FREE to PROVE I can Train You at Home in Spare Time to BE A RADIO TECHNICIAN

J. E. SMITH, President,
National Radio Institute
Our 31st Year of Training Men for Success in Radio

I Trained These Men

$200 a Month in Own Business

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

$600 a Year in Spare Time

"At present I am doing spare time radio work. I earned money in radio before graduating. My profits for the last twelve months were $600." ERWIN F. BOETTCHER, Marinette, Wisconsin.

Chief Operator Broadcasting Station

"Before I completed your lessons, I obtained my Radio Broadcast Operator's license and immediately joined Station WMPC where I am now Chief Operator." HOLLIS F. HAYES, 327 Madison St., Lapeer, Mich.

Communication Station Operator

"Am with the Civil Aeronautics Administration at the Shreveport Airways Communication Station. Have a lifetime position, with pension after retirement." JESSE N. ROBERTS, Box 1076, Shreveport, La.

You May Never See a Better Time to Make Your Start in Radio

I will send you my Lesson, "Getting Acquainted with Receiver Servicing," FREE, to show you how practical it is to train for Radio at home in spare time. It's a valuable Lesson. Study it—keep it—use it—without obligation! And with this Lesson I'll send my 64-page, illustrated book, "Win Rich Rewards in Radio" FREE. It describes many fascinating jobs Radio offers, tells how N.R.I. gives you Radio experience by practicing with SIX BIG KITS OF RADIO PARTS I supply!

Future Looks Bright for Capable Radio Technicians and Operators

Many opportunities are ahead for well-trained Radio Technicians, Operators. Keeping old Radios working is booming the Radio repair business. Profits are large—peacetime prospects are bright, too. Think of the new boom in Radio Sales and Servicing that's coming—when new Radios are again available—when Frequency Modulation and Electronics can be promoted—when Television moves into its new era of expansion!

Broadcasting Stations, Aviation Radio, Police Radio, Loudspeaker Systems, Radio Manufacturing all employ qualified Radio men at good pay—and most of these fields have a big backlog of business that built up during the war, plus opportunities to expand into new fields opened by wartime developments. You may never again see a time when it will be so easy to get a start in Radio!

Many Beginners Soon Make $5, $10 a week EXTRA in Spare Time

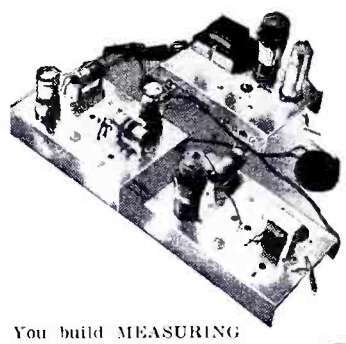
The day you enroll for my Course I start sending you EXTRA MONEY JOB SHEETS that help show how to make EXTRA money fixing Radios in spare time while still learning. I send you SIX big kits of Radio parts as part of my Course. You LEARN Radio fundamentals from my illustrated, easy-to-grasp lessons—PRACTICE what you learn by building real Radio Circuits—and USE your knowledge to make EXTRA money!

Mail Coupon for FREE Lesson and Book

These are fast-moving times. The opportunities now given beginners to get started in Radio may never be repeated. So take the first step at once. Get my sample Lesson and 64-page illustrated book, FREE. No obligation—no salesman will call. Just mail Coupon in an envelope or pasted on a penny postal. —J. E. SMITH, President, Dept. 5AR, National Radio Institute, Washington 9, D. C.

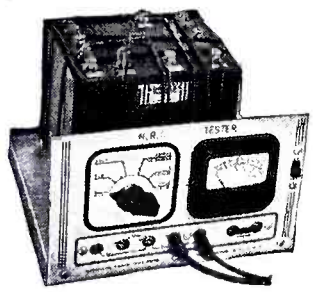
You Build These and Many Other Radio Circuits with 6 Kits of Parts I Supply!

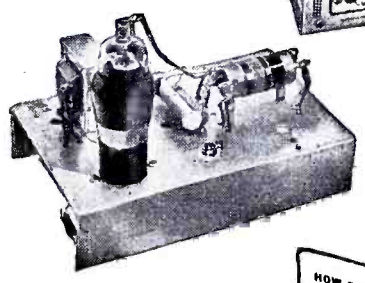
By the time you've conducted 60 sets of Experiments with Radio Parts I supply, made hundreds of measurements and adjustments, you'll have had PRACTICAL Radio experience valuable for a good full or part time Radio job!



You build the SUPERHETERODYNE CIRCUIT (left) containing a preselector oscillator-mixer-first detector, i.f. stage, diode detector-a.v.c. stage and audio stage. It will bring in local and distant stations. Get the thrill of learning at home evenings in spare time while you put the set through fascinating tests!

You build MEASURING INSTRUMENT (right) early in Course, useful for Radio work to pick up EXTRA spare time money. It is a vacuum tube multimeter, measures A.C., D.C., R.F. volts, D.C. currents, resistance, receiver output.





Building the A.M. SIGNAL GENERATOR at left will give you valuable experience. Provides amplitude-modulated signals for test and experimental purposes

SAMPLE LESSON FREE

Mail coupon for your FREE copy of Lesson, "Getting Acquainted With Receiver Servicing," to see how practical it is to train for Radio at home in spare time. Study it—keep it—use it—without obligation! Tells how Superheterodyne Circuits work, gives hints on Receiver Servicing, Locating Defects, Repair of Loudspeaker, I.F. Transformer, Gang Tuning Condenser, Etc. 31 illustrations.

My Radio Course Includes
TELEVISION • ELECTRONICS
FREQUENCY MODULATION

GOOD FOR BOTH 64 PAGE BOOK SAMPLE LESSON FREE

J. E. SMITH, President, Dept. 5AR
National Radio Institute, Washington 9, D. C.

Mail me FREE, without obligation, Sample Lesson and 64-page book, "Win Rich Rewards in Radio." (No salesman will call. Please write plainly.)

Name..... AGE.....

Address .....

City..... Zone..... State.....4FR

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

JANUARY • 1945 VOLUME 33, NUMBER 1

CONTENTS

FEATURES

Foreign Broadcast Intelligence Service.....*Oliver Read, W9ETI* 25
Television Is Coming to the Smaller Cities.....*A. C. Lescarboura* 29
Television in Great Britain.....*Leon Laden* 32
Television—as I see it.....*Dr. Lee de Forest* 35
Modulated Signal Generator.....*G. H. Welles* 36
Television for Future Airway Traffic Control...*Thomas M. Morse* 38
Television Receiver Design.....*Milton S. Kiver* 40
Television Industry Prepares for Postwar.....*James H. Carmine* 43
Practical Radio Course.....*Alfred A. Ghirardi* 44
Servicing Public Address Equipment.....*Willard Moody* 46
Microphone Input Circuit.....*Theodore E. Campbell* 49
An Introduction to Television.....*Edward M. Noll* 50
Television—for Industry and Home.....*Will Baltin* 53
The Saga of the Vacuum Tube.....*Gerald F. J. Tyne* 54
Service Now—Sales Later.....*Chas. N. Tunnell* 64
Air Corps Radio Phraseology Training...*2nd Lt. Byron A. Susan* 70
News from Overseas.....*Kenneth R. Porter* 82

DEPARTMENTS

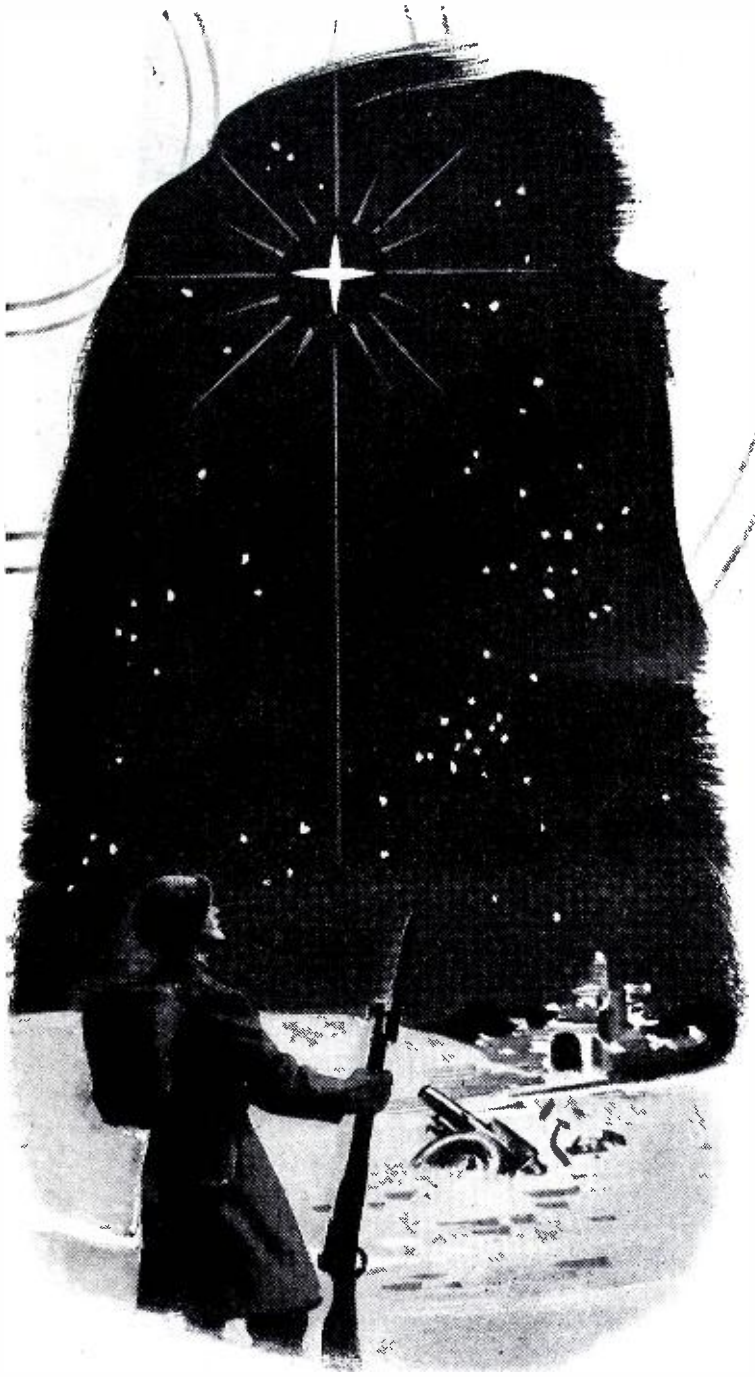
For the Record 8
Spot Radio News..... 12
QTC .....*Carl Coleman* 57
International Short-Wave .....*Kenneth R. Boord* 58
Technical Book and Bulletin Review..... 62
What's New in Radio..... 74
Within the Industry..... 96
Manufacturers' Literature 104
Letters from Our Readers..... 118
RADIO NEWS Index for 1944..... 136

COVER PHOTO
By Frank Ross
(Staff Photographer)

Late model television camera being operated by NBC engineer.

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, International Building, 1319 F Street, N.W. Washington 4, D. C. Los Angeles Office, William L. Pinney, Manager, 815 S. Hill St., Los Angeles 14, Calif. Subscription Rates: In U. S. $3.00 (12 issues), single copies, 35 cents; in Mexico, South and Central America, and U. S. Possessions, $3.00 (12 issues); in Canada $3.50 (12 issues), single copies 40 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.



"In times like the present, men should utter nothing for which they would not willingly be responsible through time and in eternity."

Abraham Lincoln, 1861

a Merry Christmas and Happy New Year

Jensen

Jensen Radio Manufacturing Company

6601 S. Laramie Ave., Chicago, Ill.

FOR THE RECORD

by the editor

America's Next Great Industry—TELEVISION—is ready

SKILLFUL use of a nationwide television system immediately following the war would be a most powerful force to arouse the spirit of our people in the critical postwar period. Production of television sets can, in the opinion of experts, result in the employment of at least 600,000 workers by 1948. That's a lot of jobs! It is estimated that video receivers will sell for an average price of $200.00 and that the demand for sets will create a market for 30,000,000 units during a ten year period. The immediate development of postwar television can certainly contribute greatly to a healthy business and economic life by its added purchasing power and by its employment of thousands of persons in our industry.

Radio broadcasting has, in the past, sold its sponsors goods "sight unseen." Television, on the other hand, will permit Mr. and Mrs. America to actually see what they are buying. Thus—television becomes a servant of the people. This medium appeals both to the ear and to the eye. By adding motion to pictures—television will offer a "third dimension" to advertising. Its lifelike images will certainly attract the attention of the set owner far more than the customary oral ballyhoo of present programs.

Testimony at the recent FCC hearings has convinced this editor that television is ready now! Existing technical standards are entirely adequate for good pictures. Frequency allocations are sufficient for a practical service. Improvements can, and will be made, in existing television transmitters, antennas, and relay systems as the art progresses without upsetting the function of receivers for many years to come.

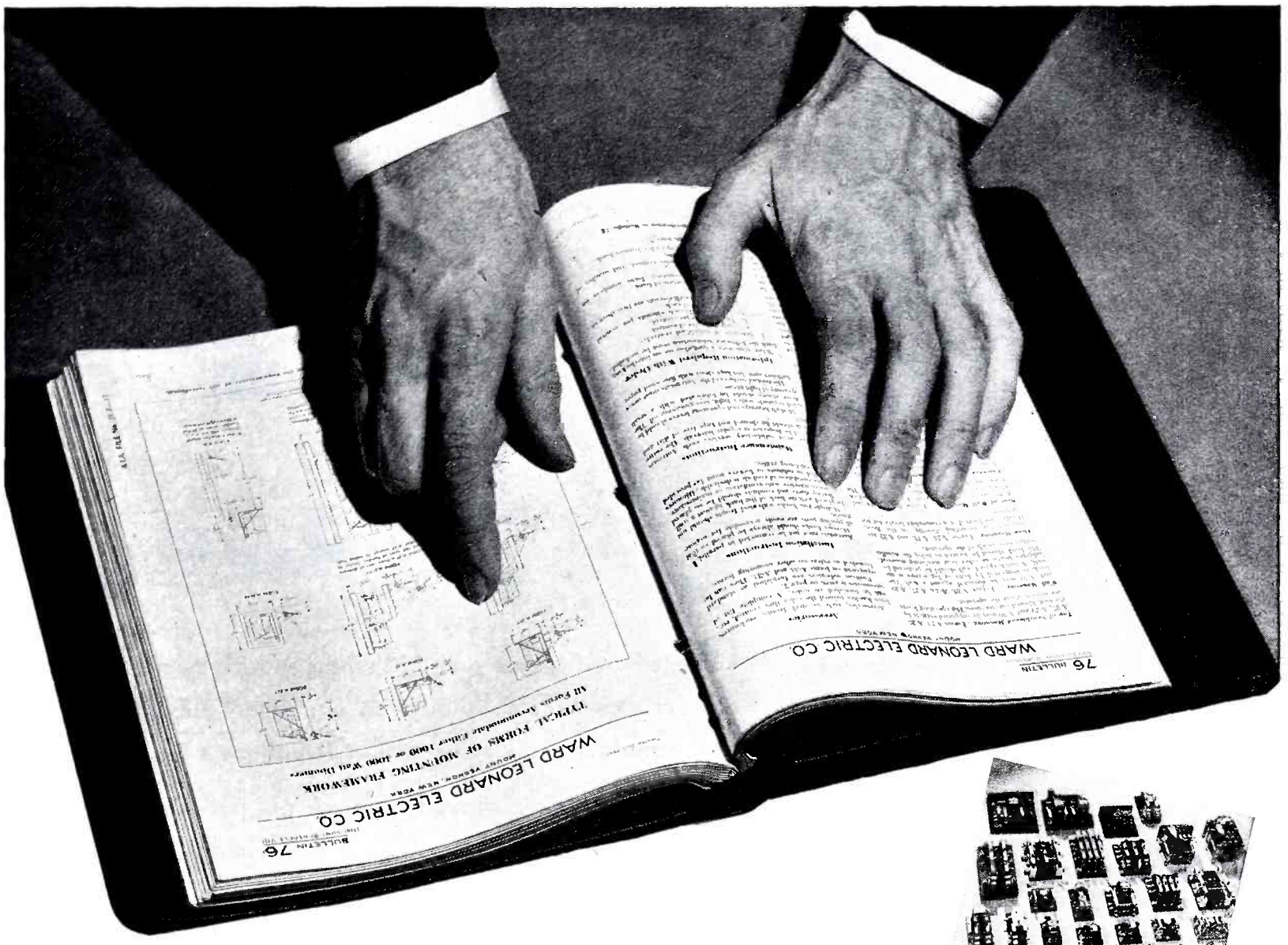
As proof that television is ready, and to bring our readers up-to-date on the subject, RADIO NEWS is devoting many of its editorial pages this month to a review of video progress.

Television will offer a tremendous opportunity to raise another type of standard—that of doing away with "singing commercials" and other "spots" that have reached a very low level in radio programming. Yes—television producers will have an unlimited opportunity to contribute to a dignified service—one that can serve as a powerful medium for the greatest number of people. We sincerely hope that those responsible for the production of television programs will set their standards high at the very launching of its career and keep them high. If they do, it will do much to encourage Joe Doaks and family to buy television and to use it.

The miracle of Sight Added to Sound is at the very finger tips of this industry. It must not be held back!

O.R.

NO LOST TIME FOR *Reconversion*

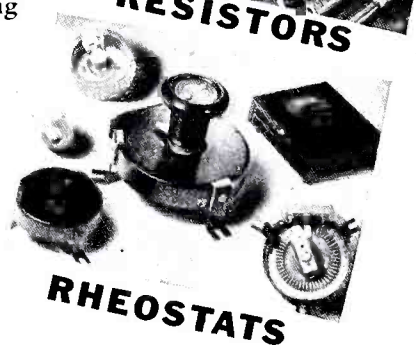


These Controls Are Ready

Practically every Ward Leonard Product used for war purposes required little or no equipment change. The controls of the machines of peace are essentially the same controls of machines of war. Hence, when the entire facilities of Ward Leonard were needed for the war emergency, production went on as usual, only in greater magnitude. Those same facilities are available for postwar production as and when they are released from war service. Again the change-over will be made without delay as there is no need for reconversion. The products are the same except for specifications and will be made by the same workers and same machines. When planning the controls for your postwar products, you will save time and money and be assured of war-tested units, controls and assemblies by making your selection from the Ward Leonard line. Send for bulletins describing controls of interest to you.

RELAYS

RESISTORS



RHEOSTATS

WARD LEONARD

ARMY E NAVY

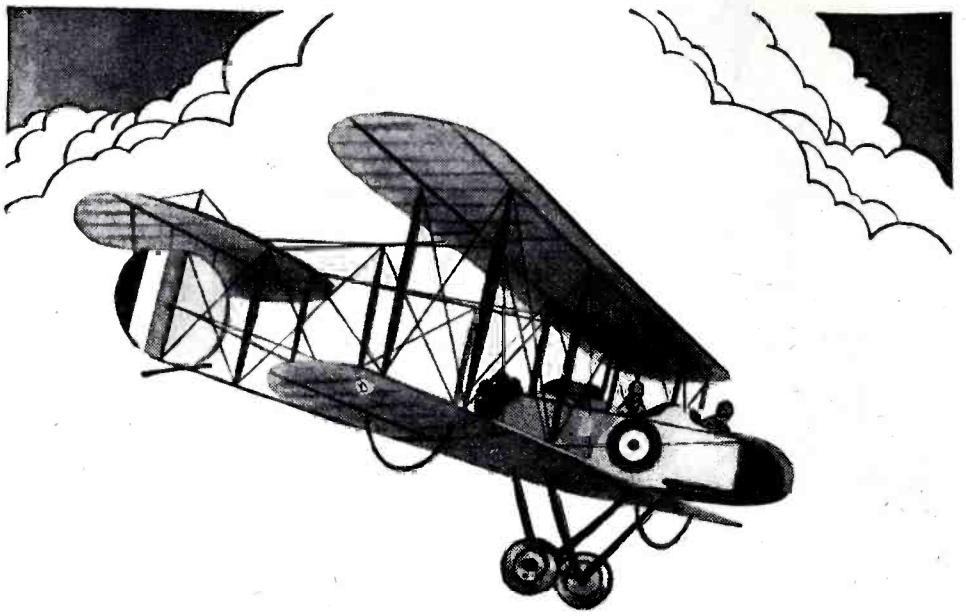
RELAYS • RESISTORS • RHEOSTATS

Electric control (WL) *devices since 1892.*

WARD LEONARD ELECTRIC COMPANY · 47 SOUTH ST. · MOUNT VERNON, N. Y.

...Hardly had man learned to fly than he began to feel the urgency of the need to communicate between ground and plane.

Radio headsets are one of C. T. & E. Division's contributions to aviation communications in World War II.



One of the first successful attempts in such two-way contact was accomplished with equipment designed and manufactured by *Connecticut Telephone & Electric.*

Since the early days of the telephone, our people have been identified with progress in communications. Today the principles of communications have applications of the greatest importance to industry, in connection with product development and production control.

Our developmental engineers also have much to offer to industrial executives seeking to produce a better product at lower cost. If our engineering and production facilities might tie in with your plans, we shall be happy indeed to talk with you.

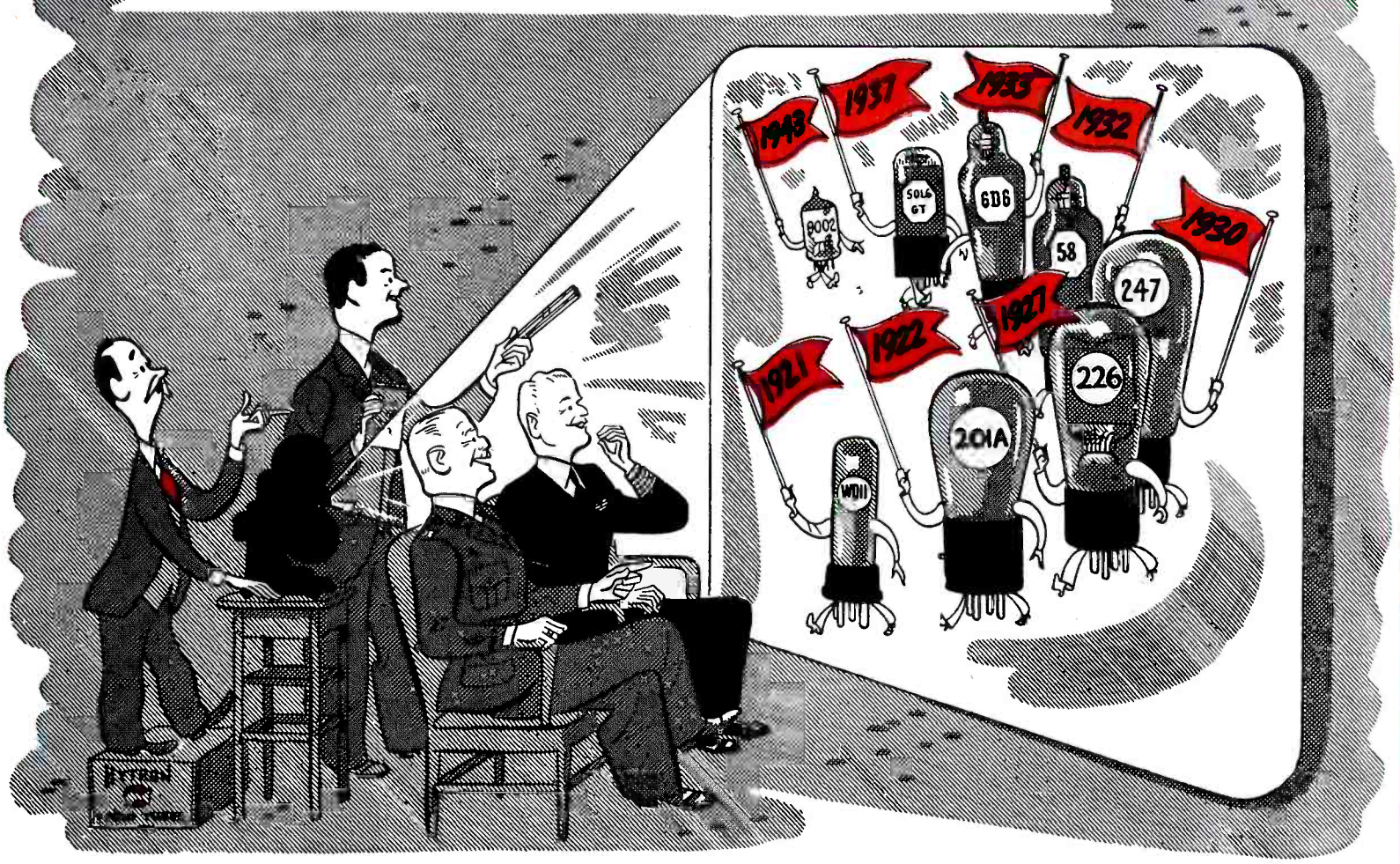
CONNECTICUT TELEPHONE & ELECTRIC DIVISION

GREAT AMERICAN INDUSTRIES, INC.

MERIDEN, CONNECTICUT

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

HYTRON has made them all!



The march of Hytron receiving tube progress down through the years is fascinating. One looks back on tubes, tubes, and more tubes: battery, AC, AC/DC, diodes, triodes, pentodes, beam tetrodes, multiple purpose types, G's, MG's, BANTAM GT's — and now the miniatures. Price and size have been drastically cut; quality and performance, amazingly improved.

Hytron has made them all. Its long and varied experience is priceless in a complex industry where probably never will all the answers be known. In making radio tubes, painfully acquired practical experience must supplement the formulae of science.

With an eye to present and future, Hytron is concentrating its production of receiving tubes on preferred BANTAM GT types needed for war — for today's civilian replacements — and ultimately for post-war. Its wartime activities are teaching Hytron new techniques of miniature production. Many potentially popular Hytron miniatures are in development. Typical American dissatisfaction with anything but perfection continues; the parade of Hytron receiving tubes marches on.

OLDEST EXCLUSIVE MANUFACTURER OF RADIO RECEIVING TUBES

HYTRON CORPORATION ELECTRONIC AND RADIO TUBES

SALEM AND NEWBURYPORT, MASS.

ARMY (E) NAVY

HYTRON RADIO TUBES

BUY ANOTHER WAR BOND

Spot Radio News

By RADIO NEWS Washington Correspondent

Presenting latest information on the Radio Industry.

FEW OCCASIONS HAVE DISCLOSED the intriguing story of radio progress so effectively as the five-week FCC allocation session that was concluded during the first week of November. In over a hundred statements, personally presented by leading experts and engineers of government and industry, every phase of industry operations was discussed. The variety of data offered will serve as a basis of many industrial analyses of the future.

An interesting example of the completeness of the testimony offered appears in the statement of J. H. Wofford, engineer in the Safety and Special Servicing Division of the FCC. He discussed relay press, a comparatively new service. According to Mr. Wofford, a relay press station is a station licensed to transmit to or from points where other communication facilities are not available. The information transmitted is, of course, news or special information relating to press services. Thus far, the Associated Press, United Press, and the Telegram Publishing Co. of Salt Lake City, Utah, have used this system successfully. Mr. Wofford revealed that United Press used a pack set for relay press work at the World's Fair in 1939. The occasion was the arrival of the King and Queen of England. Signals were transmitted within a three-quarter mile radius of the Working Press Building. The report stated that the signals were clear and conversation was carried on despite the usual blare of horns, loud speakers, etc. To successfully describe the activities on this occasion, reporters were perched on top of buildings. The Associated Press also reported that they used relay press facilities in reporting golf tournaments between 1935 and 1940. Both press associations indicated that this form of transmission will become an important factor in press service.

THE RADIO RELAY SYSTEM was also discussed by E. W. Engstrom who is in charge of the RCA Laboratories. Mr. Engstrom reported that television broadcasters appear to be the first and most important prospective users of radio relays. Facsimile also was described as an important user of the relay method. In this respect he cited the growing need of the service for business machines. He said that manufacturing, transportation, and merchandising organizations and the public they serve, will benefit from the advantages of decentralized and widespread operations using centralized management and control, provided for by facsimile transmission.

Multiplex telephone communications also will use radio relays in long-distance operations, Mr. Engstrom pointed out. Aircraft traffic will profit, too, by the use of relay systems, he said. Discussing the frequency ranges of relay systems, Mr. Engstrom explained that initially we will use frequencies as high as 1,000 megacycles. However, he pointed out, we are certainly going as high as 30,000 megacycles and in the not-too-distant future. The towers required for transmitting and receiving antennas will vary from as low as 100 feet to as high as 300 to 400 feet. This will depend, of course, upon the terrain contour and the repeater station spacing. It may be possible to place the stations from 20 to 40 miles apart, depending of course, upon the heights of the antennas.

According to Mr. Engstrom, frequency modulation, or some variation of frequency modulation, probably will be used in radio relay work. This will permit amplitude limiting at the repeaters, he said, to remove variations in received signal amplitude and also to assist in removing distortion due to nonlinear amplification.

Discussing the multiplicity of systems that relay systems will carry, Mr. Engstrom said: "In a relay system for transmitting television signals, it is considered essential to transmit the zero or very-low frequency components of the modulation so that the synchronizing pulses may occupy a fixed range of the modulation characteristic. Otherwise, the variations in image background level may modulate the waveform and amplitude of the synchronizing pulses in a manner to detract from the quality of the reproduced images. This means that the highest frequency modulations of the frequency-modulated carrier current will be superimposed upon a carrier frequency which can vary between the value set for the black and white levels. This requires that the radio-frequency band width be equal to twice the highest modulation frequency plus the range of frequency lying between the black and white levels. For practical reasons, it is suggested that radio relay systems should have a nominal channel width of 20 megacycles to serve the present standard television signals."

Mr. Engstrom reported that his RTPB panel recommended that 600 megacycles in the 300- to 3,000-megacycle band be set aside for relay purposes involving at least one intermediate repeater. A tentative RTPB as-

signment of a 300-megacycle band in width from 1,900 to 2,200 megacycles was also cited by Mr. Engstrom. Such a band would provide 15 channels, 20 megacycles in width.

Commenting on the present research work that has been done at the super high frequencies, Mr. Engstrom stated that while it is not possible to reveal the types of tubes and performance characteristics used, the data is available and will be put to effective use as soon as security permits.

RAILROAD RADIO WAS QUITE A FEATURED SUBJECT at the hearings. Appearing on behalf of the Association of American Railroads, J. L. Niesse of the New York Central System, reported that railroads will need 88 channels between 100-200 mc., 36 channels over 100 mc., 6 channels below 3 mc., and channels between 2600 and 2700 mc. for development work. Interviews with railroad electronic engineers, revealed that the RTPB railroad radio committee prepared a rather complete report on the requirements of railroad services, which was offered to the FCC during the hearings. According to the report, train radio was initiated 30 years ago, and the first such installation was made by the Delaware, Lackawanna and Western Railroad. Experiments were conducted between the years 1914 and 1919. The tests were not too successful, but it must be remembered that during that period little was known about the vacuum tube. The report goes on to state that in 1920, train radio was reactivated and tests were made by the Baltimore and Ohio; Chesapeake & Ohio; Great Northern; Indiana Harbor Belt; Nashville, Chattanooga and St. Louis; New York Central; New York, New Haven and Hartford; Pennsylvania; and the Virginia Railroads. During these tests, contact was established between two points on a moving train as well as from the train to a fixed station. Incidentally the New York Central and Pennsylvania Railroads tried radio, during this period, in tugboat dispatching operations in the New York Harbor. Between 1930 and 1940 substantial progress was also made in the art of railroad radio. During this period, the Central Railroad of New Jersey; Chicago and Northwestern; Grand Trunk Western; Lehigh Valley; New York Central; New York, New Haven and Hartford; Southern Pacific; and the Pennsylvania conducted tests.

This year has seen an extensive series of tests conducted by many systems, which included Atchison, Topeka and Santa Fe; Baltimore and Ohio; Chicago, Burlington and Quincy; Chicago, Rock Island and Pacific; Denver and Rio Grande Western; Reading; Seaboard Airline; the New York Central; and the New York, New Haven and Hartford.

According to the report, there are quite a number of applications of radio systems to a railroad. Included among these applications are end-to-end communications or two-way service; fixed point and train communications; terminal operations; service to trains enroute and dispatchers; work equipment during emergencies, such as derricks, snow plows, fire fighting equipment, etc.; remote-control operations; control of power distribution; radar for inland watercraft; ship-to-shore; direction finding for inland waterways; warning services; and general emergencies.

In the 1920's the highest frequencies used were approximately 60 megacycles with the best results obtained in the 30- or 40-megacycle band. Currently 157 megacycles are being used and with very satisfactory results, according to the report.

The increased interest of railroad radio in two-way end-to-end service became quite apparent from the fact that 40 out of 122 railroads contacted indicated that they will use radio if frequencies are allocated for that service. These 40 railroads represent a mileage of 152,320 or 66.8% of the total mileage. In the Chicago area, 16 of the 33 railroads indicated a desire for radio service.

In practically all instances AM equipment was used during tests. And according to the RTPB report, atmospheric noise was not a factor and man-made electrical interference could be controlled by suitable noise-limiting circuits.

Interesting design factors also were revealed in the report. Because of the extreme vibration, racking and impact, equipment for both engine and caboose will have to be designed very sturdily. The report says that shocks of the order of 15 G are not uncommon in regular operation. The equipment will also have to stand extreme temperatures, from 0° to plus 140° F. Equipment mounted in the roof of a locomotive cab, will have to have the same construction as our tropical military equipment. The apparatus also will have to be mounted in weatherproof and dustproof housings, sufficiently strong to stand the weight of a man and yet be readily accessible for maintenance.

Direct communication between a fixed point and a train anywhere on a railroad covering distances generally up to 300 miles, is characteristic of the enroute and dispatcher service. To conduct this service effectively, the railroad experts asked the Commission to assign 6 channels in the 159.12- to 159.84-mc. band. In addition, band widths of 2½ megacycles were requested for frequencies in the 1,000 to 1,045-mc. band. The latter frequencies would be used for a relay system along the right-of-way. The fixed stations would be about 30 miles apart and accordingly, transmitters will have to have a range of about 15 miles between the relay point and the train, according to the RTPB report.

Commenting on the use of radar, the report said that it should be very helpful as a means of avoiding collisions between tugs and ships in harbors during fog conditions.

The railroad committee also indi-

cated that they would like to have the 2600- to 2700-mc. band for experimental and development work. They believe that this band offers many possibilities that will subscribe to improved railroad radio service.

THIRTEEN REPRESENTATIVES OF THE FORESTRY conservation services offered testimony on their frequency requirements, at the allocation hearings. Pilot and communications officer, F. C. Mac Lane, of the New York State Conservation Department, stated that only by means of radio communications can the various phases of forest-fire control be coordinated properly. He said that no man has been seriously injured or lost his life in any fire in New York State where radio was used.

Testimony in favor of radio was also offered by Harris Collingwood, Chief Forester of the National Lumber Manufacturers Association, representing 16 regional associations of lumber manufacturers, comprising over 1500 individual companies. He said that fires annually destroy nearly 1½-billion board feet of saw timber, equal to about 5% of the annual harvest. Radio can prevent this, he emphasized. Only portable pumps precede radio in importance, according to Mr. Collingwood. One lumber company, he said, has 36 radio transmitters and numerous fire fighting trucks and service cars equipped with two-way apparatus.

The State of Pennsylvania has 211 pieces of radio apparatus used for fire fighting, according to George H. Wirth, chief forest fire warden. To combat the fire menace, it will be necessary to have three times that many, he said.

Florida has used radio very extensively in firefighting, according to Joseph R. Gramling of the Forest and Park Service. He pointed out that the State has eight base radio stations, 39 portable-mobile units, 1 portable unit and 200 receivers. This equipment is used to patrol 23,000,000 acres of forest land.

W. T. Hartmann, assistant chief, Texas State Forest Service, reported that 10 to 12 of the Civil Air Patrol Texas Forest Patrol planes, are equipped with 6- to 10-watt medium-frequency transmitters for fire service.

The Government is probably one of the largest users of radio for fire fighting. According to Glenn H. Nielson, assistant Chief in the Safety and Special Service Division of the FCC, the Government has 228 land stations, 476 portable stations and 1260 portable-mobile stations. These operate on 18 channels and 806 frequencies. Mr. Nielson indicated that 49 channels and 2,042 frequencies are required.

TESTIMONY OFFERED BY N. S. ROGERS State Forester for Oregon, indicated that this state has one of the most complete radio systems in the nation. According to Mr. Rogers, Oregon was one of the first states in the Union to install radio for the police and highway departments. Today the highway departments have 21 fixed transmitters installed at various division, district and section maintenance headquarters, 7 portable-mobile transmitters, receivers at 2 additional district offices, and receivers in 30 cars. In addition the Oregon State Police have two fixed transmitters, 147 mobile receivers and 17 portable-mobile transmitters. Approximately $87,000 has been invested in this equipment as of January 1, 1944. The highway department's network has furnished one way dispatching services to approximately 70 different agencies, including police and fire departments, county sheriffs, and fire wardens not only in the State of Oregon, but in the southern part of Washington.

THE UTILITIES WERE ALSO REPRESENTED. Speaking for the RTPB and the industry at large, Russell V. Dondanville of the Chicago Edison Company stated that radio has demonstrated its preventive possibilities and its development for special emergency work is a vital factor. He described the wide-spread use of radio during the recent Atlantic Seaboard hurricanes. He asked the FCC to eliminate the "corrective situation" restriction imposed by regulations and permit radio to be used with more frequency by the power utilities.

C. H. Underhill, a member of the electric utility group of RTPB, stated that thus far 50 electric light and power companies had installed emergency radio communication systems, operating about 750 transmitters. This represents but a small fraction of the transmitters actually required, according to Mr. Underhill. A survey of 50% of the industry indicated that 3300 transmitters are planned during five years after the war.

Many new uses are scheduled, too. Included among these new applications are automatic relaying; remote control; automatic transmission of alarm signal systems; and walkie-talkie or handy-talkie uses.

THE WATER SUPPLY INDUSTRY ALSO HAD A VOICE AT THE HEARINGS. C. F. Meyerherm, speaking for the industry, said that of sixty, 50,000-population cities, 51% now use radio for water utility; 43% use police fixed transmitters as a primary transmitting station. Today there are 20 fixed and 200 mobile transmitters, in addition to 350 mobile receivers in use. On the basis of present regulations, the industry plans to install around 947 transmitters five years after the war, according to Mr. Meyerherm. And should the regulations be relaxed this quantity will be doubled.

REPRESENTATIVES OF THE BUS AND TRUCK INDUSTRIES at the hearings indicated that these industries have found radio of immeasurable value. Describing the vast re-

(*Continued on page* 20)

FINEST PICTURE QUALITY IN BLACK AND WHITE AND IN FULL COLOR!

Sharper, more brilliant pictures than ever before possible are now a reality with Federal's new broadband television technique . . .

In a revolutionary contribution to the television art, Federal's system permits combining *sight and sound* on one carrier frequency . . .

For the broadcaster—a single transmitter, and consequently, lower first cost, lower power consumption, less space requirement, and fewer high power tubes . . .

For the television audience — a simpler, less expensive receiver, more compact and efficient, and requiring fewer tubes.

This great forward stride is the logical outcome of Federal's long list of achievements in the field and the contribution of Federal's engineers to the development of the "Micro-ray" more than a decade ago . . . the forerunner of modern television technique.

And as a result . . . Federal has been selected by the Columbia Broadcasting System for the construction of its new television transmitter atop the Chrysler Tower in New York.

Federal's modern television technique will also be reflected in an equally advanced Federal television receiver for the home . . . producing the finest picture quality.

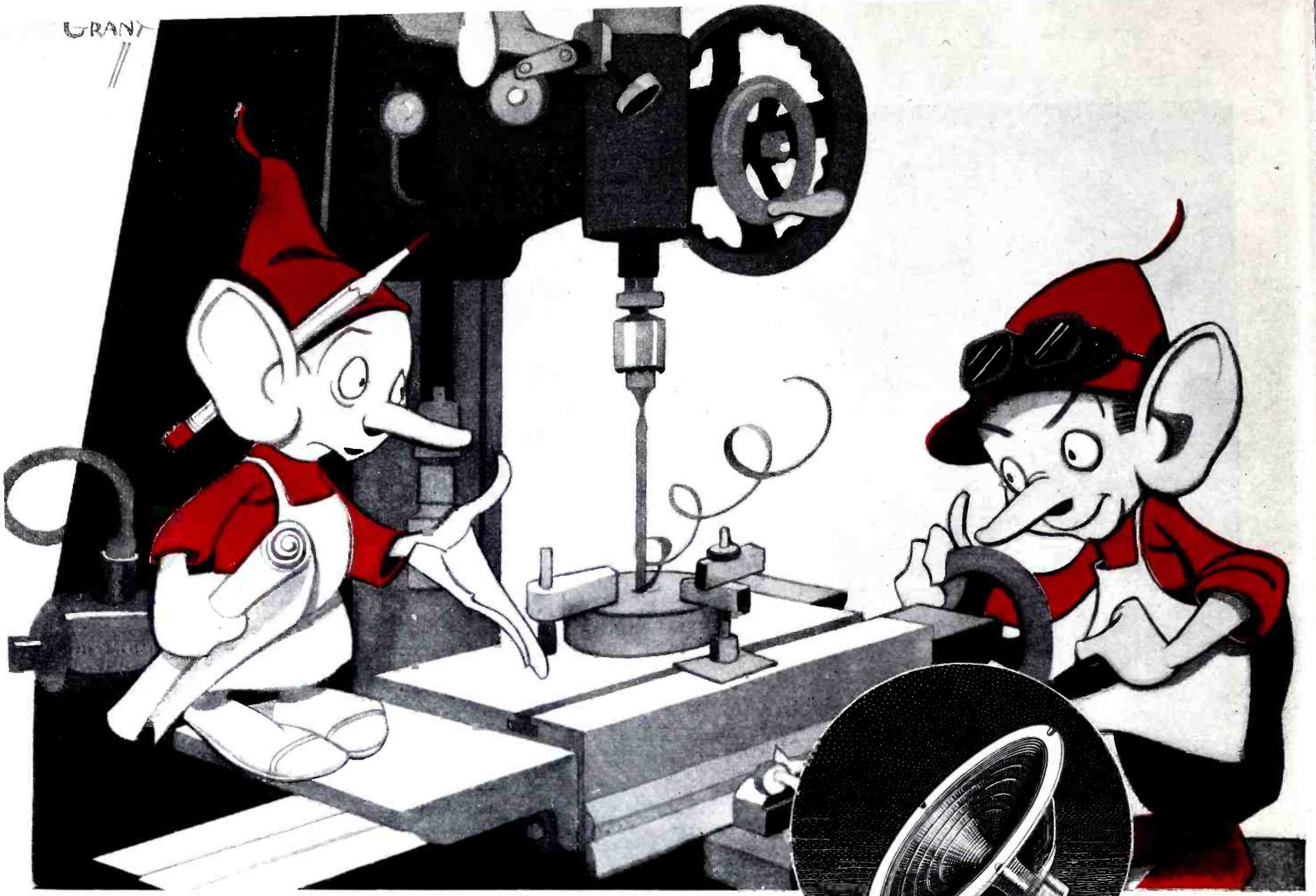
Federal has the experience, the facilities, the technique, needed to build television equipment for any broadcasting requirement. For the best in television — see Federal first.

FEDERAL TELEPHONE & RADIO — FTR

Federal Telephone and Radio Corporation

AN IT&T ASSOCIATE

Newark 1, N. J.



UTAH SPEAKERS: More than 20 million Utah speakers have been made for radio, and public address systems.

THE UNBROKEN CIRCUIT

A machine like that shown above may look like a complicated and perplexing mass of metal to you, but not to Utalins*.

They visualize the precision of the resulting tools . . . made in Utah's own factory to Utah's undeviating standards. They know these tools will play a major part in creating the quality products that make possible the modern electronic circuit.

And Utalins* *know* the performance of these products! For Utah's process is absolutely comprehensive . . . the making of tools is only the first step. It is followed by the close supervision and painstaking testing of all steps of manufacture, from raw material to finished product . . . *the unbroken circuit.*

When finally these products become an integral part of an electronic device, those listening—as well as those working in the many phases of electronic development—can recognize the quality of the products that emanate from Utah's self-contained plant.

*Utalins—Utah's helpers.

utah
RADIO PRODUCTS COMPANY
CHICAGO, ILLINOIS

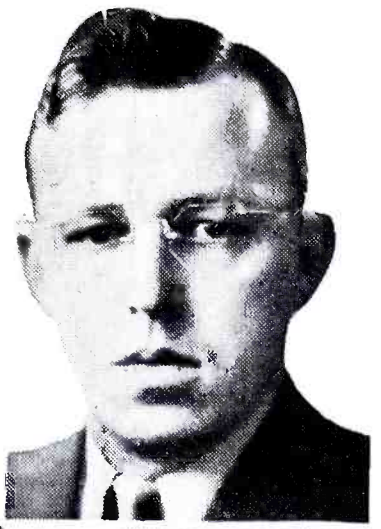
ARMY E NAVY

SPRAYBERRY RADIO TRAINING

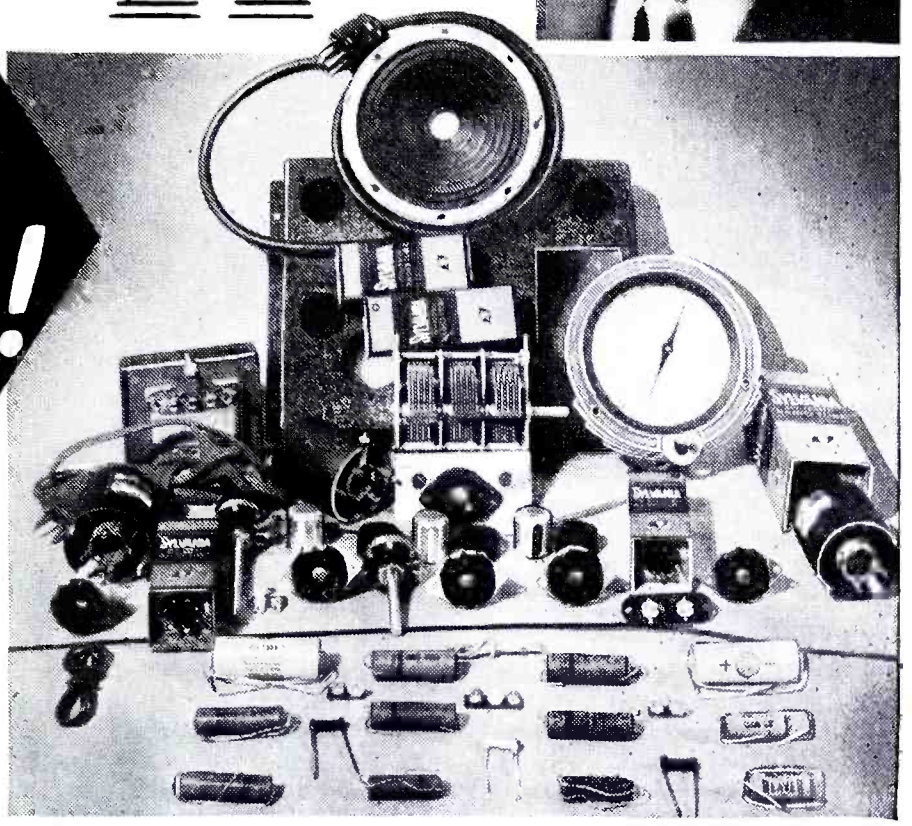
Gives you Both

TECHNICAL KNOWLEDGE

SKILLED HANDS



FULL RADIO SET SUPPLIED FOR SHOP PRACTICE!



HERE'S THE ONE PRACTICAL WAY TO TRAIN FOR BIG EARNINGS AHEAD IN RADIO-ELECTRONICS & TELEVISION

The offer I make you here is the opportunity of a lifetime. It's your big chance to get ready for a wonderful future in the swiftly expanding field of Radio-Electronics INCLUDING Radio, Television, Frequency Modulation and Industrial Electronics. Be wise! NOW'S the time to start. No previous experience is necessary. The Sprayberry Course starts right at the beginning of Radio. You can't get lost. It gets the various subjects across in such a clear, simple way that you understand and remember.

I'll Show You a New, Fast Way to Test Radio Sets Without Mfg. Equipment

The very same Radio Parts I supply with your course for gaining pre-experience in Radio Repair work may be adapted through an exclusive Sprayberry wiring procedure to serve for complete, fast, accurate Radio Receiver trouble-shooting. Thus under Sprayberry methods you do not have one cent of outlay for manufactured Test Equipment which is not only expensive but scarce.

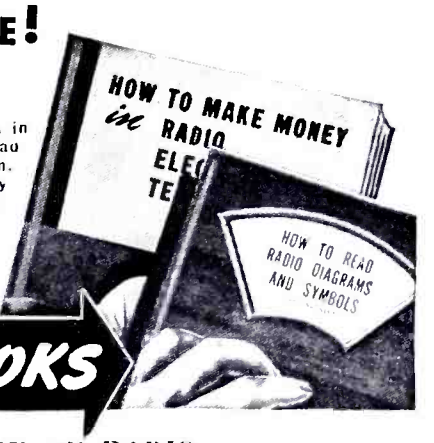
Prepares You for a Business of Your Own or Good Radio Jobs . . . Civilian or Military

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

JUST OUT! FREE!

"How to Read Radio Diagrams and Symbols"

. . . a valuable new book which explains in simple, non-technical English how to read and understand any Radio Set Diagram. Provides the quick key to analyzing any Radio circuit. Includes translations of all Radio symbols. Send for this FREE book now while supply lasts and along with it I will send you another big FREE book describing my Radio-Electronic training.



GET FREE BOOKS

SPRAYBERRY ACADEMY OF RADIO
F. L. Sprayberry, Pres.
Box 500 WN
Pueblo, Colorado

Please rush my FREE copies of "HOW TO MAKE MONEY IN RADIO, ELECTRONICS and TELEVISION," and "HOW TO READ RADIO DIAGRAMS and SYMBOLS."

Name ..... Age.....
Address .....
City ..... State.....

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

(*Continued from page* 16)

quirements of radio for buses, Richard R. Mead of the National Association of Motor Bus Operators said that buses cover 300,000 miles as compared to 229,000 of railroads. The use of radio, he said, not only facilitates message dispatching but provides for transmission of essential information during emergencies. L. H. Ristow, chairman of the National Bus Traffic Association said that two-way radio would help bus service by providing sufficient seats to handle passengers at all times between all points, particularly those arriving on connecting trips; avoid delays in arrival or departure of buses, including the elimination of transfer problems; and provide proper service of passengers at eating and rest stops.

Supporting the truck industry's need for radio, John W. Lawrence, managing director of the American Trucking Associations, pointed out that the truck driver with the aid of radio would contribute immeasurably not only to the efficiency of transportation service, but to the welfare and safety of the public at large. Trucks with medicine and supplies could be routed, with the aid of radio, to places of greatest emergency during floods, hurricanes, storms, etc.

THE INCREASED USE OF RADIO for studying the physical properties of the earth and surrounding atmosphere has also presented a frequency-allocation problem, according to experts who appeared at the hearings. Testimony presented by FCC engineer J. H. Wofford revealed that the geophysicists have asked for six frequency channels in place of the two now allotted. These are in the 1.6-, 3-, 31-, 74-, and 171-mc. regions.

The only type of geophysical service radio station authorized by the Commission at the present time, according to Mr. Wofford, is the geographical radio station. There are 358 licensed at present, operated by 31 licensees. These stations are used primarily in investigating the surface of the earth and the physical characteristics of the strata below the surface of the earth. The stations also may be used for geological exploration. Oil companies are active in the latter instance in prospecting for oil and other subsurface products. Generally, the power is limited to 10 watts, although as high as 50 watts has been used.

These stations serve two purposes. They permit communications between field parties and the transmission of impulses that are used in seismic prospecting.

Describing the seismic exploration procedure, Mr. Wofford said that a charge of dynamite exploded in the earth at a depth of 40 to 150 feet provides the recording impulse. That is, the time of arrival of the vibratory waves from this shot, at various detector points, is transmitted to and photographically recorded by equipment in an instrument truck. The distance between the point of explosion and detector points and the distance between the various detector points may vary from a minimum of 200 feet to a maximum of 15 miles. As the dynamite is exploded, explained Mr. Wofford, recordings are made of the instant of explosion, the instant of arrival of the first vibratory waves at the surface near the explosion point and the instant of arrival of the waves at the detector points. Communications between these points, of course, is necessary. It provides for the transmission and reception of orders and instructions and recording of the timing elements. The timing factor is the basis, of course, for all calculations made from the recordings to determine the existence and depth of subsurface formations favorable to the accumulation of petroleum and gas, explained Mr. Wofford. Wire line field telephones are not practical for these activities because of the distances involved, the terrain and the temporary type of installations required. Operation is mostly mobile and therefore radio offers the only practical means of service.

At the present writing the FCC has 11 outstanding construction permits for new geological radio stations.

FACSIMILE WHICH APPEARS DESTINED to become increasingly important, had a score of experts testify in its behalf. An exceptionally complete analysis of the art was offered by John V. L. Hogan, chairman of RTPB panel 7 and world-famous inventor. He said that facsimile is essential to a variety of services, including education, railroads, police, power utilities, etc. He pointed out that police need facsimile to transmit vital material rapidly. And it is now possible to provide such transmission: an 8x10 page in two minutes. Facsimile also can handle foreign language code and characters, such as Chinese, Persian, and Turkish, in terms of ordinary English text, at rates of more than 1,000 words a minute, cited Mr. Hogan. According to Mr. Hogan, a high-fidelity sound channel can carry 40 square inches or 600 words per minute. Thus, every page of a 50,000-word book could be transmitted in a little over an hour.

The use of multiple transmission in facsimile operation was stressed by former FCC commissioner George Henry Payne, who is now vice-president of Finch Telecommunications. He said that multiplexing will facilitate transmission of fingerprint and identification data for police. It will also permit pilots to receive and transmit maps, storm warnings and barometric readings without interference from beam frequency reception. In multiplex transmission, two or more signals are transmitted over a common carrier wave. These signals can be two or more sound signals or they can be sound and visual or facsimile. Mr. Payne pointed out that when the Queen Mary was in operation, its radio crew sent and received facsimile mes-

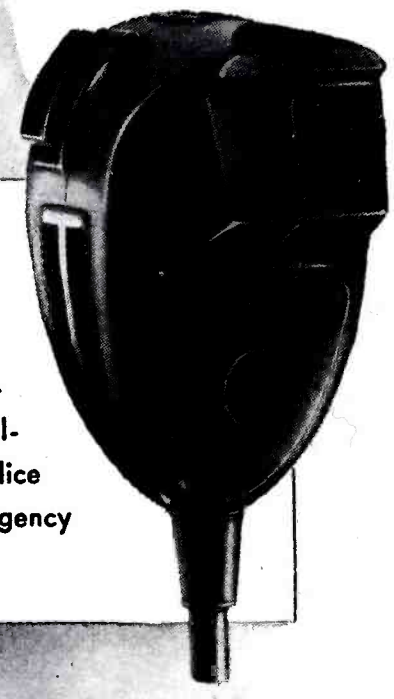
(*Continued on page* 124)

NOW AVAILABLE

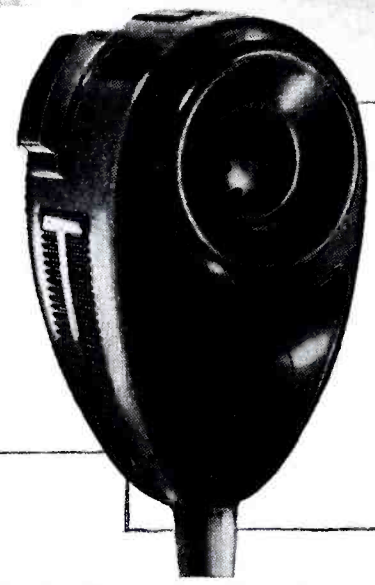
NEW CATALOG, DESCRIBING THE COMPLETE LINE OF

Electro-Voice COMMUNICATIONS MICROPHONES

Electro-Voice Differential Microphone, Lip-Type Model 245 for applications where background noise elimination, free use of hands and high articulation are required.



Electro-Voice Differential Carbon Microphone, Hand-Held Model 205-S, an ideal microphone for aircraft, industrial, railroad, police and emergency services.



Electro-Voice Carbon Microphone, Model 210-S, a single button microphone which embodies all of the latest developments required for military use

Electro-Voice Dynamic Microphone, Hand-Held Model 600-D, designed for high fidelity speech pick-up in those locations where the ambient noise does not exceed 100 db.

ELECTRO-VOICE CORPORATION
1239 South Bend Ave., South Bend 24, Ind., Dept.RN-1

Please send us your new "Electro-Voice Communications Microphones Catalog."

NAME OF COMPANY_____

ADDRESS_____

CITY_____ STATE_____

ATTENTION OF_____

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

ARMY (E) NAVY

ESMERALDA COPE HAS TWO JOBS . . .

Esmeralda Cope is one of many hundreds of women workers in the Detrola Radio Division who now are building land mine detectors, FM signal generators and other electronic war equipment. This job continues until Victory. But without detracting from this primary task, many of these workers are being acquainted also with their post-war assignments on the same production lines. Thus they will be ready to build hundreds of thousands of fine radio receivers, automatic record changers, television receivers and other products to enrich the life of a world at peace. Yes, Esmeralda Cope has two jobs. And International Detrola's creed of highest quality rules them both.

BUY WAR BONDS TILL VICTORY

DETROLA RADIO

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

C. RUSSELL FELDMANN PRESIDENT

FOREIGN BROADCAST INTELLIGENCE SERVICE

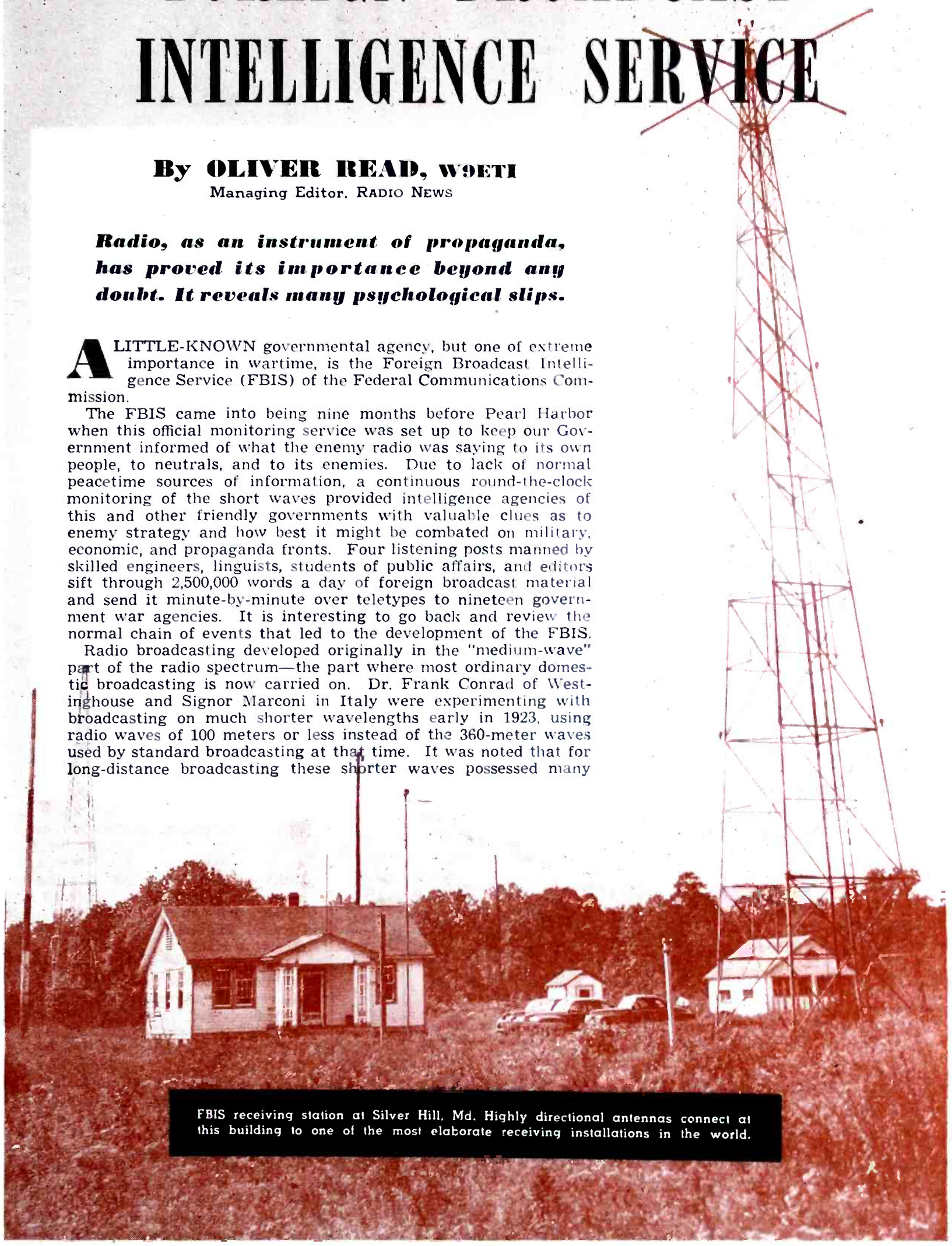
By OLIVER READ, W9ETI
Managing Editor, RADIO NEWS

Radio, as an instrument of propaganda, has proved its importance beyond any doubt. It reveals many psychological slips.

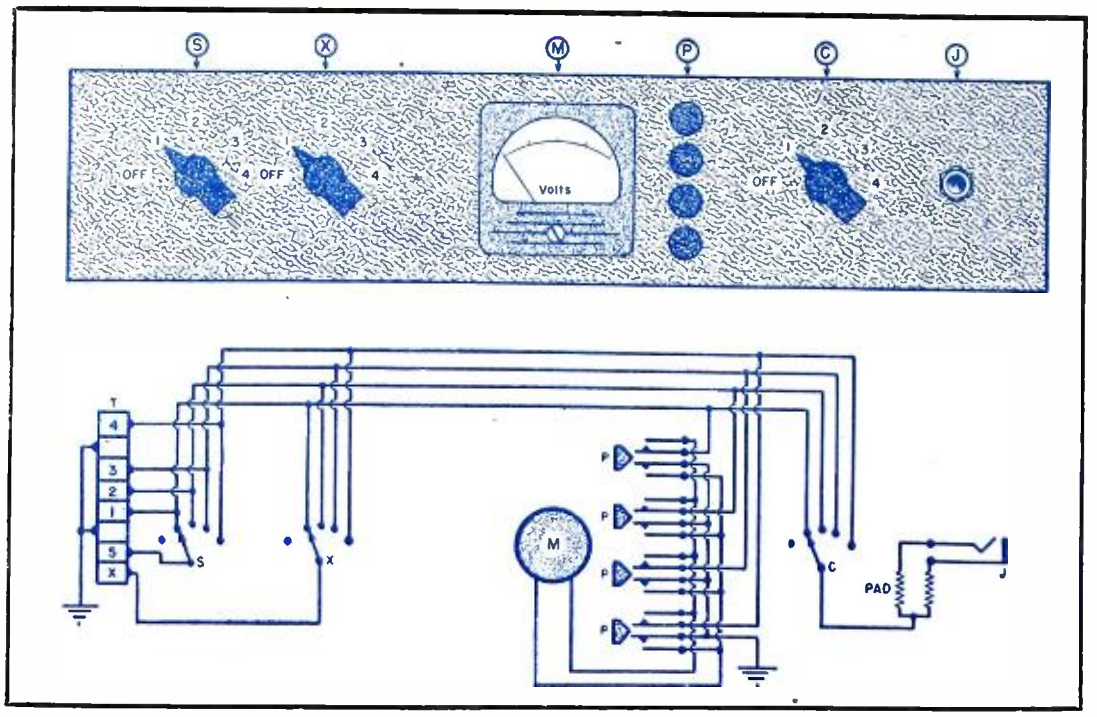
A LITTLE-KNOWN governmental agency, but one of extreme importance in wartime, is the Foreign Broadcast Intelligence Service (FBIS) of the Federal Communications Commission.

The FBIS came into being nine months before Pearl Harbor when this official monitoring service was set up to keep our Government informed of what the enemy radio was saying to its own people, to neutrals, and to its enemies. Due to lack of normal peacetime sources of information, a continuous round-the-clock monitoring of the short waves provided intelligence agencies of this and other friendly governments with valuable clues as to enemy strategy and how best it might be combated on military, economic, and propaganda fronts. Four listening posts manned by skilled engineers, linguists, students of public affairs, and editors sift through 2,500,000 words a day of foreign broadcast material and send it minute-by-minute over teletypes to nineteen government war agencies. It is interesting to go back and review the normal chain of events that led to the development of the FBIS.

Radio broadcasting developed originally in the "medium-wave" part of the radio spectrum—the part where most ordinary domestic broadcasting is now carried on. Dr. Frank Conrad of Westinghouse and Signor Marconi in Italy were experimenting with broadcasting on much shorter wavelengths early in 1923, using radio waves of 100 meters or less instead of the 360-meter waves used by standard broadcasting at that time. It was noted that for long-distance broadcasting these shorter waves possessed many



FBIS receiving station at Silver Hill, Md. Highly directional antennas connect at this building to one of the most elaborate receiving installations in the world.



Audio level and output control panel, used at the FBIS receiving station at Silver Hill, Md. (P) Push buttons to check audio level. (C) Selective switch for phone output. (M) Voltmeter (0-150) with 2250 ohms substituted for multiplier. (S) Selective switch for Memovox recorders. (J) Phone jack. (T) Terminal for rack of four receivers.

advantages. Soon experimental short-wave broadcasting stations in the U. S. and in England were exchanging programs. Thus, international broadcasting was inaugurated about 1923.

These original international broadcasts were *relayed*. There existed in each country but a handful of radio receivers capable of tuning in short-wave programs. The only way to build up audiences for these broadcasts was to pick them up and then rebroadcast them in the standard radio band used by ordinary listeners. The cooperation of radio stations in both countries was required for successful international broadcasting.

No one doubted in the early twenties that this international broadcasting would be a prime force of international peace and good will among nations. They anticipated no friction. Shortly thereafter, however, radio amateurs and others began constructing radio receivers which were able to pick up foreign broadcasts directly by short-wave instead of being limited to the standard band rebroadcasts of these international programs. Soon, enterprising manufacturers were marketing radio receivers that included short-wave bands and anyone could listen to foreign broadcasts on short-wave.

The result was that the international broadcast stations could build up listening audiences from other countries even for those programs which the other countries chose not to rebroadcast. About this time medium-wave broadcasts were being used across national borders for political propaganda. The Russians took the lead in this field. Adolph Hitler in 1933 rose to power with his doctrine that "words are deeds" and quickly perceived the disrupted possibility of sowing seeds of distrust and dissension by international radio. Short-wave transmitters became a new kind of Nazi weapon.

Transmitters were pouring forth words in scores of languages by 1938. Great Britain used the short waves extensively as a means of welding the far flung dominions to the Mother country. The League of Nations broadcast news of its activities through a powerful Swiss station. The Nazis were stirring up conflict within neighboring countries.

The Germans developed special directional antenna systems for their transmitters and beamed their propaganda to every corner of the world. The British, for example, would be told that the United States would soon dominate the world, while the Americans were simultaneously being warned through another transmitter that the British were the chief danger. When war came in 1939, this radio warfare became intensified. Lord Haw-Haw, the Nazi radio star, built up a tremendous listening audience in England and was featured on front pages of American newspapers. In this way, direct German propaganda procured the fullest access into both Britain and the United States. Simultaneously, the Nazi barrage of anti-American broadcasts to Latin America was intensified.

The FBIS was set up at the suggestion of the State Department with the approval of the Board of War Communications to operate as a central agency serving all Government agencies requiring foreign broadcast material.

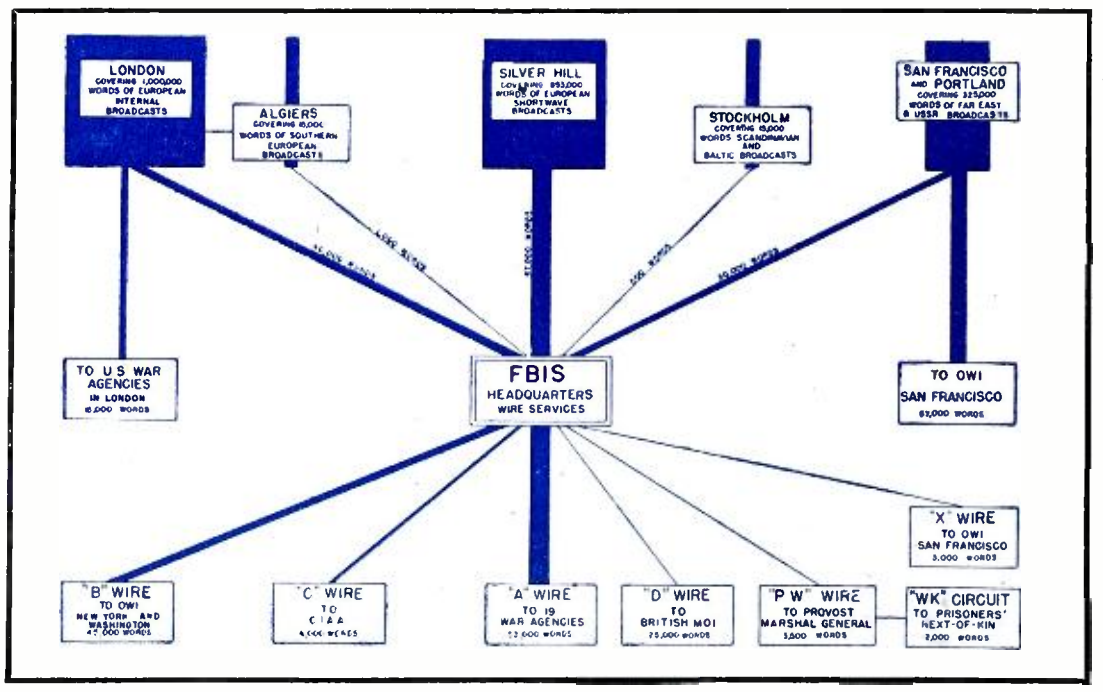
There are nine simultaneous or successive steps in FBIS operations. These are (1) Scheduling; (2) Interception; (3) and (4) Monitoring and recording (that go on simultaneously); (5) Translating; (6) Wire services, including editing and teletyping; (7) reports (including editing and mimeographing); (8) analysis (including periodic and special reports) and (9) individual services of various kinds.

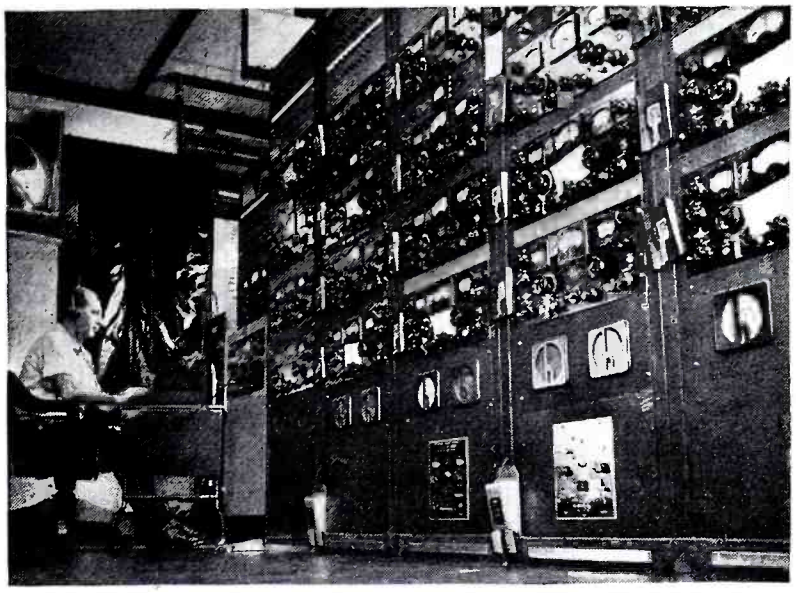
Special services are provided by the FBIS to Government officials requesting them. For example; at the time of the Hitler speech following the Italian surrender, the White House had a special telephone installation with Hitler's voice on one end and Churchill, General Marshall and others on the receiving end.

Principal speeches by German and Japanese leaders, by standing order, are recorded as received on permanent high fidelity discs and are furnished the OWI and the equivalent British Overseas Broadcast agency for use in their Library of Direct Quotations.

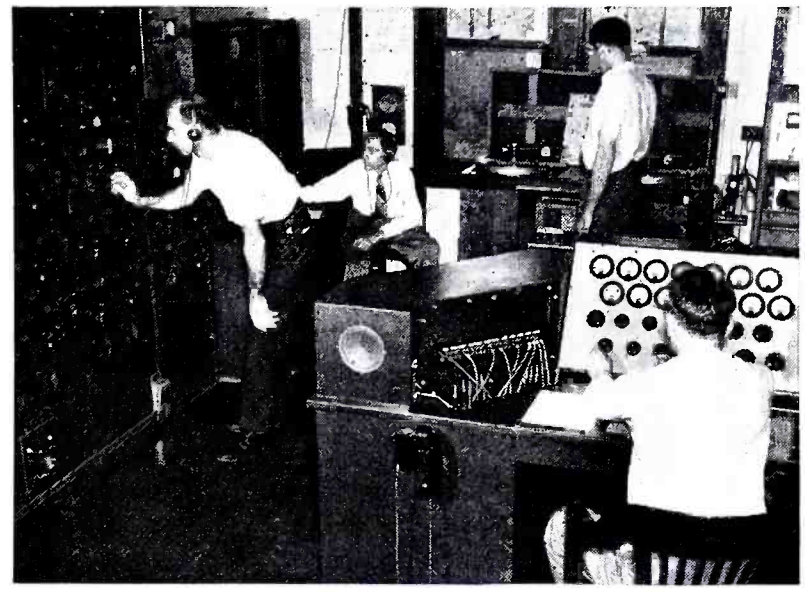
We visited the FBIS receiving station at Silver Hill, Md., to get first-hand information on the important functions of this nonmilitary unit. There are four such stations operating for the express purpose of checking all foreign short-wave broadcast transmissions, recording their contents and interpreting them into English. The receiving stations are chosen for ex-

Organization chart of the Foreign Broadcast Intelligence Service (FBIS).





Monitoring officer "logs" transmissions from all parts of the world and notes the exact time which they are heard, together with any other information needed for future reference.



Radio transmissions are picked up by 29 SX-28 receivers and piped through the console (foreground) to the wax cylinder recorders located seven miles from this receiving station.

cellence of reception. They include a maze of communications receivers (Hallicrafters SX-28's), Memovox and Presto recorders, and various and sundry units assembled and developed by FBIS personnel. The receivers are mounted in bays. They are easily accessible from the rear for quick servicing. All of the sets are in continuous operation. There are twenty-nine of these in operation at Silver Hill alone.

In charge of each receiving station is a Monitoring Officer. Under him are a number of monitoring officers and radio operators working in shifts, whose job it is to maintain an accurate worldwide program "log" and to pretune receivers to prescheduled programs over a twenty-four hour period.

Connecting to these receivers is a highly complex antenna system including five Rhombic antennas, each covering a maximum angle of twenty degrees. The operators select the antenna which provides the strongest signals to be heard. The outputs of the receivers go through a control console provided with complete "patching" facilities. There are special telephone circuits which go to the central office located many miles distant and which terminate to wax cylinder recorders. The audio level is maintained by the console operator at a predetermined level, one which will afford correct modulation for the wax-cylinder recorders.

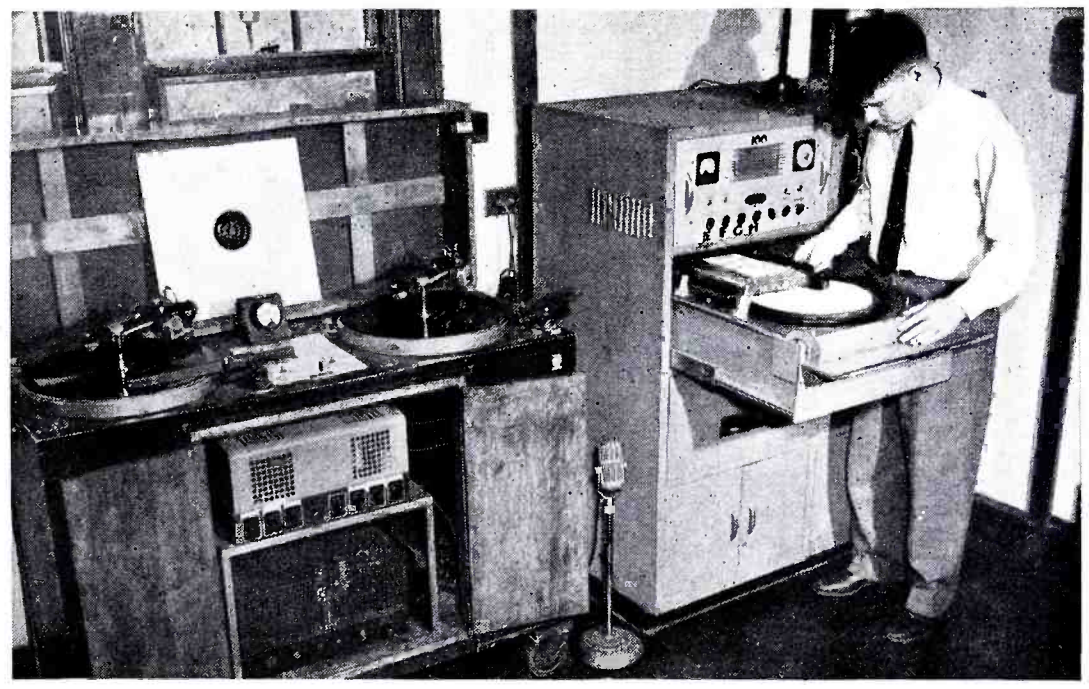
Other equipment, as mentioned previously, includes Memovox recorders employing paper-based discs capable of holding over an hour's recording per side. These are used when a complete transcription is required for counter-propaganda purposes. In addition, two Presto tables are in readiness to record any type of intelligence requiring high fidelity.

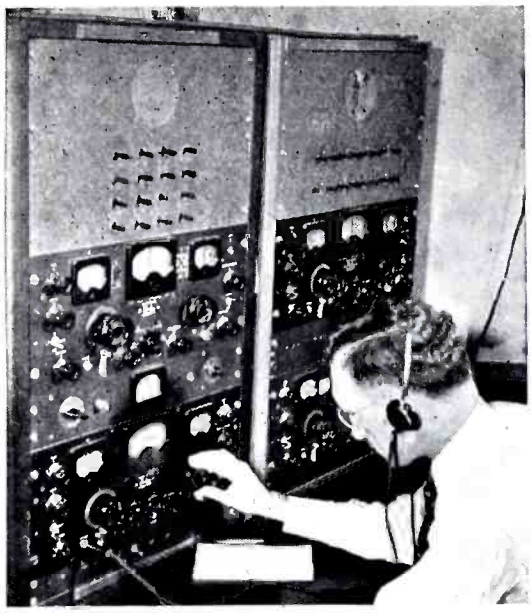
The FBIS interpreters are not lolated at the receiving stations. They work from the downtown headquarters of the FBIS in Washington (seven miles away). The experts of the FBIS are equipped to monitor thirty-four different languages plus thirty other dialects. Most of the interception carried out by the personnel involves voice broadcasts. A small part, particularly enemy news, is transmitted by International Morse code. The Germans use it frequently. The Jap Domei Morse in the Japanese language presents some peculiar difficulties however. It is directed from Tokyo to its satellite newspapers in the Asiatic area. The Jap announcement of the resignation of the two Japanese Chiefs of Staff, for example, was first received in the United States via these Jap press broadcasts. The Japanese language itself is written in ideographs which cannot be transferred directly into dots and dashes. They must first be changed into a Roman alphabet reading of the Jap language on a purely phonetic basis. This Romaji is then transmitted by International Morse code. At Portland, Oregon, where Jap broadcasts are monitored, engineers receive and type it out as so many meaningless letters. It is teletyped in this form and is translated to English at the Washington headquarters. Such translations take about four times as long as for any other language. These experts, specializing in various languages, listen to the programs as they come over the telephone circuits. They wear a pair of headphones and type the intelligence as they listen. They do not make a complete transcription, however, unless it is of extreme importance. A second cylinder may be cut in instantaneously so that an uninterrupted recording may be had. These are kept in special racks for a period of forty-eight hours in case an entire program is requested by one of the various agencies using the service.

Other important functions of the FBIS include editorial and teletype rooms.

A special service has been rendered on occasions to the Department of Justice. This is in connection with trials involved in sedition, violation of alien registration laws, and the treason clause of the Constitution of the United States. One of these was in

David Cooper, FBIS Supervisor, records a broadcast on a Memovox machine. Over an hour's intelligence may be recorded on each side of the flexible discs. Continuous recording is possible by using duplicate machines.





Frank X. Green, monitoring officer-in-charge, cruises the ether in search of new stations or program changes.

This monitoring officer, at Portland, Oregon, caught the sensational news that Tokyo had been raided by Gen. Doolittle's flyers. Japanese broadcasts are four times more difficult to interpret than any others.

August, 1942, of William Dudley Pelley and two other defendants on charges of having violated the federal sedition Act. Dr. Pelley, leader of the American Silver shirt organization, was publisher at the time of the trial of a periodical called "The Galilean." This periodical contained material reflecting and corresponding to the main lines of Axis propaganda and contained no material which contradicted these main lines of Axis propaganda.

Two government witnesses, one of them Ensign Harold N. Graves, Jr., then Assistant to the Director of FBIS, who testified to the main lines of Axis propaganda, identified fourteen themes constantly "harped on" by the radios of Germany and Italy. The second witness, Dr. Harold Lasswell of the Library of Congress, testified that an analysis of "The Galilean" showed it to reflect Axis propaganda to a considerable degree. It was shown at the trial that members of "The Galilean" organization actually had taken notes of foreign short-wave broadcasts and that on at least one occasion, notes from an Italian radio broadcast had appeared with some modification in following issues of "The Galilean." Pelley was convicted and sentenced to five years in the penitentiary. The case was appealed but the verdict was upheld by a higher court.

Historical news, too, has come from the facilities of the FBIS. For example, the scoop story on Doolittle's raid on Tokyo back in April, 1942, was made possible by the alertness of one of the monitors at the Portland, Oregon, receiving station. Picking up the Japanese word "Kushu" and thinking simultaneously in ideographs (picture characters which give the meaning of Jap words) this monitor knew that here was the news all America awaited. Upon completion of the item it now was known that our fliers had successfully raided and bombed Kobe and Nagoya. This information was later confirmed by the Doolittle fliers themselves.

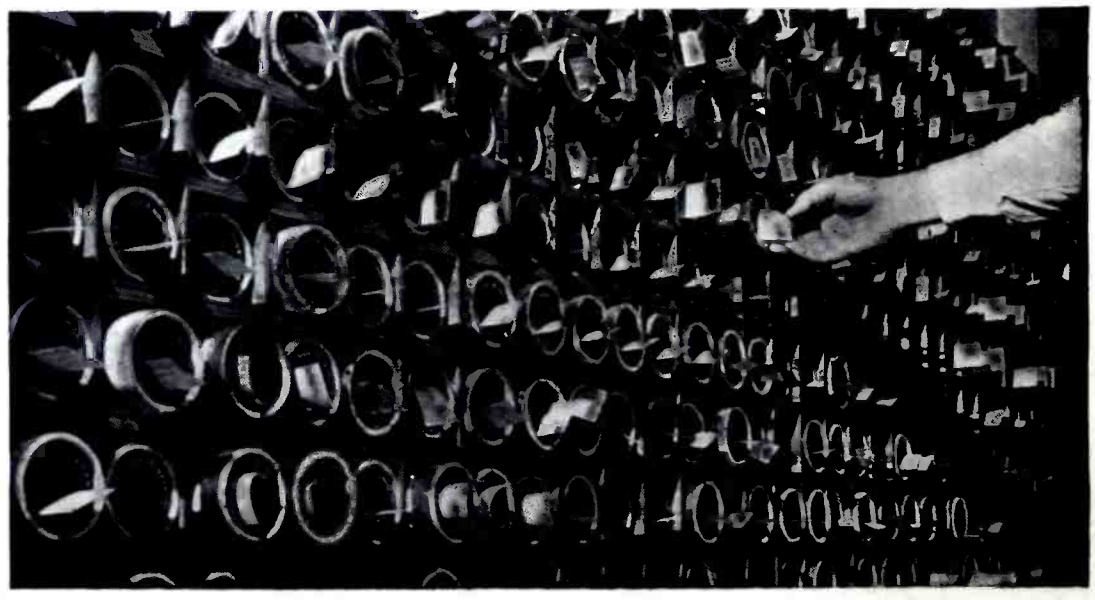
It is interesting to note that most of the operating personnel at the receiving stations are, or were, radio amateurs. Their skill and technical know-how gave them a valuable background for this type of work. In charge of the station at Silver Hill is Frank X. Green, former engineer of KFXJ, KFEL, KOA, KMA, and KIVL. While there we met an interesting chap by the name of James G. Wedewer, Assistant Monitoring Officer, who is an official of several short-wave listening clubs and an authority on short-wave broadcast stations of the world. He told us the location of all the call letters we mentioned.

A group of four Hallicrafters SX-28 receivers is used for scanning the ether for new stations, changes in schedules and other information in order to keep the "log" accurate. Each receiver is supplied with a small booklet placed in a metal clip adjacent to the set. Complete calibrations are included which show the exact tuning setting for any frequency throughout the spectrum. These must be kept currently accurate, particularly if a sudden change in weather is encountered. A constant check on frequency is had by means of several crystal controlled secondary standards that put out signals at either 100 or 1000 kc. The personnel at Silver Hill rigged up a special changeover switch (seen

(*Continued on page* 102)

Miss Ann Wilkinson, French language monitor and daughter of Vice Admiral T. S. Wilkinson, shown listening at her post.

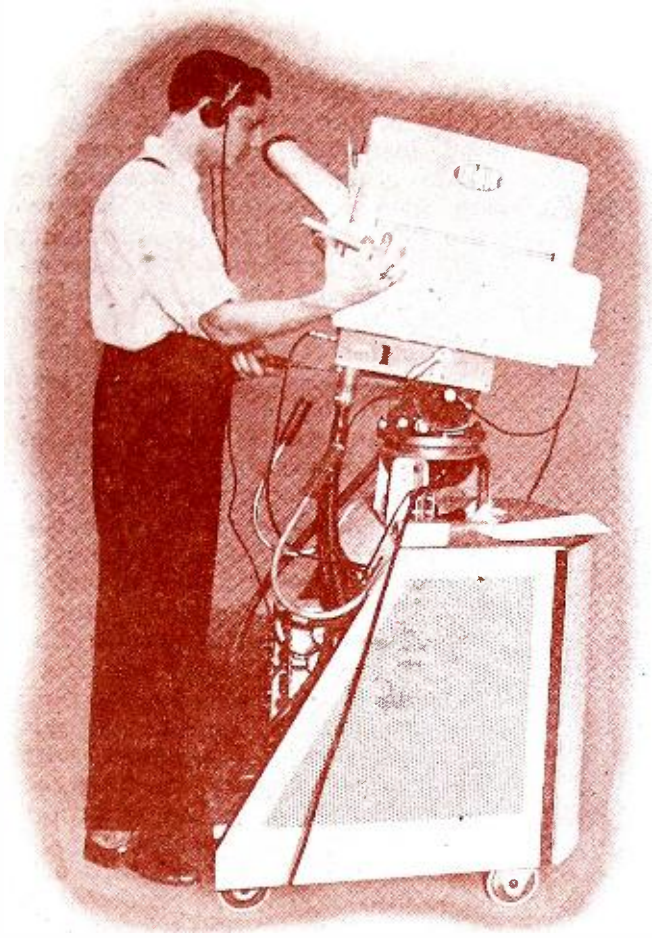
Wax cylinders containing the original intelligence that has been received from the elaborate receiver installation located at Silver Hill, Maryland, are kept for a period of forty-eight hours, and then are reshaven for further use.



TELEVISION is coming to the SMALLER CITIES

By AUSTIN C. LESCARBOURA

Du Mont Station WABD demonstrates that telecasting can be done on modest scale.



Du Mont television camera. Cameraman views pick-up thru the electronic viewfinder, which produces an image the same as that being transmitted.

TELEVISION has its recruiting bureau. Likewise, its boot training and even advanced training. And that accounts for the growing army of television specialists ready to man and operate those telecasting stations scheduled to go on the air from coast to coast, once the go-ahead is given on television equipment.

Hundreds of writers, directors, advertising men, and advertisers already have enlisted in the ranks of postwar telecasters. Likewise, hundreds of professional entertainers—actors, singers, magicians, jugglers, lecturers, and what have you—have jumped at the chance of appearing before the television camera in order to test their drawing power via the new medium. Potential telecasters not only have studied the proposition at first hand but have even run a station to get the feel of the thing, while engineers, cameramen, control room operators, and other technicians are in training for their future jobs.

All of which sums up the purpose of Station WABD which, in four brief years packed with notable achievements, has advanced from an engineering test to a television kindergarten and now to a dress rehearsal of tomorrow's commercialized telecasting.

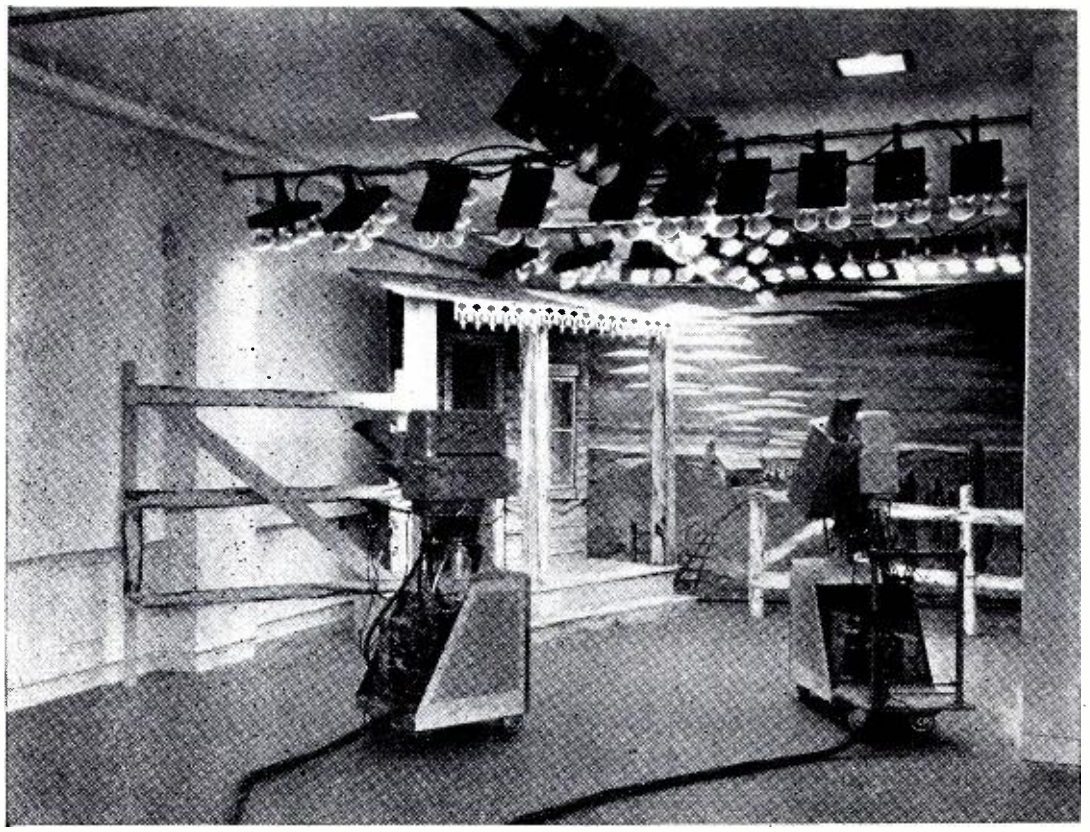
Station WABD is actually the prototype of the hundreds of telecast stations that are certain to dot this country from coast to coast within the next few years. Equipment has been simplified to the utmost, and made in handy units linked together in "chains" for any desired studio facilities and transmitter coverage, thereby permitting of a modest start and subsequent additions thereto, with a minimum of obsolescence. Studio appointments have been kept at a minimum. For something like a quarter of a million dollars—that's peanuts in broadcasting language—a Class A 25 kw. telecasting station can be launched on its commercial career, so far as the equipment is concerned. And that amount can be slashed considerably for a more modest start.

Thus, television is coming to the smaller cities. No longer is it the battle of the Goliaths over the choice big metropolitan areas. Of course, following the pattern of radio broadcasting with which it shares much in common, telecasting will have its big stations and elaborate studios spotted here and there where metropolitan audiences run into the millions. But in addition there will be hundreds of modest stations scattered about the country, transmitting to smaller audiences local programs as well as network telecasts piped by ultra-shortwave relays at first and ultimately, very ultimately, by coaxial cable.

High Power Debunked

First and foremost, the Du Mont station operates on a modest power rating. The transmitter pumps out approximately 5 kw. peak for the video component, and about 1 kw. for the audio. The final stage of the video →

Transmitting antenna of station WABD. The tower atop the 42-story New York skyscraper raises the doughnut audio and crossarm dipole video antennas to a height of 650 feet above sea level.



General view of the new studio of Du Mont Station WABD, showing scenery, ceiling lights, and television cameras. Overhead lights are arranged in banks of 1800 watts each.

layout uses a pair of GE 889 tubes. The final audio stage uses a pair of Eimac 450 TH. The crystal frequency control starts at 129 kc., doubling along to attain 83.75 mc. for the audio and 79.25 mc. for the video. The station operates on television channel No. 4, or the 78-84 mc. band. The audio is frequency modulated, while the video is amplitude modulated.

The video antenna is a crossed dipole of copper-plated steel tubing, while the audio antenna of similar tubing is a doughnut, directly above the crossarms. The two antennas are about 650 feet above sea level, mounted on a steel pole supported by a derrick-type steel tower. The steel pole can be lowered down inside the derrick, and the antennas inspected and repaired from the platform atop the derrick tower.

Despite the modest power rating (25-kw. video and 12.5-kw. audio being specified for postwar Class A television stations) and despite the antenna height which is less than that of other television transmitters in the area, the station delivers a dependable and ever-powerful signal over a radius of 50 miles. Fan mail discloses regular lookers-in even up to 100 miles' distance.

Studio Elbow Room

The original studio shared the cramped quarters of the 42nd floor of the tower of the skyscraper at 515 Madison Avenue, with the transmitter, business office, reception room, tiny dressing room, film projection room, and shop. Its modest dimensions were packed with scenery, props, piano, spot lights, two cameras, cameramen, studio director, kibitzers, and finally the sweating performers under the ceiling banks of reflector bulbs. The maximum available stage space was about 15-feet wide by somewhat less depth.

Yet, despite these space limitations, Station WABD (previously W2XWV) went right ahead with its development of television entertainment technique. Increasingly ambitious presentations were attempted, climaxed last Christmas season by the two-hour Dickens' "Christmas Carol" which set new standards for lighting, camera angles and telecast performance generally. The studio had all the atmosphere of a storage warehouse when such props as Scrooge's bed, Cratchet's bookkeeper's desk and the dinner table in Tiny Tim's home, were crammed into the pint-sized space. The two cameras were swung from one side to another, picking up the scenes and closeups in sequence. Meanwhile, the banks of lights, mounted on overhead swivel frames, were swung from one side to another to provide the intense illumination required. Electrical transcriptions provided the appropriate incidental Yuletide music.

Recently, with the change in call letters from W2XWV to WABD that signifies a commercial television license, the station put on its long pants, figuratively speaking, by way of new and enlarged studio facilities. Leaving the 42nd floor intact and still using the small studio there for some rehearsals and some pickups, the station opened its new and very much larger studio on the 2nd floor, alongside the new general offices, two viewing rooms, a 60-seat theater with projected-on-screen television images, a prop room, dressing rooms and other facilities.

The new studio has many advantages over previous working quarters, aside from more elbow room. For one thing, there are blowers and ducts to provide plenty of fresh air for the comfort of performers and studio staff, in contrast to working under the hot lights in the unventilated studio upstairs. Again, there is more illumination, provided by many more swivel banks of reflector lights on the ceiling, each bank totalling 1800 watts. The higher level of illumination permits of smaller lens diaphragms which in turn means greater depth of focus for the telecast images. The soundproofing of the studio represents the most advanced practice of leading acoustical engineers.

Between studio proper and other rooms is a vestibule or sound lock. The doors are double-gasketed around all edges and are fitted with special hardware to force the door tightly against the gaskets when closed. This arrangement insures against the leakage of sound from the control room and it also effectually excludes extraneous sounds from outside the studio—incidentally marking the advent of really serious telecasting, without the chance remarks and background noises heretofore creeping into telecast programs on occasion.

The banks of reflector lamps, mounted on universal joints, can be swiveled quickly and easily into position for the lighting of four separate stage spaces, or collectively grouped on the full studio area. Unusually flexible and fast control is provided through silent wall switches.

With adequate elbow room at last, with ample illumination, and with the comfort afforded by the fresh-air ducts which later will provide air conditioning when and as such equipment becomes available, the engineers are already turning to bigger game in the entertainment field Among other projects, a two-hour telecast version of "Journey's End" is in the making, which is indicative of the sort of thing they now are ready to tackle.

There also is to be a live studio audience, and for this purpose the studio is being widened to accommodate several dozen theater seats down one side. Based on radio-broadcast experience, the studio staff and most of the performers feel that a studio audience makes for a more natural performance.

Television Cameras at Work

There are two Du Mont television cameras in the new studio, each resting on its gyro-head which in turn is mounted on a rubber-tired dolly. These highly-mobile and flexibly-mounted cameras can be maneuvered rapidly for any long shot, closeup, angle, or other effect. Power supplies for both iconoscope and electronic viewfinder are based on the camera dolly. Ruby signal lights placed on the cameras warn actors and cameramen when they are on the air. Actors can face or play to whichever camera is "on," as indicated by the ruby light.

The electronic viewfinder is an exclusive Du Mont development. It is actually a miniature television receiver attached to the camera, showing the cameraman the televised pic-

ture exactly as it will appear when telecast. It indicates precisely the scope of the lens, the focus, and the illumination in telecast terms instead of in usual optical terms, which might not be the same thing at all.

A "live talent" studio requires two iconoscope cameras. This is much more than a matter of standby equipment or protection against accidents. It enables the director to televise a person or scene with one camera, while bringing his second camera to focus from a different angle or on a new scene. He can switch this new angle or scene to the air without interruption and then use his first camera to prepare the next "shot," and so on. The use of two cameras makes it possible to alternate from full-lengths to closeups, from front views to profiles, from printed announcement to product demonstration, or to lap-dissolve from one scene to another.

The lap-dissolve from one scene to another, and the simple fadeout, are also recent developments. These effects are obtained by means of potentiometers in the control room.

The Microphone Boom

In sound broadcasting, the performers come to the stationary microphone, and that's that. But in television, the performers have full freedom of action and indeed must move about to provide the necessary animation required for good video presentation. Thus, the microphone must be brought to the performers and, what's more, kept out of sight. Hence, the microphone boom, or microphone mounted on a long adjustable arm that is swung over the scene and out of sight of the camera. Constantly shifting the boom microphone keeps one man very busy during the telecast.

Supplementing the studio sound pickup are the electrical transcription turntables in the control room, supplying incidental music and sound effects as required.

Putting the Program Together in the Control Room

While the cameramen wearing earphones receive their instructions over the intercommunicating system from the director in the control room, the telecast is being assembled and edited in the control room proper. Experience has shown that the program producer works best in the privacy of a glassed-in room overlooking the studio. Here, by means of the intercommunicating system, he can instruct the studio staff individually or collectively without interrupting the "shooting."

The control room for the new studio is raised several feet above the studio floor level, so as to provide an unobstructed view through its plate glass window. The studio control desk accommodates a collection of units serving as video monitors, switches, and controls. The producer can select the pickup of either camera and place same on the air. The images can be "shaded" or corrected for uneven lighting or excessive highlights or shadows, in the control room. Meanwhile, the sound pickup also is monitored so as to maintain the proper level. The units are placed at an angle in the racks of the control desk, so as not to obstruct the view through the plate glass window. Also, a current of air is circulated through the units for cooler operation.

Scene during the telecasting of "The Boys from Boise" in the new studio of Du Mont Station WABD. Note the many overhead clusters of reflector bulbs.

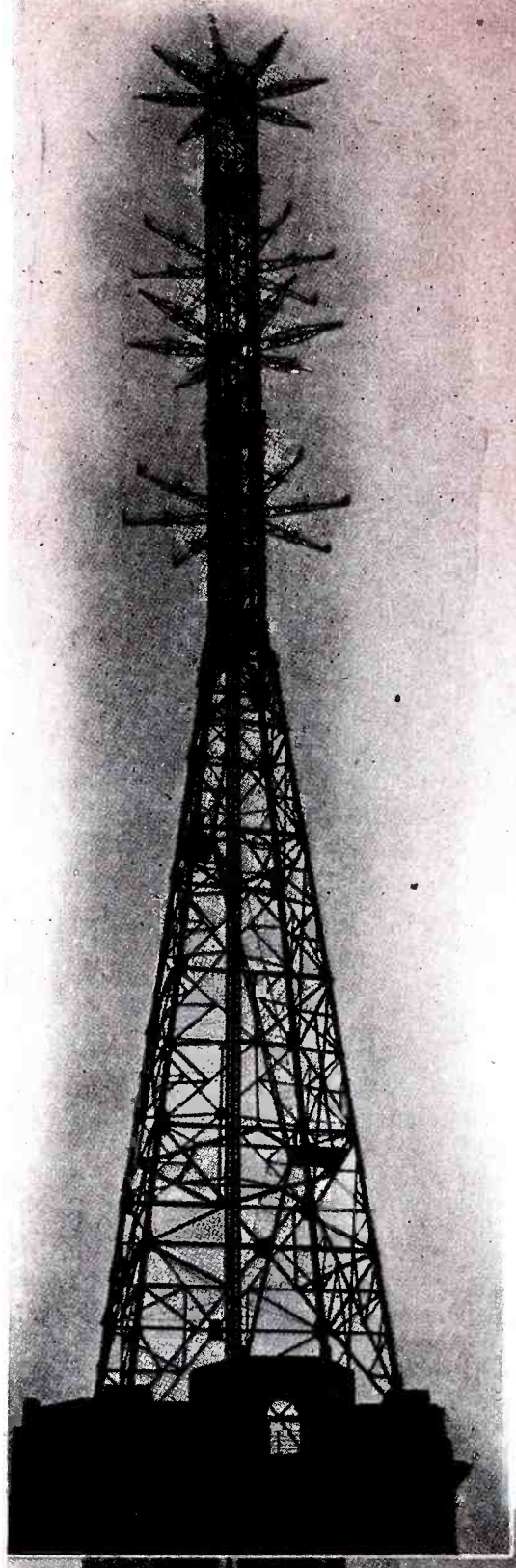
The studio pickup is transmitted by coaxial cable to the 42nd floor where it passes through the master control board. After the cameramen have done their best, much can still be done to improve the quality of the picture, by the engineers operating this master control board. Since they operate more effectively if they do not see the scene being televised, the master control board is installed in a room apart from the "live" production studio. From this board the pickup goes to the transmitter and then on the air.

Television Movies

Station WABD uses movies to some extent in making up its programs. In fact, one of its most interesting offerings is the "Thrills and Chills" feature in which thrilling travel or adventure films are shown, while their maker, being interviewed in the studio, supplies the running comment. The film projectors used at present are standard motion picture theater equipment with special lens adapters for the projection of images upon the sensitive

(*Continued on page* 108)

Studio of Station WABD as viewed through the plate glass window of the control room. Sound engineer is at right, video engineer at left, and production manager in center, with microphone for issuing instructions to cameramen in the studio. The cameramen receive these instructions through earphones.



TELEVISION IN GREAT BRITAIN

By LEON LADEN

London, England

Colored stereoscopic television, as a result of John Logie Baird's latest invention, the Telechrome, may become an outstanding feature of the postwar British television industry.

A BLUEPRINT of postwar television, a sort of television Magna Charta, is now being worked out by Britain's leading radio engineers, scientists, and manufacturers serving on the Government Television Advisory Committee,[1] appointed over a year ago, to consider postwar development of television and advise the Postmaster-General on future requirements.

This Committee already has taken evidence from representatives of the BBC scientists, engineers, manufacturers, cinema and studio proprietors, and other bodies concerned with the future of the industry. It can also be divulged, authoritatively, that the Committee's findings and recommendations are expected to be made public within a very short time.

Till then, however, the road along which the British television industry will travel in the postwar period of its development or the signposts by which it will be guided remain, necessarily, unconfirmed.

This contingency equally applies to the type of domestic receiver which will make its appearance on the home and export markets and to the type of television station that will transmit the outgoing programs.

[1] The equivalent of the U.S. Radio Technical Planning Board.

[2] The BBC is a public corporation operating under Royal Charter and responsible to the British Parliament.

Mr. Baird's first demonstration of television in color and stereoscopic relief. Top photo shows the lattice television mast at the Alexandra Palace, accommodating the vision (above) and sound (below) aerial arrays, with a signal carrier range of over 50 miles.

The BBC's Postwar Plans

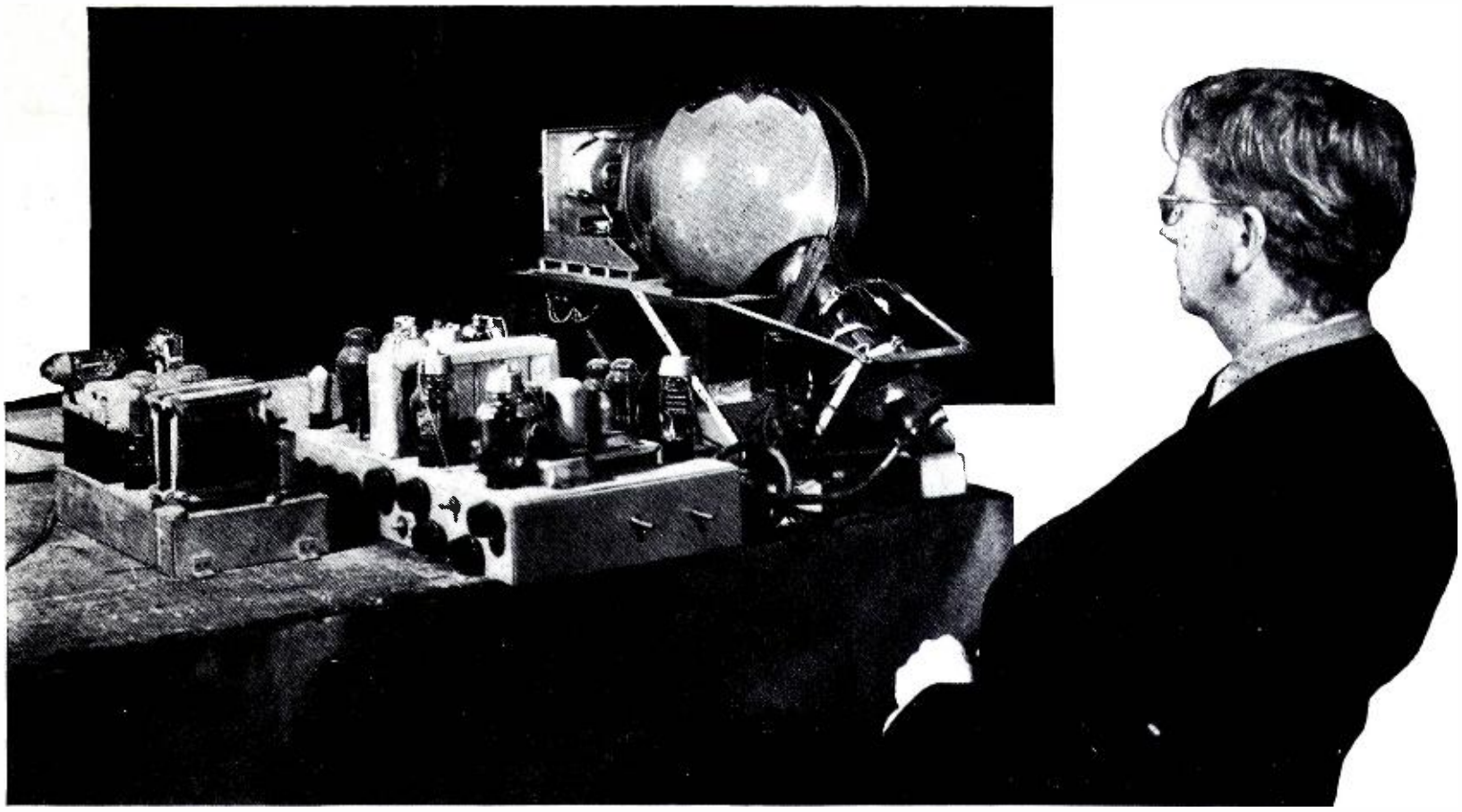
No official yardstick, therefore, exists for the measurement of the BBC's future television development and no statement on their peacetime policy has been authorized, thus far, by either Mr. W. J. Haley, the new Director-General or Sir Noel Ashbridge, Deputy Director-General in charge of Engineering.

Nevertheless, it is regarded as a certainty that the television service, closed down on the 1st of September, 1939, will be on the air again soon after the termination of hostilities, though in what form it is extremely difficult to predict, especially since the BBC's Charter [2] is due for renewal at the end of 1946, and much water has flowed under the bridge since the Charter was granted over 21 years ago.

In spite of this, however, it is reliably reported that far-reaching plans for the strengthening of the BBC's service are completed which call for the erection of a super "Radio City" in the center of the British capital, incorporating the entire broadcasting system and controlling every phase of its complex and ever-growing work.

This new broadcasting nerve-center —for which building sites became available when the tenement flats adjoining Broadcasting House were destroyed by enemy action—will contain repertory theaters with a seating capacity for many thousands, big concert and opera halls, and provision for television studios, control rooms, and equipment.

Imaginative television programs providing a wide and varied pattern



John Logie Baird shown with his color-television equipment, employing the newly-designed Telechrome tube.

selection of entertainment, information, and education to the people of this country, will be produced in the "Radio City" and put on the air (as before the war) by the Alexandra Palace transmitting station, linked with it by special coaxial cables.

A similar cable-route network will connect, in turn, Alexandra Palace with regional relay transmitting stations in such centers of population as Manchester, Birmingham, Newcastle, Glasgow, and Aberdeen, a chain of highly directive automatic relay stations catering for the more sparsely populated areas.

It is estimated that this nationwide network, stretching from Land's End to John o' Groats, and extending the range of television broadcasting to Britain's population of some 45 million, will be completed within less than five years after the war's end.

This outline is regarded to constitute the long-term policy of the BBC and also comprise provision for color-television transmissions.

For the intervening span of time, the BBC plans to put into operation a less costly and ambitious scheme consisting of high definition television, unchanged in essentials from the pre-1939 service; the higher standards will be introduced by a 'staggering' process as the super Radio City grows, the gargantuan network strengthens its complex web of tentacles across the land, and the infant service matures.

Black and White versus Color

Amazing as the development of television may have been in the fifteen years of its existence as a public service, it generally is agreed, nevertheless, that many unchartered possibilities still will have to be explored before colored television can seriously challenge black and white.

Mr. John Logie Baird has done more than anyone else to put color television on the map and was the first to hit upon the brilliant idea of combining the antiquated Victorian stereoscope with the familiar conception of the existence of three primary colors (red, green, blue) in the visible light spectrum.

The information this 56-year-old television pioneer imparted to the author was well worth the trip to the small country town where he has been living since his London home was hit by a flying bomb.

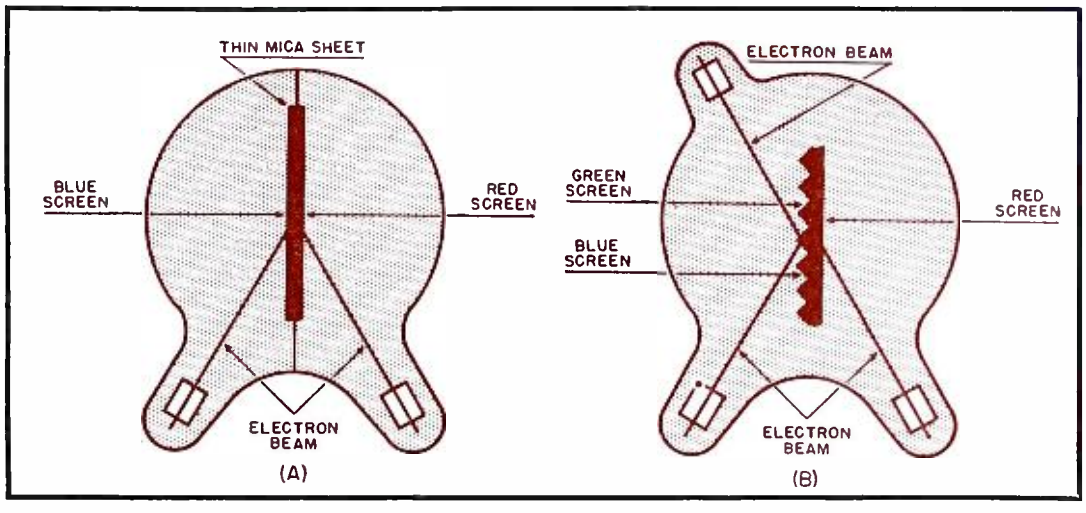
"I am most optimistic about the possibilities of color television," Mr. Baird said, and then he proceeded to paint a vivid picture of the revolutionary changes television, and particularly color and stereo television, was about to effect in our daily lives. Perhaps the most interesting and significant features of it are associated with the vast range of fresh opportunities which would be provided for the entertainment, information, and education of the people while in their own homes.

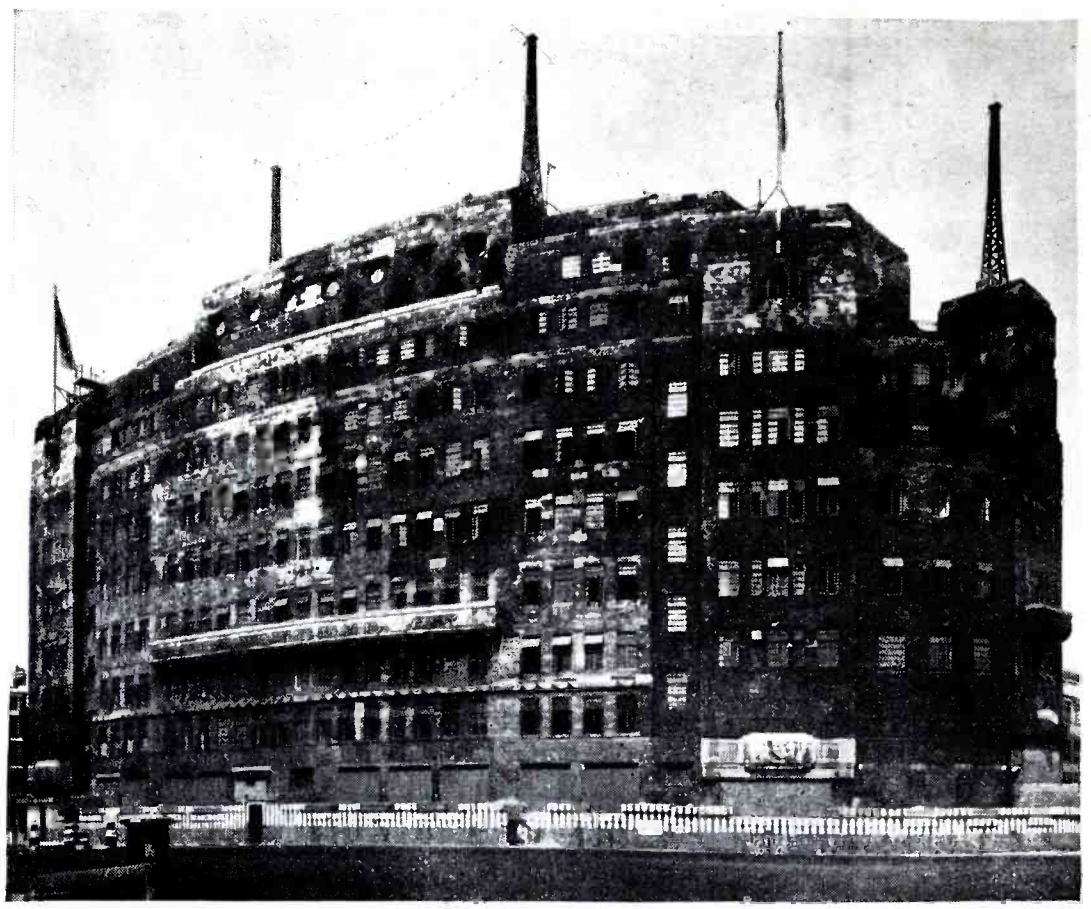
But the highest place among the notable accomplishments of Britain's best-known television authority belongs to his latest invention, the "Telechrome."

This excellent piece of new equipment was demonstrated last month to a small gathering of members of the press. It has focused the attention of those interested in television developments once more on colored stereoscopy, which possesses greater possibilities than black and white and promises to become the outstanding feature of the postwar British television industry.

In describing the Telechrome the inventor revealed that for the first time

Fig. 1. Telechrome tube construction: (A) for two-color effect; and (B) for three color.





Wartime view of camouflaged broadcasting house, London, showing several antenna arrays and belt of concrete encircling ground floor as protection against bomb blasts.

he had perfected a cathode-ray tube capable of reproducing on the screen a coherent picture of 600-lines in natural colors and stereoscopic depth without the aid of intermediate filters.

"By utilizing a new form of scanning," Mr. Baird stated, "every line in the picture is reproduced instantaneously and in the color it actually occurs. The revolving discs and lenses which prevented the colored image from appearing directly upon the fluorescent screen of the tube and made colored stereo television less efficient and silent than black and white, have been eliminated."

The Telechrome already has been used with very good results, and stereo television without the previously necessary colored glasses, now a visible practicability, opens up an entirely new prospect for television.

Fifty-six year old John Logie Baird, holding his latest invention, the Telechrome. This tube has a 10-inch diameter disc screen of thin mica, coated blue-green on one side and orange-red on the other.

In Mr. Baird's opinion, however, there is not much likelihood that this broadcasting medium would become available to the British public immediately after the war is brought to an end in Europe or the Far East.

Another invention, on which he had been at work since the beginning of 1941, was also mentioned by Mr. Baird.

"It is a special type of facsimile apparatus for automatic operation in connection with the sending of telegrams, enabling enormous speeds to be obtained in the handling and dispatching of cables," was the way its inventor described the apparatus, adding that it was based on "a novel method of transmitting messages by television and recording them photographically on a moving band."

The details of construction and operation of this new electronic device were not revealed, however, owing to the wartime embargo on technical inventions which may benefit the enemy.

Mr. Baird concluded this most interesting and informative conversation by presenting the copy of a book entitled (eloquently) "Television—Today and Tomorrow" to which he had contributed the foreword, and drew my attention to an account of one of his earliest demonstrations of television in London, written in September, 1926, by a special correspondent of RADIO NEWS (described in the book as "America's foremost radio journal").

The account read as follows: "Mr. Baird has definitely and indisputably given a demonstration of real television. It is the first time in history that this has been done in any part of the world."

"This early testimony to practical television was the first to appear in print in the United States, I think," were the last words of the man who has now added another chapter to the history of television.

Postwar Plans of Manufacturers and Engineers

In talking to manufacturers of television equipment, one gathers that not color and stereoscopy but economy (in materials) and simplicity (in design) will be the keynotes of the postwar British television receiver.

"Premarketing tests show that an extensive market exists for an efficient and fairly cheap television receiver," a member of the British Radio Manufacturers' Association--the most powerful body in the radio industry—explained, adding that he did not expect color television sets to be put into mass production before their process of manufacture could be made as cheap and efficient as that of the black and white ones.

It is emphasized further by the manufacturers that they have spent large sums on improving pre-1939 models and laying plans for the manufacture of these by mass production methods at a reasonable price as soon as essential materials are released and the official 'go ahead' is given. These moneys they maintain, would have to be written off as a dead loss to the industry if overnight novel methods of transmission were to be introduced, instead of gradually over a number of years. This applies in their opinion, equally to the introduction of FM as well as to color and stereoscopy.

The British radio engineers share the manufacturers' view that this country's peacetime television industry will be dominated more by economic than technical factors, but suggest that in addition to black and white broadcasting for domestic use, provision should be made for an alternative service of color television programs for cinemas.

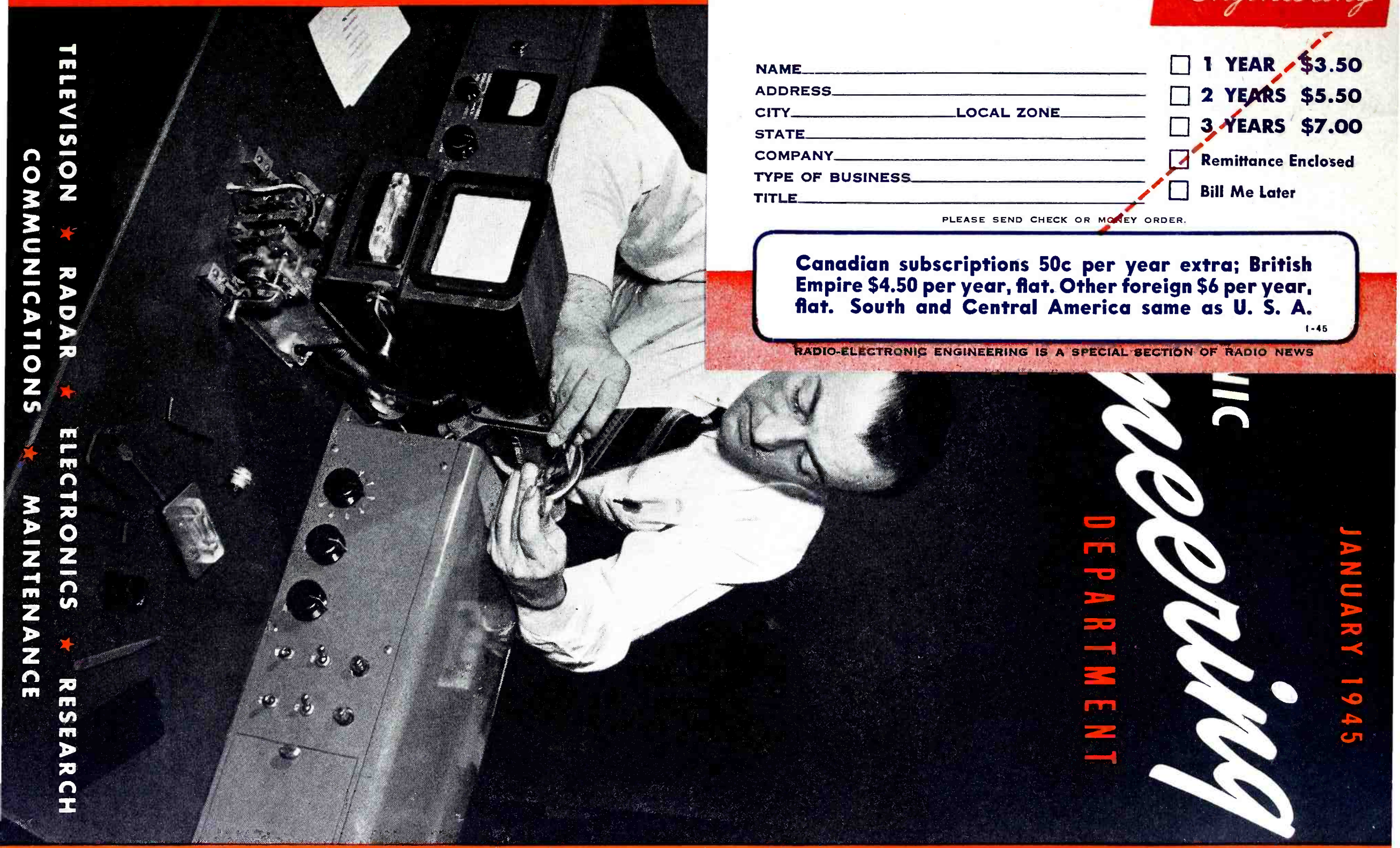
Regarding sound transmission, the engineers think it would be expedient to retain prewar amplitude modulation for the London service in addition (or supplementary) to frequency or pulse modulation, if and when either of these are introduced.

These views are expressed in a report submitted by the British Institution of Radio Engineers to Lord Hankey, chairman of the Government's Television Advisory Committee.

Among their other proposals of interest are recommendations for the formation of a Radio Research Institute to study postwar possibilities in the ultra-high-frequency spectrum, the adoption of co-operative research methods in the television industry, and the standardization of domestic television receiver circuits. The report also endorses the BBC's monopoly of television and the Government's control over available wavebands.

It stresses, too, that "serious consideration should be given to better utilization of the 4-mcs. bandwidth by making use of vestigial sideband

(*Continued on page* 84)

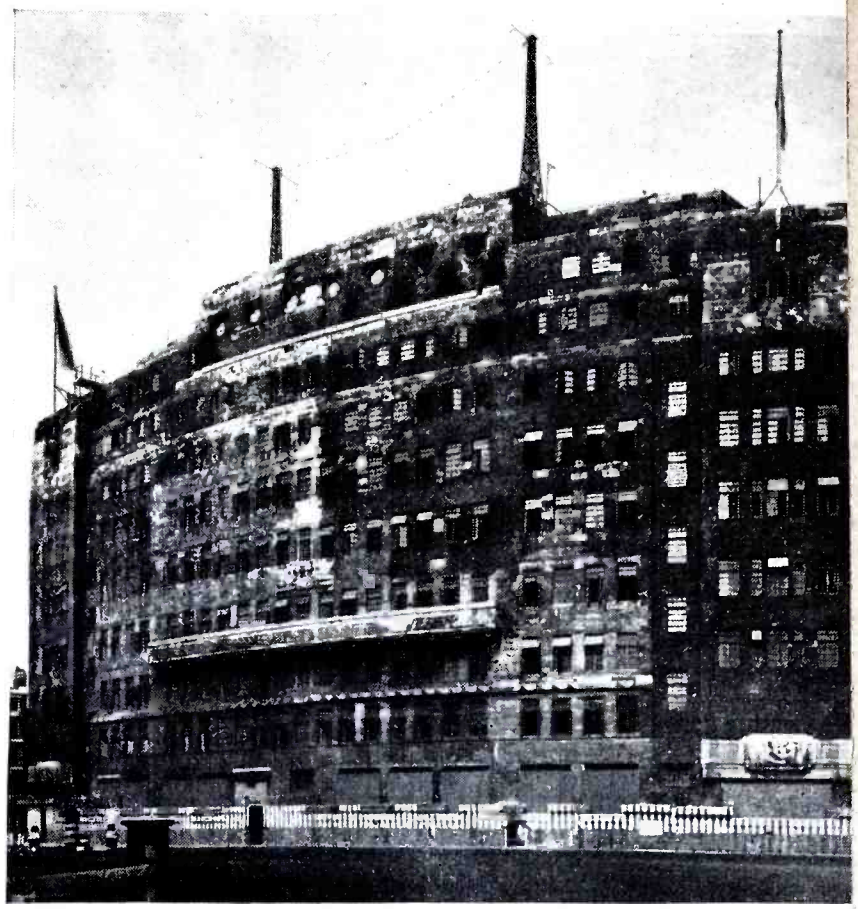


TELEVISION ★ RADAR ★ ELECTRONICS ★ RESEARCH
COMMUNICATIONS ★ MAINTENANCE

Radio-Electronic Engineering

DEPARTMENT

JANUARY 1945



Wartime view of camouflaged broadcasting house, London, showing arrays and belt of concrete encircling ground floor as protection agai

he had perfected a cathode-ray tube capable of reproducing on the screen a coherent picture of 600-lines in natural colors and stereoscopic depth without the aid of intermediate filters.

"By utilizing a new form of scanning," Mr. Baird stated, "every line in the picture is reproduced instantaneously and in the color it actually occurs. The revolving discs and lenses which prevented the colored image from appearing directly upon the fluorescent screen of the tube and made colored stereo television less efficient and silent than black and white, have been eliminated."

The Telechrome already has been used with very good results, and stereo television without the previously necessary colored glasses, now a visible practicability, opens up an entirely new prospect for television.

Fifty-six year old John Logie Baird, holding his latest invention, the Telechrome. This tube has a 10-inch diameter disc screen of thin mica, coated blue-green on one side and orange-red on the other.

In Mr. Baird's o
there is not much lik
broadcasting mediu
available to the Briti
diately after the war
end in Europe or the E

Another invention, on which he had been at work since the beginning of 1941, was also mentioned by Mr. Baird.

"It is a special type of facsimile apparatus for automatic operation in connection with the sending of telegrams, enabling enormous speeds to be obtained in the handling and dispatching of cables," was the way its inventor described the apparatus, adding that it was based on "a novel method of transmitting messages by television and recording them photographically on a moving band."

The details of construction and operation of this new electronic device were not revealed, however, owing to the wartime embargo on technical inventions which may benefit the enemy.

Mr. Baird concluded th s most interesting and informative conversation by presenting the copy of a book entitled (eloquently) "Television—Today and Tomorrow" to which he had contributed the foreword, and drew my attention to an account of one of his earliest demonstrations of television in London, written in September, 1926, by a special correspondent of RADIO NEWS (described in the book as "America's foremost radio journal").

The account read as follows: "Mr. Baird has definitely and indisputably given a demonstration of real television. It is the first time in history that this has been done in any part of the world."

"This early testimony to practical television was the first to appear in

well as to color and stereoscopy.

The British radio engineers share the manufacturers' view that this country's peacetime television industry will be dominated more by economic than technical factors, but suggest that in addition to black and white broadcasting for domestic use, provision should be made for an alternative service of color television programs for cinemas.

Regarding sound transmission, the engineers think it would be expedient to retain prewar amplitude modulation for the London service in addition (or supplementary) to frequency or pulse modulation, if and when either of these are introduced.

These views are expressed in a report submitted by the British Institution of Radio Engineers to Lord Hankey, chairman of the Government's Television Advisory Committee.

Among their other proposals of interest are recommendations for the formation of a Radio Research Institute to study postwar possibilities in the ultra-high-frequency spectrum, the adoption of co-operative research methods in the television industry, and the standardization of domestic television receiver circuits. The report also endorses the BBC's monopoly of television and the Government's control over available wavebands.

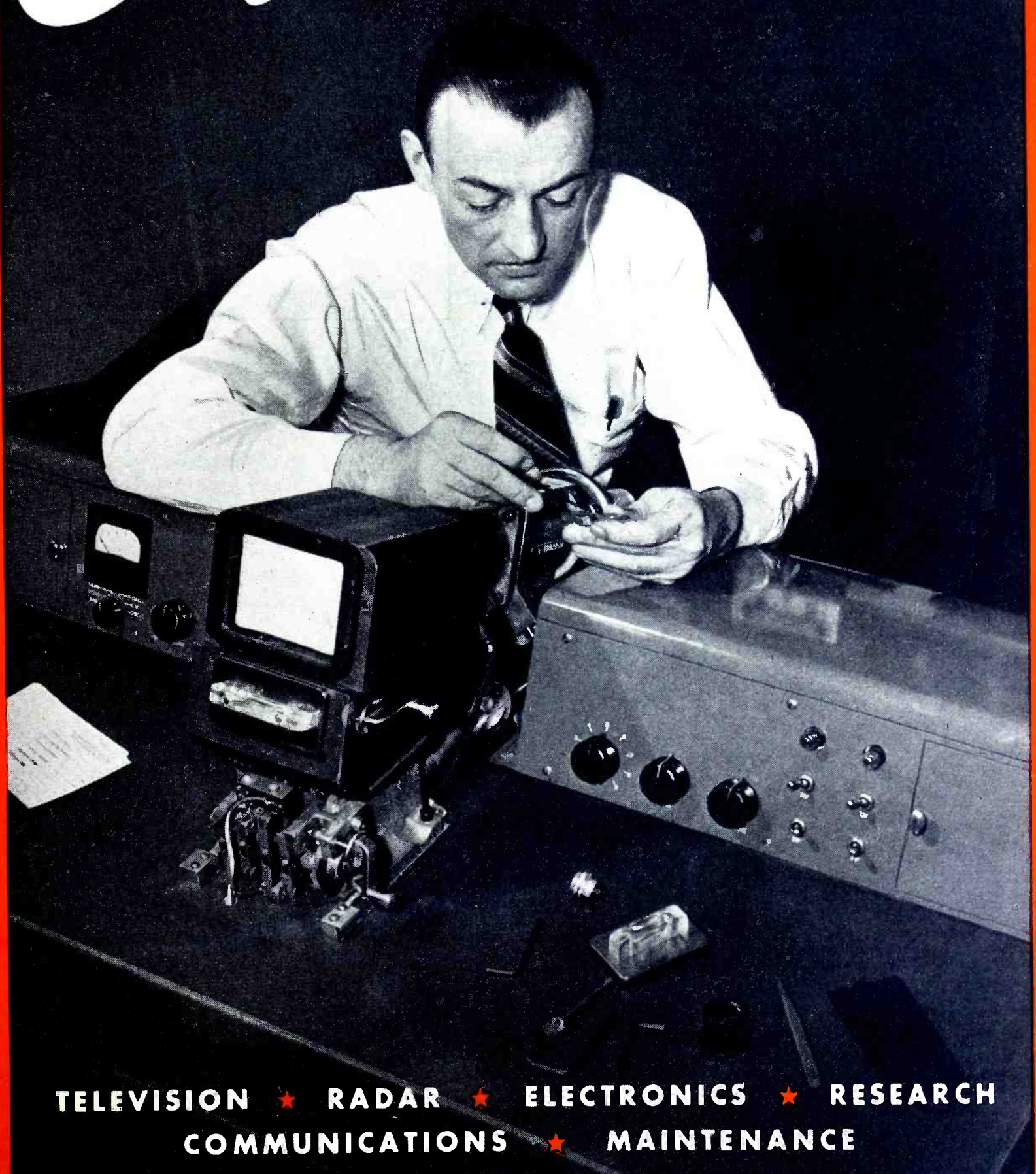
It stresses, too, that "serious consideration should be given to better utilization of the 4-mcs. bandwidth by making use of vestigial sideband

(*Continued on page* 84)

RADIO NEWS

JANUARY 1945

RADIO-ELECTRONIC *Engineering* DEPARTMENT



TELEVISION ★ RADAR ★ ELECTRONICS ★ RESEARCH
COMMUNICATIONS ★ MAINTENANCE

RADIO NEWS

RADIO-ELECTRONIC Engineering DEPARTMENT

ELECTRONICS • COMMUNICATIONS • TELEVISION • RESEARCH • MAINTENANCE

JANUARY, 1945

GYRO FLUX GATE COMPASS ..... Robert F. Lane 3

V.H.F. MEASUREMENTS ..... D. Fidelman 7

ELECTRIC STRAIN GAGES ..... W. R. Mehaffey 10

EFFECT OF FUNGI ON ELECTRONIC EQUIPMENT ..... Wilfred F. Horner & Helen M. Conlon 13

CONTROL CIRCUITS FOR RESISTANCE WELDING ..... John D. Goodell 16

R. F. GENERATOR CHARACTERISTICS FOR INDUCTION HEATING ..... T. P. Kinn 20

SHOCK EXCITED OSCILLATOR ..... R. G. Middleton 24

RH-507 INVERTED TRIODE ..... W. A. Hayes 26

DEPARTMENTS

PERSONALS 28

INDUSTRIAL REVIEW 32

NEW PRODUCTS 36

PATENTS 47

TELEVISION 38

CALENDAR 39

NEWSBRIEFS 45

RADIO-ELECTRONIC ENGINEERING is published each month as a special edition in a limited number of copies of RADIO NEWS, by the Ziff-Davis Publishing Company, 540 N. Michigan Avenue, Chicago 11, Ill.

VOLUME 4 NUMBER 1

Cover Photo—by Frank Ross, Staff Photographer

Perry C. Smith of the Electron Microscope Division of RCA working out details on the new console electron microscope. This instrument provides two direct magnifications of 500 or 5000 diameters.

GYRO FLUX GATE COMPASS

By ROBERT F. LANE

Adv. Mgr., Pioneer Inst., Eclipse-Pioneer Div., Bendix

A gyro-stabilized compass system for aircraft, utilizing the horizontal component of the earth's magnetic field.

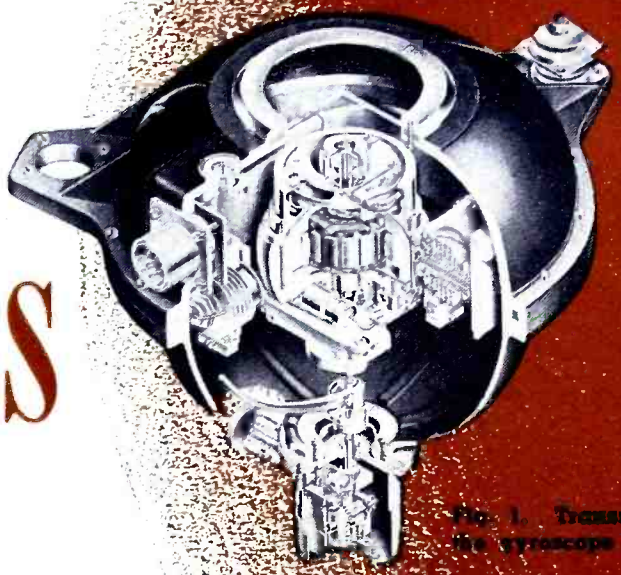


Fig. 1. Transmitter unit, showing the gyroscope and the Flux Gate.

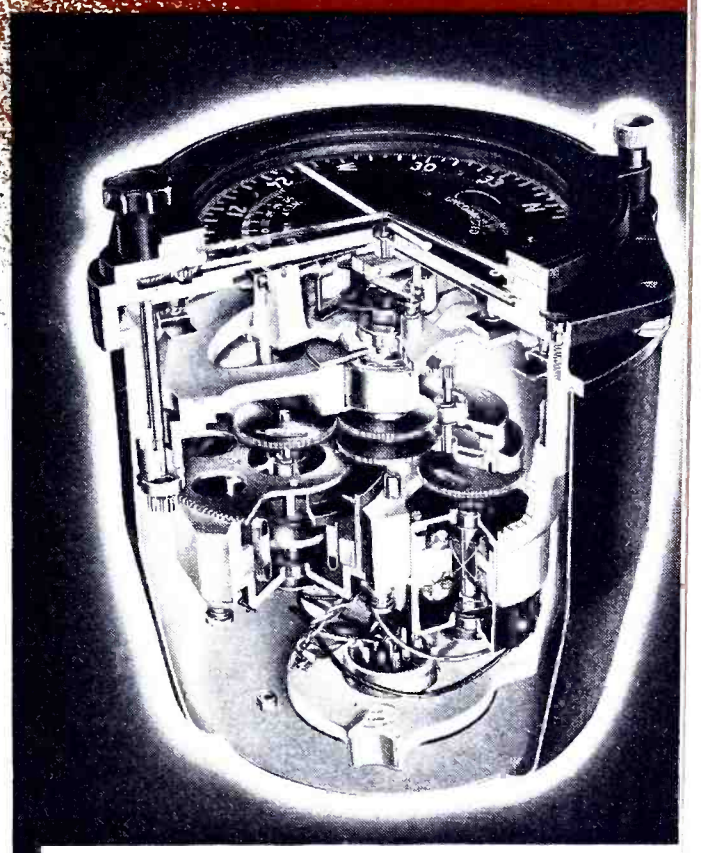


Fig. 2. Cut-away view of master indicator showing magnesyn, autosyn, and motor.

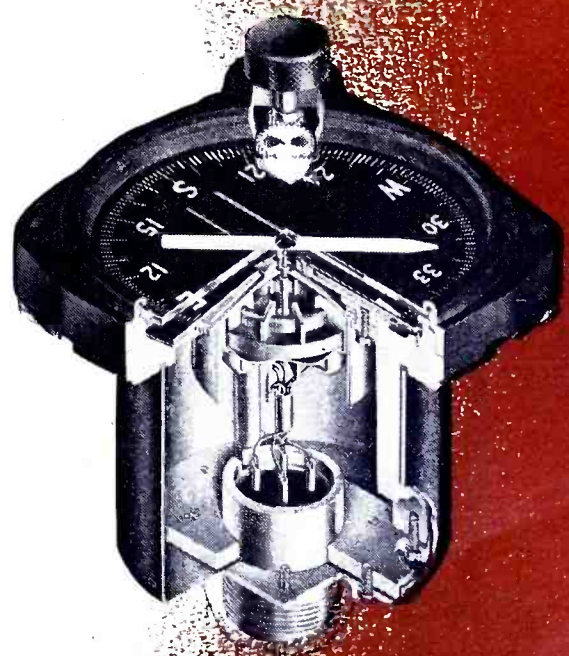


Fig. 3. Repeater indicator, comprising a Magnesyn for controlling the pointer.

THE development of the Gyro Flux Gate* Compass ranks as one of the major achievements in the search for better navigational aids for aircraft. This compass is superior to the conventional magnetic compass in many respects: in particular, the heart of the instrument, the Flux Gate, is gyro-stabilized, thus eliminating that age-old bugaboo of acceleration and turning errors so well known to pilots of aircraft; the Flux Gate may be located at any point in the airplane, far from the engine and other ferromagnetic materials, thus avoiding magnetic disturbances caused by these objects; as many as six repeater indicators may be operated by a single master indicator, thus enabling compass indications to be read at many points throughout the plane; the compass indicator is not limited to a horizontal position, but may be located in any convenient position.

The device is actuated by the horizontal component of the earth's magnetic field. Essentially, the Flux Gate consists of a triangular-shaped core, upon which are wound two coils. The earth's field induces a voltage in one of these coils, and the induced voltage is caused to actuate various mechanisms which in turn actuate the indicator, thus showing the direction in which the aircraft is headed.

It is well to describe the operation of each component part in some detail, as this will assist in understanding the over-all operation of the device.

A cut-away view of the complete transmitter unit is shown in Fig. 1 The *transmitter* consists of the Flux Gate, a gyroscope to maintain the Flux Gate horizontal at all times, a caging mechanism for properly orienting the gyroscope initially, and an erection mechanism to keep it properly oriented at all times. All parts are enclosed in a non-magnetic housing.

The *Flux Gate,* which is the sensitive compass element, is mounted on the bottom of the gyro frame and is thus stabilized by the gyro. It is triangular in shape, each side containing a laminated core of a magnetic alloy. The primary exciting coil is wound in series around these three cores, and the secondary is delta wound on the same cores, leads being tapped off at the points where the three legs join. The primary coil is so wound that the effects of the exciting current at a potential of 2½ volts, originating in a 487½ cycle oscillator, cancel out so far as inducing an effect in the secondary winding is concerned.

The characteristics of the magnetic alloy of which the cores are made, the dimensions of the core, the value of the exciting current, and the number of turns in the primary winding are chosen so that the core will be entirely saturated whenever the excitation current rises towards a peak, which will occur twice for each cycle of exciting current (once for each peak). At these points of saturation, no further magnetic effects can be produced in the core either by the exciting current or the earth's magnetic field. However, as the exciting current passes the peak, falls toward zero, and changes direction, the core is no longer saturated, and the earth's magnetic field affects the core, inducing signal voltages in the secondary. These voltages rise, fall, reverse polarity, and rise and fall

* *Trademark of Bendix Aviation Corp.*

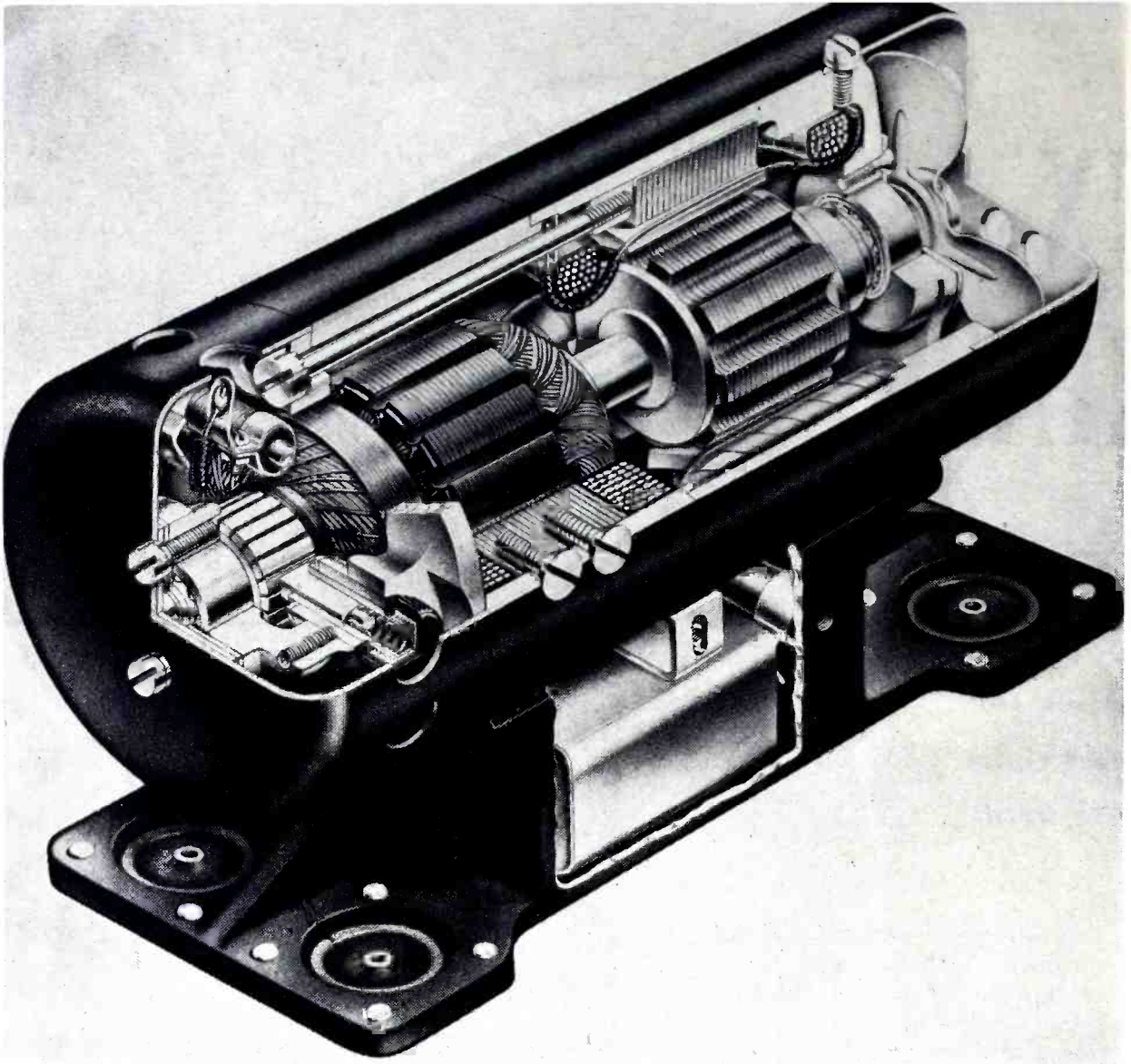


Fig. 4. Inverter for providing 400 cycle supply from the aircraft's battery.

again twice for each cycle, giving a signal voltage frequency of twice the exciting frequency, or 975 cps. The signal voltages across the taps of each leg differ in value and depend for their values on the position of the flux gate element with reference to the direction of the earth's magnetic field.

It is important that the Flux Gate be kept horizontal with respect to the earth's surface at all times. It is the purpose of the gyroscope mechanism to do this.

The gyro with its erection mechanism and the Flux Gate are suspended in gimbal rings. The *gyro* consists of a two-phase, four-pole, capacitor-type induction motor, operated from a 115 volt, 400 cycle single phase source which is supplied to the motor through hairsprings at the gimbal ring bearings. The gyro rotates around the stator at a normal speed of 10,500 rpm.

Fig. 5. Repeater indicator.

A gyro, if perfectly balanced and with no outside force acting on it, will maintain its axis of rotation in a fixed position in space. For example, should a gyro be spinning in a vertical position and be transported for any distance over the earth's surface, its axis of rotation at any new location would be exactly parallel to its axis of rotation at the starting point, and would no longer be vertical. Since an aircraft in flight follows the curvature of the earth, the gyro must do likewise if it is to maintain the Flux Gate in a position horizontal to the earth's surface at all times. This has been accomplished by means of the erection mechanism, which also counteracts any tendency of the gyro to drift away from the vertical as a result of friction in the bearings or unbalance in the gimbal assembly.

The *erection mechanism* consists of a ball running in a circular track cut in the top of the gyro housing. A small circular magnet is attached to the gyro rotor shaft, and turns inside a drag cup, which is fastened to an erection disc mounted above the ball. A slot is cut in this disc to fit the ball, so when the disc turns due to the magnetic drag cup, the ball is carried around its circular track. The magnetic coupling is designed so that the erection disc turns at approximately 30 rpm.

When the axis of the gyro is vertical, the erection ball runs evenly in its track and there is no unbalance of forces acting on the gyro. If the gyro is tilted slightly, the speed of the ball is increased on the downhill side and decreased on the uphill side, resulting in an unbalanced force on the gyro. The characteristics of a gyroscope are such that it tends to move at right angles to an applied force, thus the unbalanced force due to the ball causes the gyro to right itself. The greater the amount of tilt, the greater the unbalanced force, and the greater the tendency of the gyro to right itself. Thus, the axis of the gyro is at all times kept parallel to the earth's gravitational field.

The *caging mechanism* of the gyro is a mechanical arrangement for erecting the gyro to approximately the correct operating position after the gyro motor is started.

The output of the Flux Gate is fed to the *master indicator,* shown in Fig. 2. This unit consists of an Autosyn,* a low inertia motor, and a Magnesyn,* as well as the indicator dial and a correction mechanism.

The *Autosyn* consists of a single-phase, two-pole rotor which revolves within a three-phase, two-pole, "Y" connected stator. The three tapped leads from the secondary coil of the Flux Gate are connected to this stator. Thus, the three 975 cycle voltages induced in the Flux Gate secondary by the earth's magnetic field are reproduced in the Autosyn stator. This results in an oscillating magnetic field within the Autosyn whose direction at all times is dependent on the position of the Flux Gate with respect to the earth's magnetic field. Consequently, there is induced in the rotor a signal voltage whose value is dependent upon the position of the rotor with respect to the magnetic field produced by the stator. No signal voltage will be induced in the rotor when its poles are perpendicular to this field. This condition is called the "null" position of the Autosyn.

The voltage induced in the secondary of the Autosyn is fed directly to the input of the *Autosyn amplifier,* Fig. 8. The amplified voltage is then fed to one phase of the low inertia motor, which is a two-phase induction motor. The other phase, known as the fixed phase, is constantly excited by approximately 25 volts at 975 cps. The rotor of this motor is connected to the rotor of the Autosyn through a gear train,

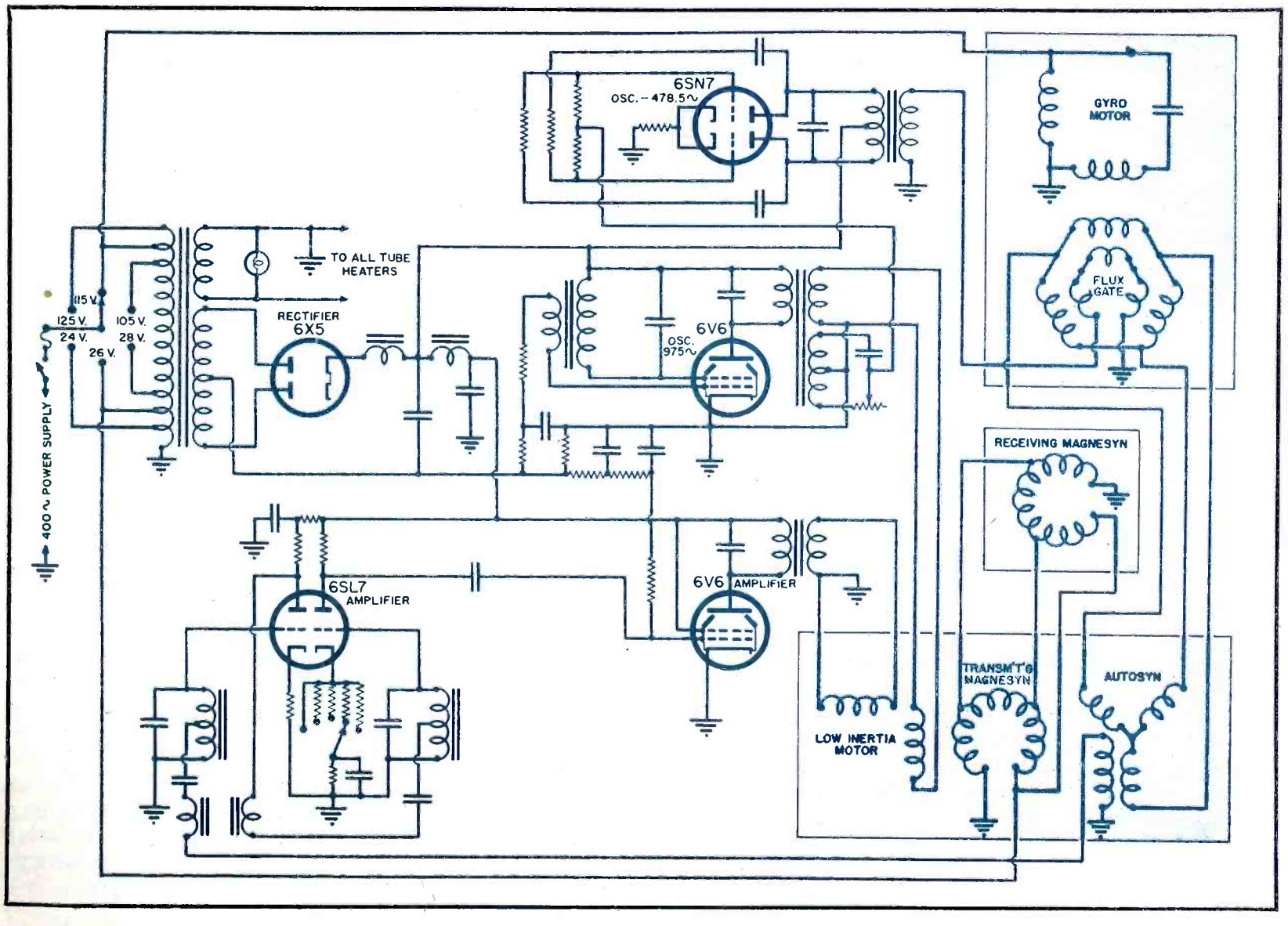
so when voltage is applied to both phases of the motor, it will rotate and cause the Autosyn to rotate until the latter is driven to its null point. At the null point, no voltage is induced in the rotor windings of the Autosyn, no signal is fed to the amplifier, and the low inertia motor no longer turns. The pointer is geared to the Autosyn, and so the pointer always indicates the direction in which the aircraft is headed with respect to the earth's magnetic field, irrespective of the orientation of the aircraft.

The *Magnesyn,* geared to the indicating mechanism, is the device which in effect transmits the compass reading from the master indicator to the repeater indicators, permitting the compass reading to be determined at as many as six locations in the aircraft, in addition to the master indicator reading. This is one of the most valuable features of this compass system.

The Magnesyn consists essentially of a stator and a permanent magnet rotor. The stator consists of a circular laminated core, wound with an exciting coil which is tapped off at each 120-degree point, thus making four leads altogether, two input leads and two tapped leads. Outer laminations are placed inside the Magnesyn

Fig. 6. Master indicator, showing knob for adjustment of compensating mechanisms.

Fig. 7. Schematic of complete unit, including transmitter, master indicator, repeater indicator, oscillators, and amplifier.



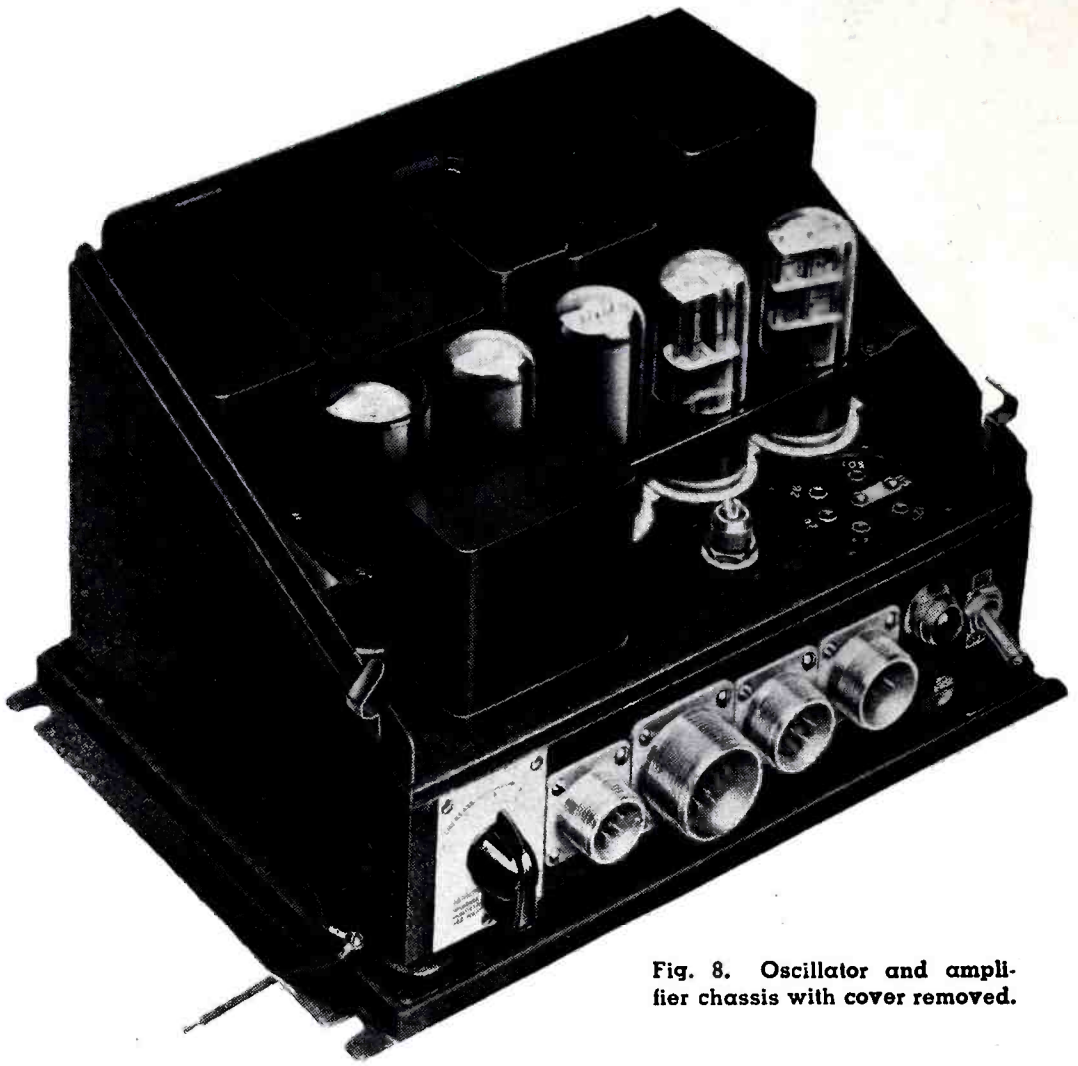


Fig. 8. Oscillator and amplifier chassis with cover removed.

case to provide a return path for the magnetic flux.

The rotor consists of a permanent magnet in the form of a flat disc with a small shaft through the center.

The exciting current for the stator is 400 cycles at a potential of 26 volts. The characteristics of the stator core and exciting windings are such that the exciting current saturates the core twice for each cycle. As in the case of the Flux Gate, no further magnetic effects can be produced in the core by the exciting current or the permanent magnet rotor while the core is saturated. However, as the exciting current falls toward zero, the core is no longer saturated and outside magnetic influences are free to produce an effect therein. During this time, the rotor's magnetic field affects the core, superimposing signal voltages on the stator winding. These signal voltages are twice the frequency of the exciting current, or 800 cycles per second, and differ in value across the three legs of the stator winding, depending upon the position of the stator winding with respect to the rotor's magnetic field.

The rotor in the *transmitting Magnesyn* is geared to the master indicator pointer so the rotor will be driven to a new position each time the aircraft changes heading. As the rotor changes position, it will cause three different voltages to be induced in the stator windings. These voltages are transmitted to the Magnesyn in the repeater indicator. The rotor of this Magnesyn will follow the direction of the magnetic field set up by the stator, so the rotors of both Magnesyns will always be synchronized.

The *repeater indicator* is shown in Fig. 3. It consists essentially of a receiving Magnesyn and a dial and pointer.

The *receiving Magnesyn* is very similar to, though smaller than, the transmitting Magnesyn, and operates on the same principle, so a detailed discussion of its operation is not deemed necessary. As mentioned before, up to six receiving Magnesyns may be operated by a single transmitting Magnesyn, by connecting the receivers in parallel.

The *amplifier,* Fig. 8, contains a conventional power supply, a 487½ cycle oscillator section, a 975 cycle oscillator section, and an Autosyn signal amplification system. Power is obtained from a 400 cycle supply at 24, 26, 28, 105, 115 or 125 volts, usually from an inverter operating from the aircraft's batteries.

The 487½ cycle oscillator provides the power for exciting the primary of the Flux Gate in the transmitter. It consists of a 6SN7-GT oscillator tube, delivering approximately 2.5 volts under load.

The 975 cycle oscillator provides power for the fixed phase of the low inertia motor in the master indicator. The 6V6-GT/G oscillator tube delivers approximately 25 volts under load. The frequency of this oscillator is locked into that of the 487½ cycle oscillator so the two will always be in step. This relationship must be maintained for the circuit to operate, although there is a wide degree of tolerance in the actual frequency of the oscillators.

The amplifier section, which amplifies the Autosyn signal, consists of a two-stage amplifier tube (6SL7-GT) and a 6V6-GT/G power output stage. A gain control is provided in the cathode circuit of the second stage to increase or decrease the sensitivity of the compass system. This is necessary because of the wide variation in the strength of the horizontal component of the earth's magnetic field at various points on the earth's surface. By means of this control, the Gyro Flux Gate Compass System may be made to give satisfactory performance in latitudes where indications would be uncertain or even unobtainable with a conventional compass.

The above components, when properly assembled, go to make up the Gyro-Flux Gate Compass System as used in aircraft. Views of the completely assembled master indicator (Fig. 6) and the repeater indicator (Fig. 5) are included to give a better over-all picture of the device.

A block diagram (Fig. 9) has been included to give a clear indication of the operation of the device. The horizontal component of the earth's field induces a combination of voltages in the Flux Gate; these voltages are fed to the stator of the Autosyn and a signal voltage is induced in the Autosyn rotor. This induced signal voltage is amplified and fed to the variable phase of a low inertia, two-phase motor which is geared to the Autosyn. The motor rotates until the voltage from the amplifier, originating in the Autosyn rotor, drops to zero.

The Magnesyn transmitter is also geared to the Autosyn and motor, and transmits voltages corresponding to the position of the rotor with respect to the exciting field. These voltages serve to activate the Magnesyns located in the repeater indicators.

A simplified schematic of the complete device is shown in Fig. 7. Terminal strips and interconnecting cables have been omitted for the sake of clarity, and resistor and condenser values are not indicated.

In installing this system, the transmitter must be located as far as possible from magnetic disturbances, such as hard steel, control rods and cables, and electric wiring, particularly that carrying direct current. If it is impossible to isolate the transmitter completely from all magnetic disturbances, it is possible to compensate for these disturbances. The compensating system is entirely mechanical, and permits corrections to be introduced every 15 degrees. The introduction of a correction at one point does not bring about a change in the deviation at

(*Continued on page* 35)

V.H.F. Measurements

By D. FIDELMAN

Methods of measuring various electrical quantities such as frequency, voltage, current, power, and impedance in the 30-300 mc. frequency range.

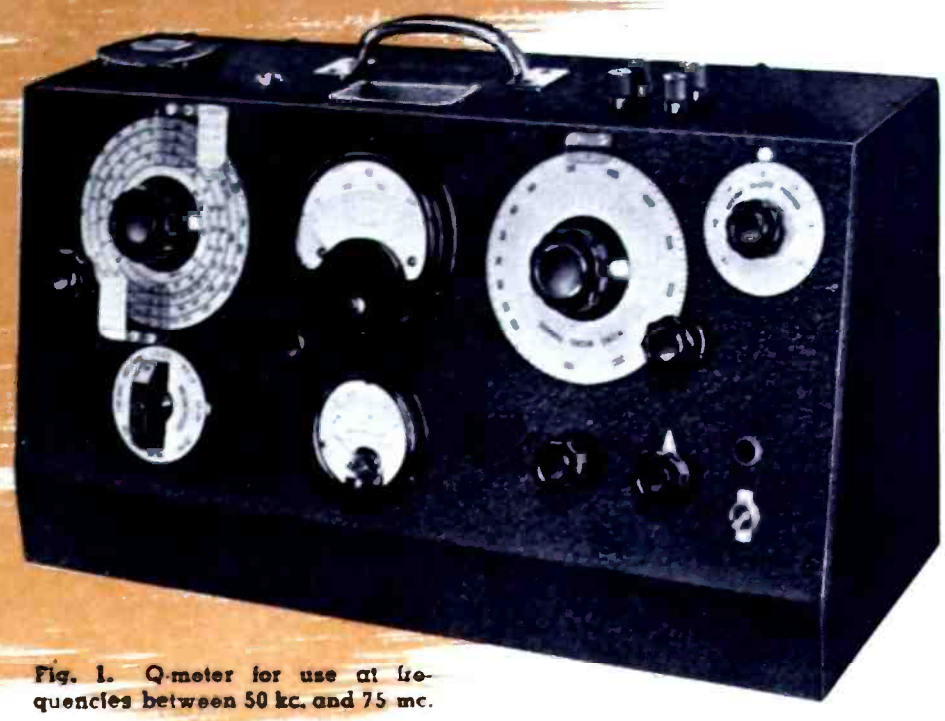


Fig. 1. Q-meter for use at frequencies between 50 kc. and 75 mc.

WITH the increasing use of very high frequency (v.h.f.) systems for present and post-war applications, the experimental laboratory and measurement techniques that must be employed at these frequencies assume an increasing importance. In some respects, laboratory techniques used for high frequencies do not differ appreciably from those used for low frequencies. Usually, however, modifications of low-frequency methods are necessary, and even when low-frequency techniques are applicable directly, much greater care and attention to detail is necessary when working at high frequencies. In the v.h.f. range lumped circuit elements can be used as inductance and capacity, in contrast with the ultra-high frequency range, where transmission lines must be used as circuit elements. The values of the lumped inductances and capacitances used in v.h.f. circuits are generally found to be very small, and therefore the effects of residual inductance and capacitance become quite pronounced and must be taken into account.

With these considerations in mind, this article has been prepared as a brief practical review of those measurements which have been found most useful in general v.h.f. practice. The frequency range that will receive major emphasis in the following discussion extends from the present television and FM broadcasting frequencies up to about 100 mc. Since post-war television bands will extend higher than this, certainly up to frequencies of about 300 mc., this range will be discussed to some extent, and certain techniques will be discussed which are applicable to frequencies still higher.

In general, the most important quantities that may be measured during the course of the design, construction, testing or servicing of any type of v.h.f. equipment are: (1) frequency, (2) voltage and current, (3) impedance, (4) radio-frequency power, and (5) electric field intensity. There is generally available a fairly large selection of excellent instruments and measuring equipment which have been designed specifically for use in measuring various of these quantities at high frequencies. However, since new instruments are constantly being developed, an attempt will be made in this article to indicate not only what instruments are commercially available for particular types of measurements, but also to emphasize the basic techniques wherever possible.

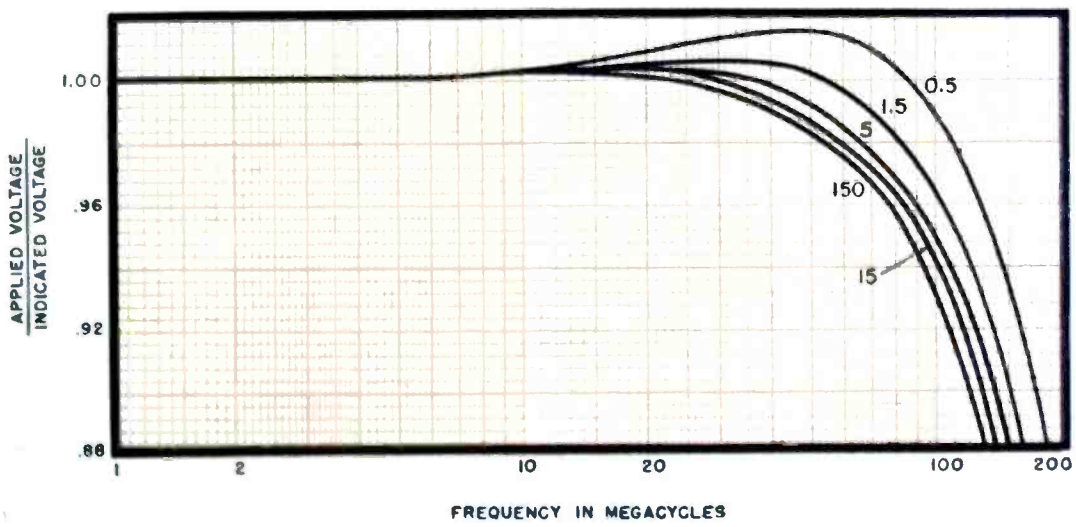
Frequency Measurement

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

1. wavemeters
2. heterodyne frequency meters
3. lecher wires.

The simple absorption-type wavemeter is extremely valuable for making preliminary adjustments on transmitters, and for general experimental work. It consists of an ordinary resonant circuit tuned by a variable condenser and provided with a calibration that gives the resonant frequency in terms of the condenser setting. To measure frequency, the inductance of

Fig. 2. Frequency correction curves for vacuum-tube voltmeter shown in Fig. 8.



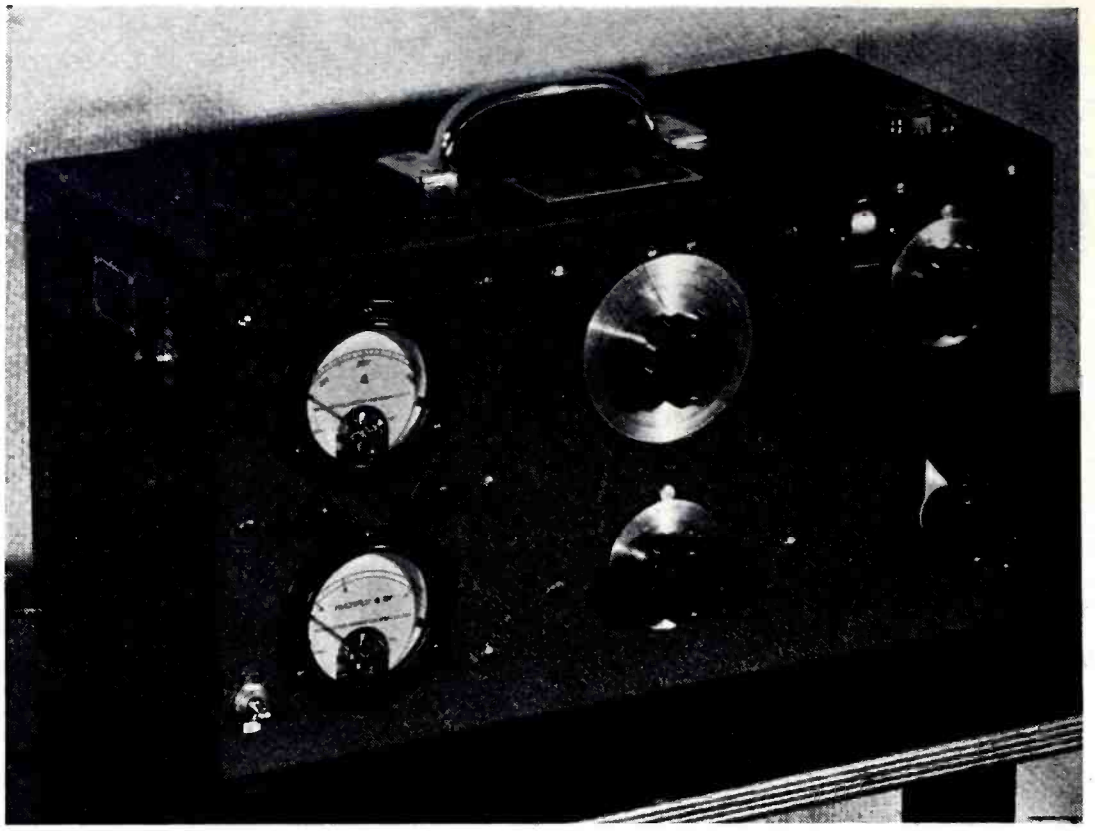


Fig. 3. Q-meter for use at frequencies between 30 and 200 megacycles.

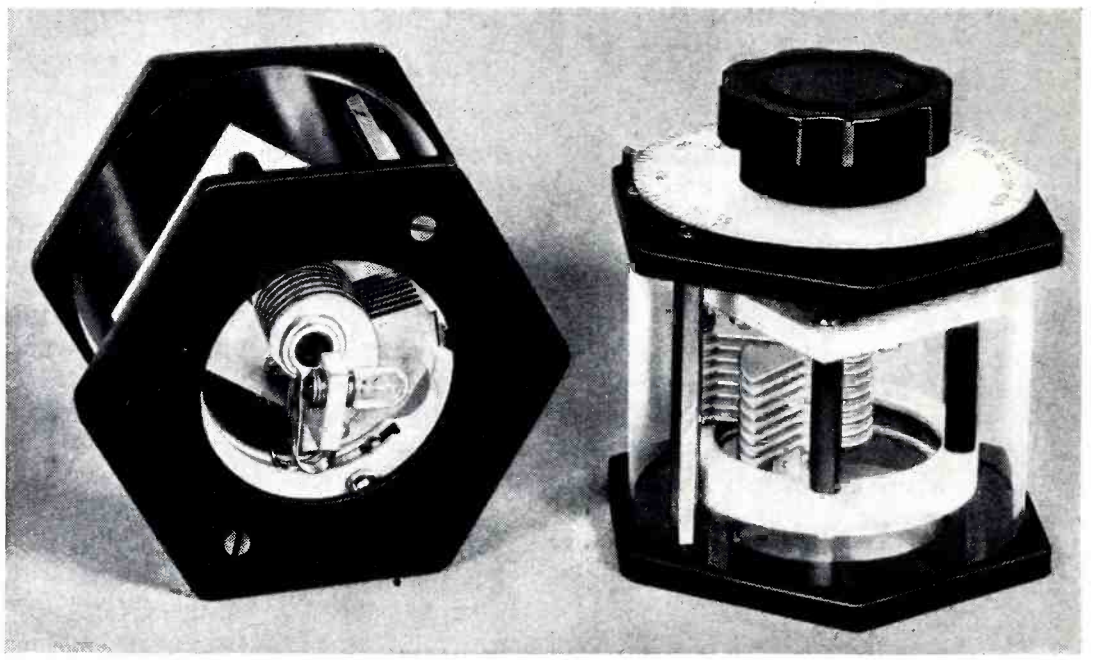
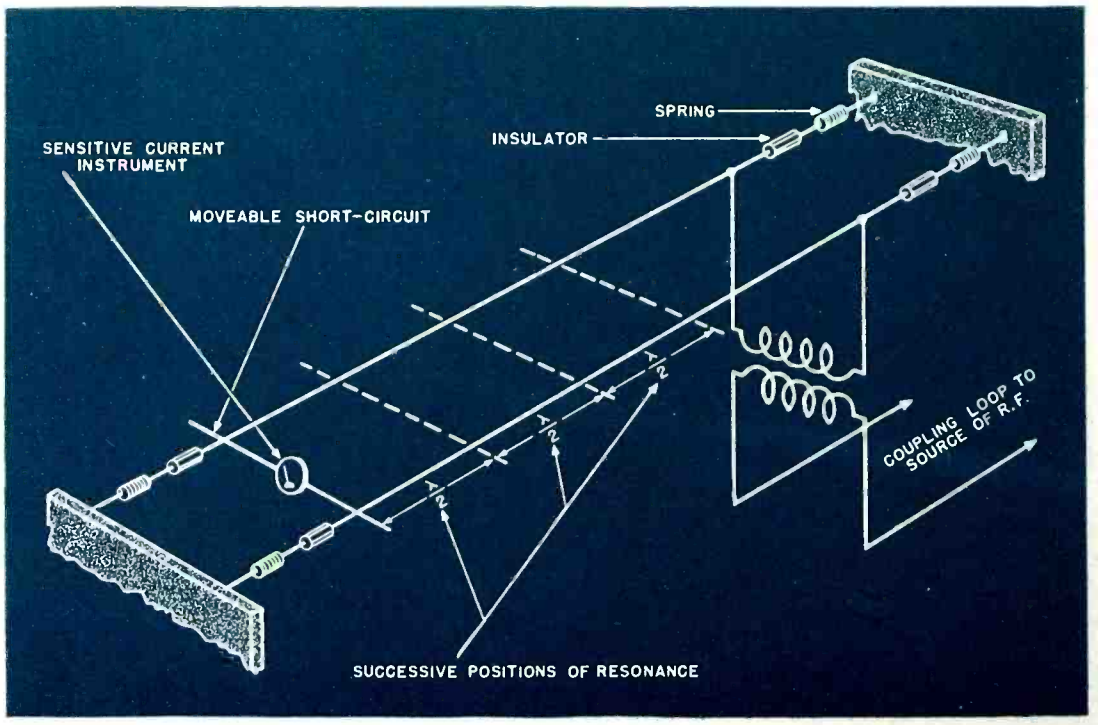


Fig. 4. Wavemeter for measuring frequencies between 55 and 400 mc.

Fig. 5. Lecher wire system used for measuring wavelengths at v.h.f.



the wavemeter is coupled into the circuit being measured, and the condenser setting of the wavemeter is varied until it is brought into resonance. Resonance can be determined by a meter or incandescent lamp connected in the wavemeter circuit, or by the reaction upon the circuit being measured. Two photographs of an excellent type of wavemeter covering the frequency range of 55 to 400 mc. are shown in Fig. 4. In this instrument the capacitance and inductance are varied simultaneously, thus permitting a very wide range of frequencies to be covered with a single coil. Resonance is indicated by an incandescent lamp, and settings can be made to an accuracy of $\pm$ 2%.

A heterodyne frequency meter is primarily an oscillator which is very precisely calibrated for frequency as a function of tuning capacity. A receiver or simple detector and audio amplifier serve to indicate beat notes between the oscillations of known frequency and the voltage of unknown frequency coupled into the circuit of the frequency meter, and may be included as part of the instrument. The procedure in measuring unknown frequencies is to set the known frequency, or one of its harmonics, to zero beat with the unknown and read the frequency directly from the dial of the frequency meter. When measuring high frequencies, a harmonic of the known generated frequency must be used. In this manner frequencies up to about 300 mc. can be measured by means of a heterodyne frequency meter having a fundamental frequency range from 10 to 20 mc. For greater accuracy, a stable crystal oscillator may be included for self-calibration. The over-all accuracy of a heterodyne frequency meter, when self-calibrated or checked against standard-frequency broadcasts, may be 0.01% or better. The heterodyne frequency meter is one of the most useful types of frequency measuring devices. It may be used for measuring the frequencies of a large number of transmitters (both local and remote), for calibrating and servicing receiving equipment, and for checking the ranges of receivers and oscillators.

By observing standing waves on a two-wire transmission line, or Lecher wire system, it is possible to determine frequency by measuring the length of the unknown waves directly. A fundamental system of this type is shown diagrammatically in Fig. 5. The line is coupled into the circuit containing the frequency to be measured, and resonance indications of the standing waves on the line can be obtained in a number of different ways, depending upon the amount of power present

at the unknown frequency. When measuring the frequency of a transmitter, an incandescent lamp may be coupled to the tank into which the Lecher wires are coupled, and a shorting bar moved along the lines until there is a sharp dip in the brightness of the lamp. The distance between successive dips in the lamp brilliance is equal to one-half the wave-length. Another method of determining the resonance points along the lines is to insert a sensitive current-indicating meter in the shorting bar and to measure the distance between successive points of maximum current, which is again equal to the length of a half-wave. When checking a receiver, where low amounts of radio-frequency power are present, it is necessary to use the output of the receiver as an indication of the positions of maximum power absorption along the Lecher wires. The greatest accuracy that can be attained by means of a Lecher wire system is of the order of 0.1% under the best conditions. The advantage of this method of measuring frequency is that it is readily applicable to extremely high frequencies where other measuring methods can be used only with great difficulty.

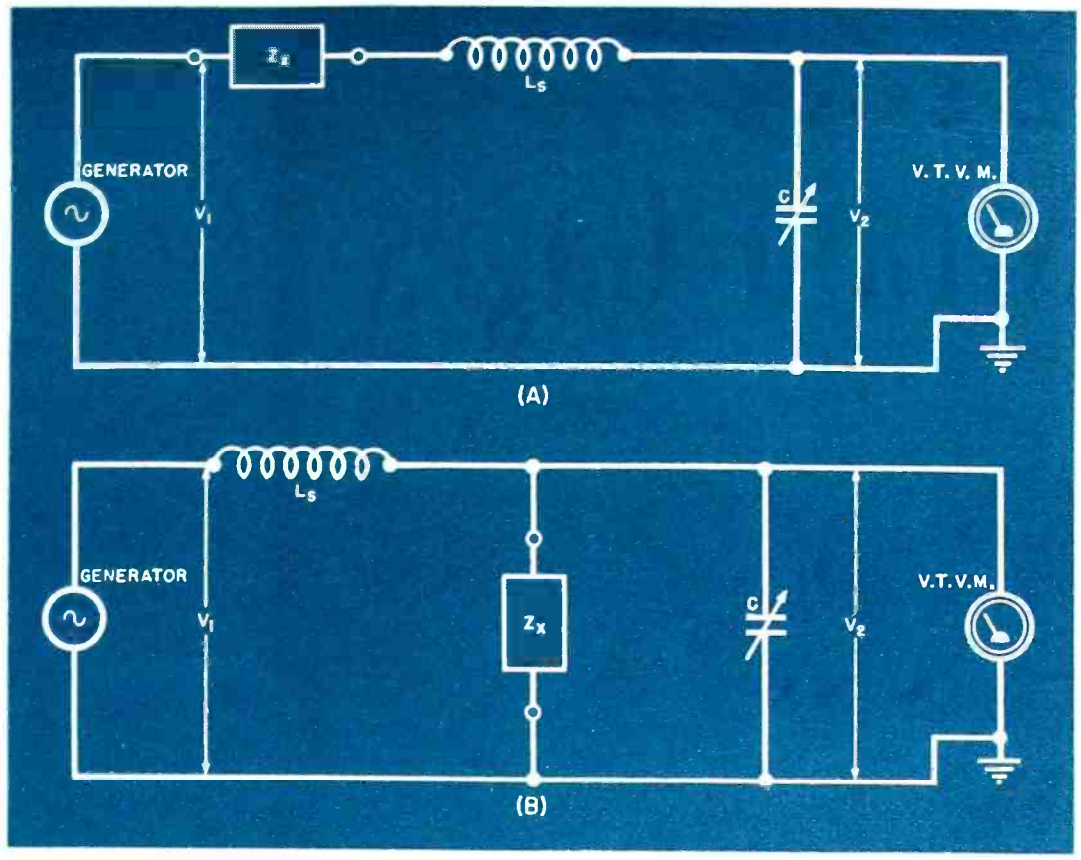


Fig. 6. Use of Q-meter to measure any unknown two-terminal impedance. (A) indicates series connection, while (B) represents parallel connection.

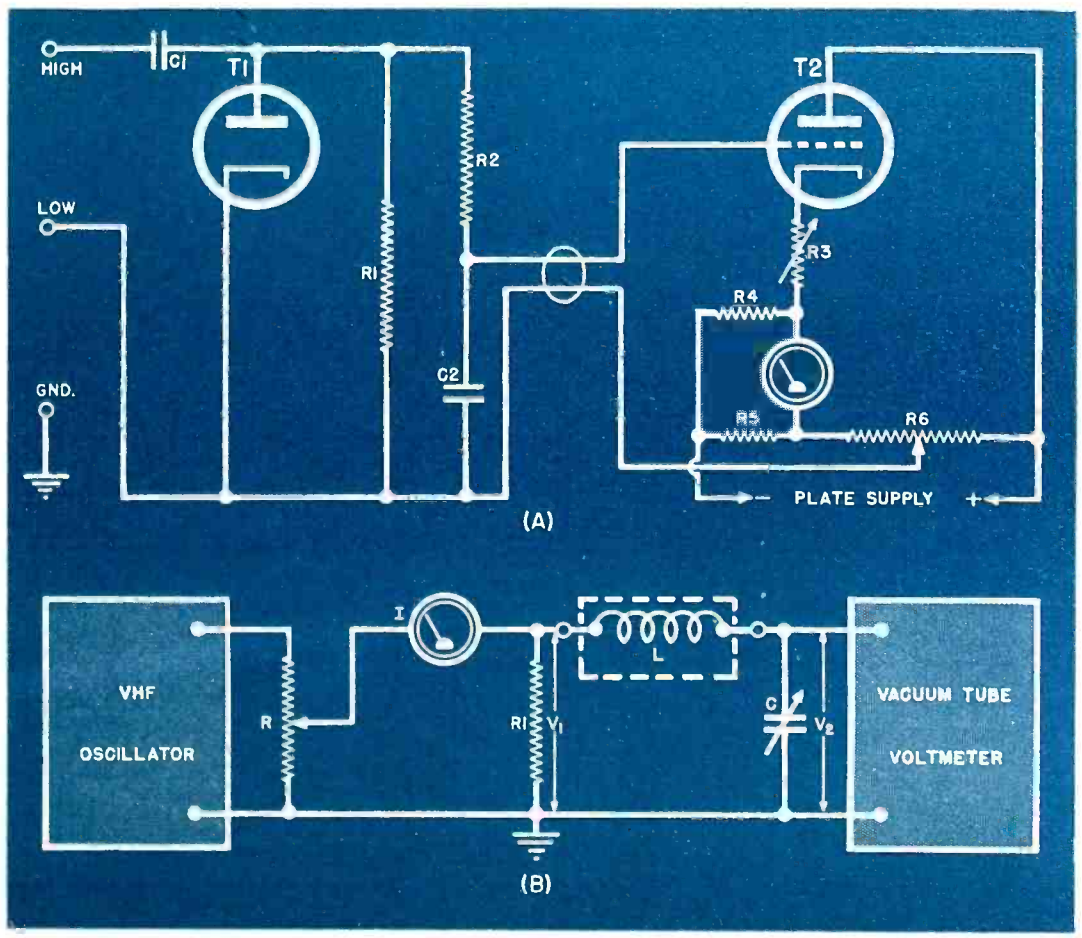
Measurements of E and I

At v.h.f. the principal means of measuring voltage and current are thermocouple meters and vacuum tube voltmeters. Thermocouples are the standard method of measuring current at these frequencies. The current to be measured heats a short piece of resistance wire that is associated with a thermocouple whose output is measured by a sensitive d.c. microammeter, thus giving an indication of the high-frequency current passing through the heater. By proper construction, keeping the heater wire very small in diameter to minimize skin effect and very short to minimize the difficulties that would be associated with a current distribution along its length, thermoammeters can be used at frequencies of the order of 100 mc. with a sensitivity of 1 ma.

However, voltage measurements are much more often required than current measurements at high frequencies. Thermocouple voltmeters consisting of a thermoammeter in series with a high resistance can be used to measure voltage, and may have a sensitivity up to 1000 ohms/volt. But by far the most useful and satisfactory instrument for v.h.f. voltage measurement is the vacuum tube voltmeter. The high-frequency vacuum tube voltmeter is essentially the same as that used at low frequencies, that is, a detector tube in which the change in plate current that takes place with the application of a signal voltage is used to measure the applied voltage. In order to minimize the effects of having long leads from the voltmeter to the circuit being measured, the detector must be mounted in a movable probe enabling it to be placed as close as possible to the measured circuit. A photograph of a vacuum tube voltmeter suitable for both audio and high-frequency measurements is shown in Fig. 8. The circuit diagram of this voltmeter is shown in Fig. 7(A). The entire a.c. measuring circuit, using a type 955 acorn tube in a diode condenser-rectifier circuit, is built into a small probe made of low-loss bakelite. The rectified voltage is carried through a cable to a d.c. amplifier and indicating meter in the cabinet

(*Continued on page* 42)

Fig. 7. (A) Circuit diagram of vacuum-tube voltmeter shown in Fig. 8. (B) Circuit illustrating the basic principle of operation of the Q-meter.



Electric Strain Gages

By W. R. MEHAFFEY
Armour Research Foundation

Recording static or low frequency dynamic strain by strain gages.

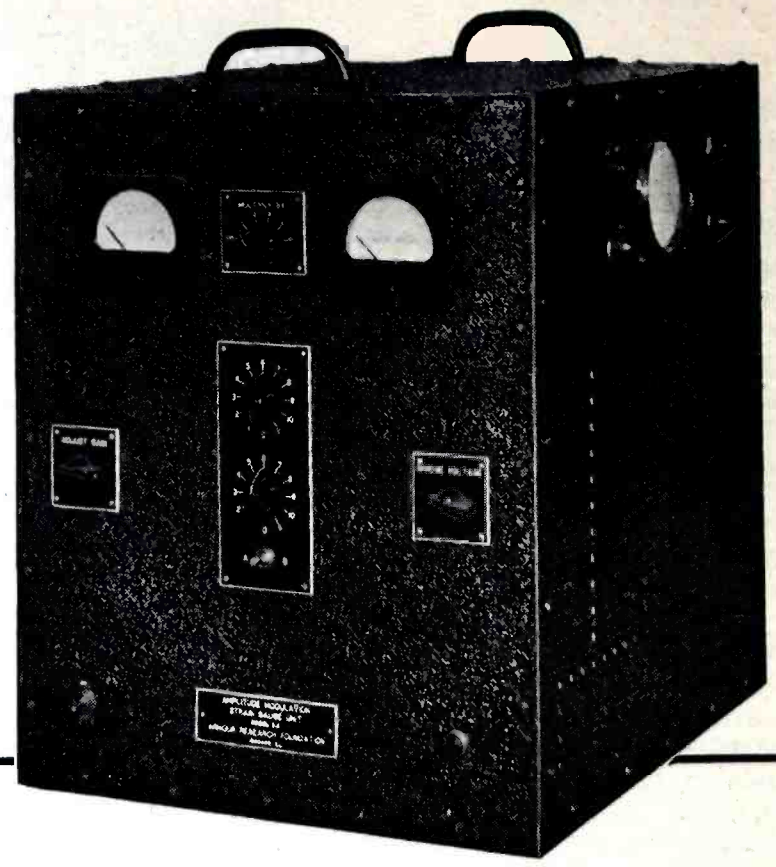


Fig. 1. Strain gage unit provided with internal calibrating system.

WE are living in an age in which speed and performance rule. In order to design high speed trains, aircraft and ships, it is necessary to know accurately the loads to which each structural member will be subjected during use. The old practice of allowing large safety factors to take care of unknown loads and variations in material must be eliminated or excess weight will result. This new demand for stress analysis has been greatly accelerated by the development of the electrical resistance strain gages.

These gages consist of a grid of fine alloy wire .001 inch in diameter, arranged as shown in Fig. 9(A). This wire is cemented to a paper base which, in turn, is cemented to the surface of the structural member. The ends of the wire are soldered to heavier lead wires which are also cemented to the paper base. During manufacture, the length of wire is carefully controlled so the over-all resistance will not vary more than ½ ohm in 120.

The principle of operation of the gage is that a wire changes resistance when strained due to a change in length and cross section area, according to the formula

$$R = \rho L/A \quad \ldots\ldots\ldots\ldots (1)$$

An analysis of various types of wire for strain gages revealed that greater resistance changes actually occur than could be predicted from geometric changes in the wire. This effect is due possibly to the fact that the coefficient of resistivity changes with tension and compression.

The cement used must transmit the strain accurately from the surface to the strain-sensitive wire. Since the wire is bonded along its entire length it can not buckle and therefore it will work equally well for tension or compression. For low temperatures (in the vicinity of room temperature) cellulose nitrate cements are used, while bakelite cement must be used for higher temperatures.

The gages have a slight cross sensitivity due to the fact that some gage wire is not parallel to the axis of the gage. This effect is proportional to the number of end loops in the gage, thus it becomes more noticeable with short gage length gages in which many short loops are used. To overcome this effect, a flat helix winding is employed for the short gage length gages. In this case the end connections rise vertically from the surface so as to reduce cross sensitivity. This general type is shown in Fig. 9(B). The cross sensitivity factor is defined as

$$\text{Cross sensitivity factor} = \frac{\text{transverse sensitivity}}{\text{Axial Sensitivity}}$$

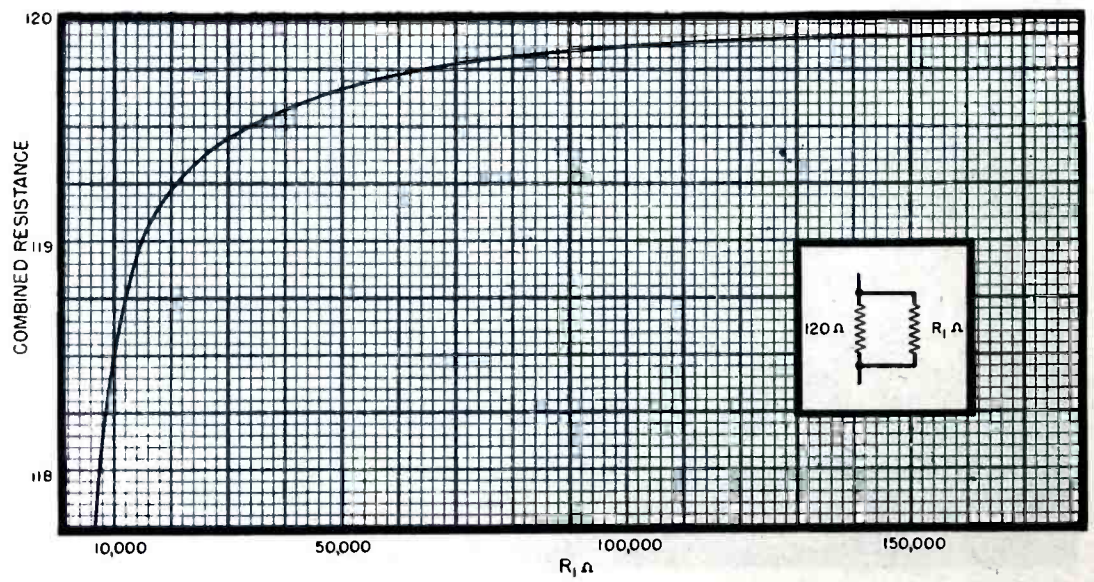
For comparing gages, a ratio called the "strain sensitivity factor" is used. This factor is defined as follows:

$$K_s = \frac{\Delta R/R}{\Delta R/L} \quad \ldots\ldots\ldots\ldots (2)$$

This factor is tabulated in Table I, together with the cross sensitivity factor and gage length. This data is assembled from references given in the bibliography.

The gage factor has been found to remain constant for strains which exceed the elastic limit for the gage wire, but, of course, under these conditions a permanent set will remain when the load is removed. These gages can be used for increasingly greater strains up to about 2% of their gage length.

Fig. 2. Curve showing the change in adjusting resistance necessary for balancing variations due to strain in the gage.



Strain gages have a temperature coefficient which is, in general, larger than that of the wire; it depends on the relative temperature difference between gage wire and the surface to which the gage is attached. If the gages are used on metal, the heat transfer is great enough to permit operation with 6 volts bridge excitation without excessive creep. If they are used on wood or concrete this excitation must be reduced to about one volt for best results.

AM Amplifiers

For measuring static or low frequency dynamic strain phenomena, the most practical system is amplitude modulation, see Fig. 4. The strain gage is arranged as one arm of a balanced bridge circuit. A second strain gage is used as an adjacent arm and is mounted on a piece of unstrained metal. If this compensating gage is located near the active gage it will be subject to the same temperature changes as the measuring gage so that temperature errors will tend to cancel.

Fig. 8 shows the relation between strain and unbalanced voltage for A 1 strain gages having a nominal resistance of 120 ohms with one volt bridge excitation. For any other value of bridge voltage the unbalance is directly proportional to the voltage. The dotted curve in Fig. 8 shows the necessity of providing capacity balance. If this is not provided the null will be broadened and a non-linear curve will result.

Fig. 11 is a simple bridge circuit in which both resistance and capacity balance are provided. Fig. 2 shows the change in the adjusting resistance necessary for balancing variations due to strain in the gage. Since a reciprocal relation exists it is obvious that a decade box having a wide range of values must be provided. If both strain gages were of identical resistance, it would be extremely difficult to balance this circuit.

In order to simplify the decade adjusting network a definite unbalance is created by shunting a resistance across the arm adjacent to that arm across which the balancing network is located.

Fig. 6 shows another bridge circuit which has several advantages. The capacity balance can be obtained by shunting a capacitance decade and variable condenser across the active gage or the compensating gage. The slide wire is a 2000 ohm Beckman Helipot having 10 turns to cover 2000 ohms. It is shunted by a .5 ohm advance resistor. Thus, it covers a range of 2000 microinches. A decade switch is provided for changing the balance in steps of 1000 microinches. The total range then becomes 12000 microinches. The switch S_1 is a two-gang 11-point Mallory switch, with the corresponding contacts wired in parallel.

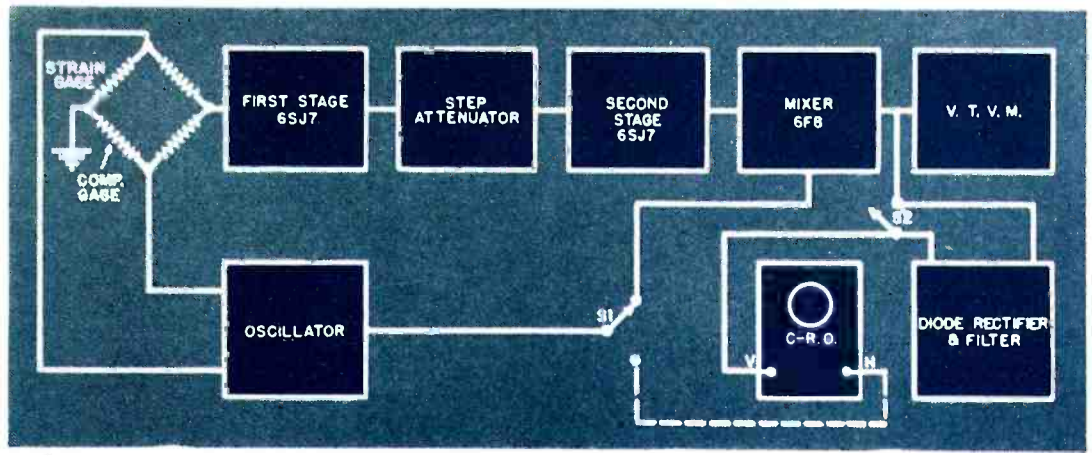


Fig. 3. Block diagram of the circuit of the instrument shown in Fig. 1.

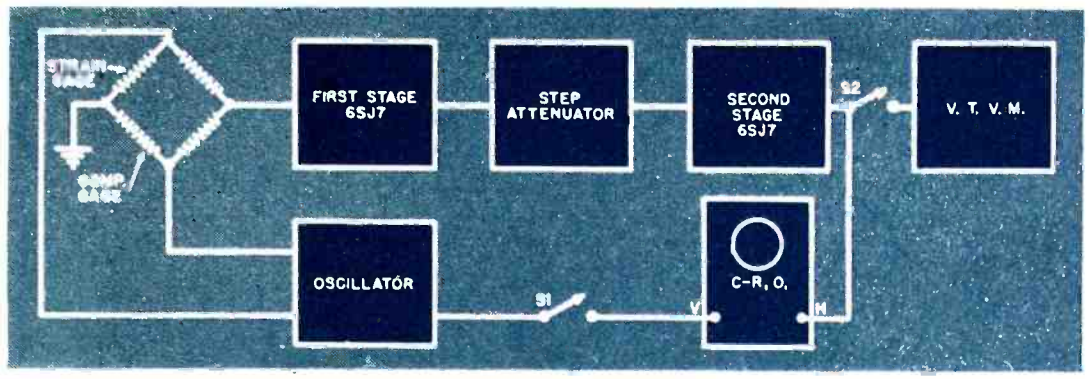


Fig. 4. Amplitude modulation for measuring static or low freq. dynamic strains.

TABLE I

Type	Gage Length	Nominal Resistance Ohms	Gage Factor Approx.	Cross Sensitivity Factor Approx.	Construction
A_1	15/16	120	2.04	.02	Fig. 9(A)
A_5	1/2	120	2.02	.035	Fig. 9(A)
A_8	1/8	120	1.80	.02	Fig. 9(B)
C_1	11/16	500	3.53	.0175	Fig. 9(A)
C_5	1/2	350	3.34	.04	Fig. 9(A)
C_7	1/4	500	3.30	.01	Fig. 9(B)

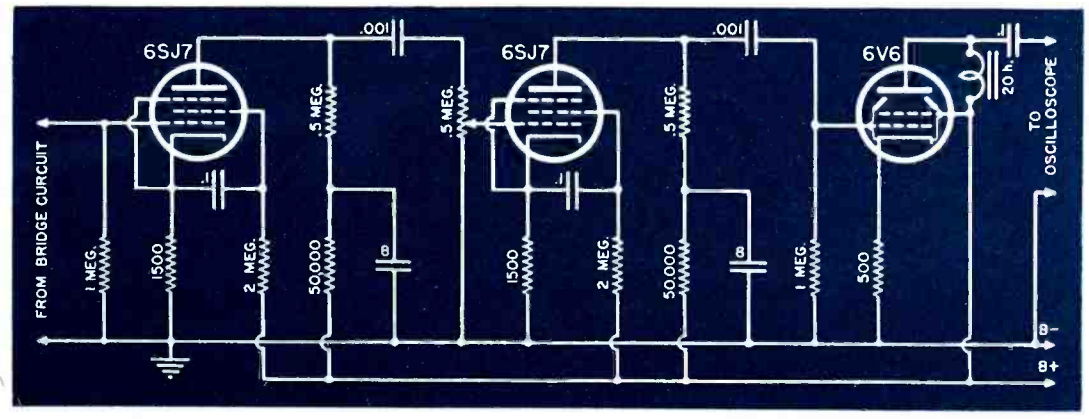
Tabulation of gage factor and cross-sensitivity factor with gage length.

Capacity balance is very essential when long cables are used, as the capacity unbalance of ordinary two-conductor shielded cable is usually very large.

There are many possible designs for the amplifier; the basic block diagram (Fig. 4) incorporates a pentode first stage followed by a step attenuator having five steps with the ratios 1, 2, 3, 5, and 10. The amplifier has inverse feedback which is introduced by omitting the cathode bypass condensers.

The coupling condensers are made small in order to destroy low frequency response since the amplifier

Fig. 5. Schematic diagram of a 3 stage amplifier which may be used.



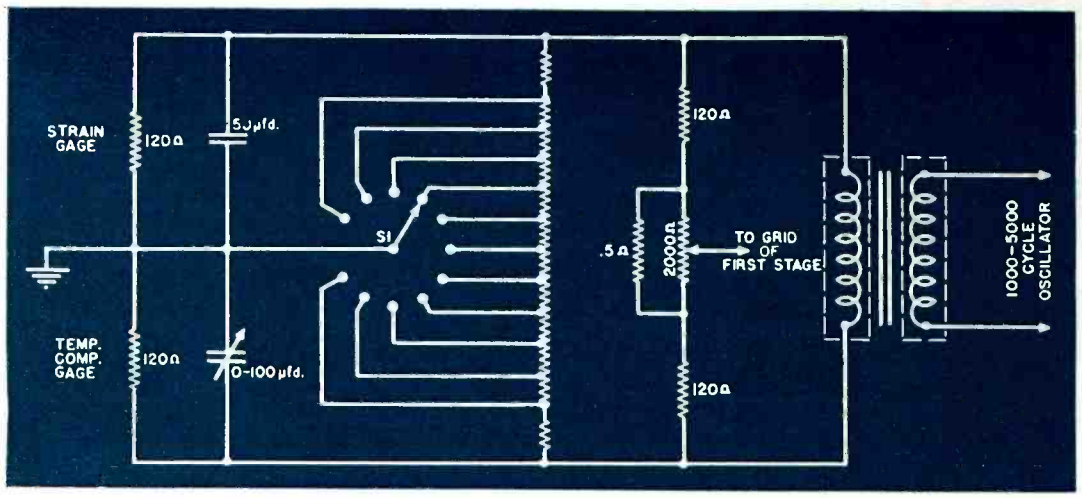


Fig. 6. Simple bridge circuit providing resistance and capacity balance.

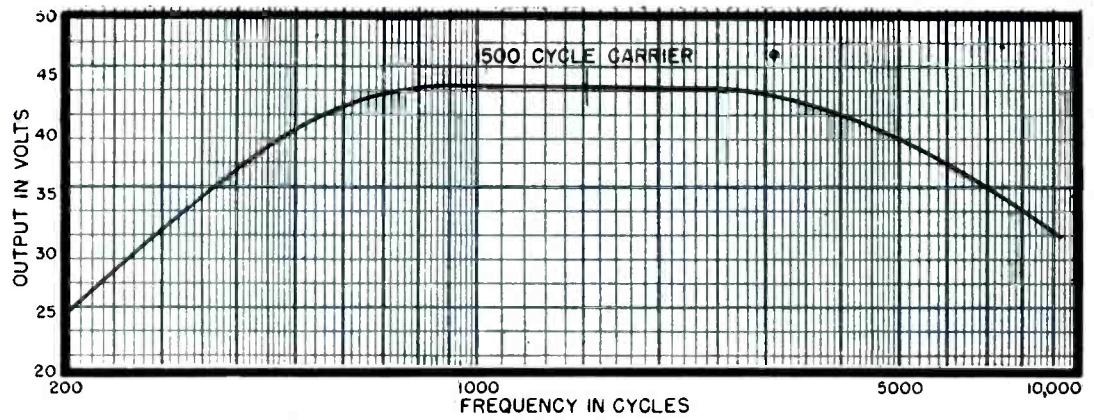


Fig. 7. Frequency response characteristic of amplifier shown in Fig. 6.

Fig. 8. Unbalance voltage vs. strain for type A_1 B.S. strain gages.

only requires a response from 800 to 3000 cycles. In this case, the carrier frequency was adjusted to 1500 cycles. It is generally agreed that this system is capable of recording up to 10% of the carrier frequency. The response curve is shown in Fig. 7 and it will be noted that it is flat over the band width of 1500 ± 150 cycles.

This amplifier has ample gain to give a 2" deflection on a 3" du Mont 3AP5 cathode ray tube for a strain of 500 microinches. If this sensitivity is not required, the 6V6 output tube can be improved by using single stage feedback of a high degree and by-passing the cathode resistor. In most cases the output of the second 6SJ7 can be fed directly to the oscilloscope amplifier, thus eliminating the distortion of the 6V6 output stage.

To determine whether the bridge is unbalanced on the tension or compression side, a reference voltage from the oscillator is placed on one pair of plates of an oscilloscope and the output from the amplifier on the other set of plates; the resulting eliptical figure indicates a 180° phase shift when the bridge goes through balance. If the amplifier is used for static work, greatest accuracy will result when a null system is used. This can be accomplished by first balancing the bridge and reading the dial of the slide wire, then applying the load to the structure and rebalancing the bridge. The change in strain, as indicated by the difference in readings on the slide wire, is accurate to the same degree as the slide wire calibration is accurate. The amplifier gain does not affect the accuracy since the amplifier is merely an indicating device.

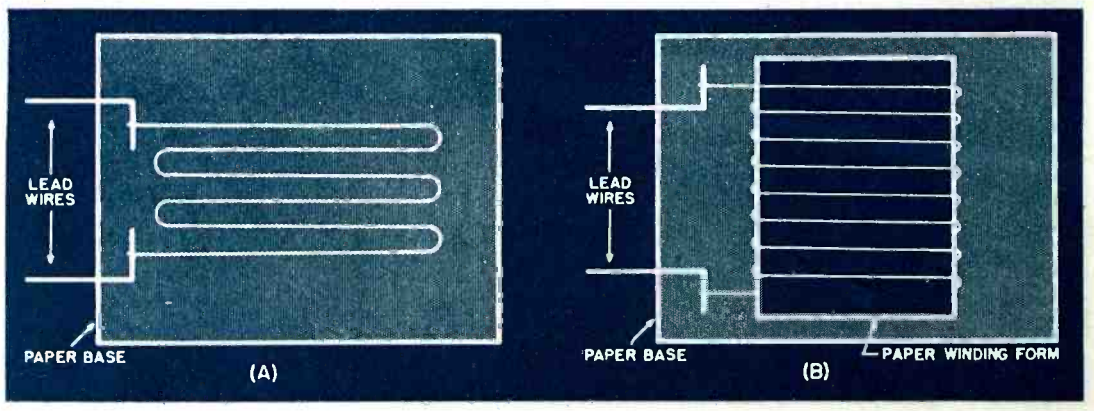
When the unit is used for dynamic recording of vibration conditions, the unbalance voltage is recorded by photographing the trace on a cathode ray oscilloscope. If the bridge is initially balanced before applying the dynamic conditions to the structure, the attenuator will provide a multirange instrument. This is satisfactory if the dynamic strain starts at zero and goes to a maximum in the "tension" direction, but if the strain then goes through zero and increases in the "compression" direction, the record is worthless. To overcome this difficulty the bridge is usually offset on the tension side. This means that the offset will change with the attenuator setting. Fig. 3 shows the block diagram of an improved system in which the offset is produced by a reference voltage from the oscillator which is introduced into an electronic mixing circuit. The bridge is then operated at balance and the attenuator provides a multirange instrument.

A phase shifting network should be provided to adjust the phase angle between the reference and signal so they are either in phase, or 180° out of phase. A phase shifting bridge should be satisfactory for this work.

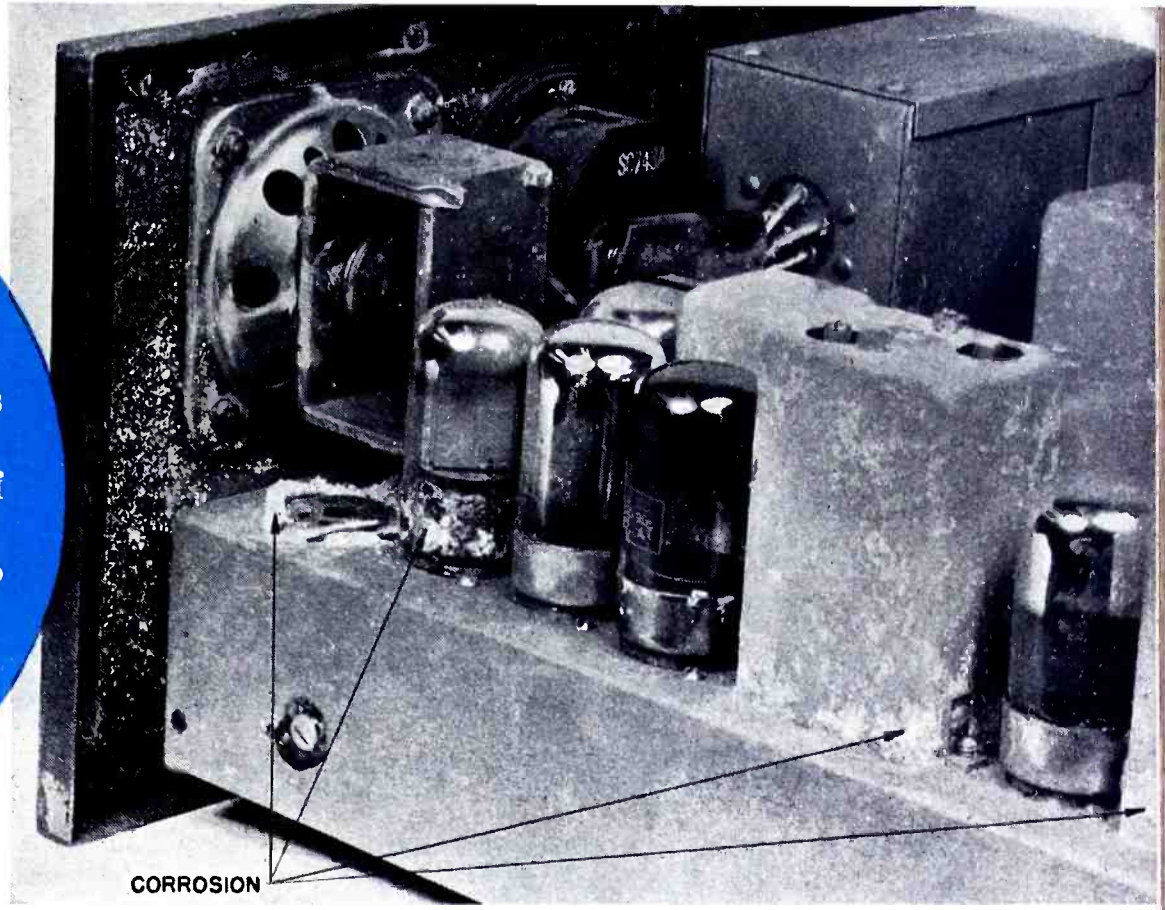
Fig. 10(B) shows the mixing circuit. The two plates of a 6F8 are coupled together and one grid is connected to the reference voltage and the other grid to the signal output from the second stage of the amplifier. The plate current is composed of two components, one of which is controlled by the reference voltage, and the other is controlled by the signal voltage. The phase angle between the two voltages can be 0° or 180°. In the 180° case the

(Continued on page 44)

Fig. 9. (A) Resistance strain gage. (B) Flat helix type of strain gage.



Methods of testing and applying various fungicides for inhibiting the growth of fungi which are injurious to electronic equipment.



Corrosion on Signal Corps equipment used in tropical climates.

Effect of Fungi on Electronic Equipment

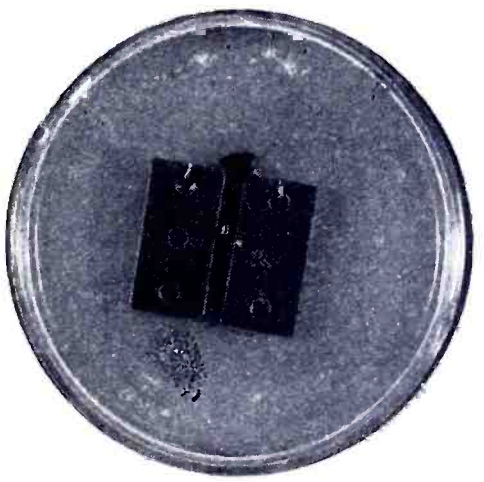
By Wilfred F. Horner and Helen M. Conlon
Director — Biologist
Biological Lab., Eng. Dept., Belmont Radio Corp.

THE problems pertaining to maintenance and operation of electrical equipment have become of vital importance to American manufacturers since the beginning of the Pacific War. Extreme difficulties have been encountered in battle areas due to the effects of the tropical deterioration of this type of equipment as a result of moisture and fungus growth. So severe was this menace to operating efficiency that new methods of moisture and fungus control were necessary, in order that the progress of the armed forces might not be impeded. The problem of fungus growth in radio equipment is not entirely new. Certain regions, such as Florida, the Gulf coast, and the Pacific coast, have had this difficulty, but it was of such minor importance to the manufacturer that it received very little attention. Laboratory research and field investigation into the problems of fungus growth, control of fungus growth, and the duration of life of electrical equipment were undertaken. As a result of this work methods of protection have been established by the various branches of the armed services and are required of manufacturers making war equipment. Technically speaking, problems of this nature come under the study of tropicalization. The term "tropicalization" refers to the procedures and tests used to combat the failures of equipment due to moisture and fungus growth. Among the laboratories doing research of this kind is the new, fully equipped Biology Laboratory of Belmont Radio Corporation.

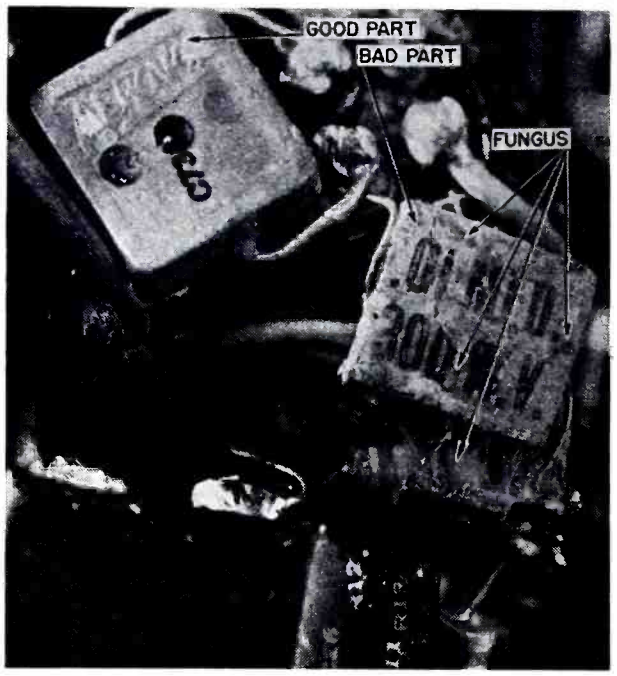
The fungi that attack radio and electronic equipment are commonly referred to as molds. Structurally, molds are a mass of plant tissue having no roots, stems, or leaves. They are multicellular organisms made up of cells lying adjacent to one another, forming filaments. These filaments branch profusely and thus form an entangled mass called a thallus. The initial growth of a fungus colony on a piece of equipment may be due to the germination of a single spore or a group of spores. Molds produce great numbers of spores in a short period of time (anywhere from a few days to a week or more). This abundant production of spores is the ordinary method of propagation; however, once the thallus is established, it in turn produces more spores.

Because molds are unable to produce their own foods from raw materials, as do most plants, they must obtain their nutrition from materials

Growth of fungus on improperly treated bakelite. Results after 9 days.

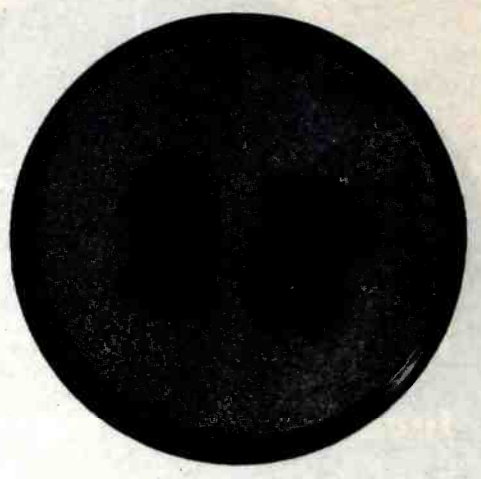


Bakelite protected from fungus growth by proper tropicalization treatment.



Comparison of fungus growth on properly and improperly treated components.

Pieces of fabric protected from fungus growth by the use of an effective fungicide.



Growth of a fungus on untreated felt. Results after seven days.

which are at least in part organic in nature. Molds are often found growing on equipment which supplies them very little nutrition. Only small traces of organic matter, such as dust, deposits due to handling, small quantities of organic matter in the materials themselves, etc., are necessary for these organisms to subsist. Molds are well adapted to grow on solid materials. However, before they can do so they must first secrete enzymes into these materials to dissolve them. The presence of the enzymes and moisture causes a breakdown of the organic materials into simple substances which are absorbed in a liquid state by the numerous filaments of the mold. Any amount of mold growth on a material acts as an agent for the condensation of more moisture. Most molds produce organic acids by fermentation when growing on a material which contains a carbohydrate; for example, Aspergillus niger produces citric and oxalic acids.

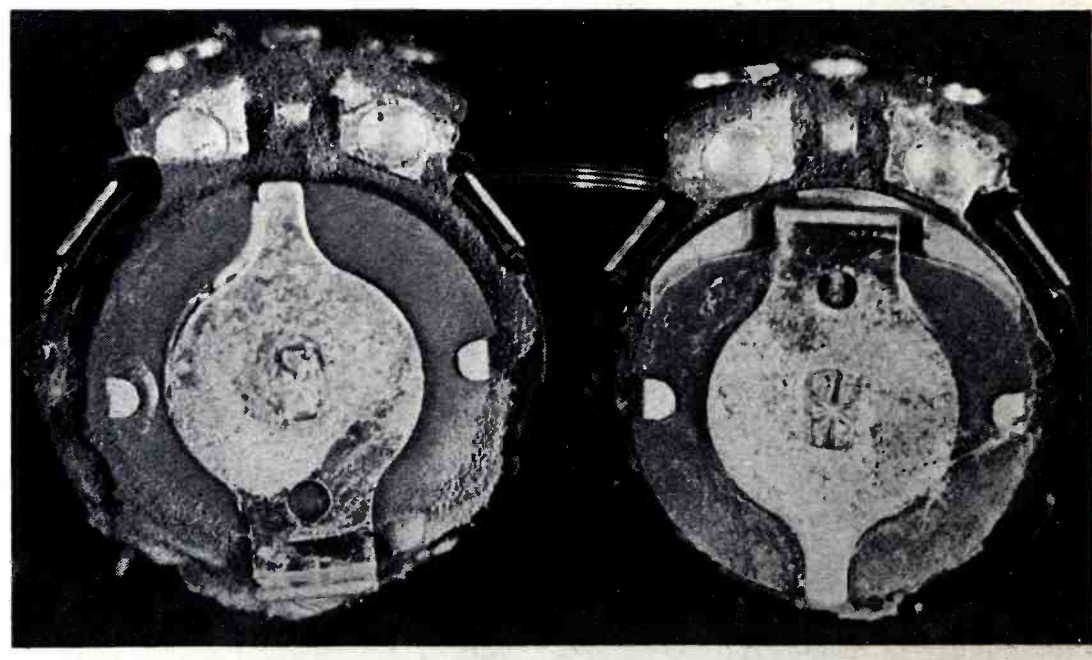
Optimal moisture and temperature are essential factors in the growth of a fungus. Most of the molds require a relative humidity over 70%. Growth is greater when the relative humidity varies between 90 and 95%. The temperature requirements vary with the species of mold, but in general a 30°C (86°F) temperature is optimal. The temperature range varies from about 24°C (75.2°F) to 40°C (104°F). Molds for the most part are strictly aerobic (require the presence of oxygen). Molds grow more slowly than do bacteria and consequently are not generally found growing in competition with bacteria. In addition to attacking electrical equipment, a number of molds are parasitic to the human body; for example, a species of Aspergillus grows in the ear; others grow on like parts of the body.

There are thousands of species of fungi, many of which are found in the United States where they do not ordinarily cause serious difficulties unless proper humidity and temperature are reached. Tropical and semi-tropical climates afford luxurious growth for most fungi. The number of species for each type of fungus varies greatly; for example, 36 species of Aspergillus, over 600 species of Penicillium, etc., are known. Some of the species that are of importance in the study of tropicalization are:

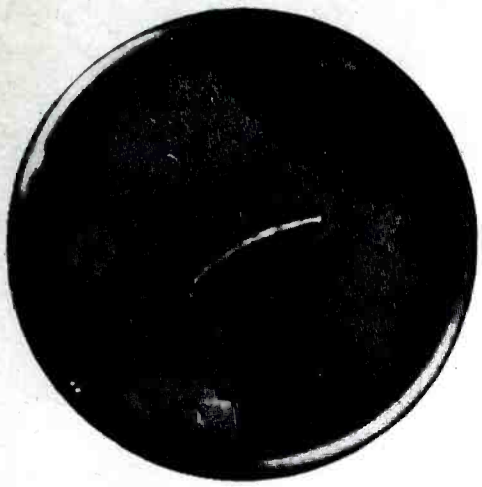
Aspergillus species
Chaetomium globosum
Penicillium species
Trichoderma köningi
Mucor
Poria incrassata
Memoniella echinata
Oospora
Stachybotrys papyrogena
Metarrhizium species
Rhizopus nigrosans
Etc.

Some species of molds, such as Aspergillus and Penicillium, belong to a group which produces spores from superficial filaments growing over the entire surface of the colony. Species belonging to this group of molds are commonly referred to as "superficial mildew organisms." These fungi are often found discoloring materials, but are not active cellulose destroyers and do not greatly reduce the strength of the materials. While Penicillium and Aspergillus are closely related molds, the former is found predominately in northern soils, while the latter is found more commonly in the tropics and semi-tropics. Other species of molds, such as Trichoderma, Chaetomium, Metarrhizium, and Stachybotrys, belong to a group of active cellulose destroyers. This group of organisms is responsible for most of the deterioration of fabrics. Tropicalization treatment of materials that are readily attacked by molds under war time conditions can increase the life of materials over 100 times.

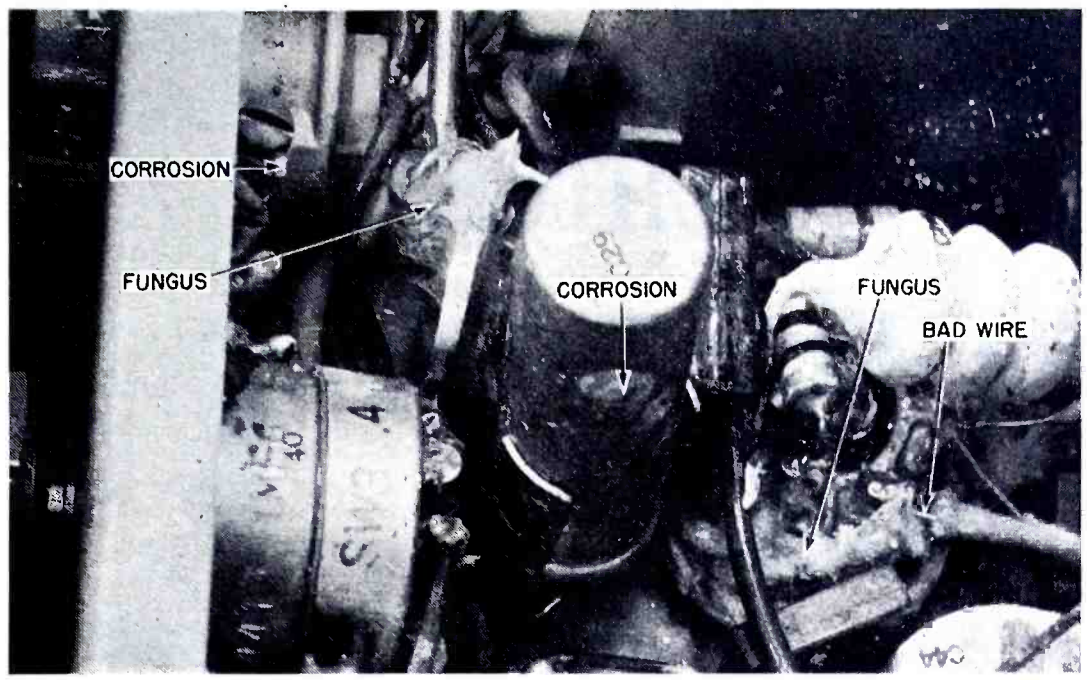
Many types of materials used in radio and radar equipment showed an abundance of fungus growth when tested in the laboratory. In many



Abundance of growth on volume controls (covers removed) after several days at proper temperature and humidity for encouraging such growth.



Growth of a fungus on untreated hook-up wire. Results after seven days.



Corrosion and fungus growths on Signal Corps equipment after exposure to tropical conditions.

cases the fungus growth resulted in alteration of electrical properties, decrease in accuracy of instruments, shortening the duration of usefulness of the equipment to a matter of a few days or weeks, material damage, formation and release of corrosive acids, absorption of water by the insulating materials causing leakage, warping, and deterioration, and lowered morale of the personnel using the equipment. Laboratory research and experience in the field have definitely shown that tropical and semi-tropical conditions are most conducive to fungus growth.

It is believed that some of the fungi that develop in field equipment in tropical, semi-tropical, or foreign points are introduced in the United States at the time of assembly and develop because of adequate humidity and temperature. The extent of deterioration of component parts or whole units of electrical equipment varies considerably with the type of equipment and the conditions under which it operates. It has been found that such units and materials as condensers, resistors, transformers, volume controls, wires, the various types of bakelite, glass, oils, waxes, paints, varnishes, lacquers, metals, many of the plastics, paper, cardboard, linen, cotton, celanese, canvas, glues, rope, rubber, leather, felt, and others support fungus growth. Many of the above materials showed disintegration in time due to the growth of molds. Others, however, supported fungus growth but showed no substantial deterioration.

Several cases of the growth of fungi on eye-glasses have been seen by this laboratory. In one case, a British commissioned officer visited this laboratory for the purpose of exchange of ideas on tropicalization and brought with him a pair of his eye-glasses from which eight species of tropical fungi were isolated. Upon identification of these fungi, it was found that most of the species can be found in the United States. The glasses were so badly etched that they were no longer useable. This condition was the result of a three month period in the southwest Pacific.

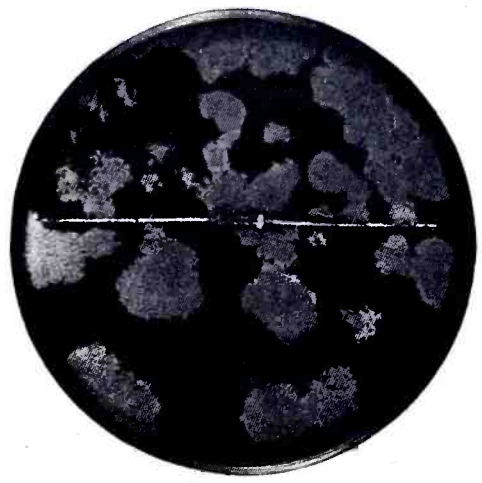
Manufacturers, government and private laboratories, and laboratories of the armed services have studied the problem of tropicalizing war equipment. As a result of such study, a number of methods, such as the use of fine liquid sprays containing water repellent or fungus resistant materials, or both, the coating, painting, or vacuum impregnation of component parts with waxes, lacquers, or varnishes containing some type of fungicide, reduction of humidity in larger sets by use of heaters or desiccants, air tight inclosure for the more susceptible and easily damaged parts, choice of materials wherever possible that are more resistant and more easily protected against fungus growth, etc., have been employed by manufacturers. In addition to the above measures, it has been shown that proper handling, packing, and storing of equipment, continuous use, and periodic inspection and drying out of equipment are other factors which contribute toward protection against mold growth.

Some of the properties that a fungicide should possess to be of value in tropicalization are:

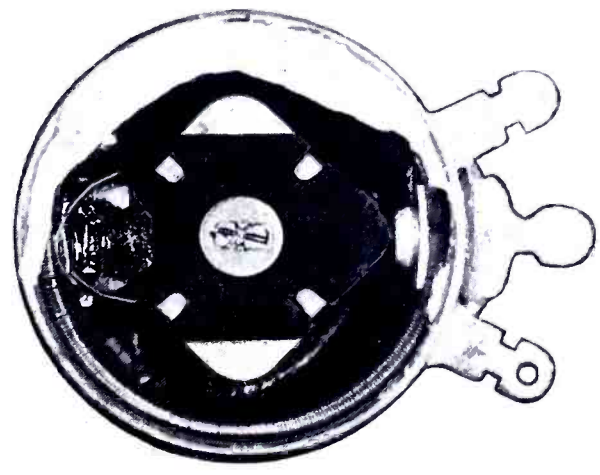
1. it must prevent the germination of the spores and not permit the

(*Continued on page* 31)

Wire protected from fungus growth by proper use of a fungicide. Note the zone of inhibition (clear area) around wire.



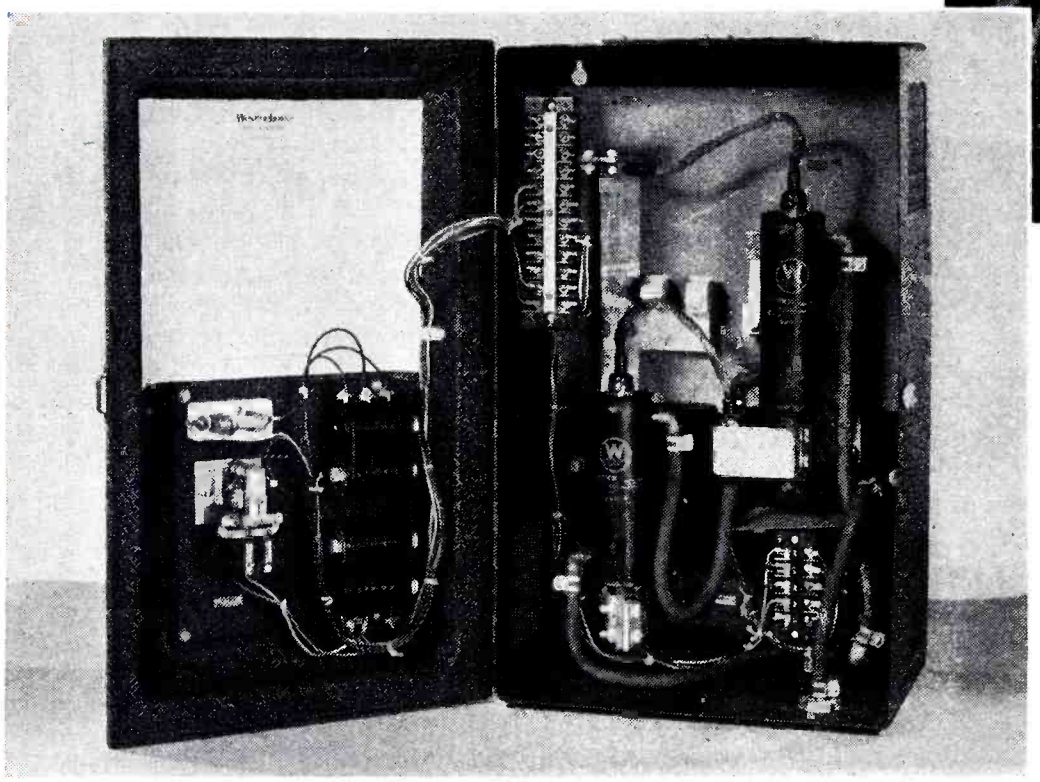
Growth of fungi up to a resistor but not on it. Results after nine days.



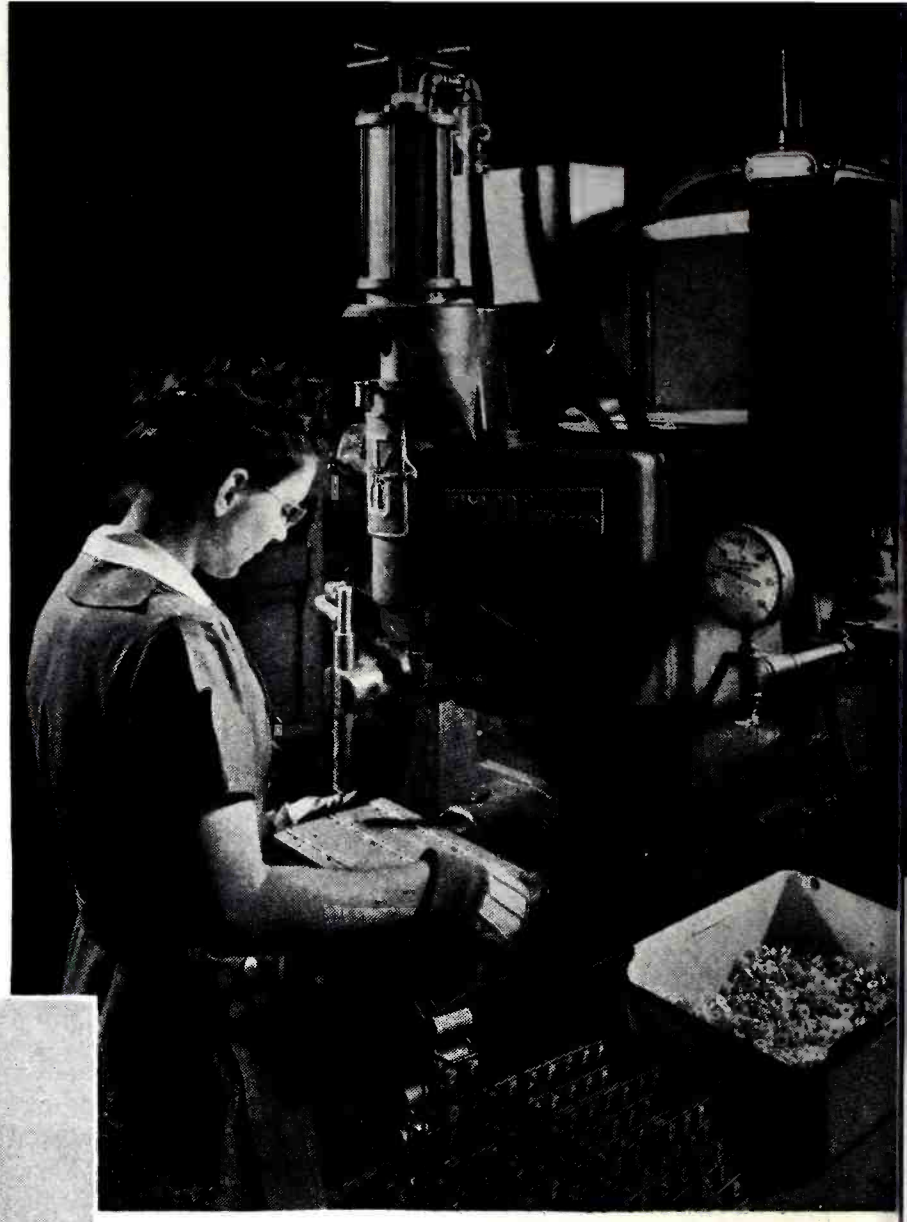
Heavy fungus growth, abundance of moisture, and corrosion in a wire-wound volume control.

Control Circuits For Resistance Welding . . .

By JOHN D. GOODELL
Consulting engineer, St. Paul



600-ampere frame Weld-O-Trol, a power switch for resistance welding applications.



Battery of resistance welders equipped with Weld-O-Trol power switches.

Circuits for obtaining synchronous control, heat control, and exact timing for various resistance welding applications.

ALMOST everyone has seen a defective lamp cord in which a short circuit has fused the wires together. This is a demonstration of resistance welding. In the early days the process was practical only for rough work, but the advent of electronic control introduced refinements in accuracy that assured laboratory results on the production line.

To produce a satisfactory weld, parts must be held together under pressure. A specific quantity of current for a definite length of time is passed through this juncture to create the necessary heat, soften the metal, and lock the molecular structures together. The currents required range from a few hundred to hundreds of thousands of amperes. It is evident that fast acting mechanical switches capable of handling such magnitudes are difficult to design.

Probably the best way to convey the manner in which electron tubes are used to facilitate and control resistance welding processes is to describe a circuit that includes the basic functions of greatest importance. The schematic diagram presented in Fig. 1 has been somewhat simplified for clarity, and includes only those elements necessary to an understanding of the principles involved.

The various effects are best explained if they are first considered from the final result and then described in reverse order. As a matter of fact, this also gives the sequence of their importance as the work becomes increasingly difficult and the control more critical. Current flow through the work is obtained by shorting out the secondary of the welding transformer through the electrodes. The throat formed by the electrode arms is generally long and constitutes a large inductive loop. This is of considerable importance in design because the power factor of welding machinery is almost invariably poor. Since the work usually consists of large cross sectional areas, the resistance is low and the "Q" of the circuit is undesirably high.

The first function of electron tubes is to provide rapid, inertia-less, on-

and-off control of the current. In small bench welders, such as are used in the fabrication of metal parts for electron tubes (*e.g.*, ignitrons), a pair of thyratrons or a single ignitron is adequate for this purpose. In the larger welding operations, a pair of ignitrons are connected for full wave rectification, as shown in Fig. 1.

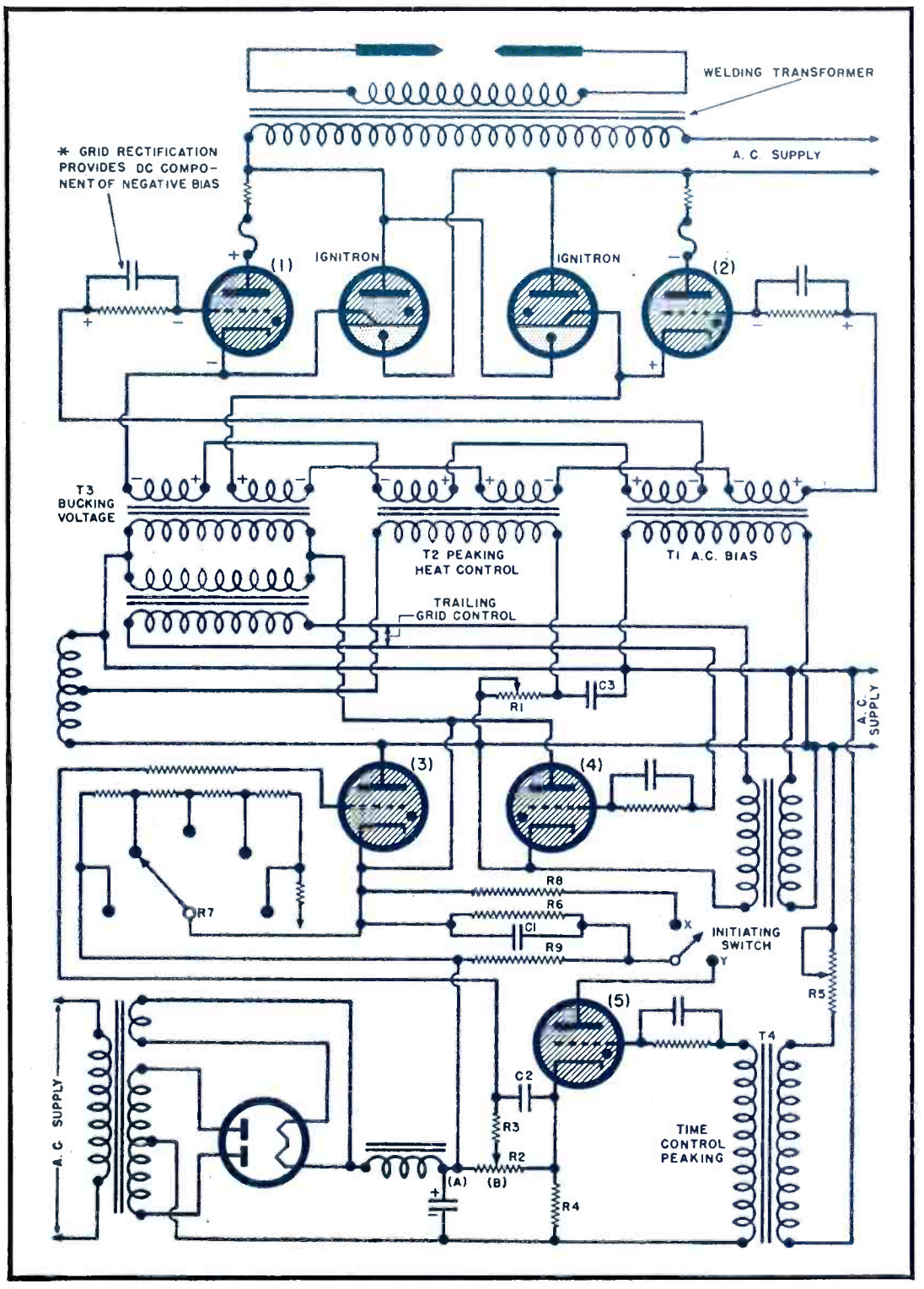
With no further control, this would mean that complete cycles of current would be applied. Tap switches on the welding transformer are sometimes used to adjust the relative magnitudes of supply and welding currents, but this is not a continuously variable control and consequently requires adjustment of the welding time to compensate and produce the desired result. By timing the firing of the ignitrons with thyratrons and regulating the grid-plate phase relationship of the thyratron supply, stepless and continuously variable control of the quantity of welding current is possible. The amount of heat produced is a direct function of the quantity of current applied, and since it is the heat that produces the weld, this type of circuit is called "heat control." The results are indicated in Fig. 2(A).

There are many ways to accomplish phase shift in a thyratron grid circuit. In the simpler devices, resistance-capacitance phase shifting alone is used. The disadvantage of this solution lies in the danger of initial transients if the switch is closed at the wrong instant on the voltage wave. It is impossible, of course, for an operator to effect other than a random relationship between the closing of the initiating switch and the instantaneous voltage. In operations where the weld time is 20 cycles or more, an initial power transient may be a negligible portion of the total, but in instances where the time ranges below six cycles, synchronization must be obtained. This condition is shown in the graph of Fig 2 (B). For highly consistent results, synchronous control is always desirable, and when dealing with such difficult materials as brass, stainless steel and aluminum, it is vital. In many welding applications, spoilage of a single piece may represent a loss of several hundred dollars, and synchronous control is an important factor in minimizing such losses.

In Fig. 1 an a.c. bias is applied to the grids of the firing control thyratrons 180° out of phase with the plate potentials through transformer T_1. A capacitive resistance phase-splitting combination, designated R_1 and C_3, supplies the primary of the peaking transformer T_2, and this voltage is superimposed on the a.c. bias. Fig 2(C) shows the peaks as they appear on the bias wave form. This peaking voltage is adjusted so that it will just fall short of driving the grids sufficiently positive for the tubes to conduct. When transformer T_3 is energized, it produces a bucking voltage which opposes the a.c. bias supply just enough to permit the peaking transformer to swing the grids positive and allow the tubes to fire. The application of current to the bucking transformer is now the initiating control, but regardless of the time it is applied, the tubes cannot fire until the peaking transformer supplies an additional pulse of current. Thus control of the point on the voltage wave where the tubes will start conducting is automatically effected. The amount of phase shift employed, hence the "heat control," depends on the setting of R_1. With the polarities on the three transformers as indicated on the diagram, Tube 1 will fire at a time determined by the peak from the heat control transformer.

With this arrangement, the time during which welding current flows is still dependent on the reflexes and judgment of the operator. To accomplish the accurate timing required for precision spot and projection welding, it is necessary not merely to apply a predetermined number of cycles of current, but to initiate the power at a definite point on the voltage supply wave form and terminate it in a mirror position after a predetermined number of cycles. This is accomplished by synchronous timing circuits. Again referring to Fig. 1, a control current is supplied to the bucking

Fig. 1. Synchronous timing and phase shift heat control for resistance welding.* Grid current limiting resistors are by-passed in a.c. grid circuits to prevent transient firing when bias is beginning its negative swing.



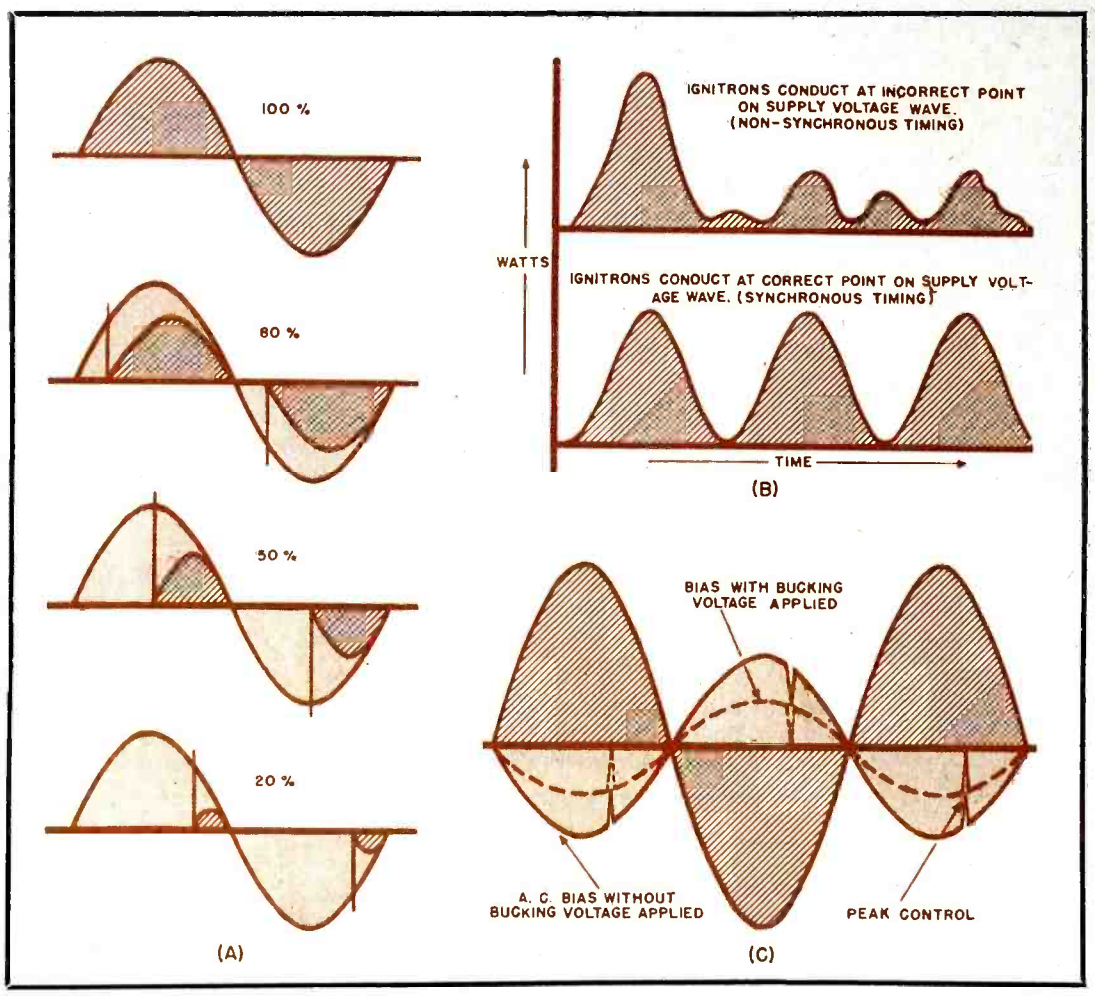


Fig. 2. (A) Heat control curves. (B) Results of synchronous and non-synchronous timing. (C) Various components of grid bias compared with plate current.

transformer through Tubes 3 and 4. It is evident that the cathodes of these tubes are at opposite potentials, and in order to apply the timing voltage to them from a single source, a "trailing" tube circuit is used. When Tube 3 conducts, the bucking transformer is energized and a voltage is induced in an auxiliary winding marked "trailing control." In order to work properly, the load on this circuit must have a lagging power factor so that when the polarity of Tube 3 is reversed and it ceases to conduct, there will be sufficient lagging current in the trailing control winding to hold the grid of Tube 4 (which is now in the proper plate-cathode polarity relation for conduction) sufficiently positive to allow it to fire. Whenever Tube 3 is fired, Tube 4 will automatically conduct on the following half cycle. Timing of this trailing tube cannot shift because it is fundamentally dependent on the reversing polarities of the supply voltage to which it is connected 180° out of phase with Tube 3.

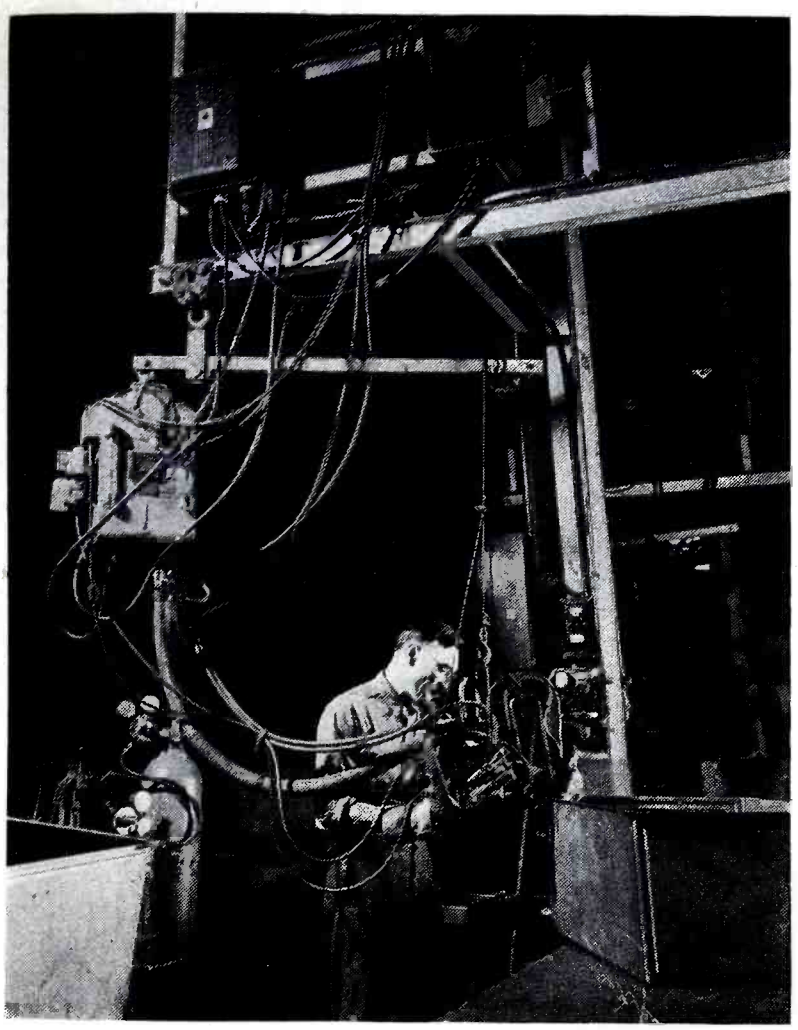
Timing circuits are designed to accomplish many different control functions. Spot, pulsation, seam and projection welding all require different timing of various operations. The principles are much the same and their applications are simply more or less elaborate, depending on the type of work involved. The circuits described here are not to be taken as corresponding exactly to any commercial equipment, but only as representing basic methods of solving typical problems.

The output of the conventional power supply feeds d.c. for operating the timing control circuit. A small portion of this voltage across R_4 is used as grid bias on Tube 5. The balance of the d.c. supply is dropped across R_2 and provides grid control of Tube 3 through the operation of Tube 5 and the timing capacitor C_1, as explained later.

The secondary of the timing control transformer T_4 is in series with the bias supply of Tube 5. This is another peaking transformer with the primary connected to the a.c. mains. It supplies the necessary impulse voltage to fire Tube 5. The point on the supply voltage wave at which this peak occurs may be shifted by adjusting R_5, which changes the L-R ratio of the circuit and shifts the phase relationships. In order to understand the importance of this additional peaking control, it is necessary to refer to the circuit of Tubes 3 and 4 and the heat control peaking transformer. Tubes 3 and 4 function as a full wave rectifying circuit, one of them firing on each half of a full cycle. The secondary of the heat control peaking transformer consists of two windings, one connected in the grid circuit of each of the ignitron firing control thyratrons, *i.e.*, Tubes 1 and 2. These are also connected for full wave rectification and each receives a peak impulse on its respective half of the supply cycle. Now, if Tube 5 could conduct at any random instant when the initiating swich might be closed in the *Y* position, Tube 3 might be fired just after the peak of the heat control transformer appeared on the corresponding half of the supply voltage wave. This would mean that the first actual current supply to the welding transformer would occur when the trailing Tube 4 conducts. If the timing control is set so that Tube 3 conducts again, it is inevitable that Tube 4 will also conduct on the following half cycle, and the result will always be a half cycle short of the desired interval. The timing control transformer T_4, however, can only supply a peak of the proper polarity to fire Tube 5 at one instant in the entire voltage cycle. If this action is synchronously timed with the setting of the phase shift on the heat control transformer, the undertiming described above cannot occur.

R_3 and C_2 form a filter which acts to compensate for any slight variations in supply voltage regulation, *i.e.*, the charge on C_2 maintains a relatively constant bias on the grid of Tube 3. Note that with the switch in the *X* position there is no current flow, hence no voltage drop in R_9, and the cathode of Tube 3 is at the same potential as point *A*. The voltage drop across R_2 between points *A* and *B* provides the bias between grid and cathode necessary to prevent conduction in Tube 3. When the switch is thrown to the *Y* position, Tube 5 will conduct at the next instant when a peak impulse of the correct polarity is supplied to its grid by T_4. Tube 5 and R_9 in series combination are connected in parallel with R_2; hence the voltage across R_2 (minus the arc drop of Tube 5) appears across the resistance R_9.

R_7 and the timing capacitor C_1 in series are in parallel with R_5, and the instantaneous voltage is maximum across R_7, decreasing exponentially as C_1 charges. The voltage appearing across R_7 must be enough greater than the drop between points *A* and *B* on R_2 to drive the cathode of Tube 3 negative with respect to the grid, thus firing the tube. Conduction will continue through Tube 3 on alternate half cycles with Tube 4 trailing on the other half, until the voltage across R_7 decreases to a value less than the drop from *A* to *B*. At this time the grid will again be sufficiently more negative than the cathode to cut the tube off on the next half cycle of the supply voltage when its plate goes negative. The number of cycles, hence the time, during which Tube 3 conducts is



Resistance welding on gun welding application.

Spot welding aluminum on Boeing Flying Fortress.

a function of the setting of R_7. The control is shown with only five taps for purposes of simplification, but in practice approximately 30 positions would be provided so that one-cycle steps over this range would be available. When the switch is returned to the *X* position, a low resistance discharge path is provided through R_8.

To summarize the action of this circuit, it is described as follows, starting this time with the initiating switch. When the switch is closed in the *Y* position, Tube 5 conducts when a peak from the timing control transformer appears on a positive half cycle of the supply voltage. The current flow through R_7 causes a voltage drop which drives the cathode of Tube 3 negative with respect to its grid for a time determined by the charging rate of C_1 (controlled by the setting of R_7). Tube 3 conducts and energizes the bucking transformer so that the grid bias on Tube 1, provided by the a.c. bias supply transformer, is diminished sufficiently to permit a peak from the heat control transformer to fire the tube. Tube 1 provides the energy necessary for the igniter of the associated ignitron to initiate an arc. The ignitron fires and a pulse of current is supplied to the primary of the welding transformer. This induces the current in the secondary which flows through the electrodes and the parts to be welded, producing the necessary heat. When the a.c. voltage supply reverses polarity, there is enough lagging current present in the trailing control winding of the bucking transformer to hold the grid of Tube 4 sufficiently positive for this tube to fire, and the cycle of events takes place through Tube 2 and its associated ignitron.

The timing control is of interest not only in connection with welding apparatus, but also in many other industrial applications. This portion of the circuit is separately presented in Fig. 3. The use of R_6 in Fig. 1 (shown as R_2 in Fig. 3) is seen quite commonly in this type of control. R_6 is not necessary for purposes of explaining the operation of the welding timer, but an understanding of its effect is of practical importance. For the calculation of the time lapse, various values of R_6 may be used to make the capacitor appear larger, or may be thought of as making the series resistance appear smaller. When the parallel resistor is used, the capacitor will never charge to the full value of the applied voltage, and at first view it might appear that this arrangement would shorten the time involved. Actually, of course, the problem is to make the capacitor charge to a *specific* value in the given time, and in this respect the parallel resistance increases the time involved. It is possible to consider this problem in terms of an equivalent force-free circuit, setting *E* equal to zero, and thus representing the differential equation. Inspection of such a diagram shows that for purposes of calculating the time constant, the series and parallel resistors may be considered as an effective series resistor equal in magnitude to their parallel value. Analytical considerations are not as simple as first inspection would indicate, and the derivation of an equation for the series resistor in terms of the other values is of interest. The following mathematical statements are concluded with an expression for R_1 and, in passing, demonstrate the comments above.

The currents I_1 and I_2 in Fig. 3 are given by

$$I_2 = \frac{dQ_2}{dt};\ I_1 = \frac{dQ_1}{dt} \qquad (1)$$

Adding the voltage drops algebraically around the closed circuits gives

$$R_1\left[\frac{dQ_1}{dt} + \frac{dQ_2}{dt}\right] + R_2\frac{dQ_2}{dt} = E \qquad (2)$$

Since the voltage across the capacitor equals the voltage across R_2,

$$\frac{Q_1}{C} = R_2\frac{dQ_2}{dt};\ \frac{dQ_2}{dt} = \frac{Q_1}{R_2C} \qquad (3)$$

Substituting (3) in (2) gives

$$R_1\left[\frac{dQ_1}{dt} + \frac{Q_1}{R_2C}\right] + \frac{R_2Q_1}{R_2C} = E \qquad (4)$$

Expanding and simplifying yields

(*Continued on page* 34)

R.F. Generator Characteristics for Induction Heating*

By T. P. KINN
Section Eng., Radio Div., Westinghouse

Circuits and techniques for properly utilizing induction heating effects of r.f.

Two-kw. industrial r.f. generator.

DUE to war time conditions, radio frequency heating has had a chance to demonstrate that it can be a very useful tool. The vacuum tube used as a generator of this radio frequency has therefore placed itself in industry along with the more common generators of electric energy. The vacuum tube r.f. generator, like any other piece of electrical equipment, has its characteristics and these characteristics dictate its uses and limitations. It is the purpose of this article to define some of these characteristics and show how the r.f. generator may be properly applied to induction heating problems.

The phenomena of producing heat by an alternating magnetic field has been known since the 1880's, while in 1890, Colby was granted a patent for this method of generating heat. In 1900, according to popular belief, the first practical induction furnace was put into operation by Kjellin. It has taken the ensuing years to produce electrical equipment suitable for heating. However, it has taken the need for all-out war production during the past three years to provide the incentive for widespread acceptance of this form of heating. With the rapid advance in the use of induction heating, the use of the vacuum tube oscillator as a source of alternating power for induction heating has shown a very rapid advance.

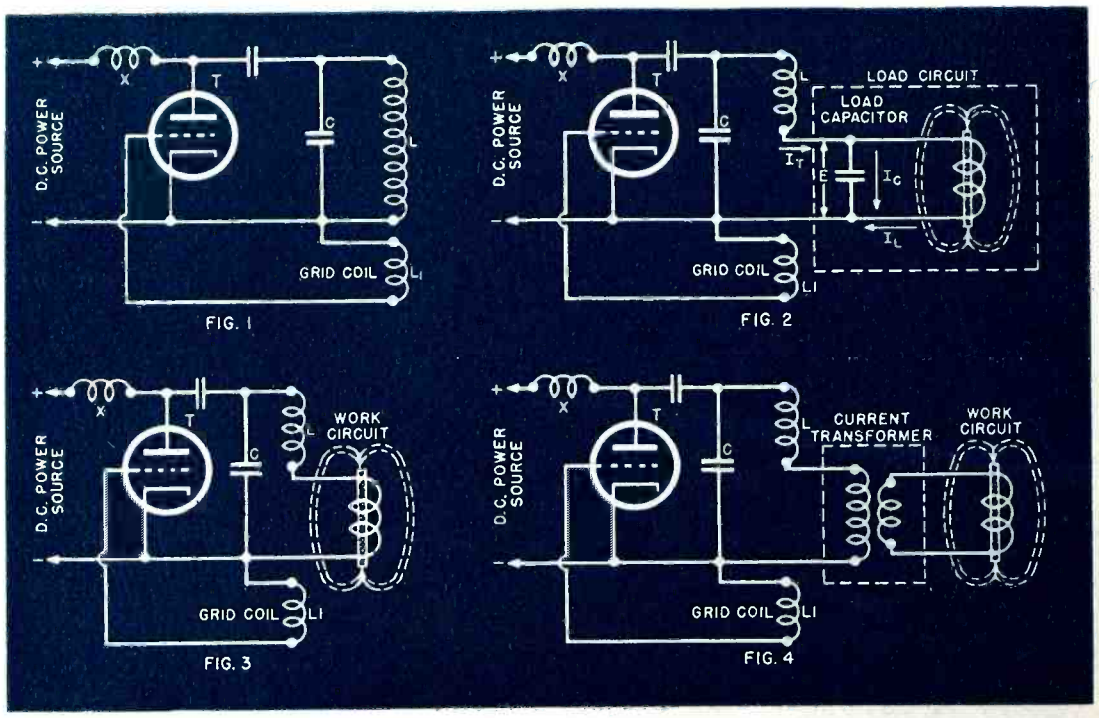
Except in isolated cases, the small amount of induction heating used in industry prior to the present war utilized power obtained from rotating machines or spark gap oscillators. The vacuum tube r.f. generator, along with the vacuum tube itself, is now proving its usefulness in industry. This is evidenced by the publicity electronics is receiving. Because the vacuum tube r.f. generator has been confined to the radio field up to this time, its operation and characteristics are not too well known to those not connected with the radio industry.

Induction heating is now being accomplished at frequencies from 60 cycles up to 10,000 cycles and higher by rotating machinery. The rotating machine is a common source of power and therefore its use and limitations for induction heating are well known. The service and maintenance problems encountered in this type of heating are well established.

The spark gap oscillator finds its most useful range of frequencies around 20 kc. This type of generator is very useful for certain specific applications. The main advantages are its simplicity and ease of operating technique, while its limitations are power output and reliability. New developments surrounding the spark gap itself, which are appearing now and will appear after the war, will help to better the output and reliability of this type of generator.

The scope of both the rotating machine and the spark gap generator is limited and it is for this reason that the vacuum tube oscillator can do many of the jobs now being done by the rotating machine or the spark gap in addition to performing many jobs which these machines cannot accomplish. At the present time, when a job can be done by either method, the initial investment is 2 or 3/1 in favor of the rotating machine. This is due primarily to the well established manufacturing procedures and facili-

Fig. 1. Basic oscillator circuit. Fig. 2. Load capacitor circuit. Fig. 3. Oscillator and work circuit. Fig. 4. Current transformer circuit.



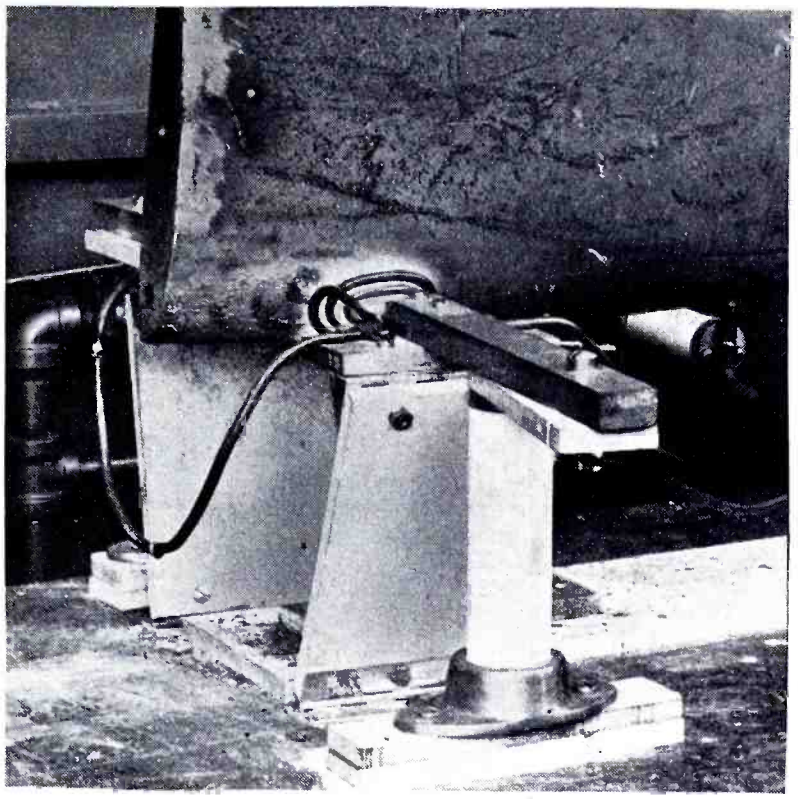
* *Courtesy of A.I.E.E.*

ties used in making the rotating machine. Post war use of the vastly expanded radio facilities plus ever increasing demand for the vacuum tube equipment will reduce this difference rapidly.

R.F. Generator Characteristics

The vacuum tube generator is a brand new device to the average user and like any other new technical device, a certain amount of study is necessary in order to understand its operation and application. The vacuum tube self-oscillating generator is fundamentally a simple device as evidenced by the circuit shown in Fig. 1. Tube T acts as a valve or switch which is used to take energy from the d.c. source at regular intervals and supply it to the tuned circuit made up of inductance, *L*, and capacity, *C*. The grid of the tube acts as the control of the valve and determines when the valve shall be shut off and when it shall be open. The valve is opened for a short portion of a cycle of the frequency determined by the circuit *L* and *C*. The circuit *L* and *C* will then oscillate just as any undamped circuit will oscillate. The vacuum tube supplies energy to maintain this oscillation during a short portion of each cycle. The grid obtains its controlling voltage at the right phase relation by induction to coil, L_1, thus the oscillator becomes a self-excited oscillator because the grid is excited by power from the oscillating circuit, *L* and *C*. If the grid control voltage should be supplied by or from a separate source, then the generator would be known as an amplifier to differentiate it from the self-excited type. This self-excited type of generator is the one most commonly used for industrial purposes.

There are many types of self-excited oscillator circuits, but they are all merely variations of the fundamental circuit shown in Fig. 1. The circuit shown in Fig. 1 and the associated Figs. 2, 3, 4 and 8, have been simplified to their most basic fundamentals by the elimination of the filament supply, bias supply, plate supply and control circuits normally associated with a complete oscillator.

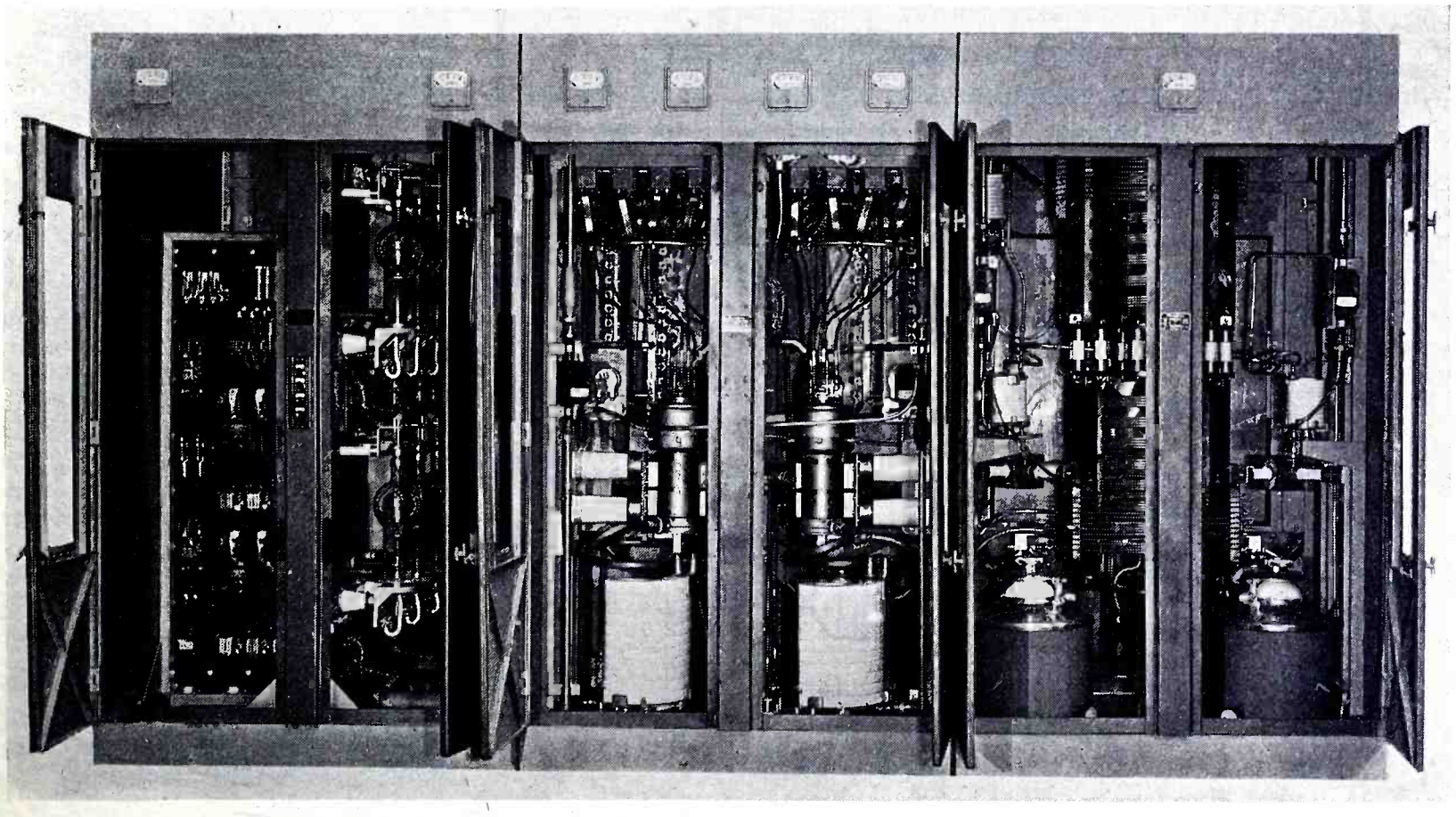


Propeller edge brazing at 450 kilocycles.

The spark gap oscillator differs very little from the vacuum tube oscillator. By replacing the tube with a spark gap which is capable of self quenching or extinguishing itself at a sufficiently rapid rate to permit the L-C circuit to oscillate, the action becomes the same as for the tube. The gap acts as the valve but no grid is necessary because of the self starting and extinguishing characteristics of the arc. The limit of frequency in the spark gap type oscillator is determined by the time required to extinguish the arc. The frequency at which the vacuum tube will function as a valve is unlimited from this standpoint.

In order for a self-excited vacuum tube oscillator to oscillate properly, there must be sufficient stored energy in the L-C circuit to maintain good

A view of the various component parts comprising a two-hundred-kilowatt industrial radio frequency generator.



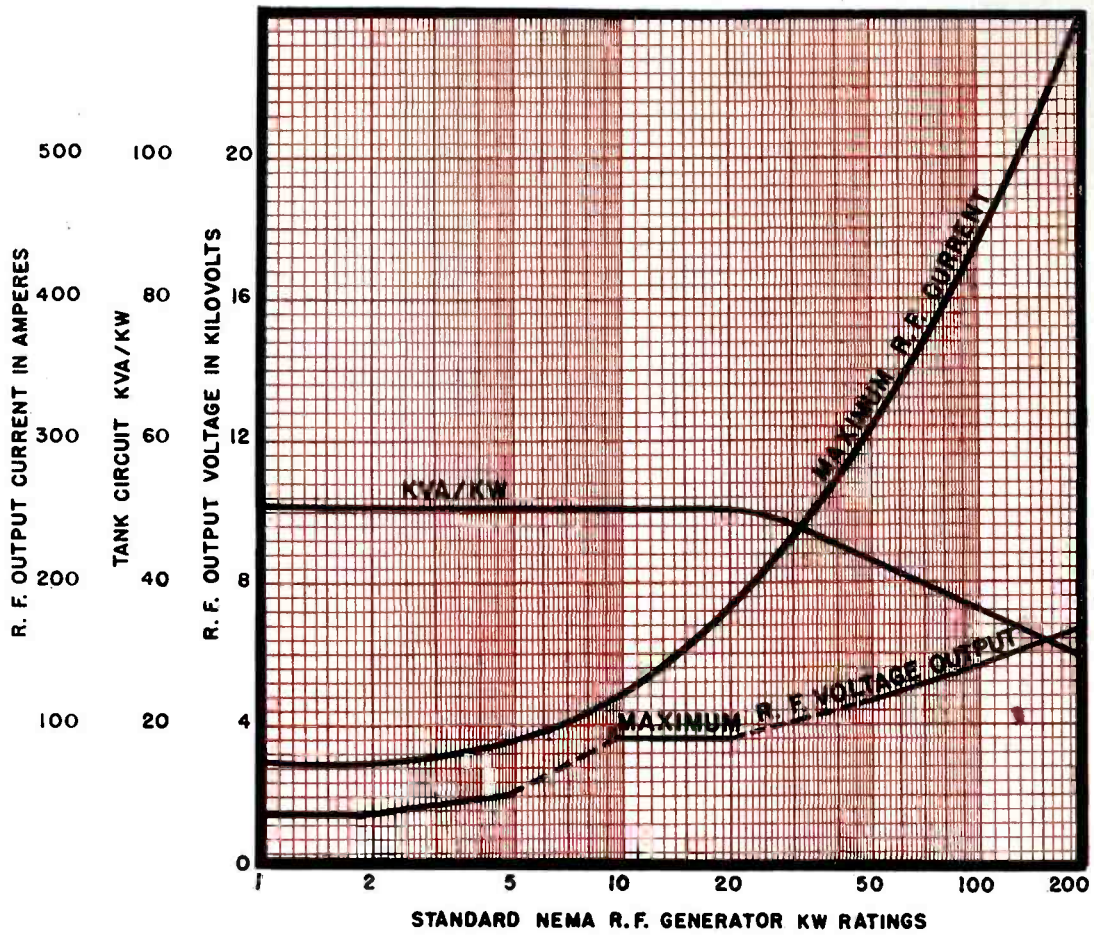


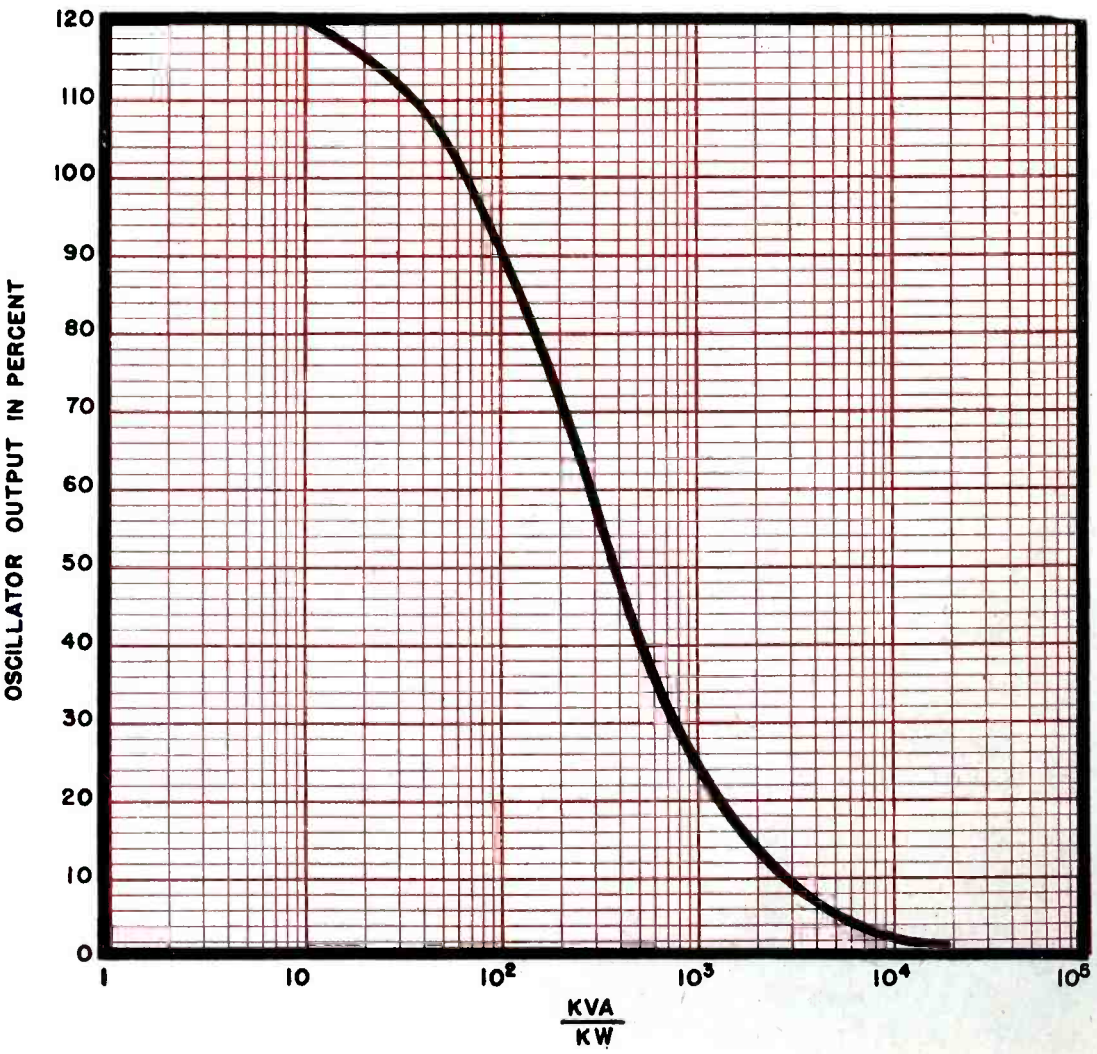
Fig. 5. Output current, voltage, and tank circuit KVA/KW, for typical oscillator.

regulation throughout a complete cycle. See Fig. 7.

The grid voltage and bias voltage are adjusted in value and phase such that the condition shown in Fig. 7(A) exists. Plate current flows only during that portion of the cycle where the effective plate voltage, E_p, is at a minimum. During the rest of a cycle any a.c. energy required from the circuit must be supplied by the L-C circuit. To produce this condition, the kva/kw ratio must be kept high. The larger the capacitor, *C*, the more stored energy and/or the more circulating current in the L-C circuit. The higher the current in this circuit the greater will be the kva/kw ratio.

Most induction heating problems resolve themselves into the number of ampere turns necessary to produce the desired heating. For this reason, it is almost always necessary that the generator be capable not only of supplying power, but also of providing maximum current flow. The current available from a vacuum tube self-excited oscillator is dependent on the value of the capacity, *C*, in the oscillator circuit and the voltage across this capacitor. The relation kva/kw, therefore, becomes a figure of merit or means of easily describing the capabilities of a vacuum tube generator. This value of kva/kw should be as high as practical and, in addition, the current portion of the numerator should be as large as possible. Fig. 3 illustrates the usual method of utilizing the oscillator L-C circuit current for induction heating by placing the work circuit in series with the oscillator inductance, *L*.

Fig. 6. Variation of oscillator output with TANK CIRCUIT KVA/WORK CIRCUIT KW ratio.

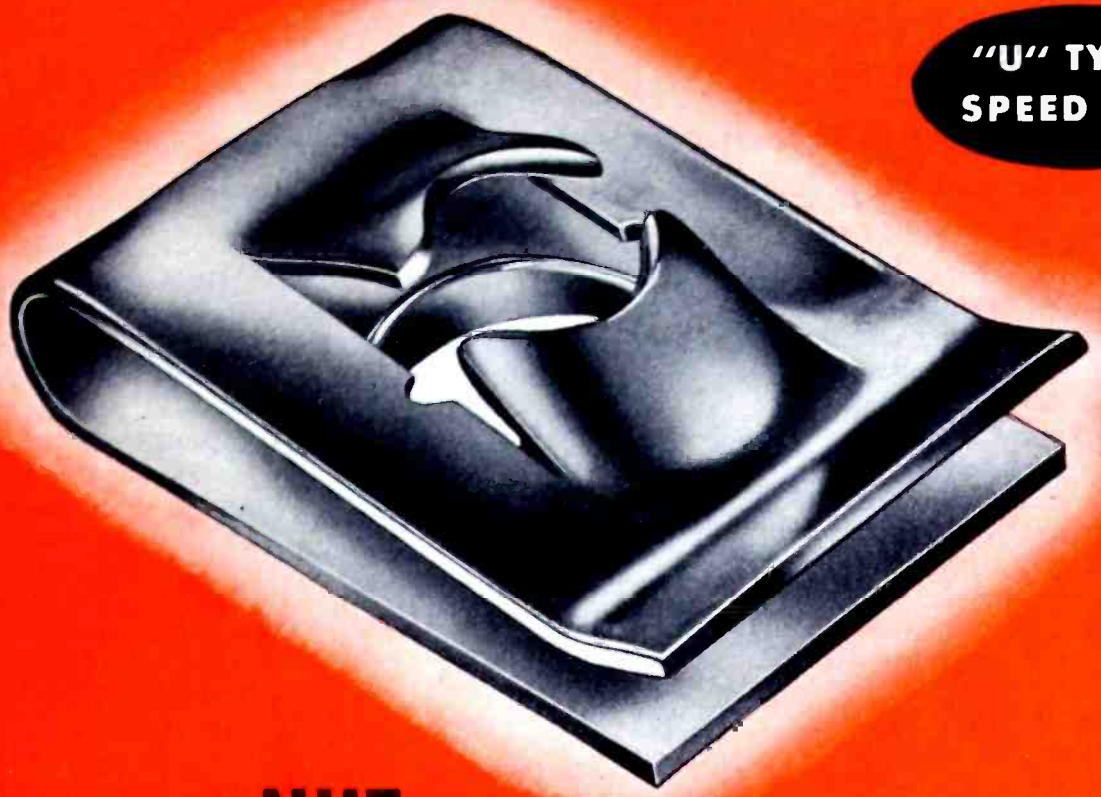


The r.f. voltage across the oscillator L-C circuit is a direct function of the plate voltage applied to the vacuum tube. From Fig. 7(A), it can be seen that the peak of the a.c. voltage is usually slightly less than the d.c. plate voltage and the RMS value normally runs approximately 65% of the d.c. plate voltage. This is only an approximation as the exact voltage depends on the characteristics of the tube in use, the degree of loading, grid voltage relationships and other items, but it does represent average conditions and will suffice for this discussion. Referring to the relation kva/kw it can be seen that for a given tube and output, the value of oscillating circuit current or tank current is the only variable, and therefore, the value of capacity is the only means of controlling the kva. The maximum kva is then limited by the maximum value of capacity that can be used.

There are two main factors which usually control the maximum value of capacity. One is that of economy and space, it being impractical usually to include large values of capacity in the oscillator due to initial cost of the capacitors and the added space required in the generator to house or package the added capacity. The second factor is that of the allowable loss in power than can be tolerated in the oscillator L-C circuit. Normal design of vacuum tubes allows for practically no excess power from the tube which may be dissipated in the oscillator circuit elements and still leave

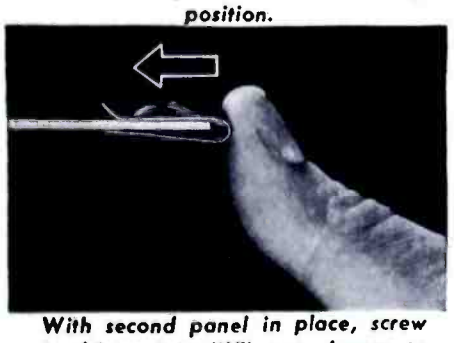
(*Continued on page* 28)

ONE OF A SERIES PORTRAYING THE "SPEED NUT FAMILY OF FASTENERS"

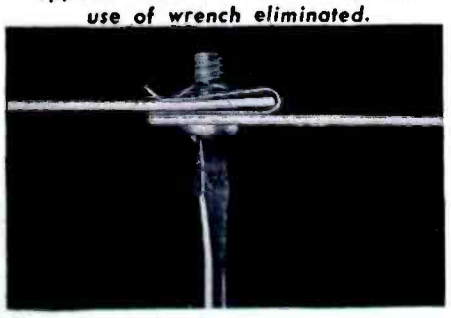


HERE'S THE NUT THAT *Holds itself* IN PLACE!

As "U" nut is slipped over panel, extrusion on lower leg snaps into hole—locking nut in screw-receiving position.



With second panel in place, screw is driven into "U" nut. Access to opposite side is unnecessary and use of wrench eliminated.



Here is a spring steel lock nut that broadens the smile of engineers and assemblymen everywhere. No more fussin' or cussin' over blind location fastening problems. No more expensive welding, riveting, or clinching nut plates in location. For "U" type SPEED NUTS merely snap into holes along the edge of panels, brackets, or flanges.

An extrusion formed in the lower leg of the "U" nut snaps into the screw hole and retains the nut in perfect register until final assembly. By varying the size of the hole, any degree of "float" may be obtained, to compensate for misalignment.

In addition to simple and speedy application, "U" type SPEED NUTS possess exceptional holding power and their arched prongs absorb vibration to definitely prevent loosening. Millions of "U" nuts were used on metal, wood, and plastic products before the war—millions more are being used today on war equipment. And postwar products that will capture the biggest markets will be assembled faster and at lower costs with SPEED NUTS. The men with the assembly "know-how" are the ones who move up the fastest. Write today for literature.

TINNERMAN PRODUCTS, INC.
2126 FULTON ROAD, CLEVELAND 13, OHIO

Speed Nuts* PATENTED

*Trademark Reg. U. S. Patent Office

FASTEST THING IN FASTENINGS

SHOCK EXCITED OSCILLATOR

By R. G. MIDDLETON
Asst. Project Engineer, Templetone Radio Co.

An oscillator of interest to laboratory technicians for generating damped sine waves as a result of a square wave input.

THE simplicity and constancy of calibration afforded by the shock-excited oscillator, together with the automatic synchronism of successive wave trains with the exciting square wave, appeal to the laboratory designer of measuring equipment.

Essential features of the shock-excited oscillator are shown in Fig. 1(A).

Operation of the circuit is as follows. With no negative charge upon the grid of the tube, current flows through L, limited only by internal resistance of the tube and the value of the limiting plate resistor. The latter prevents exceeding the allowable dissipation of the tube.

Upon a negative square wave being impressed upon the grid, the tube suddenly cuts off and the magnetic field energy of coil L ($W = \frac{1}{2}LI^2$) oscillates around the reactive circuit, becoming dissipated as heat in the unavoidable circuit resistance after a certain number of cycles. This oscillating energy is practically sinusoidal as will be seen.

The mathematical description of the circuit thus includes the three parameters R, L, and C. From these the frequency of oscillation of the circuit is obtained by analysis as:

$$f = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \frac{R^2}{4L^2}} \quad \ldots\ldots\ldots\ldots\ldots (1)$$

The oscillation frequency of the circuit is thus dependent upon the circuit resistance or Q, although for high-Q coils the familiar formula for resonant frequency may be used with small error:

$$f = \frac{1}{2\pi\sqrt{LC}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

It may be shown that the current in the oscillating circuit is computed as:

$$i = \frac{I}{\omega\sqrt{LC}}\, e^{-at} \sin(\omega t + \phi) \quad \ldots\ldots\ldots (3)$$

where: i = instantaneous oscillating current
I = d.c. during conduction of tube
$\omega = \sqrt{\frac{1}{LC} - \frac{R}{4L^2}}$
e = base of natural logarithms
a = R/2L
t = seconds
$\phi = \tan^{-1}(\omega/a)$

This formula tells a great deal about the behavior of the circuit. A sine wave of current flows in the circuit during cut-off, which causes a sine wave of voltage to appear across the capacitor C, Fig. 1 (B). The wave has a natural decrement of an exponential form, due to circuit resistance; the higher the Q, the longer the oscillations will persist. Since the wave has an exponential envelope, it is a modulated wave, and will exhibit sidebands to reactive loads. The general waveform obtained is sketched in Fig. 1(C).

The designer is interested chiefly in three properties of the oscillatory circuit: (1) the natural frequency, (2) the rate of decay, (3) the voltage available across C.

The natural frequency is a function of R, L and C as has been noted. The rate of decay may be calculated by noting that each successive crest of either voltage or current is a certain percentage of the preceding crest; when the sine is equal to one, which occurs at each crest, the current may be computed from the equation:

$$\frac{E}{\pm L\sqrt{\frac{1}{LC} - \frac{R^2}{4L^2}}}\, e^{-\frac{Rt}{2L}} \quad \ldots\ldots\ldots\ldots (4)$$

which enables the designer to rapidly sketch the envelope to intersect with an ordinate specifying a given percentage of the decay.

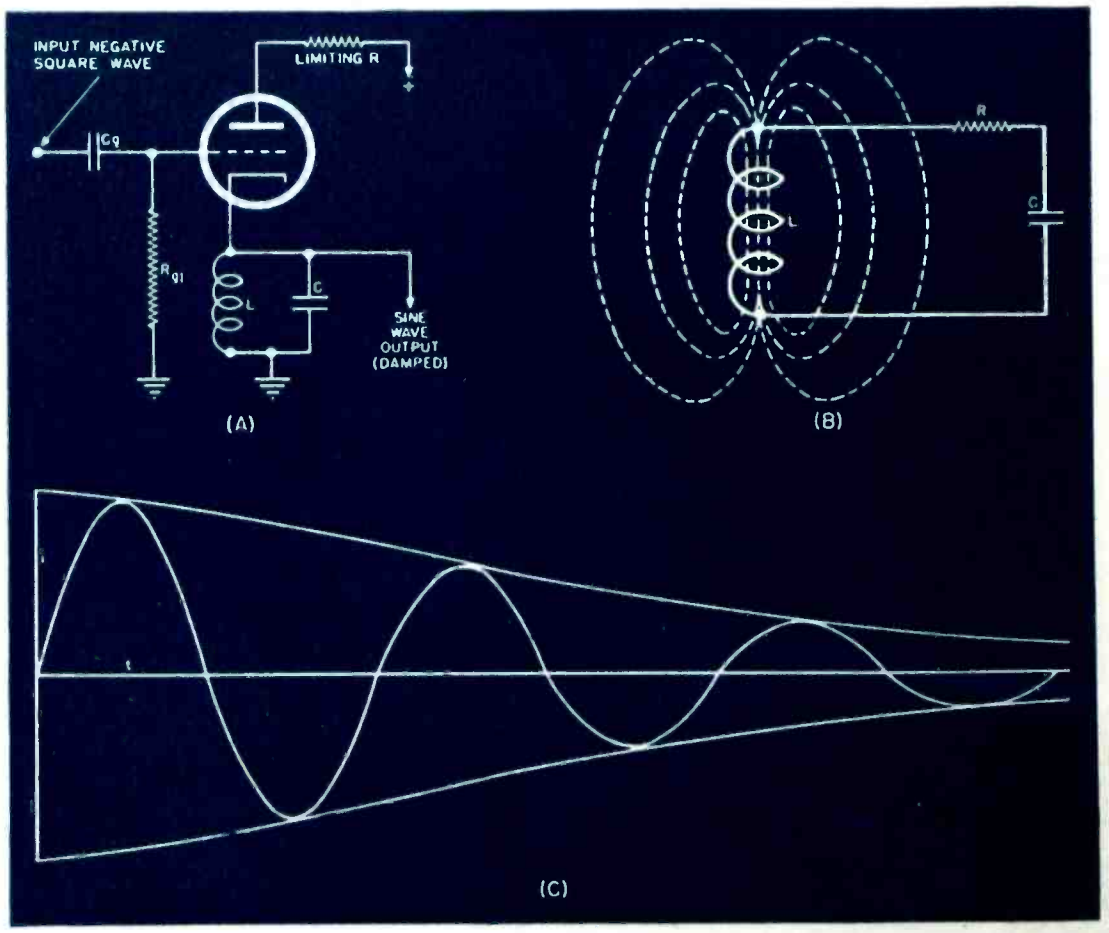
The voltage available across the capacitor is known from the current through the tube, due to periodic energy interchange between coil and capacitor: $\frac{1}{2}LI^2 = \frac{1}{2}CE^2$.

It may be observed that this quantity of energy can disappear only in the circuit resistance, and that the integral of energy dissipated in the circuit over infinite time is equal to this initial energy of the coil field.

The shock-excited oscillator is usually employed to drive an essentially capacitive load with a negligible resistive component. Resistive loads will increase the rate of decay.

At higher frequencies, the designer will add the capacitive component of the load to the circuit capacitance.

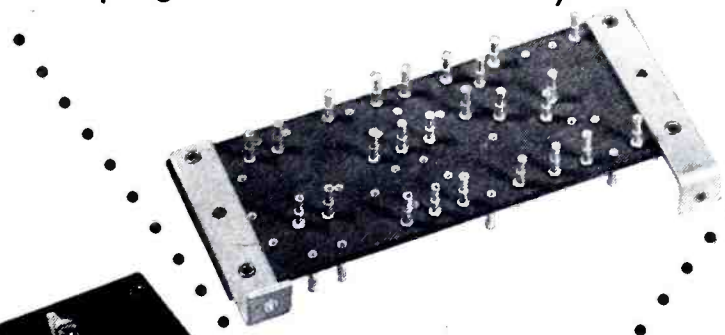
Fig. 1. Circuit diagram of shock excited oscillator (A), magnetic field around coil of resonant L-C circuit (B), and damped sine wave output of oscillator (C).



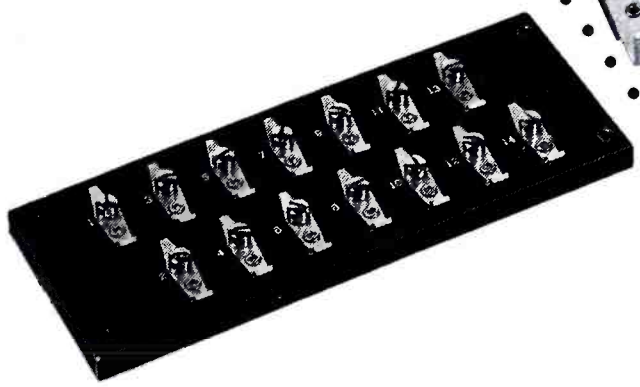
Modern Components by Micarta

MICARTA'S FACILITIES

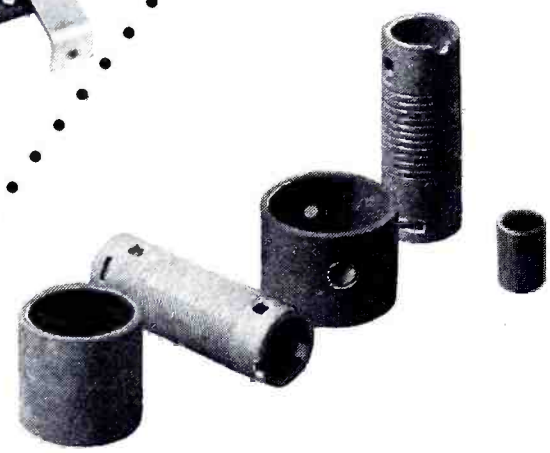
are devoted to the manufacture of terminal strips, coil forms, battery connectors, banana plug assemblies and many other modern components.



Resistor Boards

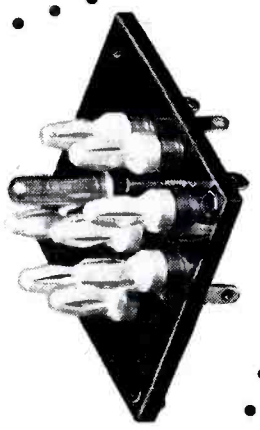


Terminal Boards



Coil Forms

Banana Plug Assemblies



Engraving · Printing · Stamping · Screen Processing—These Micarta processes efficiently mark laminated materials and metal.

DIALITE *by Micarta*

- ★ Tough molded shell; high impact strength
- ★ Rigidly anchored to bracket to assure permanent position
- ★ Leads securely soldered, will not short inside shell
- ★ High dielectric strength
- ★ Unlimited mounting bracket possibilities for any requirement

Fabricators of Laminated Materials

Write for our new catalog No. 101

Serving the Radio and Electronic Industry for Over 20 Years

MICARTA FABRICATORS, INC.

5324 RAVENSWOOD AVENUE, CHICAGO 40, ILLINOIS · LONGBEACH 9700

RH-507 Inverted Triode

By W. A. HAYES

Electronics Eng., Westinghouse

Using plate as control grid minimizes space charge effect and permits zero grid current.

MEASUREMENT of currents as low as 10^{-15} ampere is made possible by the development of a new tube, called the inverted triode. In this tube the outer electrode, which is normally the plate in an ordinary vacuum tube, is used as the control grid. This inversion minimizes the space charge effect thereby making it possible to select a value of grid bias that will result in zero grid current.

The sensitivity of this tube is made possible by an extremely low grid current and a high grid-to-cathode resistance. In addition to measuring currents as low as 10^{-15} ampere, it will permit indication of currents as low as 10^{-16} ampere, which represents a flow of about 625 electrons a second. Direct potentials of 10^{-4} volts may be measured in circuits having up to 10^{12} ohms resistance.

Due to the small magnitude of the currents expected in the type of applications to which the tube is usually put, it is absolutely necessary that none of the minute quantities of current be absorbed in surface leakage. Therefore, the tube has been designed to eliminate leakage as far as possible. So-called "glass pant leg" supports, consisting of a glass sleeve surrounding a wire which acts as a support, provide the necessary insulation between electrodes so that practically no energy is absorbed from the source being measured.

Even a microscopic film of moisture on the bulb surface would provide a leakage path between the control electrode and the cathode. Consequently, it is advisable to mount the tube in a reasonably tight shielded can containing a drying agent. The outside of the bulb may also be treated with Silicone Resin or other suitable material, which helps break up the possible formation of moisture into tiny droplets, and so tends to prevent a continuous leakage path from forming through the moisture.

Electrostatic charges which might accumulate on the inner surface of the glass bulb can seriously affect the overall tube sensitivity. To eliminate this condition, a small piece of spring wire resembling a "cat's whisker" is mounted with a slight pressure against the inner wall of the glass bulb and brought out to a terminal for grounding. The tube and all leads from the voltage supply should be shielded very carefully from any stray magnetic or electrostatic fields. It is also necessary to shield the tube from light as there may be some photoelectric effects while sensitive readings are being taken.

The filament is operated at a low temperature to minimize primary or photo emission from the grid. The electrodes are operated at rather low voltages and currents to reduce the possibility of ionizing residual gas in the tube. These low voltages require

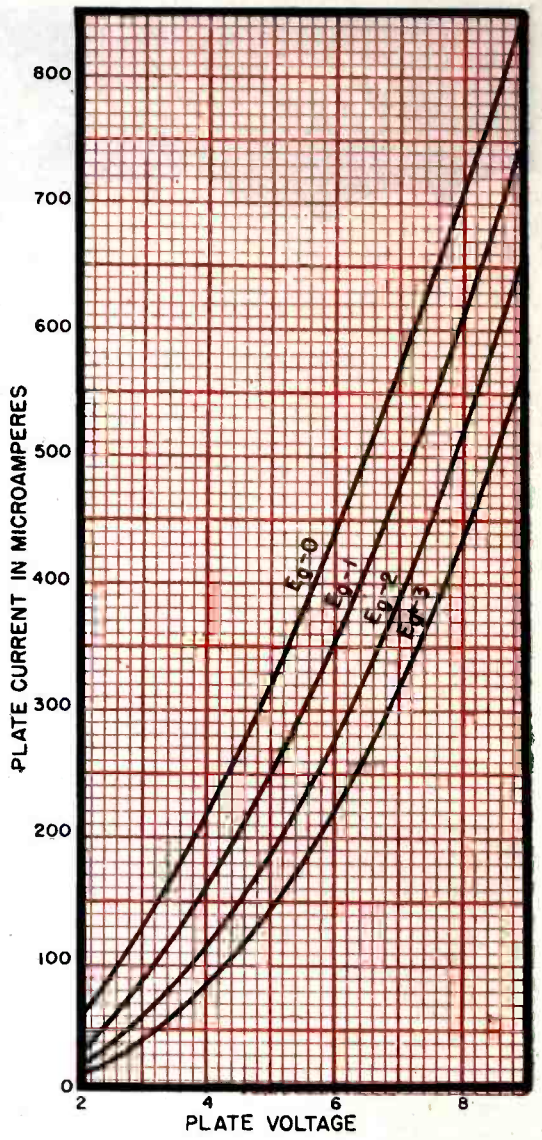


Fig. 2. E_p—I_p characteristic curves.

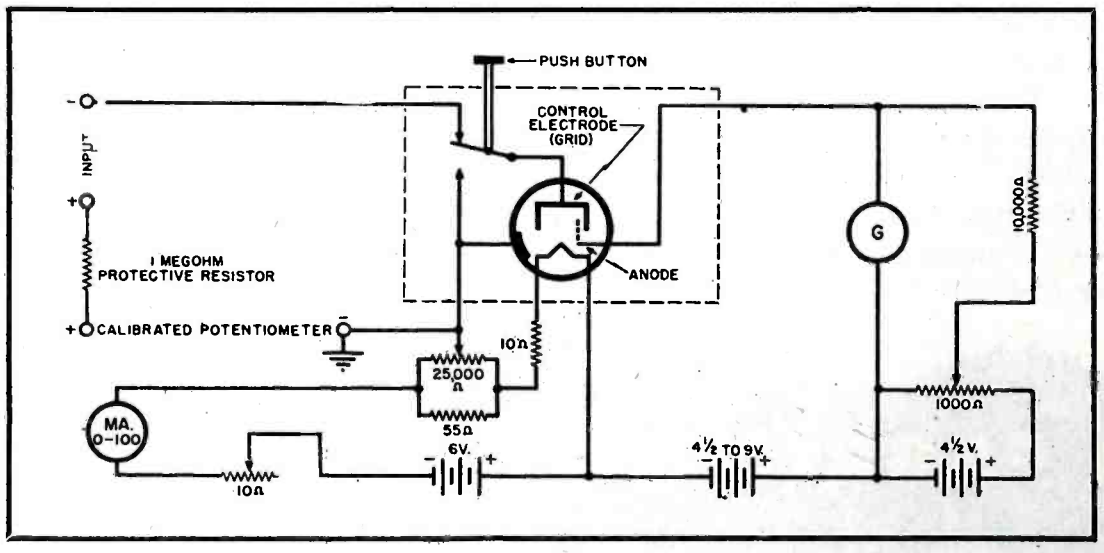
the use of a galvanometer or microammeter for indicating purposes.

The output may also be fed into a suitable amplifier, in which case the RH-507 tube will serve as a coupling device between the source under measurement and the amplifier proper. In this way it is possible to use more rugged and cheaper instruments to obtain measurements previously requiring laboratory precision equipment. A typical electrometer circuit is shown in Fig. 1.

The characteristic curves shown are taken from readings of several tubes. The plate current curves (Fig. 2) therefore represent average values, although individual tubes should not vary greatly from the average.

The grid current curves also represent average values taken on several tubes but the readings on individual tubes may vary considerably from the figures shown. The curve in Fig. 3 with 4.5 volts on the anode shows that the grid current passes through zero at minus 1.8 volts. The important feature to notice is that the grid current of every tube crosses zero at some bias voltage near this value. It is therefore possible to select a value of grid bias such that the grid current is zero; hence extremely minute currents can be measured accurately. By adjusting

Fig. 1. Typical electrometer circuit using the inverted triode tube.



the grid bias so that the grid current is zero it has been found practical to measure grid currents as low as 10^{-15} amperes and to obtain indications of grid currents as low as 10^{-16} amperes. By providing a bias adjustment on either side of the "floating potential," reversal of control current is effected to advantage in electrochemical polarization studies.

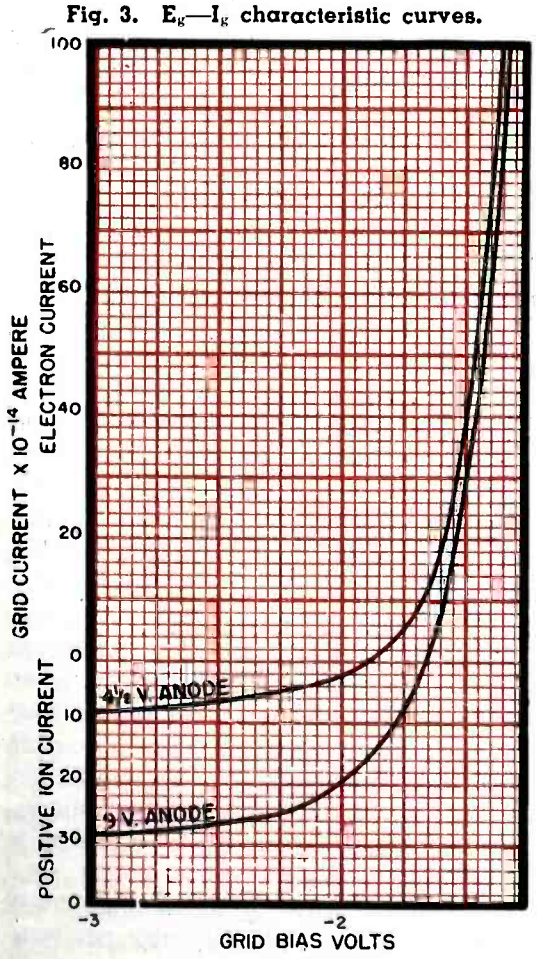
The sensitivity of this tube makes several operations practical that were previously considered very difficult or impossible. It is used to measure:

1. Hydrogen ion concentrations.
2. Currents produced by phototubes when subjected to starlight.
3. Ion current in mass spectrometer.
4. Alloying constituents of steel.
5. Minute quantities which previously required an electrometer or its equivalent.

The tube filament may be operated from an Air Cell type battery or No. 6 dry cells. The filament current is very critical and must be held constant, so only seasoned batteries should be used. Good "C" batteries may be used for the grid and plate supplies.

Because of the extreme sensitivity of this tube, every precaution must be taken to insure that no electrical leakage is present in the circuit wiring. Wherever possible, all leads from the electrodes should be air insulated. Where construction requires "feed through" insulators, the finest grade of insulating material should be used, such as quartz glass or a material which offers extremely high resistance to surface leakage.

Fig. 3. E_g—I_g characteristic curves.



Personals

DR. ALEXANDER J. ALLEN has been selected by the Chancellor of the University of Pittsburgh to the post of Graduate Professor of Engineering for the Westinghouse graduate student program. In his new position Dr. Allen will assist in planning a series of courses leading to advanced degrees and will be responsible for the guidance of thesis work as well as teaching certain highly specialized courses of graduate level.

LEON GOLDER has been appointed the manager of General Instrument Corporation's new speaker division, according to the announcement made by Mr. Richard E. Laux, Executive Vice-President of the company. Mr. Golden is a veteran of the radio component field and brings with him to this new job a varied background of commercial experience. The distributor of General's new speakers will be General Electronic Apparatus Corp.

A. J. HALL has joined the staff of Universal Microphone Company of Inglewood, California, in the capacity of production and research engineer. He comes to the company from Kellogg Switchboard and Supply Company of Chicago where he served as an engineer in charge of the design, research and development laboratories. Prior to his service with Kellogg, Mr. Hall was a planning engineer for Western Electric and Leich Electric Company.

EDWARD LAING has been promoted to the post of division manager of Westinghouse's Application and Training Department. Mr. Laing joined the staff of Westinghouse in 1936 as sales promotion manager of the Eastern District after twelve years' experience in the manufacturing, advertising and technical publishing fields. He will be responsible for developing and coordinating application data activities and district sales training programs.

WALTER D. MARONEY has been appointed superintendent of the Transmitter Division of the General Electric Electronics Department, according to a recent announcement made by C. A. Priest, manager of the division. In his new capacity, Mr. Maroney will be in charge of all manufacturing activities of the transmitter division with headquarters in Syracuse. He has played an important part in supplying equipment to the Armed Forces.

D. MARTIN will serve as the Chief Engineer for Wilcox-Gay under the terms of his new appointment which was announced recently by Mr. Wilcox and Mr. Gay. A graduate of M.I.T., Mr. Martin brings to his new post a background of fifteen years experience in the design and research division of the engineering field. He was formerly employed by Westinghouse, DeForest Radio Company, Federal Telephone and Radio, and Radio Receptor.

R.F. Generator

(*Continued from page* 22)

normal expected power for useful output from the generator. As pointed out previously, an increase in the capacity, *C*, increases the currents in the L-C circuit and this increased current flowing through the capacitor and coil, *L*, increases the power lost or dissipated in those parts. This power must be supplied by the vacuum tube and is not useful output. This power loss must, therefore, be kept as low as possible to provide the maximum useful output from the generator. Fig. 6 illustrates this condition and is plotted from data obtained from actual 10 kw. equipment.

High current can be obtained more economically at low values of voltage. It would therefore seem desirable to use vacuum tubes which operate on low values of plate voltage, but here again the vacuum tube is basically a high impedance device and consequently requires high voltages to secure the desired power. The designer of the r.f. generator and also the designer of the vacuum tube is therefore required to use high voltage and high impedance circuits.

In general, the plate potential used for the operation of vacuum tubes increases with the power output of the tube. This condition requires the use of high current, high voltage, high frequency, and low loss capacitors in the oscillating circuit of the oscillator. Such capacitors are at the present time constructed from mica, pressurized gas, paper, or oil as the dielectric material. Each type has its construction limitations which restrict the kva ratings to rather low values compared to that needed in the higher powered oscillators. The paper and conventional oil capacitors have too high a power factor with the result that although a relatively high kva can be provided, the power dissipated in the capacitor at the high frequencies involved is abnormal and cannot be tolerated. The mica and compressed gas capacitors have a sufficiently low power factor to permit reasonable losses in the capacitor at high frequencies, but to date physical limitations in construction restrict these types of capacitors to relatively low values of capacity and current carrying capabilities The design engineer must keep these limitations in mind with the result that present day vacuum tube generators for induction heating purposes, in the frequency range of 100 to 550 kc., have characteristics approximately as shown in Fig. 5.

It will be noted that as the power output of the vacuum tube r.f. gen-

erator gets above 50 kw, the effective kva/kw ratio drops off due to the limitations in oscillator capacitor capabilities. As future developments in the capacitor field are made, this condition will be corrected or bettered. The curve of r.f. voltage shown in Fig. 5 represents the maximum usable r.f. voltage from the generator and as explained before, this voltage is dependent on the plate voltage necessary on the vacuum tube. This will, of course, vary with the type and make of vacuum tube used, but in general the curve is representative of what can be expected. The maximum r.f. current curve is representative of current available and, as pointed out before, is dependent on the allowable power loss that can be permitted in the capacitor and coil of the oscillating circuit and the plate voltage necessary on the vacuum tube.

The kva/kw curve shown in Fig 5 is for full output from the r.f. generator. Quite often full power capabilities are not required from the generator with the result that the kva/kw ratio increases in direct proportion to the drop in power requirements. It becomes possible, by taking advantage of this characteristic, to supply power to excessively high kva/kw ratio loads.

The generally accepted frequency range for the r.f. generator for induction heating use lies between 100 and 550 kc. The upper limit of this range has been arbitrarily set for two basic reasons. The frequencies between 500 and 1500 kc. are occupied by the broadcast band and it has been generally accepted as good practice to keep industrial generators from operating in this frequency range in order to eliminate the possibility of interference with broadcast reception. Except for special case hardening problems where extremely shallow depth of penetration is necessary, the frequencies above 1500 kc are normally used for dielectric heating rather than induction heating. This leaves 550 kc. as the normally accepted upper frequency limit for induction heating.

For a given set of conditions it is possible to raise the kva in an r.f. generator by raising the frequency, because lower capacitive reactance and the resultant higher generator current can be obtained as the frequency is increased. The majority of r.f. generators, therefore, operate at frequencies from 400 to 550 kc. to take advantage of this increase in kva. This range of frequencies is adequate for practically all types of induction heating problems and provides the most economical design.

In all rotating machine problems the load is adjusted to a point where efficiency and output satisfy the rat-

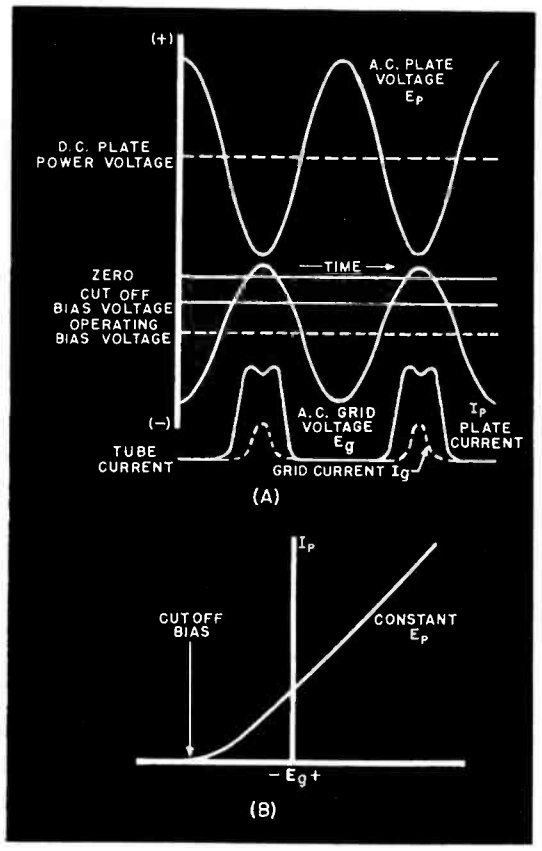


Fig. 7. (A) Typical tube voltage and current relationships. (B) Characteristic curve for indicating operating point.

ings of the generator. This same procedure is necessary for proper and efficient operation of the r.f. generator. The rotating machine and spark gap oscillator are both generators with low internal impedance characteristics. The majority of induction heating loads are also low impedance with the result that adjustment for proper efficiency and full power from the generator is relatively simple. The r.f. generator has an inherent high impedance characteristic and to apply this type generator to the low impedance induction heating loads, it becomes necessary to obtain a suitable impedance match between the load and the r.f. generator.

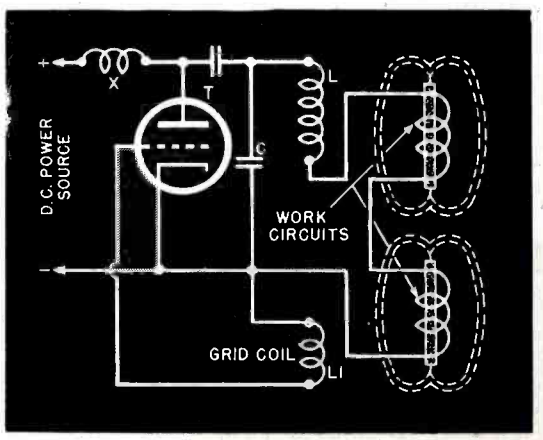
In the case of the rotating machine full power is obtained from the generator by power factor correction capacitors connected across the load or by the use of step down transformers. In the case of the r.f. generator, the solution is handled in much the same manner. The usual method for taking power from an r.f. generator is illustrated in Fig. 3. It is necessary to first arrive at a suitable coil design which will allow rated power to be taken from the generator with the current available from the generator. This is accomplished by a suitable selection of ampere turns and spacing between the work and coil. In general, the number of turns in the work coil is selected to give the desired ampere turns. Many jobs are such that the impedance match and ampere turns requirements cannot be met due to physical limitations. For instance, it is often physically impractical to get a sufficient number of turns in the work coil due to the shape of the piece to be heated. Then again the shape of the material may restrict the proximity between work and the work coil. The latter condition is normally referred to as coupling, with close proximity between coil and work known as *tight coupling,* and when the coil is a considerable distance from the part to be heated, a condition of *loose coupling* exists. To correct the condition where insufficient ampere turns are available to properly load the r.f. generator there are two or three methods which may be used.

The first of these methods is similar to that used in the case of the M.G. set; *i.e.,* capacity is connected across the work coil to increase the current in this coil. This is a form of power factor correction as the work coil circuit is being partially tuned to resonance with the generator frequency in order to realize an increase in current in the work coil. Fig. 2 illustrates this circuit.

The extent to which capacity may be added across the work coil to increase the current is limited by the relation between the kva/kw ratio in the generator circuit and the kva/kw ratio in the load circuit. From Fig. 2 it can be seen that two separate circuits exist, one the normal L-C circuit of the generator and the other the circuit formed by the work coil and the added capacitor across this coil.

Oscillations in a vacuum tube oscillator normally take place around the circuit with the lowest loss. When more than one circuit exists, as in the circuit of Fig. 2, it is absolutely essential that the main oscillator L-C circuit remain the controlling circuit. Circuit loss is normally expressed by the value $Q=\omega L/R$ and is therefore a function of reactance and resistance. Multiplying this expression by I^2 gives $\omega LI^2/RI^2=EI/W$ or kva/kw. The kva/kw ratio can therefore be used as a measure of circuit loss and the higher this ratio, the lower the loss. For the main oscillator L-C circuit to retain control of oscillation its kva/kw ratio must, therefore, be larger than that of the load circuit. In this case, the value of kw is the same for both circuits and is taken as the total power dissipated in the load circuit. It has been found in practice that the work circuit kva/kw (Q) should always be 80% or less than the generator kva/kw ratio.

Fig. 8. Typical r.f. oscillator circuit with two work circuits in series for more efficient operation under certain conditions.



The second method which may be used to increase the load circuit current is shown in Fig. 4. A transformer is placed in series with the generator oscillating circuit. This transformer is a step-down transformer with a high current, low voltage secondary (low impedance) to match the low impedance of a high current load or work circuit.

This method of impedance matching is ideal when the work coil must necessarily be very low impedance such as a single-turn coil with very short leads. If the impedance of the secondary gets the least bit high due to long coil leads or excessive turns in the coil, the transformer cannot be used and one must use the capacitor across the load method. The transformer for r.f. use must, of necessity, be an air core design which means the leakage reactance is high and the efficiency poor. A guide to when a current transformer is desirable can be obtained from the load circuit kva/kw ratio. If this ratio is in the order of 10 or less and the current necessary is from 3 to 5 times that available from the generator, the current transformer will provide the best impedance match and the best all-around performance.

Still another method of impedance matching can quite often be used to advantage when the impedance of the work circuit is low. It is possible to series two or more of the work circuits when the nature of the work permits the heating of more than one piece at a time. To do this it may be necessary to increase the heating time of the individual piece but the effective heating time may be lower than for one piece because more than one piece is being heated at the same time.

Fig. 8 shows this type of proposed connection. This is an especially useful method when the r.f. generator is of a higher rating than is necessary to perform the desired work.

Combinations of the above impedance matching systems are of course possible and will present themselves as the individual problems arise.

The author gratefully acknowledges the assistance of Mr. W. W. Meier in compiling much of the data used in this article.

Fungi

(*Continued from page* 15)

growth of the filaments on the materials treated;

2. it must not affect the electrical properties of a treated material;
3. it should have heat stability;
4. it must not bring about or increase corrosion;
5. it should not be too volatile;
6. it must not "leach out" of the treated materials;
7. it must not be toxic (cause dermatitis);
8. it should be effective against the ordinary types of fungi encountered;
9. it should be easy to handle in preparing;
10. it must not be so expensive that its use is impractical;
11. it should be relatively water insoluble;
12. it should be readily available on the market;
13. it should have a high "phenol coefficient"; and
14. it may show a "zone of inhibition."

It is evident that since there are thousands of species of fungi, no single fungicide is likely to be effective for all cases. Many of the species have the ability to become acclimated to various types of poison, so that a compound which at one time is highly lethal might later allow them to thrive in its presence. It is well to keep in mind that even after a fungus growth is killed, some of the carbohydrates, etc., of these filaments remain on equipment and may cause electrical difficulties or serve as a nutritional foundation for later mold growth. It therefore follows that it is important that a fungicide prevent the germination or filament growth of a mold in the immediate vicinity of the treated materials as well as on the materials themselves. Because of this feature, a fungicide is sometimes classified on the basis of its zone of inhibition in spore suspension tests in the laboratory. The "zone of inhibition" is that area around a treated material in a nutrient-agar plate test in which there is no fungus growth (a clear area).

Recently much emphasis has been placed on the zone of inhibition. However, the authors do not overemphasize the phenomenon when testing a fungicide with spore suspension tests in the laboratory, because the presence of a wide zone of inhibition indicates one of three things; sublimation, reduction, or leaching of the fungicide. We believe that there is a likelihood for the misinterpretation of the effect which may in the last analysis be detrimental rather than beneficial. If the creation of a zone around a treated object in which no growth occurs is the result of the slow vaporization of the toxic agent, the effect is very likely desirable in cases where there is very little air circulation within the equipment. This is not the case in larger pieces of equipment. The fact that this effect is likely due to the leaching, reduction, or sublimation of the toxic agent has been borne out by numerous observations in this laboratory. Parts which have been cultured for some time and which have shown the existence of an inhibited zone, have been removed from the agar plates during the course of examination. In many of these instances, continued culturing has shown the area originally inhibited to be permanently sterile.

The following procedure has been found to be valuable when testing the effectiveness of a new fungicide. Various percentages (ranging from ¼% up to 15%) of the fungicide are prepared in waxes, lacquers, and varnishes. Wires, small pieces of bakelite, fabrics, filter paper, etc., are then dipped, painted, vacuum impregnated, or sprayed with the above preparations. Before wax samples, with the fungicide added, are tested, they are heated for eight hours at 300°F. to determine if any of the fungicide is driven off. Lacquer and varnish coated materials, with the fungicide added, undergo a similar test. The latter is known as a "leaching test." It involves soaking the treated materials in distilled water for six hours and drying at 85°C for two hours. Each test sample is subjected to two consecutive mycological tests, the presumptive and determinative tests. The presumptive test is an inoculation and spore suspension test run on a nutrient-agar medium, incubated at 32°C (89.6°F) for seven to nine days with the relative humidity between 90 and 95%. Usually the presumptive test is sufficient to determine the presence or absence of fungus growth on the sample materials. If this is not the case, the determinative test is used. This test involves taking the sample materials (inoculations or spore suspensions) from the first test and incubating them under similar conditions for fourteen to twenty-one days in a non-nutrient-agar medium. If any fungus growth occurs at all in the second test, it must occur on the sample materials themselves because no nutritional ingredients are included in this agar medium.

On the basis of the presumptive mycological tests, materials fall into three rather distinct groups. These are:

1. those materials which definitely

(*Continued on page* 39)

Industrial Review

Electronic Treatment

A NEW treatment, which promises more efficient cameras, microscopes, field glasses and eyeglasses after the war, consists of applying a film of a specific transparent material to both sides of the glass to a thickness of 5 millionths of an inch. This film, the thickness and hardness of which is controlled by electron tubes, increases transparency by minimizing the tendency of the glass to reflect light.

This is just one of the everyday applications of electronics to improving necessary items, according to Mr. Fred W. Wentker of RCA who made the announcement of this new processing technique. The Electronic Apparatus Section of *RCA Victor Division* is responsible for this development.

* * *

W. E. Gun Director

THE success of the Battle of London against the robot bombs is in a large measure due to the product of American ingenuity, it has been revealed.

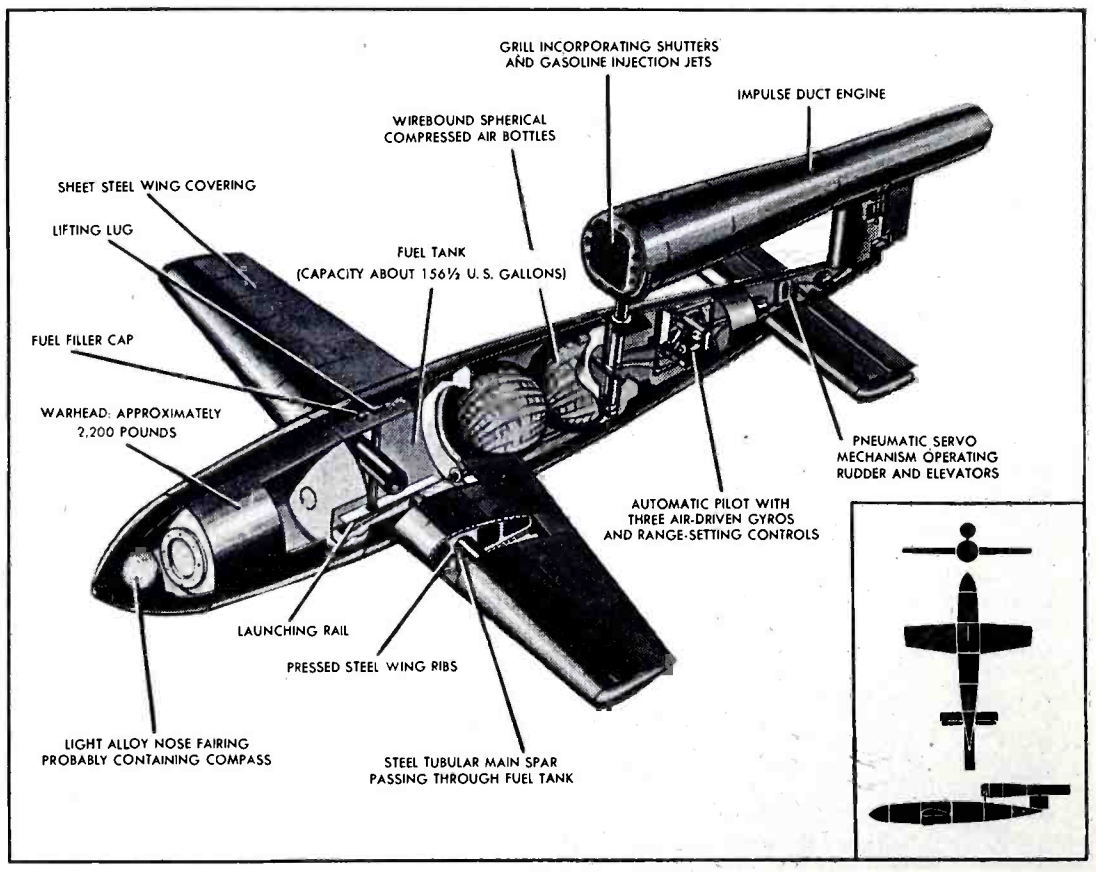
The electronic gun director, developed in the Bell Telephone Laboratories and manufactured by *Western Electric Company,* is playing a vital role in the accurate gunfire which is bringing the robots down short of their targets.

Almost immediately after a bomb leaves the launching site, its position is plotted on a large chart. In a few seconds its course is evident and word is flashed to aircraft and to anti-aircraft gun batteries. As the flying bomb approaches the range of the anti-aircraft battery, the operators of the "tracker" unit of the electrical gun director spot the bomb in the two telescopes and follow its course. As these telescopes follow the course of the robot, a mechanism is set in motion which transmits the altitude angle and the azimuth angle to the computor unit.

At the same time another instrument called a "height finder" feeds the computor information concerning the actual height of the approaching robot. The computor plots the robot's distance, course and speed, aims the anti-aircraft gun and sets the fuse of the shell so that it will burst at the proper moment for a hit. In making these calculations, the computor takes into consideration such items as the muzzle velocity of the gun, shell drift due to spin, air density, time of the shell's flight, pull of gravity on the shell, direction and velocity of the wind and the distances from the tracker to the gun itself.

The increased success in bringing down the robots has been attributed to this device.

Diagram showing the mechanism of a robot bomb.

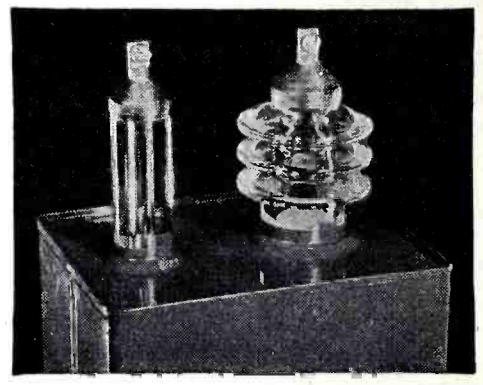


* * *

Glass-to-Metal Seals

IN order to prevent leaks and moisture damage in various capacitors and resistors, the Sprague Electric Company has developed and perfected a new glass-to-metal seal.

In the case of capacitors, the usual ceramic terminals are supplanted by those made of glass. These glass bushings are sealed by an exclusive



Sprague process direct to the metal capacitor container and do not require adjacent metal rings with "matched" temperature coefficients of expansion. In the case of the Koolohm Resistors, the resistance unit is encased in a special glass tube which is sealed directly to the metal ends. The resulting seals make the glass and metal a solid, integral unit. They are leak-proof, shock-proof, and humidity-proof. The component is constructed without the use of organic bushings or other material subject to fungus attack.

The seal sizes range from very small up to 3" in diameter. Capacitors and resistors utilizing the glass-to-metal seals are now available in 8,000 different electrical characteristic combinations.

Complete information on this line of components will be forwarded to interested persons requesting it from *Sprague Electric Company,* North Adams, Mass.

* * *

Ferrograph

A NEW piece of industrial electronic equipment was demonstrated recently at the Franklin Institute in Philadelphia by Dr. E. R. Mann, director of the Materials Test Laboratory of Allen B. DuMont Laboratories, Inc.

This unit facilitates the testing and checking of materials or finished pieces in accordance with various metallurgical factors. The Ferrograph

provides simple and instantaneous comparisons of ferrous materials as to analysis and heat-treatment.

At the same meeting, the Cyclograph, a unit for the non-destructive checking of non-ferrous as well as ferrous metals was also demonstrated. This instrument permits the checking of various metallurgical factors such as analyses, case depth, depth of decarburization, amount of cold working, brittleness and structure. The Cyclograph automatically sorts components according to these factors.

The development of these units is the work of the *Allen B. DuMont Laboratories, Inc.,* Passaic, New Jersey.

* * *

Spectrometer

THE *North American Philips Company, Inc.,* has introduced a new instrument for measuring distribution and intensities of X-ray reflections. This unit, known as the Norelco Geiger-counter X-ray Spectrometer, has some advantages over the conventional diffration procedures in certain applications. The spectrometer provides a rapid method for determining location and intensity of diffracted rays directly.

A scanning device, having a Geiger counter tube arranged to traverse a graduated quadrant, is used in combination with suitable scaling circuits. The intensity measurements are quantitatively accurate and can be used to determine composition of crystalline mixtures. Quantitative analyses of mixtures can be obtained in a matter of minutes.

In operation, the specimen inserted in the specimen holder intercepts the X-ray beam and deflects portions of it at various fixed angles. When the Geiger tube is moved around its quadrant it measures angular displacement and intensity of the deflected beams. A d.c. microampere meter reads intensity; the quadrant marked in degrees shows diffraction angles. A stepping counter, employed in conjunction with a specially developed scaling circuit provides means for exacting quantitative determination of intensity.

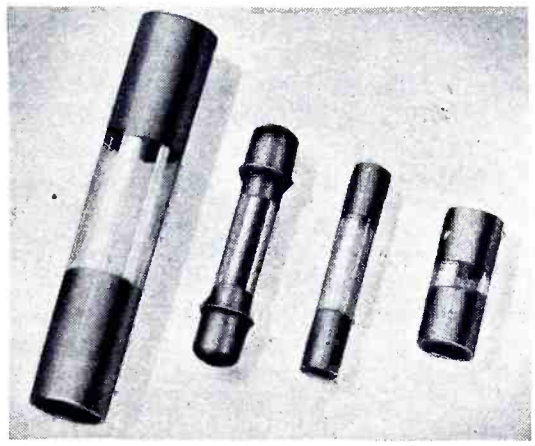
* * *

Metal Plating Glass

A NEW process which achieves a high degree of adhesion in plating to glass and ceramics has been developed by Electro Plastic Processes of Chicago.

Laboratory and field tests of this new process indicate greatly improved hermetic sealing. Tests on Pyrex glass have been conducted by heating the solder sealed piece to 350 degrees F. and immersing it immediately into dry ice, which indicates the adaptability of the new process for all temperature ranges. Adhesion obtained is said to be better than that of other commonly used methods.

Any normal soldering method is satisfactory, iron, oven or electronic and no special solders are required.



The process is adaptable to the hermetic sealing of such electrical components as resistors, condensers, small relays, transformers, and instruments. Either glass or ceramic cases can be plated with a metallic band for soldering to metallic end caps or insulators plated for solder sealing to metallic containers.

Full details of the process may be obtained by writing direct to *Electro Plastic Processes,* 2035 West Charleston Street, Chicago, 47, Illinois.

* * *

Plastic Data

A NEW and informative 12 page booklet entitled "Polyethylene Resins" has been issued by the *Plastics Division of Carbide and Carbon Chemicals Corporation* for the instruction of engineers.

The booklet describes the forms, properties, fabrication procedures, and uses of this new group of thermoplastic materials. Interesting data tables are included which present graphic summaries of the plasticity, electrical properties and thermal expansion of this latest resin.

Copies of the booklet are available to qualified persons, engineers, chemists and executives, upon request to 30 East 42nd Street, New York 17, New York.

* * *

Template Booklet

A NEW fourteen page brochure entitled "Precision Lofting" has been issued by the *Template Reproduction Company* for engineers, tooling and production executives.

Basically the method involves the mechanical reproduction of full size detail drawings directly on tooling materials. Considerable manual duplication of scale drawings, and manual transferring from blueprints to tooling materials are eliminated. Of particular value is the fact that all parts being tooled to these specifications are interchangeable and identical.

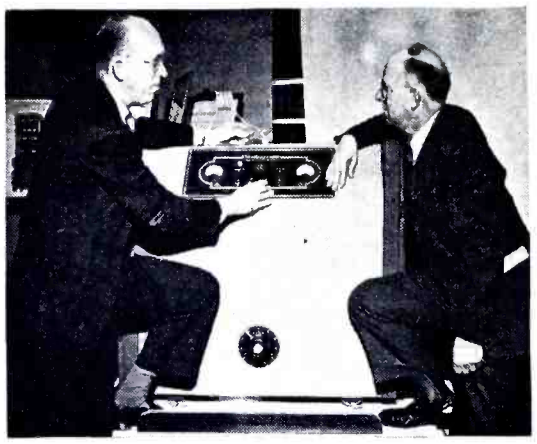
Persons interested in obtaining a copy of this booklet should address their requests direct to the company at 401 Broad Street, Philadelphia 8, Pa.

* * *

R.F. Heating

THE proper use of r.f. heating is capable of boosting production two to ten times that obtainable by other heating methods, according to S. S. Schneider, electronics engineer for the Radio Division of *Westinghouse Electric and Mfg. Company.*

While the development work on this form of processing is not complete, already high frequency heating has speeded war production and cut the number of rejects through its use.



Dielectric heating is being used extensively in the curing of plastics, the drying of synthetic binders for multiply plywood and in many other fields.

The second basic type of high frequency heating, induction heating, is being used in the case hardening of gear teeth and bearings, in brazing, soldering and heat treating. As much as 20 percent of the time and cost of manufacturing has been saved by this method of heat treating over the older methods which require scale removal and other postmanufacturing processing.

* * *

Ceramic Insulation

AFTER seven years of research, the *Sprague Electric Company* of North Adams, Mass., has announced the development of a process for depositing a thin ceramic coating on copper, nickel and other types of wire.

Full details will be forwarded to interested persons by the Sprague Electric Company, upon request.

Control Circuits

(*Continued from page* 19)

$$R_1 \frac{dQ_1}{dt} + \frac{Q_1R_1}{R_2C} + \frac{Q_1}{C} = E;$$

$$-CE + Q_1\frac{R_1+R_2}{R_2} = -CR_1\frac{dQ_1}{dt} \quad \ldots\ldots(5)$$

Let

$$R = \frac{R_1R_2}{R_1+R_2}, \text{ or } \frac{R_1+R_2}{R_2} = \frac{R_1}{R} \quad \ldots\ldots(6)$$

Substituting (6) in (5) gives

$$-CE + \frac{Q_1R_1}{R} = -CR_1\frac{dQ_1}{dt} \quad \ldots\ldots(7)$$

or, writing as an integral,

$$\int\frac{dt}{-CR_1} = \int\frac{dQ_1}{-CE + \frac{Q_1R_1}{R}} \quad \ldots\ldots(8)$$

Integrating yields

$$-\frac{t}{CR_1} = \int\frac{dQ_1}{-CE + \frac{Q_1R_1}{R}} =$$

$$\frac{R}{R_1}\int\frac{dQ_1}{\frac{-CER}{R_1}+Q_1} =$$

$$\frac{R}{R_1}\ln k\left[\frac{-CER}{R_1}+Q_1\right] \quad \ldots\ldots(9)$$

$$\ln\left[-\frac{CER}{R_1}+Q_1\right] + \ln k =$$

$$\ln\left\{k\left[-\frac{CER}{R_1}+Q_1\right]\right\} \quad \ldots\ldots(10)$$

where ln k is the constant of integration, and ln indicates log to the base *e*.

Let $t = 0$, then $Q_1 = 0$ and

$$\ln k\left[-\frac{CER}{R_1}+Q_1\right] = O \quad \ldots\ldots(11)$$

Solving for k gives

$$k\left[-\frac{CER}{R_1}\right] = 1; k = -\frac{R_1}{CER} \quad \ldots\ldots(12)$$

Substituting (12) in (9), cross-multiplying and taking anti-logs,

$$\epsilon^{-\frac{tR_1}{CR_1R}} = -\frac{R_1}{CER}\left[Q_1 - \frac{CER}{R_1}\right] \quad \ldots(13)$$

Simplifying and solving for Q_1,

$$\epsilon^{-\frac{t}{CR}} = -\frac{Q_1R_1}{CER} + 1;$$

$$Q_1 = \frac{CER}{R_1}\left[1 - \epsilon^{-\frac{t}{CR}}\right] \quad \ldots\ldots(14)$$

When $t = CR$,

$$Q_1 = \frac{CER}{R_1}\left[1 - \epsilon^{-1}\right];$$

$$\frac{Q_1R_1}{CR} = E\,[0.632] \quad \ldots\ldots(15)$$

thus

$$E_C = E\,[0.632] \quad \ldots\ldots(16)$$

$$E_{R1} = E - E_C = E\,[0.368] \quad \ldots\ldots(17)$$

It is clear that when $t = CR$, the potential of the cathode must reach a value which will cut off the tube. Therefore, the bias to be applied through R_5 between (A) and (B) must equal — (.368E + cut-off voltage), e.g. — (.368E + 5).

The value of R_1 may be obtained by solving (6) for R_1, multiplying numerator and denominator by C and substituting t for RC, giving

$$R_1 = \frac{-tR_2}{t - R_2C} \quad \ldots\ldots(18)$$

For example, assume $E = 300$ volts, $E_{g\ (cut\text{-}off)} = -5$ volts, $c = 1$ μfd, $R_2 = 1$ megohm, $t = .5$ sec. (30 cps.),

$$R_1 = \frac{-.5 \text{ sec} \times 1 \text{ megohm}}{5 \text{ sec} - 1 \text{ megohm} \times 1\ \mu\text{fd}}$$

$$= 1 \text{ megohm} \quad \ldots\ldots(19)$$

and the bias is given by $-(.368 \times 300 + 5) = -115.4$ volts. If $t = 1/60$ second, (1 cycle), R_1 is

$$R_1 = \frac{-\frac{1}{60} \times 1 \text{ megohm}}{\frac{1}{60} - 1 \text{ megohm} \times 1\ \mu\text{fd}}$$

$$= 16{,}950 \text{ ohms} \quad \ldots\ldots(20)$$

It should be noted that equal values of R_1 and R_2 have been dealt with at .5 second. A wider range of values of R_1 between .5 and 1/60 second may be calculated by initially setting R_1 larger than R_2.

In many welding operations, timing controls are required to apply the heating current and allow a cooling interval at alternations ranging from one cycle "heat" and one cycle "cool" upwards. Seam welding, in which the work progresses between roller type electrodes, is used to produce gas-tight line welds, and the accuracy required for production work is possible only with electronic timing controls. Spot welding is often done at regularly spaced intervals, both in time and physical separation, and is usually called pulsation welding when timed in this manner. The special heat treatments necessary for producing high quality welds with certain metals may be included as a part of the program of welding operation. Auxiliary timing controls are designed to follow a pattern of current application that provides pre-heating and post-heat treatment of the weld. Such devices must include facilities for independent adjustment of accurately timed heating currents as well as specific cooling intervals, and the precision possible with phase shift methods of heat control is vital to satisfactory operation. The circuits connected with the initiating switch in many electronic welding controls are arranged so that the entire cycle of events will be carried automatically through to comple-

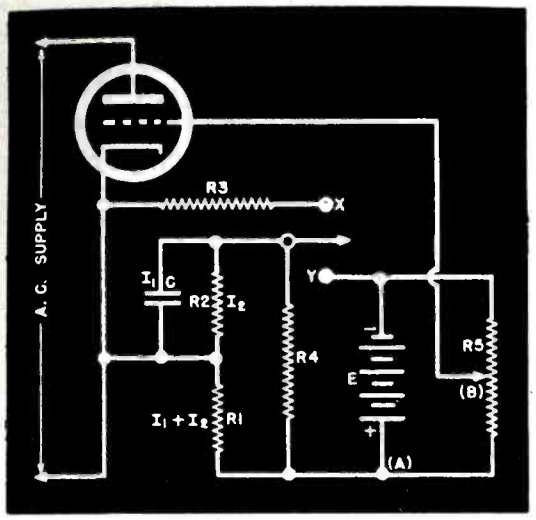


Fig. 3. Basic timing control circuit.

tion once the switch is closed, even though it be released immediately.

One of the disadvantages of a.c. welding equipment when used in connection with non-ferrous metals is the fact that very high currents are drawn from single phase lines for abrupt and brief periods. Aluminum and aluminum alloys introduce extremely critical requirements because of the narrow temperature ranges over which they have weldable characteristics. A slight excess of heat will cause them to pass rapidly into a fluid state. In order to avoid sudden demands on power supplies, energy storage welding devices are used extensively. Both capacitive and inductive methods appear in various equipments. In the latter type the welding transformer is designed with a large air gap and cross section in order to store the required quantity of energy in its magnetic field. The primary d.c. current builds up exponentially to a maximum value determined by the d.c. resistance of the coil. The rate of change at this time is relatively slow and the voltage induced in the secondary does not produce enough current flow to heat the work greatly. At a controlled time the primary circuit is opened, and the abrupt collapse of the primary field causes a high current of low voltage to surge through the secondary. The welding current required for various types of work is controlled by limiting the time during which the primary current is allowed to rise. Magnetic energy storage welding equipment is usually supplied through rectifying circuits. Three phase half-wave circuit arrangements are generally used with ignitrons controlled and protected from reverse currents by phanatrons.

Where capacitors are used to store electrostatic energy in welding machines, they are usually connected in the primary circuit of a specially designed welding transformer. The capacitance required for direct discharge through the secondary would be unreasonably large. The quantity of welding current together with the rate at which it is delivered to the work, depends on the total capacitance and the voltage to which it is charged, as well as the inductive reactance and d.c. resistance of the discharge circuit. Ignitron circuits are used in the discharge path and three phase full-wave combinations of phanatrons and thyratrons in rectifiers are used for charging. The capacitors are in an order of magnitude greater than 120 microfarads and instantaneously present an effective short circuit, hence limiting methods must be introduced in the charging circuits.

The requirements of resistance welding for various combinations of electronic control methods have greatly influenced the rapid development of new designs. This progress will inevitably produce new patterns of inventive thought with respect to other industrial applications of electron tubes.

REFERENCES

"Fundamentals of Electronic Control for Resistance Welding," General Electric Company Bulletin containing five articles. (Reprinted from 1942 and 1943 issue of Electronics) by H. L. Palmer, M. E. Bivens, S. A. Clark, G. L. Rogers and Barton L. Weller of the Industrial Control Engineering Division.

Westinghouse Electric and Mfg. Co. Bulletins on Weldotrol and other resistance welding control equipment.

"Applied Electronics" by E. E. Staff, M. I. T., John Wiley and Sons, 1943.

"Resistance Welding" by J. D. Goodell, Radio-Electronic Engineering, November, 1944.

"Peaking Transformers," unpublished mss., W. D. Mathews.

Flux Gate Compass

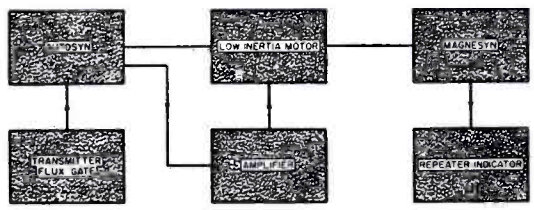
(*Continued from page* 6)

other points. A deviation of as much as 18 degrees may be corrected, although for good practice, the maximum uncompensated deviation should not exceed 6 degrees. Magnetic variation up to 56 degrees east or west may be introduced at the master indicator, and this correction automatically affects the repeater indicators.

In general, the repeater indicators follow the master indicator very closely. In cases where there are discrepancies, it may be necessary to prepare a correction card.

This compass system, which was developed and is now being produced by the Eclipse-Pioneer Division of the Bendix Aviation Corporation, has been installed in thousands of military aircraft and has seen duty in all parts of the world.

Fig. 9. Block diagram of compass.

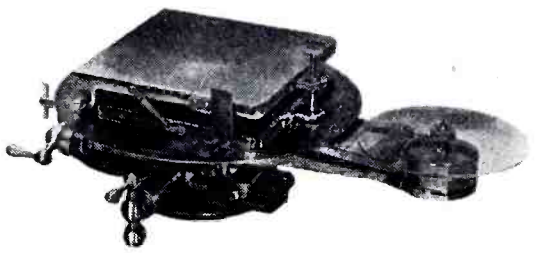


NEW PRODUCTS

LUCITE GEAR CASES

Gear case covers made of "Lucite" methyl methacrylate resin are now being used to protect quartz crystals and mechanisms during the precision cutting operations.

In this application, "Lucite" permits continuous readings of vernier calibra-



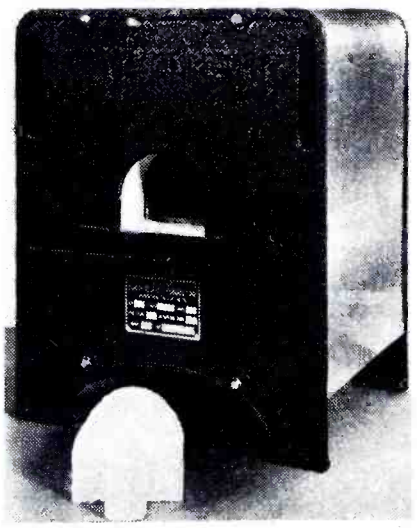
tions during the cutting while the convex cover prevents the destructive coolant and the quartz abrasive from damaging the delicate operating parts of the cutter.

"Lucite," a product of the E. I. du Pont de Nemours and Company, was selected for this application because of its superior optical qualities, freedom from distortion and ability to meet tolerances within ten-thousandths of an inch. The device is made by *Robert H. Clark Company* of Beverly Hills, California.

LABORATORY FURNACES

A complete line of high temperature laboratory furnaces with maximum temperatures of 2750 degrees F., and operating temperatures of 2500 degrees F. has been announced by the Harper Electric Furnace Corporation.

These furnaces are built for indus-



trial and school laboratory uses where materials are to be heated in an oxidizing atmosphere at temperatures above those attainable with metallic elements. They also have many applications where special conditions are involved, such as rapid heating, or heating in special atmospheres not injurious to silicon carbide.

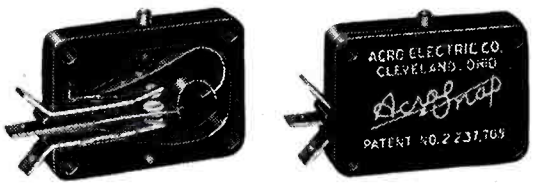
These units are available with either a plug type or a counter-balanced door. Furnaces are made in various sizes with chamber dimensions of 2⅝" x 3½" x 5" or 5½" x 6" x 18". They are available for bench mounting or with legs for floor mounting.

Complete specifications will be forwarded to those requesting them from the *Harper Electric Furnace Corporation,* Niagara Falls, New York..

SNAP SWITCH

Reported to be the smallest fully enclosed snap-action switch ever built, the new Miniac is only 17/64" thick, 13/16" high and 1 3/16" long.

This switch is engineered on the rolling spring principle, but with new de-



sign features and in a smaller size. The unit is fully enclosed in a bakelite case with four mounting holes, 3/32" diameter. Actuation is by means of a stainless steel pin plunger. All parts are non-corrosive and all contacts are of fine silver.

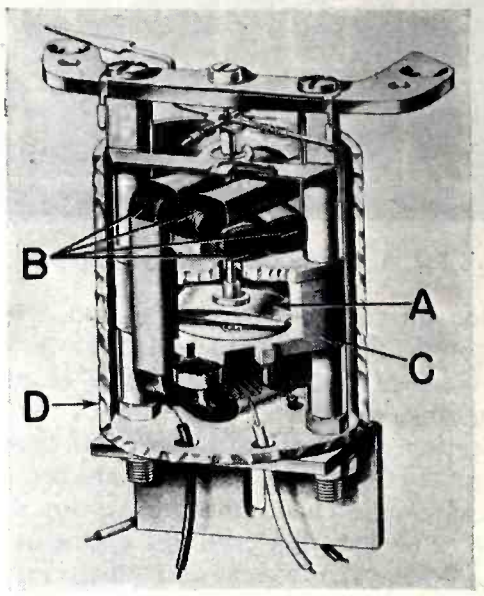
The main blade, the contact blade and rolling spring are made of beryllium copper. The unit is rated at 15 amps., 115 volts a.c. The switch is furnished in single pole, normally open and normally closed, double throw. The design is such that leaf type or overtravel plunger type actuators may be attached to the case.

Further details of the switch may be obtained by writing direct to the *Acro Electric Company,* 1363 Superior Avenue, Cleveland 14, Ohio.

EDISON METER

Information has recently been released by the military on the new electrical ratio meter which is being manufactured by the Instrument Division of *Thomas A. Edison, Inc.,* of West Orange, New Jersey.

Although this unit has been in production and use for the past few years, this is the first public announcement of this new development. The principle use thus far has been in connection with a temperature sensitive re-



sistance bulb to indicate temperatures at various critical points about aircraft, but its application to a number of other uses is in the process of development.

The design of the meter incorporates a small moving permanent magnet vane, the position of which is governed by the ratio of the currents in two sets of stationary actuating coils, placed at an angle with one another. This arrangement provides a rugged construction and permits the elimination of all hair springs. The movement may be adapted to any service in which it is desired to indicate the ratio between the values of two currents or voltages, independent of their magnitude. A small pull-off magnet is attached to the upper bridge in case it is desirable to have the pointer swing off one end of the scale when de-energized.

Coil resistances up to 1000 ohms are feasible, and the instrument will operate dependably at currents down to 3000 microamperes. The scale span ordinarily covers 120 circular degrees.

PLUG-IN TIMERS

In order to provide greater flexibility in the control of resistance welding, the Weltronic Company has introduced a new universal timer with interchangeable "plug-in" type control panels in order to provide conversion of timing controls to any of the NEMA standard types in a few seconds.

The design of the complete range of new weld and sequence timers incorporating a universal cabinet and power supply unit and a series of individual control panels that can be inter-

changed without the use of tools or rewiring, permits any resistance welder to be immediately available for any type of welding within the capacity of the control.

The Universal power supply unit is adaptable for 115, 230, 575, or 460 volts, 50/60 cycle a.c. service by shifting one jumper.

Complete details of application may

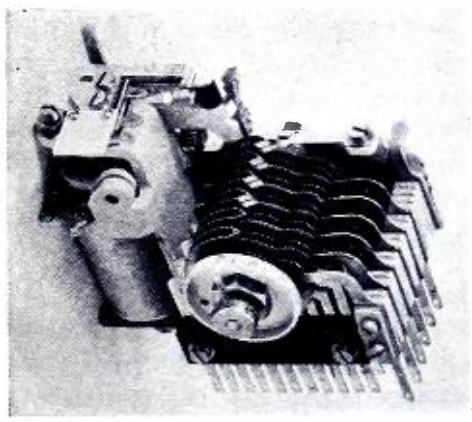
be obtained upon request to *Weltronic Company,* 19500 West Eight Mile Road, Detroit 19, Michigan.

AUTOMATIC SELECTOR

A new small and lightweight selector which occupies approximately half the space required by other selectors of comparable range has been introduced by Federal Telephone and Radio Corporation.

This unit, known as the FTR 800 automatic selector, is a multi-contact, high-speed switch adaptable for use as an automatic or remote control device for railroad, radio, airport and many industrial applications.

This unit will make connection between a number of given circuits and



a similar number of other circuits, each pre-selected from a group; control and perform various operations among a group of circuits by making consecutive individual connections; act as a timing device or switch when it is used in connection with time-pulsing apparatus. It may also be used in telegraph or electronic equipment, remote control and signaling systems, testing and radio control.

The rotor assembly is operated by a stepping mechanism which responds to current impulses. After each impulse, a reed suspended pawl engages a ratchet, moving the wipers one step forward over the bank contacts.

The stepping mechanism may be controlled manually, or automatic control for the stepping magnet may be provided by interrupter springs, electronic circuits or relay circuits.

The wipers on the rotor may be of either of two types; double-ended or single-ended. According to the type of wiper used, this selector can be arranged to have a capacity of from one to three 2-row levels of 22 points each or from one to six single-row levels of 11 points each.

The dimensions of this selector are 2½"x3¼"x3½". Operating life is estimated at 4,000,000 revolutions.

Complete information regarding these units may be obtained from *Federal Telephone and Radio Corporation,* 28 Halsey Street, Newark, 1, New Jersey.

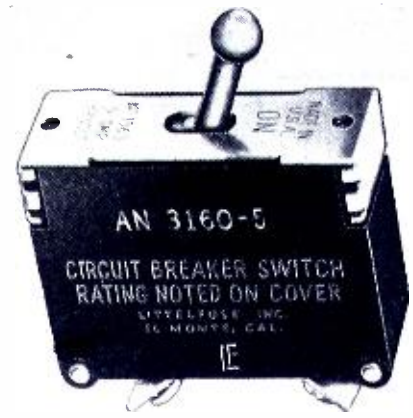
CIRCUIT BREAKER

Littelfuse, Inc., has announced a new circuit breaker which is relatively free from the effects of extreme high and low temperatures.

The performance of this unit is due primarily to a new construction which utilizes bi-metal for releasing the trigger. No appreciable mechanical load is exerted on the bi-metal as it trips the breaker.

While this unit is primarily designed for military uses, its high time lag makes it suitable for the protection of motors and other equipment which have high starting surge currents.

The range for this unit is from 5 to 50 amperes at 32 volts, a.c. or d.c. It is capable of breaking 2500 amperes on



short circuits. The actual trip temperature of this breaker is 350 degrees F. without flow of current.

The breaker is housed in a moisture-proof bakelite case, 2⅛" x 2" x ¾". The unit may be panel mounted by two 6/32 screws, ¼" long.

Further details may be secured by writing *Littelfuse, Inc.,* 4757 Ravenswood Avenue, Chicago 40, Illinois.

TROPI-PRUF RESISTORS

A new method of manufacture which prevents deterioration and failure due to fungus and humidity is being used by the Instrument Resistors Company in producing their line of "Tropi-Pruf" resistors.

Each component is enclosed in a special bakelite case. After complete dehydration, the resistor is carefully sealed in a special compound, and further made impervious to atmospheric conditions by means of a bakelite cap which is accurately machined to fit the bakelite case. The leads are bare

(*Continued on page* 40)

Television

License Applications

SEVERAL additional requests for frequency allocations have been filed for commercial and experimental stations in the video band.

WAVE, Inc. of Louisville requests channel 1 for that city on a commercial basis. Channel 5 in Indianapolis was requested by the Indianapolis Broadcasting Company, channel 8 in Seekonk, Massachusetts, was requested by Francis Taylor and the Central Ohio Broadcasting Company has petitioned for channel 8 in Columbus.

Two experimental licenses were requested; Philco requesting channel 4 in Arlington, Virginia, and the Zenith Corporation asked for assignment on 488,000 to 504,000 kilocycles.

Additional requests include: Yankee Network, channel 9 in Hartford, Conn.; Filene's Television, Inc., channel 7 in Boston; Times-Herald, channel 8 in Washington, D. C., and Intermountain Broadcasting Company, channel 1 in Salt Lake City, Utah.

* * *

Video Ready—Joyce

THOMAS F. JOYCE, RCA executive, told the FCC allocation hearing that television is ready to be sold to the public as soon as the material and manufacturing facilities are released from war work.

He made a strong appeal for adoption by the FCC of the frequency allocation proposals previously submitted to the hearing by the Television Panel of the RTPB.

Mr. Joyce also revealed at the hearing that RCA was prepared to offer greatly improved postwar television receivers to the public ranging in price from about $150.00 for a table model to $395.00 for a large projection model which would incorporate both FM and standard broadcast as well.

RCA expects to invest ten million dollars in the development of postwar television, according to Joyce. However, neither RCA nor any other company is in a position to make such a large capital investment unless the standards and frequency assignments are fixed.

Stressing the importance of giving television the go-ahead in order to provide postwar employment, Mr. Joyce who is head of the radio, phonograph and television department of RCA Victor, predicted that in the radio industry alone, employment at the end of the fifth full year will be approximately 600,000 as against a peak employment of 300,000 in 1941. At that time combined television and radio retail sales should reach $1,442,000,000.

* * *

Television Now

ALLEN B. DuMONT has urged that the FCC authorize immediate postwar commercial television based on present standards. Basing his request on three factors necessary to start the wheels of the television industry moving, namely, that the recommendations of the Panel 6 of the RTPB should be followed, adoption of suitable allocations will result in the rapid design of home receivers which is being withheld because of the possibility of frequency changes, and reconversion of plants that are no longer engaged in war production can be made as quickly as possible. Mr. DuMont pointed out that "hundreds of thousands" of persons could be gainfully employed immediately.

War time engineering improvements can be incorporated "immediately and without delay" in the new television transmitters and receivers, according to Mr. DuMont, without altering present standards.

* * *

WRGB Survey

ACCORDING to a recent survey made by WRGB, the General Electric television station in Schenectady, sixty percent of the sets in the Troy, Albany and Schenectady area are tuned in for the average telecast over WRGB.

This high average, Mr. R. L. Gibson of the GE Company asserted, cannot be attributed entirely to the novelty of television, since WRGB has been operating for five years and has presented more than 900 programs. It can probably be attributed, in part, to the fact that WRGB is only on the air four evenings each week, he continued.

From four to five persons per receiver were reported watching the programs, and 26% of the average audience was under 18 years of age, indicating that television has a tremendous appeal for youngsters.

Audience preference polls indicate that live talent shows are more popular than movies with the added advantage of clearer reception. However, Mr. Gibson feels that when movies are made for television exclusively that many of the objections to this type of transmittal will cease.

* * *

Advertisers Want Video

THE Television Broadcasters Association, Inc., presented two advertising agency executives at the FCC hearings on video allocations. Mr. Frederick Long of Batten, Barton, Durstine and Osborne, Inc., and Raymond E. Nelson of Charles Storm Agency asserted that the advertisers were ready to accept television as an advertising medium, now.

Mr. Nelson reports that after careful experimentation the Storm agency is prepared to present professional programs. He says that television as an advertising medium will produce results that will stagger the imagination.

* * *

RKO Television

RALPH B. AUSTRIAN, executive vice-president of RKO Television Corporation, recently told members of the Publicity Club of New York that although television is generally regarded as primarily a concern of radio broadcasting companies, the technique of Hollywood film producing will be a vital factor in establishing the quality and nature of selected material.

Mr. Austrian does not feel that there is a competitive factor between motion picture entertainment and television, as television programs will be different in nature from the feature film created for theater exhibition. Construction and operational costs will become a dominant consideration in bringing about desirable television, according to Mr. Austrian.

* * *

Video Courses

THE New School for Social Research at 66 West Twelfth Street, New York has announced the formation of classes in radio technique and radio writing together with a radio workshop and a television laboratory under the direction of Nathan M. Rudich.

The television laboratory will meet on Tuesdays at 8:30 P.M. The television laboratory is designed especially for production personnel, directors, designers, musicians and others. The laboratory, using advanced students from the Dramatic Workshop, prepares a series of telecasts on WABD, the DuMont television station.

JANUARY

22-26—**American Institute of Electrical Engineers,** Technical Meeting, New York, N. Y.

* * * *

MARCH

The First National Products of Tomorrow Exposition, Chicago Coliseum, Chicago, Illinois. Tentatively set for the 1st.

* * * *

APRIL

22—**National Electrical Wholesalers Association,** 37th Annual Convention at The Stevens, Chicago, Illinois.

* * * *

MONTHLY MEETINGS

Association of Electronic Parts & Equipment Mfrs. J. Arthur Kealy, Secretary pro tem, 77 W. Washington St., Chicago, Illinois.

2nd Thursday each month at the Electric Club of Chicago.

* * * *

The Representatives. R. Edward Stemm, Secy., 21 E. Van Buren Street, Webster 4840. Chicagoland Chapter, Chicago, Illinois.

Luncheon meeting 1st Monday each month.

* * * *

Sales Managers Club, Hotel New Yorker, New York. Walter Jablon, Secy., Hammarlund Mfg. Co.

Lunch meeting on the 4th Wednesday each month.

* * * *

I. R. E., Chicago Section. Alois W. Graf, Secy., 135 So. LaSalle St., Chicago, Illinois. Central 4060.

Meeting January 19, 1945, Central Y.M.C.A., 19 So. LaSalle Street, Chicago, Illinois. "Television Development" will be presented by Dudley E. Foster, Majestic Radio and Television Corporation. Also scheduled is a second paper on "Television Distribution Systems."

Fungi

(*Continued from page* 31)

support fungus growth;

2. those materials which seem to support fungus growth; but it is doubtful whether the materials tested are the source of nutriment for the fungus growth; and
3. those materials which inhibit, prevent, or kill fungus growth.

The usual types of molds are used when first investigating the mycological properties of a new fungicide. These types are Chaetomium globosum (#6205), Aspergillus niger (#6277), Trichoderma köningi, and Penicillium luteum, or Penicillium funiculosum. If the results with the above types are favorable, numerous additional fungi are used under identical conditions. However, if the results with the usual types of molds are unfavorable, no further tests are made.

A considerable amount of work has been done on component parts which have been previously treated. In such cases the object of the experiments is to test the procedure of treatment and to determine whether or not materials are fungus resistant. Routine mycological tests involving inoculations and spore suspensions are then employed. When various materials treated with several or many fungicides of different percentages are tested, a more extensive procedure is necessary. For example, when celanese, glass, and cotton braided radio instrument and hook-up wire, treated with various percentages of a number of fungicides are tested, leaching and non-leaching, corrosion, toxicity of samples, presumptive and determinative tests, and use of numerous fungi in spore suspensions and inoculations are involved.

Of the numerous types of fungicides tested, the organic mercury compounds appear to be quite satisfactory. This belief is based on hundreds of fungus, corrosion, leaching, etc., tests. However, considerable thought and words have been expressed as to the danger of toxicity. While it is true that there is always danger of toxicity when organic mercury compounds are used as fungicides, especially to the employees of the lacquer, varnish, paint, etc., industries, these difficulties are not insurmountable.

The percentages of a fungicide are usually based on the total solids content. In lacquers and varnishes, where the total solids content varies between 25 and 50%, the amount necessary to render this coating material fungus resistant runs between 0.25 lbs. and 0.50 lbs. of fungicide for 100 lbs. in a 1% mixture. Toxicity must also be taken into consideration for personnel handling the prepared and fully dried wire, bakelite, etc. Concerning this point, hundreds of patch tests (to determine toxicity) have been performed on the organic mercury compounds at low percentages. The results of these tests seem to indicate the lack of toxicity in prepared samples. Nevertheless, investigators still feel that there is a possibility of the accumulation of poison by individuals handling fully prepared materials containing organic mercury compounds even at these low percentages. Conclusive evidence for or against accumulative poisoning from such compounds has not been substantiated.

It is well known that selenium rectifiers are ruined by the presence of minute quantities of free mercury in a very short time. This immediately suggested that materials treated with a 1 or 1½% organic mercury compound in a lacquer or varnish might ruin a selenium rectifier. Consequently, a series of tests with painted, unpainted, heated, and unheated selenium rectifiers were conducted. The results of these tests were very favorable. Several manufacturers of selenium rectifiers have substantiated this point.

Other fungicides, such as pentachlorophenol and salicylanilide (10 or 15%, on the basis of solids content) have given favorable results in mycological laboratory tests. Pentachlorophenol (10 and 15%, on the basis of solids content) gives a very good initial result in laboratory tests as well as a very wide zone of inhibition. However, at these percentages, this compound "leaches out" quite readily (about 10% in eight hours). A considerable percentage of the fungicide in a vehicle is driven off when heated for long periods of time. It gives off a characteristically pungent odor. This compound sublimates rather rapidly. It has been shown to cause dermatitis, and in addition, its vapors are irritating to the respiratory passages. Some of the properties which make this compound effective are its protection against mold growth, presence of a wide zone of inhibition, high solubility in waxes, lacquers, and varnishes, low cost, and absence of corrosive properties. Salicylanilide (at 15%, on the basis of solids content) possesses all of the advantageous properties of the organic mercury compounds and pentachlorophenol. It does not induce corrosion, does not cause dermatitis, does not alter electrical or physical properties of a treated material, gives a zone of inhibition, does not "leach out," and is odorless, water white, and stable. The zone of inhibition for a 15% lacquer or varnish is distinct but narrow. This, however, is not a disadvantage.

Up to the present time, an ideal fungicide for use in waxes has not been clearly demonstrated. It has been shown that phenyl mercuric salicylate, pentachlorophenol, and salicylanilide are less effective in waxes than they are in lacquer or varnish.

A number of fungicides which protected materials when tested did not show a distinct zone of inhibition. Because the presence of a zone of inhibition is not the most important feature of an effective fungicide, its absence in such cases does not necessarily rule out the usefulness of the fungicide. The purpose of a fungicide is to protect against moisture and fungus growth without altering the basic features of materials, such as electrical properties, tensile strength, etc.

The problems of moisture conditions and moisture resistance are as great as, if not greater than, those pertaining to the control of fungus growth by the use of fungicides. In the field, it seems that a higher percentage of difficulties in radio and radar equipment is due to moisture conditions, while a lower percentage of these difficulties is due to actual fungus growth. This condition is to be expected in field equipment because moisture, as well as temperature, is a determining factor in mold growth. Consequently, the aim in tropicalizing equipment is to render treated materials water repellent as well as fungus resistant.

At this time definite progress has been made in the battle against deterioration due to moisture and fungus growth. All of the problems in tropicalization are by no means fully understood. Continued scientific investigation is necessary if we wish to solve these important problems. It is evident that not only does such a contribution take its place among the determining factors of the war, but it is definitely felt that the final benefits will add to the betterment of mankind in the post-war era.

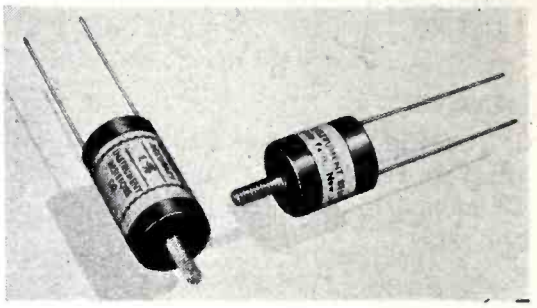
Table 1. A partial list of fungicides which have been investigated. A number have been investigated for their fungicidal properties in the pure state, in waxes, lacquers, and varnishes. Others have been investigated in various combinations with each other.

Phenylmercuric salicylate	Parabromoorthocresol
Phenylmercuric oleate	Parachlorometaxylenol
Phenylmercuric acetate	2, 2′-dichloro-5, 5′-dihydroxydiphenylmethane
Phenylmercuric nitrate	Paradichlorobenzene
Phenylmercuric borate	Mercuric chloride
Pyridylmercuric stearate	Ammonium thiocyanate
Salicylanilide	Orthobenzoic sulfamide
Chlorinated phenols	2, 4-dinitrotoluene
Puritized L N	Quinhydrone
2-mercaptobenzothiazole	Quinone
Paranitrophenol	Iodoform
2, 4, 5-trichlorophenol	Resorcinol
Copper naphthanate	Orthohydroxybenzyl alcohol
Dihydroxydichlorodiphenylmethanol	Chlorothymol
Aninilomethylbenzomercaptothiazole	6-nitroquinoline
Parachlorometacresol	Toluhydroquinone
Tetrabromoorthocresol	

New Products

(*Continued from page* 37)

at the point of entrance through the case, and are permanently and hermetically sealed with a special compound. No creepage of moisture or



fungus growth can take place at any point. Corrosion, electrolysis, or oxidation are effectively barred from the resistor unit by this method of enclosure. A 6/32" mounting screw is an integral part of the housing.

A special fungacidal coating is applied over the entire unit upon completion of the manufacturing processes.

The resistors are available in a wide range of resistance values and wattage ratings. Tolerances suitable for either general or precision applications are also available. Full details will be forwarded by *Instrument Resistors Company,* 25 Amity Street, Little Falls, New Jersey, upon request.

FUNGUS PROOF COMPONENTS

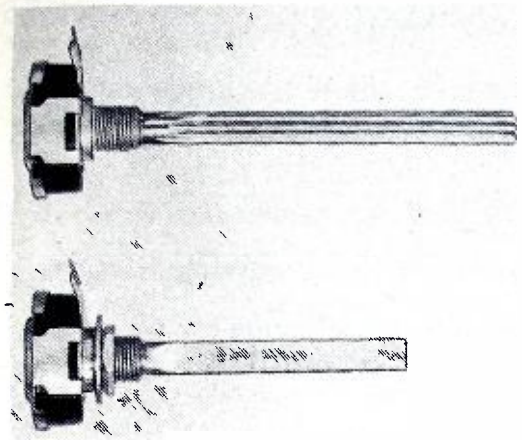
Matching the growing demand from the armed services for components protected against fungus growth, Shallcross Mfg. Company announces that the company's Akra-Ohm fixed wire wound resistors, and switches are now available treated with anti-fungus material which meet Signal Corps Specifications No. 71-2202A. These units are supplied without any manufacturing delay occasioned by the special treatment.

Complete details as well as copies of the Shallcross resistor and switch catalogues will be sent on request to the *Shallcross Mfg. Company,* Collingdale, Penna.

CENTRALAB CONTROLS

Centralab has announced resumption of the manufacture of the pre-war type of midget and standard controls using parts of aluminum, instead of the wartime steel construction.

Work has been started on some types of midgets and eventually the entire line will be of pre-war materials. The new parts have aluminum



shafts that extend three inches from the end of a ⅜ inch bushing. They feature Universal fluted mills that simplify filing and allow for all types of knobs. The wartime and the new controls are illustrated for comparison.

Complete information about the new line of controls will be forwarded upon request to *Centralab Division of Globe-Union, Inc.*, Milwaukee, Wisconsin.

PLUNGER RELAY

A new improvement has been made n the H-B Mercury Plunger Relay. This refinement consists of a new crown-shaped wire guide which has been incorporated as a part of the plunger to keep the plunger upright and friction free.

As a result of this improved performance, it is possible to achieve a faster, cleaner break with no chance for mercury splash or prolonged arc. In addition, the arc is broken over a new hardened ceramic material which eliminates powdering and prolongs service life.

These new relays are of the normally open series, available for a.c. up to 440 volts and for d.c. up to 250 volts, with contact capacities as high as 30 amperes. All of the relays have hermetically sealed mercury-to-mercury contacts which are positive, chatterless, noiseless and with no exposed arc.

Complete information on this relay, including prices, will be forwarded upon request to *H-B Electric Company,* 6123 North 21st Street, Philadelphia 38, Pa.

J-B-T MINIATURES

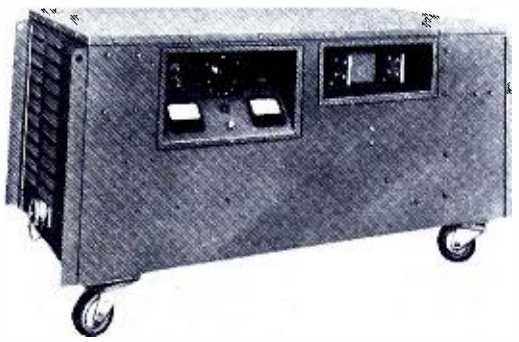
Miniature frequency meters for installation in air borne units, portable equipment and miniature panel boards are now available in the Type 21-FX vibrating reed units manufactured by the J-B-T Instruments, Inc.

This meter meets ASA C39.2, 1944 standards in depth of case as well as in mounting dimensions and mounting hardware. The unit is light in weight and is available in frequency combinations down to 40 cycles or up to 550 cycles per second. The diameter of the flange is $2^{11}/_{16}$". Accuracy from ± 2% or ± 3% is available. Single window types with from three to five reeds are available.

A letter to *J-B-T Instruments, Inc.,* 441 Chapel Street, New Haven 8, Conn., will bring full details.

MOBILE RECTIFIER

The W. Green Electric Company has designed and constructed a new mobile rectifier unit for the magnetic testing of steel propeller shafts. This



unit is a power supply which has a continuous capacity of 1500 amperes d.c. with proportionately higher rating for intermittent operation. The output voltage is adjustable in eight steps from one to six volts. A fan-cooled selenium rectifier assembly powers the unit. Rainproof louvres at each end of the unit provide for air circulation.

The d.c. output terminals on each side, and the control panel, are located in recesses in the cabinet walls. The control panel is equipped with fan starting mechanism, push buttons for main contactor control, voltage adjustment switch, pilot lamp, visual and audible overload warning signals, and a voltmeter and ammeter for output measurements.

Three phase, 440 volt, 25 cycle power supply is brought to the unit through a 25 foot cable which plugs into a weatherproof receptacle at one end of the cabinet.

Except for the fan, which may be externally lubricated through Alemite fittings, there are no moving parts. The unit is mounted on heavy-duty, rubber-tired swivel wheels and sling holes are provided at the four corners to permit crane handling.

The *W. Green Electric Company* of New York is the manufacturer.

FLUX METER

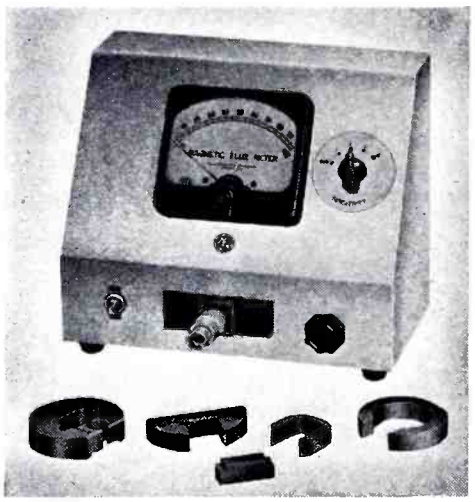
The Hickok Electrical Instrument Company is announcing a new instrument in their line of testing equipment.

Known as the Model 256 Hickok Fluxmeter, this unit utilizes an electronic circuit connected to an indicating meter in such a way that when the exploring inductor is placed in a magnetic field, the indication of the meter will be in proportion to that field. The particular model is designed to operate from 105-120 volts a.c., 50 cycles. Other voltages and frequencies are also available.

Built-in voltage regulation is provided to make the indications inde-

pendent of normal line voltage fluctuations.

Magnetic flux measurements can be



compared within plus or minus 3%. Higher accuracy may be obtained by calibration with a known gauss standard. One four-position control serves the dual purpose of turning the instrument on and off as well as selecting the three sensitivity positions.

Additional information on this unit may be obtained by addressing inquiries to the *Hickok Electrical Instrument Company,* 10524 DuPont Avenue, Cleveland, Ohio.

BALLAST CAPACITORS

Several important electrical and mechanical features have been incorporated in the new line of oil-impregnated fluorescent ballast capacitors recently introduced by the Capacitron Company.

To avoid all possibility of body acid contamination, these Capacitrons are dried, impregnated, filled and sealed without contact with human hands. A process of mechanical sealing elim-

inates high temperature oil leaks commonly caused by other methods.

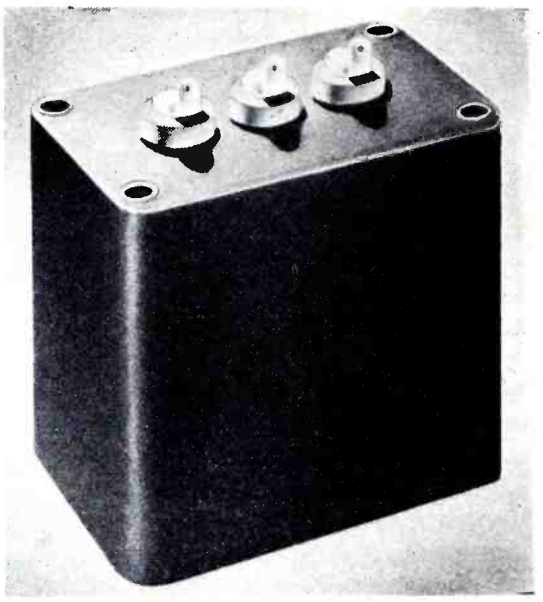
The units are built for continuous operation at 85 degrees C. and have less than a 2% power factor.

Persons interested in standard and special capacitor designs may secure assistance with their engineering problems by writing to *Capacitron Company*, 318 West Schiller Street, Chicago 10, Illinois.

INTERSTAGE FILTER

The United Transformer Company has announced a new line of interstage band pass filters featuring gain as well as frequency discrimination, and low inductive pick-up. Type B.P.I. filters have a primary impedance of 10,000 ohms with a gain of approximately 2 to 1. Type B.P.I. filters have a primary impedance of either 500 or 600 ohms, with a gain of about 9 to 1.

Both units are sharply peaked, with approximately a 2 db. attenuation at frequencies ± 3% from the mean frequency, and attenuations of approxi-



mately 40 db. per octave. Phase shift is zero at the mean frequency. Filters can be supplied for any pass frequency from 200 to 10,000 cycles.

Further information on these units will be forwarded upon request to *United Transformer Company,* 150 Varick Street, New York 13, N. Y.

PROGRAM TIMER

A new program timer to permit the greatest possible accuracy of signals at any five minute period in a 24 hour schedule is being offered by the Zenith Electric Company.

This timer is an automatic switch which can be set to close an electrical circuit at any desired five minute interval as often as desired. As high as 288 operations a day are possible.

This unit is rated at 10 amperes at 110 volts. The steel case is 8"x12"x4".

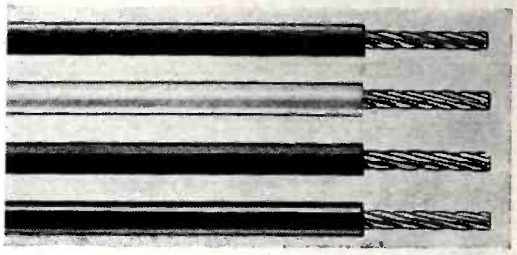
For complete data on this timer, address *Zenith Electric Company,* 152 W. Walton Street, Chicago 10, Illinois.

FLAMENOL WIRE

A new thermo-plastic lead wire for use in all types of fluorescent lamp ballasts, and marketed under the trade-name Deltabeston Flamenol wire, has been announced by the appliance division of General Electric.

Operation at 176 degrees F, at 600 volts has been approved by Underwriters' Laboratories.

The insulation of this wire is super-



aging and is resistant to flame, oils, acids and alkalies. This wire is available in solid and stranded conductors, sizes 16 and 18 AWG in brilliant colors, including black, white and red.

Further details of this product may be obtained from the Appliance Division, *General Electric Company,* Schenectady, New York.

V.H.F. Measurments

(*Continued from page* 9)

of the instrument. The input circuit of a vacuum tube voltmeter is equivalent to a high resistance in parallel with a capacity of the order of 5 to 10 $\mu\mu$f, thus very little power is taken from the source under measurement. At the higher frequencies, errors are introduced into the meter reading by resonance in the input circuit and transit-time effects in the diode rectifier. The manner in which the readings are affected by these errors can be seen from curves in Figures 2, which give the frequency correction of the vacuum tube voltmeter shown in Fig. 8 for several different values of indicated voltage.

The vacuum tube voltmeter, in addition to its usefulness in measuring high frequency voltages, can also be used as a high frequency ammeter by the use of capacitive shunts. When used in this manner, the vacuum tube voltmeter has wide applications in the measurement of antenna current, for the determination of antenna power input.

Impedance Measurements

Since the high frequency value of resistance, capacitance or inductance is often quite different from the low frequency value, resistance or reactance measurements should always be carried out at the operating frequency for the most accurate results. Stray capacities and the inductance of leads, which can usually be neglected at the lower frequencies, tend to become increasingly important as the frequency is increased. Great care should be taken to prevent errors in impedance measurements by attempting to keep leads to the measuring instruments

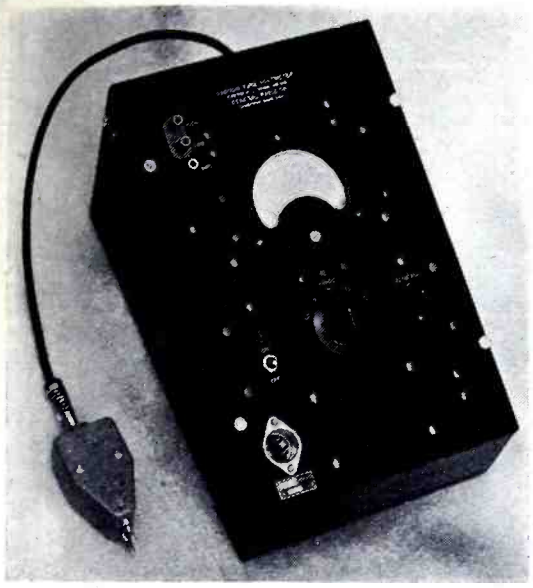


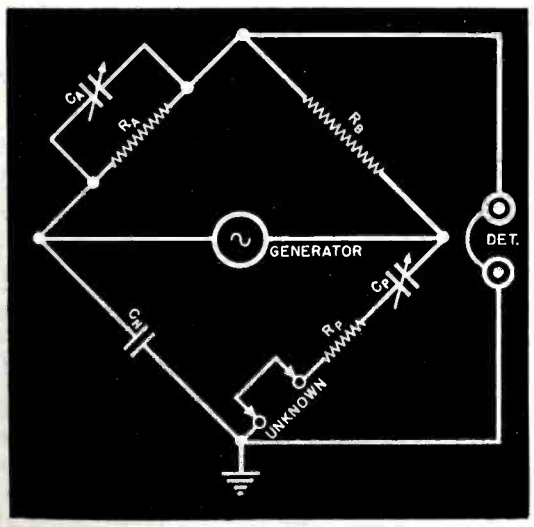
Fig. 8. Vacuum tube voltmeter manufactured by General Radio Co.

short and by avoiding stray inductance and capacitance.

Values of impedance can be determined at v.h.f. by substitution methods and by absolute methods. The substitution methods depend upon the accuracy of a calibrated condenser, and are therefore capable of extremely accurate results. The absolute method of measuring impedance by means of transmission line measurements, while not as accurate as the other methods, can however be used at much higher frequencies.

Impedances can be measured by substitution either (a) by connecting the unknown impedance in one arm of an r.f. bridge circuit, or (b) by connecting it in a resonant circuit. A bridge circuit which can be used to measure impedances by a series-substitution method is shown in Fig. 9. Measurements are made by first balancing condensers C_p and C_a with the unknown terminals short-circuited, then the bridge is rebalanced with the short circuit removed and the unknown impedance connected. The resistive and reactive components are determined from the change in settings of the condensers by:

Fig. 9. Bridge for measuring impedance by the series—substitution method.



$$R_X = R_B \frac{C_{A2} - C_{A1}}{C_N} \quad \ldots\ldots\ldots\ldots (1)$$

$$X_X = \frac{1}{\omega}\left(\frac{1}{C_{P2}} - \frac{1}{C_{P1}}\right) \quad \ldots\ldots\ldots\ldots (2)$$

where the subscripts 1 and 2 denote the condenser settings for the initial and final balances respectively. A well-constructed r.f. bridge of this type can be used to measure accurately the reactance and resistance of antennas, transmission lines, and circuit elements at frequencies up to 60 mc.

Resonant-circuit measurements of impedance can best be performed by means of the Q-meter. The basic principle can be seen from the schematic diagram in Fig. 7(B) showing the fundamental circuit of the instrument. Photographs of two commercial Q-meters which can be used at high frequencies are shown in Figs. 1 and 3; the instrument shown in Fig. 1 may be used at frequencies between 50 kc. and 75 mc. while the one in Fig. 3 covers the range from 30 to 200 mc. The Q-meter consists essentially of a high-frequency signal generator whose output is applied to a series-resonant circuit, a voltmeter to measure the voltage V_1 applied to the resonant circuit, and a vacuum tube voltmeter to measure the voltage V_2 across the condenser of the tuned circuit. The voltmeters can be calibrated in terms of the "Q" of the resonant circuit by the well-known relationship that at resonance:

$$V_2 = QV_1 \ldots (3)$$

In low-frequency Q-meters, the oscillator-output voltmeter can be a thermoammeter which reads the current through the small coupling resistor; in the high-frequency Q-meter the oscillator voltage is coupled to the "Q" measuring circuit by an inductance, and the voltage is measured by a vacuum tube voltmeter instead of by a thermocouple meter.

Measurements of inductance, capacitance, resistance, power factor, and "Q" of a circuit can be performed by means of the Q-meter. When measuring inductance, the unknown inductance is connected externally, and constitutes substantially the entire inductance of the resonant circuit and can therefore be determined from the value of the calibrated tuning condenser; the distributed capacity of the coil can be computed by taking two inductance readings at different frequencies. For other types of measurements it is necessary first to provide a simple resonant circuit by means of a standard inductance L_s, then any two-terminal impedance can be measured by inserting it either in series or in parallel, as shown in Fig. 6, and returning the circuit to the original frequency. From the frequency of measurement, the two values of circuit tuning capacitance, and the two values of "Q" thus obtained may be calculated effective values of "Q," resistance, or reactance of the unknown impedance.

The use of transmission lines as an absolute method of measuring impedance involves using their properties as portions of tuned circuits. Reactance is measured by tuning to resonance with a transmission line of known characteristics. The reactance is then determined from the frequency, and the length of the line. Further discussion will appear in the next issue.

(To be continued)

Strain Gages

(*Continued from page* 12)

plate current will decrease with an increase in voltage unbalance, while in the case of 0° phase angle the plate current will increase. In Fig. 10A the phase indicating circuit used in a commercial static balancing unit is shown. This is very satisfactory for a static unit.

Stability Problems

The drift of gain with time for a resistance coupled amplifier is due to variation in emission of the cathode, variation in value of plate and screen potentials, and change in operating temperature of circuit components. The effect of cathode emission variations are most pronounced in new tubes and can be minimized by 100-500 hours operation at rated voltage on an aging rack. The effect of variations in the values of plate and screen potentials can be counteracted by using regulated power supplies and a constant voltage transformer for the regulation of all filaments, etc. The effect of operating temperature variation on the value of resistors and condensers can be minimized by using ample ventilation, by the use of perforated metal instead of solid panels, and the avoidance of hot objects near the gain-determining circuit elements.

Fig. 1 is a photograph of the unit designed according to the circuit of the block diagram shown in Fig. 3. In this case the oscilloscope is built in and consists of a cathode ray tube with centering controls and high voltage supply. The trace on the screen is a line whose length varies according to the magnitude of the strain. The time axis is provided by a moving film in a 16 mm. moving picture camera. This unit was converted to a continuous drive camera by removing the "pull down claw," to provide a smooth, continuous motion for the film.

The detector and filters for removing the carrier from the rectified signal can be used for certain work but the amplitude modulated wave is just as useful.

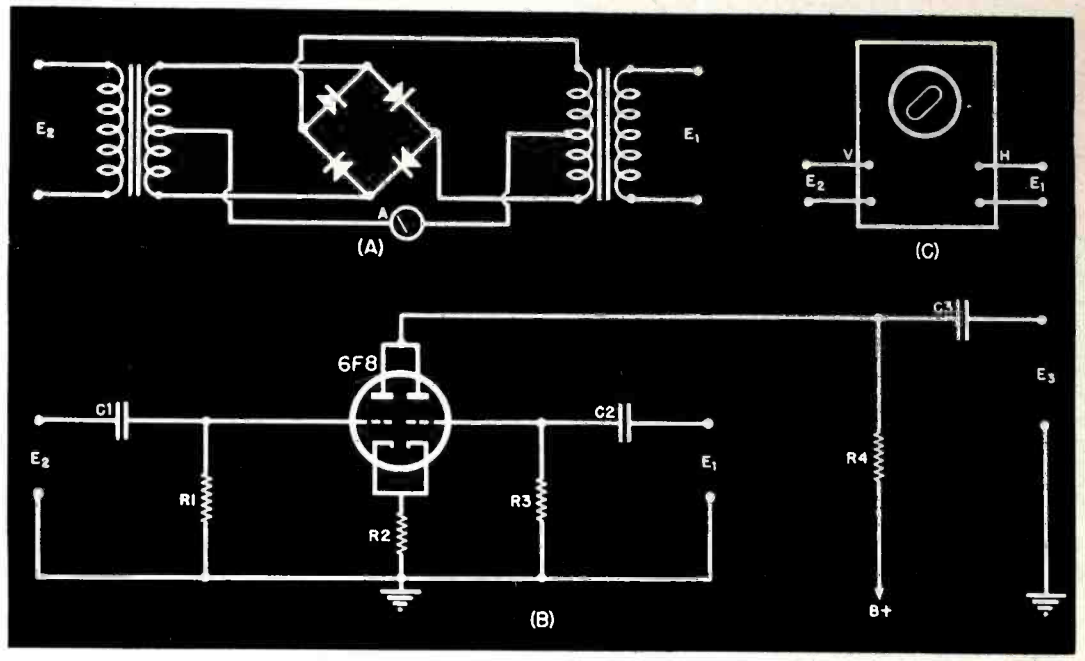


Fig. 10. Three methods for indicating the direction of bridge unbalance.

Calibration Methods

The sensitivity factor for gages is provided by the manufacturer for each gage. The user can either check this value by cementing the gage on a calibration beam or calibrating by a resistance offset method. In the unit shown in Fig. 1, a built-in calibration system which supplies a known signal of 1.5 millivolts to the amplifier is used. The gain is adjusted for a 50 volt output, thus standardizing the gain of the amplifier.

When dynamic strain effects are photographed from the oscilloscope screen, it is convenient to put a calibration directly on the film in order to avoid errors. This can be accomplished by using a series of precision resistors which are shunted across the active gage one at a time to obtain a series of calibration points on the compression side and then shunted across the compensating gage to obtain calibration points on the tension side.

It is convenient to arrange a rotary switch for this purpose.

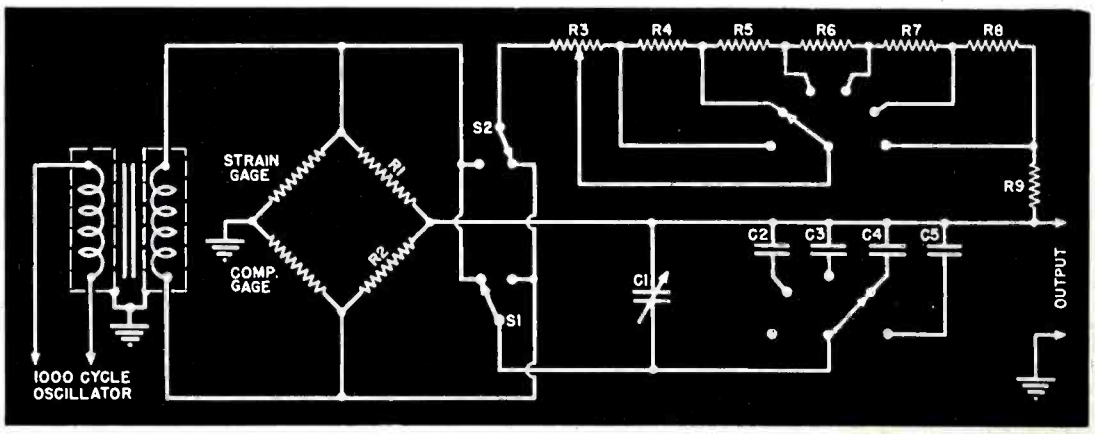
Conclusions

The preceding discussion covers the most important points in the description of the strain gages and their accompanying amplifying circuits for use in the range of 0 to 200 cycles. This range is satisfactory for most applications dealing with large structures, vibrating machinery, etc. The gages can be used for measuring other quantities such as weight, pressure, temperature, draw bar pull, etc.

The primary reasons for the popularity of these gages can be listed as follows:

1. They are easily applied by cementing.
2. They are capable of good accuracy.
3. They are inexpensive.
4. Remote indication promotes safety.
5. Short gage length.
6. The point of measurement is close to the surface of the member.

Fig. 11. Simple bridge circuit providing resistance and capacity balance.



BIBLIOGRAPHY

C. O. Dohrenwend and W. R. Mehaffey, "Measurement of Dynamic Strain," Journal of Applied Mechanics, June, 1943.

D. M. Nielsen, "Strain Gages," Electronics, December, 1943.

C. H. Gibbons, "The Use of the Resistance Wire Strain Gage in Stress Determination," Proceedings of the Society for Experimental Stress Analysis, Vol. 1, No. 1.

R. Baumberger and F. Hines, Ruge-de-Forest, "Practical Reduction Formulas for Use on Bonded Wire Strain Gages in Two-dimensional Stress Fields," Proceedings of the Society for Experimental Stress Analysis, Vol. 2, No. 1.

A. V. deForest, "Characteristics and Aircraft Applications of Wire Resistance Strain Gages," Instrument, Vol. 15, No. 4, April, 1942.

C. O. Dohrenwend and W. R. Mehaffey, "Dynamic Loading in Design," Machine Design, June, 1943.

J. H. Meier & W. R. Mehaffey, "Electronic Computing Apparatus for Rectangular and Equiangular Strain Rosettes," Proceedings of the Society for Experimental Stress Analysis, Vol. 2, No. 1.

W. R. Mehaffey, "Strain Gage Amplifier Design," Proceedings of the National Electronics Conference, 1944.

NEWS BRIEFS

IRE ELECTS OFFICERS

The Board of Directors of the Institute of Radio Engineers has announced the election of Dr. William L. Everitt to the post of president for the coming year. He will succeed Professor Hubert M. Turner of Yale University in this post.

Dr. Hendrik J. Van der Bijl of Johannesburg, Union of South Africa, was elected vice-president of the IRE to serve with Dr. Everitt. Three directors, whose terms will run from 1945-47 were named at the same time. They are; Stuart L. Bailey, consulting engineer of Jansky and Bailey, Washington, D. C.; Keith Henney, editor of "Electronics," and Dr. Benjamin E. Shackelford, engineer-in-charge of RCA Frequency Bureau. All are fellows of the institute.

This is the 33rd. election in the history of the Institute which was established in 1912. The present membership numbers 12,000.

RADIO FOR BUSES

Representatives of the National Association of Motor Bus Operators appeared before the recent FCC frequency allocation hearings in Washington to urge that 15 bands be set aside for two-way radio communication on intercity buses.

Spokesmen for the industry pointed out that the ability to communicate with buses on the highways and to receive messages from the drivers would facilitate passenger travel, promote safety and minimize delays in the event of road failures.

It was reported that already some of the bus lines plan to install experimental equipment on certain routes as soon as wartime restrictions are lifted.

INDUSTRIAL ELECTRONICS STUDY

The Westinghouse Electric and Mfg. Company has recently made its industrial electronics training course available to other companies with employee training programs.

This course consists of ten lesson booklets, two examination books and training slides and films. The lesson booklets, which are intended to supplement classroom lectures, are profusely illustrated with line drawings and photographs.

Various concepts of electron theory, tube operation and the application of electronics are explained in simple, non-technical language. The two quiz books provide a thorough method for checking on the student's progress. One examination is designed to cover material studied in the first six lessons, while the final quiz includes parts seven to ten.

Although this course was designed for Westinghouse employees, the material can be easily adapted to the requirements of other companies. Twenty hours are recommended for the full ten part course, two hours for each part. If the classes are held one night each week, class members will have an opportunity to review work already covered and do supplemental reading.

The sound slide films and records present the basic theory and applications of electronics in a clear and concise manner. These films may be used with standard sound slide film equipment.

Companies interested in presenting this course to their employees may secure complete information regarding the program from Editorial Service, *Westinghouse Electric and Mfg. Company,* 306 Fourth Avenue, Pittsburgh, 30, Pa.

FACSIMILE NEWSPAPERS

Finch Telecommunications, Inc., has indicated its entry into the field of facsimile newspaper service for the general public with its announcement of the appointment of George Henry Payne to the post of consultant for publishers.

Mr. Payne, who becomes the vice-president of the Finch Company, believes that newspaper publishers are interested in this subject and will welcome the opportunity to consult on the technical and public relations aspects of the problem. Mr. Payne was, for many years, a member of the F.C.C.

NEW TUBE BULLETIN

Nine types of electronic tubes for specialized applications are described in a new 24 page bulletin published by Sylvania Products, Inc.

The products described include strobotrons, for the study of reciprocating and rotating motion; Pirani and

thermocouple tubes for measuring vacuum; voltage regulator tubes; facsimile tubes; germicidal tubes; black light and near ultraviolet lamps.

The technical sections of the bulletin provide specifications, basic circuit diagrams and suggested applications for products and accessories.

Copies of this bulletin, No. 202, are available upon request to *Sylvania Electric Products, Inc.*, Special Products Division, 60 Boston Street, Salem, Mass.

EVERITT TO U OF I

The appointment of Dr. W. L. Everitt as professor and head of the department of electrical engineering at the University of Illinois, was announced recently by the university's president, Arthur Cutts Willard.

As head of the department, Dr. Everitt will succeed Ellery B. Paine, whose retirement was announced recently.

C-D BULLETIN

Six plastic materials used in the radio and electronic industry are described, along with their properties, in a new 12 page bulletin issued by the Continental-Diamond Fibre Company.

The materials covered in this bulletin include, vulcanized fiber, Dilecto, Dilectene, Celoron, Micabond and Vulcoid. Since each of these materials presents certain unique characteristics, manufacturers of radio and electronic equipment are urged to study the performance and engineering charts in order that the proper application of the plastic may be selected. For engineering departments confronted with difficult design problems, the engineers of Continental-Diamond offer their services.

Copies of the bulletin, GF-49, will be furnished to those requesting it from *Continental-Diamond Fibre Company*, Newark 49, Delaware.

BAKER'S SPEECH

At a recent meeting of the Post War Planning Committee of the National Electrical Wholesalers Association, Dr. W. R. G. Baker, of General Electric's Electronics Department and chairman of the RTPB, gave his views on the postwar possibilities of electronics.

Dr. Baker pointed out that much of the advertising at present over-rates electronic possibilities and romanticizes too much. He recalled the situation following the last war when it took almost 15 years to develop the discoveries and improvements of that period to the point where they had some commercial value.

Since an estimated 15,000 receivers are going out of service every day, Dr. Baker feels that the possibilities for full employment in the radio industry are great, particularly if the radio manufacturers produce combination FM-AM receivers in quantity. He warned against trying to produce FM equipment for the $9.95 or $19.95 market as the circuit and components of an FM receiver must be of highest quality to produce the desired results.

Dr. Baker believes that there might be as many as 100 television transmitters in the United States within five years after the war, serving 60% of the population.

The opportunities for electronics in the industrial field are almost without limit, according to Dr. Baker, but he feels that the logical user for high frequency heating is in industry and not in the home, as has been forecast by many persons today. Until many improvements and developments are made this is not a practical form of power for the home consumer.

KELLY V-P OF BELL LABS

Dr. Mervin J. Kelly, director of Research of the Bell Telephone Laboratories, has been elected vice-president of the Laboratories.

Dr. Kelly, who has specialized in photo-electric cells, water-cooled tubes and vacuum tube engineering, was graduated from the University of Missouri in 1914 and received his Ph.D. from the University of Chicago in 1918. He joined the Laboratories in that same year as a research physicist.

In 1930 he became vacuum-tube development director and in 1936 was named director of research. Dr. Kelly has been in charge of the Bell Laboratories development work on radar and other important fields. He is a member of the A.I.E.E. and I.R.E. in addition to several other honorary and professional societies.

TRANSITION STUDY

The third edition of "Postwar Planning Now," entitled "Transition Opportunities" is now available to the public.

This twenty page publication, edited and prepared by the New York Journal of Commerce, covers nearly 200 of the outstanding postwar trade potentialities, new products and services. The data is compiled from material made available to the Journal of Commerce by key industrialists, government and trade association officials.

Single copies of this survey are available from the *New York Journal of Commerce*, 63 Park Row, New York 15, New York. The price is $.25.

PHOTO CREDITS

Pages
3, 4, 5, 6. . . . .Bendix Aviation Corp.
7, 8 (top). . . . .Boonton Radio Corp.
8 (center), 43. . . .General Radio Co.
10. . . .Armour Research Foundation
13, 14, 15 (all at top). . . . . .U. S. Army Signal Corps
13, 14, 15. . . . .Belmont Radio Corp.
16, 19 (left), 20, 21. . .Westinghouse
19 (right) . . . . . .General Electric
32. . . . . .British War Relief Society

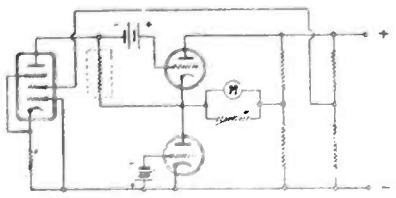
INDEX OF ADVERTISERS

COMPANY	AGENCY	PAGE NO.
Alpha Meter Service	Hart Lehman Advertising	45
Allmetal Screw Products Co.	Jasper, Lynch & Fishel, Inc.	41
Amperite Co.	H. J. Gold Co., Advertising	29
Bentley, Harris Manufacturing Co.	John Falkner Arndt & Company	48
Chicago Wheel & Mfg. Co.	Weston-Barnett, Inc.	31
Finch Telecommunications, Inc.	Wortman, Barton & Goold, Inc.	47
Hickok Electrical Instrument Company	The White Advertising Company	27
Manufacturers Screw Products	Earl B. Shields, Advertising	43
Micarta Fabricators, Inc.	Sander Rodkin Advertising Agency	25
Par-Metal Products Corporation	H. J. Gold Co., Advertising	29
Philharmonic Radio Corp.	Vanguard Advertising	46
Schauer Machine Company	Rudolph Krebs Advertising	45
F. A. Smith Manufacturing Co., Inc.	Scrivener, O'Brien Co.	33
Standard Winding Co.	Sternfield-Godley, Inc.	35
Sterling Bolt Co.	Gourfain-Cobb Advertising Agency	37
Tinnerman Products, Inc.	The White Advertising Company	23
United Metal & Plating Works		39
Western Electric Co.	Deutsch & Shea	47

PATENTS

TEMPERATURE INDICATOR

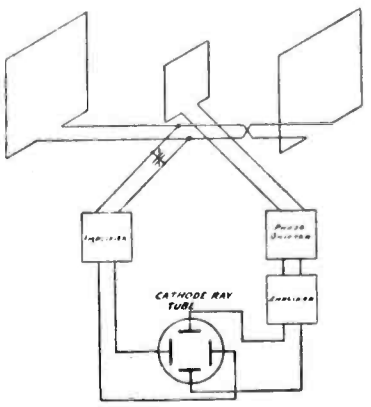
An electric temperature indicator comprising a resistor having a substantial temperature coefficient of resistance, and a vacuum tube circuit arranged to keep the current through



this resistance constant. A means is then provided for measuring the potential difference across this resistor, the means being calibrated in terms of temperature rather than potential difference. John William Smith, assigned to Collins Radio Company. Filed May 19, 1941, granted October 3, 1944. No. 2,359,334.

RADIO DIRECTION FINDER

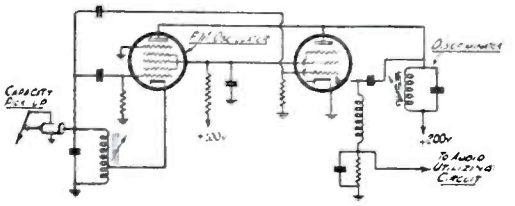
A radio direction finder having an antenna system comprising spaced loops having their planes perpendicular to their common line of centers; a circuit for conductively and differen-



tially coupling said loops in operative relation, and including a common tuning element and a common terminating impedance in said circuit. Paul B. Taylor, filed November 18, 1937, granted October 31, 1944. No. 2,361,436.

REPRODUCTION CIRCUIT

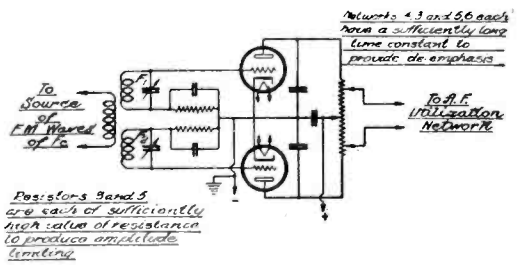
An FM oscillator circuit in which the capacity-type phonograph pick-up forms part of the frequency-determining circuit, so the output frequency varies in accordance with variations in capacity at the pick-up. A discriminator circuit is connected to the output of this FM oscillator, and is mistuned with respect to the oscillating frequency. A rectifier is provided for producing audio voltage from the FM



wave. Winfred R. Koch, assigned to Radio Corporation of America. Filed October 6, 1942, granted October 31, 1944. No. 2,361,634.

FM RECEIVER

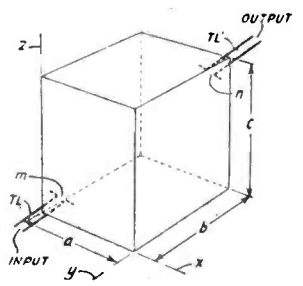
An FM discriminator circuit with a pair of grid leak detectors with outputs combined differentially, and with



means for adjusting input to such a high value so as to obtain low output response to amplitude modulation. The grid leak and condenser circuit of the detectors have sufficiently long time constants to compensate for preemphasis of some modulation frequencies at the transmitter. Clarence W. Hansell, assigned to Radio Corporation of America. Filed December 22, 1941, granted Oct. 31, 1944. No. 2,361,625.

CAVITY RESONATOR

A high frequency cavity resonator comprising a hollow closed electrically conducting surface having different



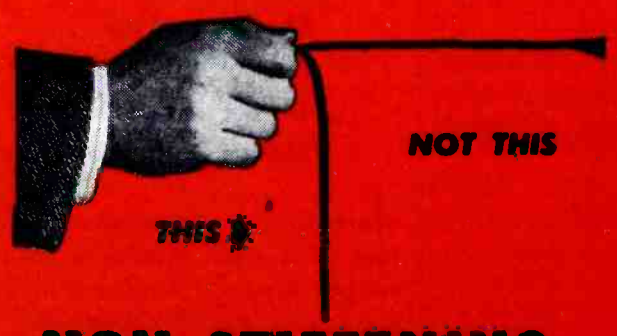
principal dimensions, and an exciting circuit in the interior of said resonator having an axis making substantially equal angles with at least two of said principal dimensions. Philip S. Carter, assigned to the Radio Corporation of America. Filed January 4, 1941, issued September 5, 1944. No. 2,357,314.

BH NON-FRAYING FIBERGLAS SLEEVING

BH EXTRA FLEXIBLE FIBERGLAS SLEEVING

2 WAYS BETTER

NON-FRAYING



NON-STIFFENING

ASSEMBLERS and electricians don't have to be contortionists when working with non-fraying BH *Extra Flexible* Fiberglas Sleeving. Remarkably resistant to stiffening, this always supple insulation won't crack or rot with age. Whether in tough, active service or dead storage, it remains "fresh" and easy to work, retaining its full insulating efficiency *indefinitely*.

This special-processed sleeving won't burn and is non-crystallizing at low temperature. It offers all the natural advantages of Fiberglas—high dielectric and tensile strength—chemical and moisture resistance—and many more—in addition to its own unusual properties.

You'll want to see for yourself the cleaner cutting, non-fraying and non-stiffening features of the sleeving that simplifies assembly, lasts longer and cuts repair costs. BH *Extra Flexible* Fiberglas Sleeving is available in all standard colors. Sizes from No. 20 to 5/8", inclusive. Write for *your* samples today and compare!

BH SPECIAL TREATED FIBERGLAS SLEEVING FLEXIBLE AS STRING!

Here's another high quality BH Fiberglas Sleeving. Due to the BH exclusive process no saturant is used, yet it will not fray out when cut and will withstand heat up to 1200°F. Made in natural color only—all standard sizes. Test it and try it!

BH PRODUCTS

NON-BURNING IMPREGNATED MAGNETO TUBING • NON-BURNING FLEXIBLE VARNISHED TUBING • SATURATED AND NON-SATURATED SLEEVING

BENTLEY, HARRIS MANUFACTURING CO.

Dept. R, Conshohocken, Penna.

Baseball game being televised. All major sports events will be brought directly to the home via television.

TELEVISION—as I see it

By Dr. Lee de Forest

This noted inventor presents the many economic problems confronting the television industry.

IN THE Foreword of my recent book, "Television Today and Tomorrow," I wrote:

"To see from a distance details that defy telescopic vision; to have sight through barriers, to recreate in the home, in a million homes, not merely messages and music for the ear, but actual scenes as they transpire miles beyond the horizon, across continents;

"To summon the apparition of loved ones far removed; to bring into one's room an athletic field, a race track, a ship sailing a far sea; in fireside comfort to meet and hear the nation's leaders as they counsel, instruct, and inspire; to annihilate space and separation, to enrich the home lives of modern millions through the medium of the mightiest miracle which science has ever yet conceived—

"This is Television!"

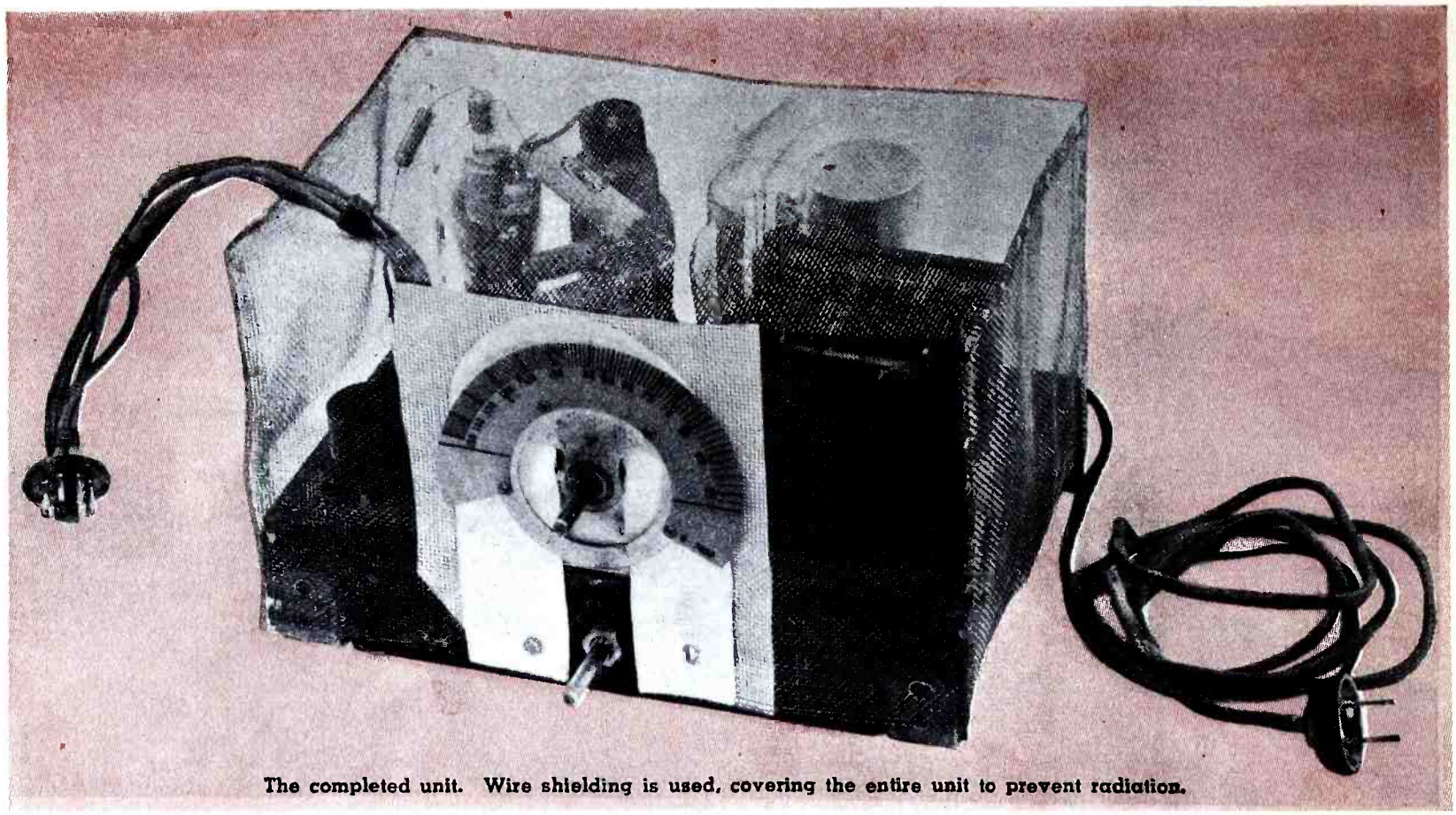
These glowing sentences briefly epitomize, in my opinion, the future scope and humanitarian possibilities of this youngest and most attractive of all the offspring of what now is known as Radio. This child, after a discouraging and tedious infancy, was growing into attractive adolescence during the last years of the second decade of the Electronic Era, when it was suddenly nipped in the bud by the total blackout imposed by our entry into this World War.

But in a hundred research laboratories intense, war-incited work along electronic lines closely akin to those involved in television has been carried on, advancing the knowledge of phenomena and principles needed for the vastly improved forms of television which science and technology will present shortly to an eagerly waiting world, once the obliterating war clouds have rolled away.

As was the case with radio after World War I, this war-incited development will be found to have hastened by many years the advancement of the television art, over what an orderly, peacetime evolution would have registered.

So we shall find shortly that the new television picture, like a butterfly, has broken out from the small conical-

(*Continued on page* 120)



The completed unit. Wire shielding is used, covering the entire unit to prevent radiation.

MODULATED SIGNAL GENERATOR

By G. H. WELLES

Inst., Radio Eng., AAFTTC

Easily-constructed 400-cycle modulated signal generator for use in aligning intermediate and broadcast frequency tuned circuits of radio receivers.

FOR many months, it has been impossible to buy a factory-built signal generator. From present indications, many more months will pass before such units will be placed on the market. Numerous circuits are available for constructing signal generators, but they all require either parts that are critical, or tubes that are impossible to get.

With these facts in mind, the writer set out to design and build a signal generator that would meet the following requirements:

1. The unit must use only parts that could be salvaged from old radio sets.
2. The output must consist of a modulated r.f. signal to cover the intermediate frequencies of superhets and the broadcast band in addition to a separate signal of audio frequency which is constant in intensity.
3. The circuit must be stable, and unaffected by line voltage changes or varying load conditions and use a minimum number of noncritical parts.
4. There must be a minimum number of controls with simplicity of operation.

For the above reasons it was decided to use electron-coupled oscillators and series modulation. By using these basic principles, it was found that the circuit could be built from a wide range of parts of noncritical value. The results were surprisingly successful.

Power Supply

A full-wave rectifier, using a minimum amount of filtering is used, due to the low current drain of the two tubes. The circuit of Fig. 2 is suggested for the sake of simplicity and the desired high-voltage output. Any power supply giving an output of 300 to 400 volts will do. If more filtering is needed it may be added, but in most cases the circuit of Fig. 2 will do.

Audio-Frequency Generator

The audio circuit is basically an untuned electron-coupled oscillator in which the screen grid of the tube acts as the plate of the oscillator section. The audio output is taken from the plate and has the advantage of the fact that the load in the plate circuit has no effect on the frequency of the oscillations. The oscillator tank circuit consists of an audio transformer with primary and secondary in series. Any audio transformer will be suitable. The condenser, C_1, (shown in the schematic diagram, Fig. 1) is a fixed condenser, the size of which will determine the frequency of the audio output.

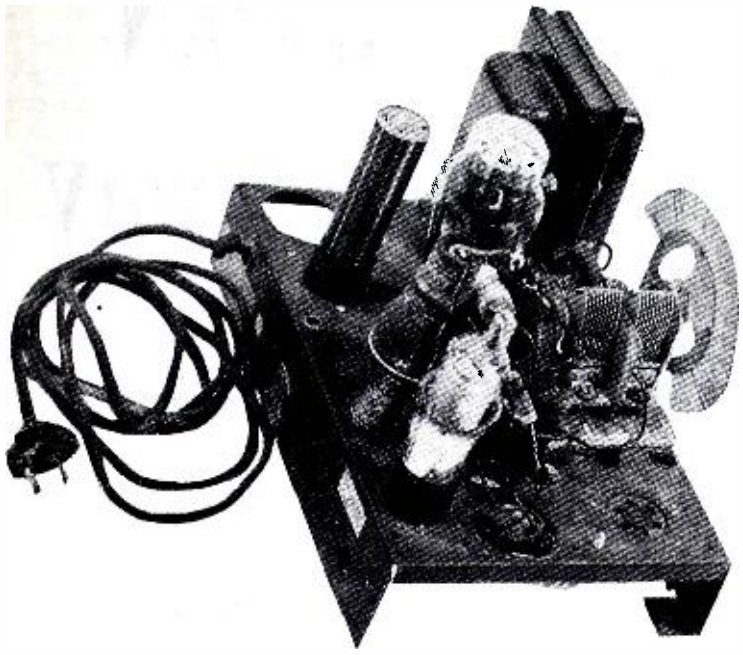
Radio-Frequency Oscillator

The r.f. oscillator is also of the electron-coupled type with the advantages previously listed. In the case of the r.f., it is also rich in harmonics. This fact is used to advantage in simplifying the number of coils used for band coverage. The tank circuit consists of a variable condenser salvaged from a broadcast receiver and a coil form to match which must be wound with sufficient turns of wire to give proper frequency band coverage to the tank.

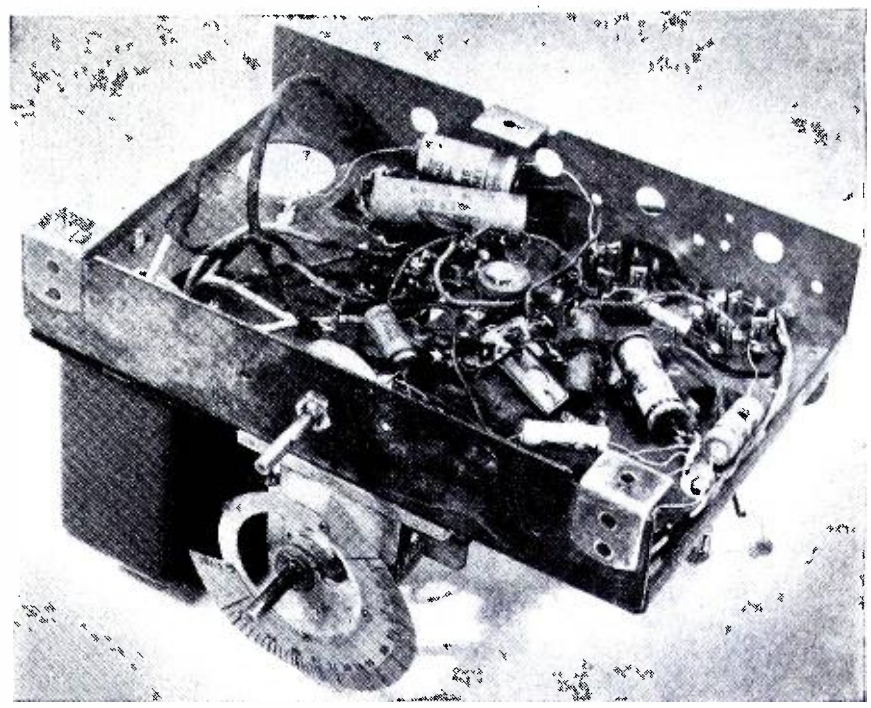
Modulation

The circuit uses the type of modulation known as series modulation, the two tubes being connected in series and plate voltage being applied to the plate of the r.f. oscillator. This causes the electron stream of the r.f. section to be modulated at an audio-frequency rate by the a.f. section.

The entire unit was constructed from parts salvaged from an old receiver,



Top view of chassis, showing component layout.



All r.f. parts and leads should be well shielded and separated.

but they may be substituted with other parts of like value or whatever may be available.

The r.f. chokes were made from an old i.f. transformer. In this case, the primary and secondary were mounted on a wooden dowel. By sawing this dowel, the two r.f. chokes were made. The coils were bank-wound and suited the requirements, both electrically and physically, as to space.

The audio oscillator coil is the output transformer of an old radio set, with the primary and secondary in series. The ends of the windings that will have to be connected must be determined by experiment. The condenser, C_1, will determine the frequency of the audio note, which should be about 400 cycles. Several sizes of condensers should be tried and the one giving the nearest to a 400-cycle note should be used.

Because the unit was to be shielded and the r.f. coil enclosed in a shielded can, it was decided to use only one r.f. coil so that the tank would cover the i.f. band on the fundamental tuning range and the harmonics could be used for the higher frequencies. The winding of this coil will have to be done by the builder and should be wound so that the low-frequency end of the band will be about 300 kilocycles. It may be wound for a lower frequency if desired. With 300 kc. at the low end of the dial, the i.f. frequencies of 455 and 465 kc. will be spread a considerable distance apart on the dial. For the coil winding, the wire was salvaged from an old speaker field coil. It is advisable to use the heaviest wire available in order to get the proper number of turns for the required inductance at the low frequency and at the same time to keep the d.c. resistance of the winding as low as possible. The coil used contained 300 turns of No. 30 enamelled wire, tapped at 90 turns and wound on a coil form 1 inch in diameter. If a larger coil form is used, a fewer number of turns will be needed. However, the builder will have to use the trial and error method in winding his coil, depending on the diameter of the coil form and the size of wire used.

Only one section of a two-gang variable condenser was used, the other section being shorted out. If a metal chassis is used and the condenser fastened to it, the condenser will have to be insulated from the chassis.

Tubes

Because tetrode tubes were available, they were used. Pentodes may also be used with the suppressor grids tied to the plates rather than to the cathodes. Pentodes will work with either connection but the plate connection seems to be the best.

Shielding

It will be necessary to enclose the r.f. coil in a shield can and also to shield the entire unit to prevent radiation. This may be done by soldering pieces of screen wire together to form a box that will just fit over the top of the unit.

The wire box should then be fastened to the chassis. A piece of screen also should be placed under the unit and grounded. A shielded output cable will be needed, also. This can be made by winding some fine magnetic wire around an insulated piece of heavier wire. The turns of the shielding wire should not be more than one-eighth of an inch apart. One end of the shielding wire is grounded to the chassis of the unit and the other end will serve as a connection to the ground post of the receiver under test. The heavy center wire, of course, will be connected to the antenna post of the receiver and will carry the output of the signal generator.

(*Continued on page* 101)

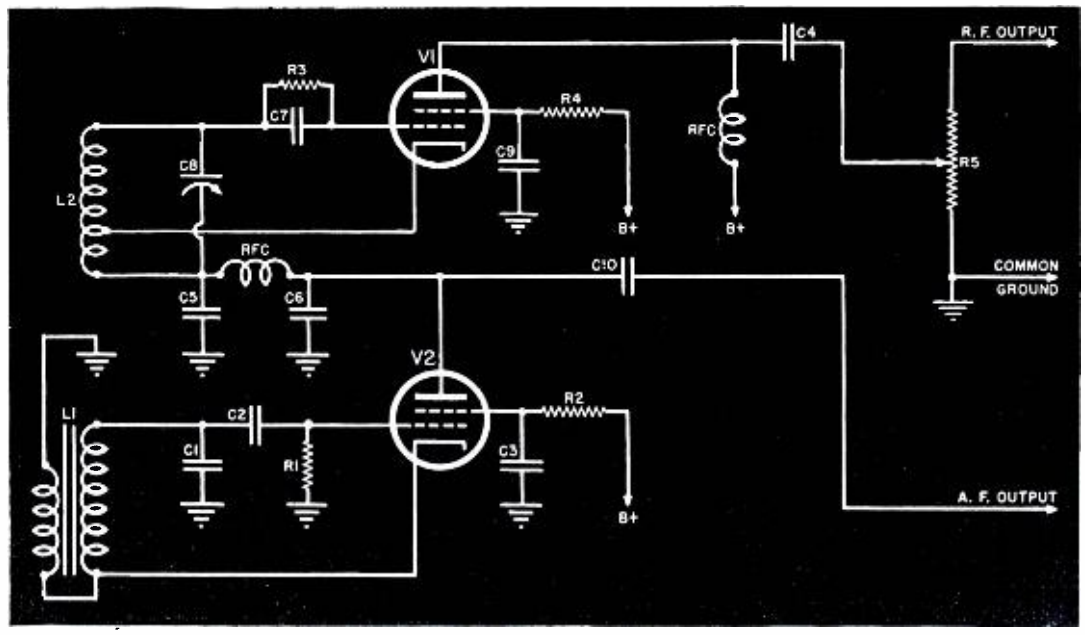


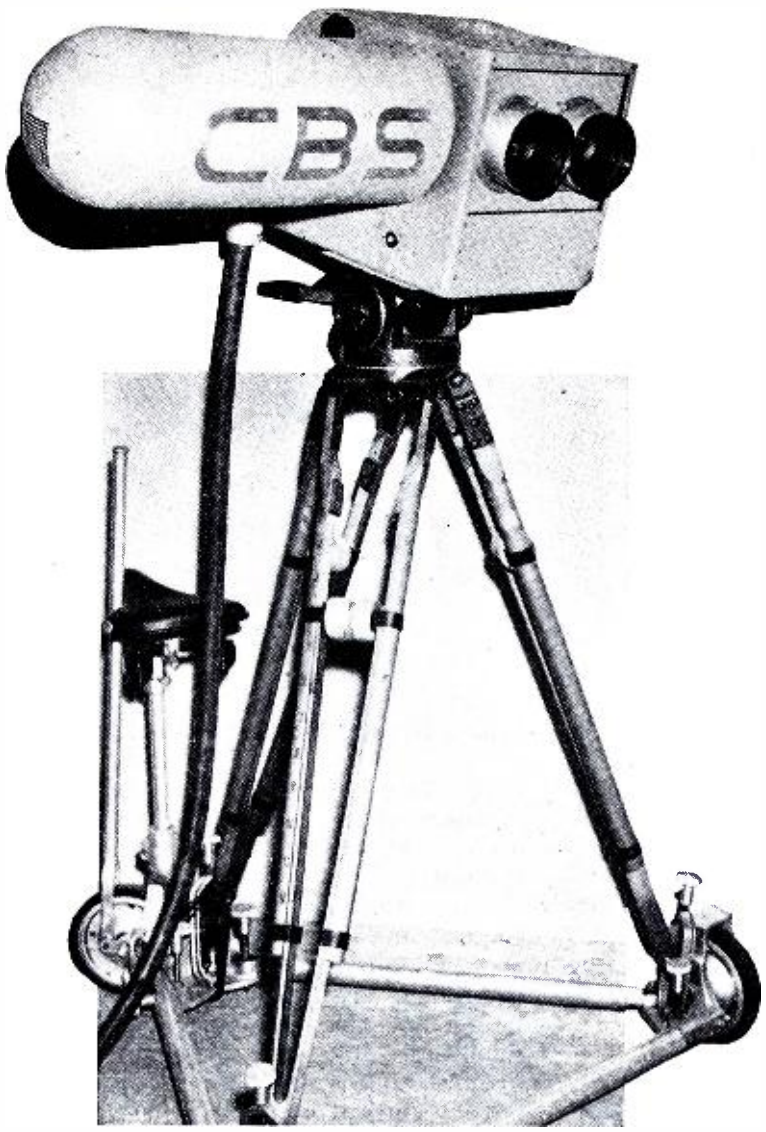
Fig. 1. Diagram of signal generator. Schematic for power supply is shown in Fig. 2.

C_1—(See Text)
C_2, C_3, C_9—.1 μfd. @ 200 v. cond.
C_4, C_5, C_6 C_7—.00025 to .001 μfd. mica cond.
C_8—365 to 400 μμfd. var. cond.
C_{10}—.1 μfd. @ 400 v. cond.
L_1—Audio trans.
L_2—Coil wound to match C_8
R_1, R_3—200,000 ohm, ½ w. res.
R_2—500,000 ohm, ½ w. res.
R_4—250,000 ohm, ½ w. res.
R_5—50,000 to 500,000 ohm pot.
V_1, V_2—Type 36 Screen grid tubes

TELEVISION For Future Airway Traffic Control

By THOMAS M. MORSE

A preview of the possible employment of television in conjunction with aircraft navigation and landing devices.



Orthicon color camera used for direct-color television pickup.

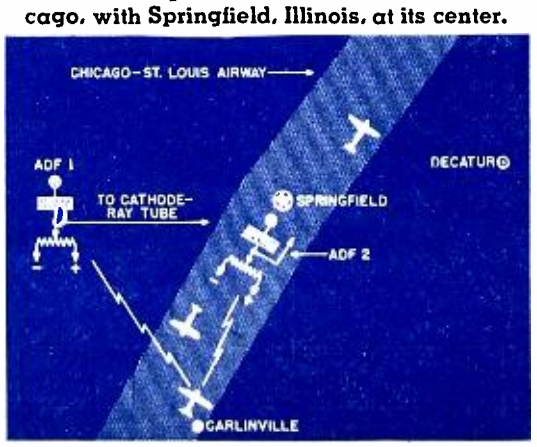
ACCORDING to the most recent reports, television is now an accomplished fact and, as such, it will begin a period of expansion for entertainment purposes soon after the war. Few have given much thought, however, to the part television may play in the development of various other commercial enterprises. The purpose of this article is to give a preview of its possible employment in conjunction with aircraft navigation and landing devices.

Let us assume that means are available by which it is possible for a ground radio station to obtain automatically a map-picture showing the positions and movement of all aircraft within a radius of, say, fifty miles. If this could be done, then it should be possible to televise this picture and transmit it to all aircraft in the area wherein it could be received upon a television screen. The enormous possibilities this would afford are evident at once. Aircraft would be able to see continuously not only their own position and movement over a given area but also the position and movement of all aircraft in this area. This would help to prevent possible collision and would greatly simplify the airway traffic control problem. Television is advanced enough at this time to enable its use in such a system. The picture being transmitted would be composed only of black and white with complete contrast between the two as will be seen later. High definition in the received picture would not be necessary. Television receivers for receiving such a picture can be made simple enough and light enough for use in all but the lighter aircraft, and probably at some future date will be suitable for use in all aircraft.

The next question may well be one regarding the method to be employed in obtaining the original picture showing aircraft positions in the area surrounding the ground radio station. It is possible to obtain such a picture by several different methods. One of the more interesting, uses conventional equipment in a manner that is not a military secret and which can therefore be described fully enough to provide our readers with an understanding of the method employed.

Referring to Fig. 1, it will be seen that it represents an area containing a section of the St. Louis-Chicago airway. Springfield, Illinois, is indicated as the center of this area. Now suppose an automatic radio-direction finder (ADF No. 1, Fig. 1) were located about twenty miles west of Springfield. This ADF would be tuned constantly to one predetermined frequency. If an aircraft commenced to radiate upon that frequency when it entered the area, its radiations would cause the loop of ADF No. 1 to rotate automatically until it faced toward the aircraft. The loop of ADF No. 1 thereafter would follow the aircraft as long as it was radiating. Geared to the loop and rotating with it would be a contact arm which would move to successive contacts, each having a different predetermined voltage (indicated by the potentiometer, Fig. 1). The voltage value imparted to the contact arm then would depend upon the position of the aircraft along the airway since the position of the aircraft would determine the position of the contact arm. This voltage value then could be transmitted by wire to the vertical deflecting plates of a cathode-ray tube located at the Springfield airport where it would help control the position of a spot of light on the cathode-ray screen (Fig. 2). The vertical position of this light spot on the screen would indicate the longitudinal position of the aircraft along the airway.

Fig. 1. Showing possible locations of automatic radio direction finders on a portion of the airway between St. Louis and Chicago, with Springfield, Illinois, at its center.



A similar ADF (ADF No. 2, Fig. 1) would be located at the Springfield airport and tuned to the same frequency as that of ADF No. 1. ADF No. 2 would obtain the voltage component to be applied to the horizontal deflecting plates for lateral positioning of the light spot. It can be seen, then, that if the aircraft moved to the right of the airway, the loop and contact arm of ADF No. 2 would follow it, and the resulting voltage applied to the horizontal deflecting plates would be such as to move the light spot to the

right of the airway on the cathode-ray viewing screen.

The cathode-ray viewing screen would have placed over it a transparent map upon which the main identifying features of the airway such as fan markers, mountains, etc., would be drawn in with luminous paint. Anything helpful to navigation could be shown on this map. For example, the pilot could obtain a longitudinal distance doublecheck as he passed over the fan markers (Fig. 2) because the fan marker indicator on his instrument panel should light up simultaneously with the entrance of the light spot into the fan marker symbol on the map. The cathode-ray viewing screen would be housed in a dark room so that maximum picture contrast could be obtained for good television scanning results. By using a fluorescent material of high persistency on the cathode-ray screen each spot would have a gradually diminishing "tail" of light which, by its "comet effect," would indicate the course of the aircraft.

Granted that the above described method will position one aircraft on the screen, the reader may well inquire as to the method to be employed in positioning several aircraft. In the case of several aircraft, the above procedure would be followed with the exception that several ADF's would be employed at each of the locations indicated in Fig. 1. Each pair of ADF's would position one spot of light on the screen or, in other words, each

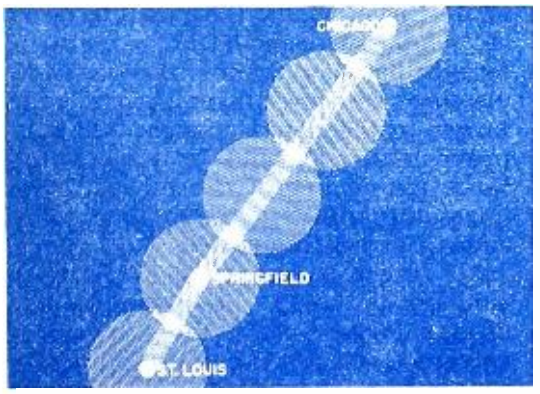


Fig. 3. With television equipment covering an area within a radius of 50 miles, a number of transmitters would be located along an airway to cover the entire aircraft route between cities.

pair of ADF's would position one aircraft. Each pair of ADF's would be tuned to a different frequency so that the pilot would have to select a radiating frequency not in use. Selection of the proper frequency could be simplified by having each spot of light on the screen visibly modulated with a certain specified number of flickers.

For example, assume there were ten frequencies available, then the light spot representing the fifth frequency would be modulated with five flickers occuring in rapid succession once each minute, and the light spot representing the tenth frequency would be modulated with ten such flickers. A pilot just coming into the area would thus know which frequencies were in use inasmuch as spots would not appear on the screen for those not in use and spots appearing would be identified. Push-button tuning would enable quick frequency selection. Ten frequencies would allow spacing of aircraft every ten miles over a one-hundred mile stretch of airway. Several aircraft could be indicated on the same screen by using a mechanical or electronic commutator to shift the spot rapidly from one aircraft position to another at a speed faster than the eye. The result would be several apparent light spots on the one screen, each representing the position of a different aircraft.

As the pilot left the Springfield area he would immediately enter another area "scanned" by another set of ADF's operating on different frequencies. It is thought that the very high or the ultra-high frequencies could be used for this work due to the line of sight distances involved. This would enable every alternate "scanned" area along the airway to use the same frequencies. The fact that line of sight distances are involved also would enable greater accuracy in the results obtained. Fig. 3 illustrates possible coverage areas from St Louis to Chicago.

One may wonder why impulses could not be transmitted directly from the ADF positions to the aircraft for the purpose of controlling meters calibrated directly in miles. It is true that this could be done but, by so doing, the main purpose of the entire method would be defeated; that is, its use for airway traffic control and collision prevention. If the above mentioned alternative were used, the aircraft pilot would know his own position along the airway at all times but he would not know the relative positions and course of other aircraft on the airway. It thus can be seen that the main objective is to compile the positions of all aircraft into one picture so that this one picture may be transmitted by television for use by all scheduled air traffic in the area. While this particular method of obtaining the map-picture is suitable only for scheduled aircraft along an airway, future developments will no doubt make it possible to position all aircraft on the screen whether they are on or off the airways. The third dimension (altitude) also may be added. Regardless of the method employed in obtaining the picture, the one thing evident is that the picture should be obtained on the ground and then transmitted by television to the aircraft.

Any distortion introduced into the television picture as received aboard the aircraft would not matter unless the distortion became extremely bad. For example, if the spot positions in the received picture were distorted, the other identifying features of the map would be distorted to the same degree so that the actual aircraft position still would be indicated with close accuracy. Equipment permanently located on the ground can be made extremely accurate at close

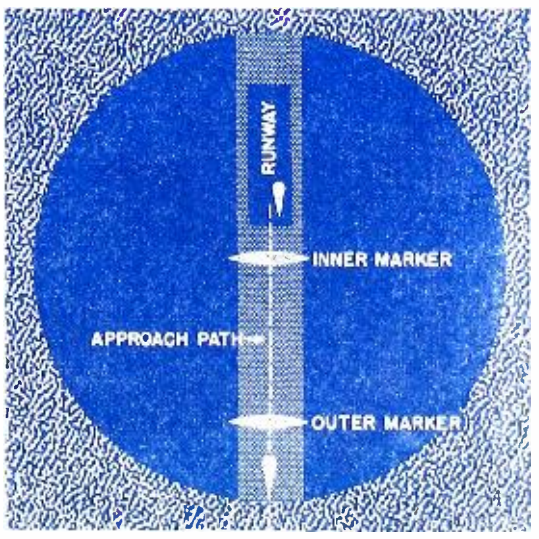
Fig. 2. A transparent map, covering an area within a radius of 50 miles, can be placed over the cathode-ray tube. Tailed light spots will indicate the location of aircraft within this area.

range. Television receivers aboard the aircraft also could be used for receiving pictures of any kind such as weather maps, printed messages, etc.

The aircraft equipment involved would not be excessive, being composed only of a low-power transmitter and a television receiver. In scheduled passenger planes a standby television receiver probably would have to be carried. Use of this television picture method would obviate the need for various other aircraft instruments and computations. For example, wind drift would not have to be computed. ADF equipment on the aircraft would not be necessary. Other collision warning devices on the aircraft would not be necessary. Air or ground speed indicators would not be needed. But most important of all, the great amount of voice transmission and confusion relative to airway traffic control would be avoided. With this method, the pilot would be in complete control of the traffic situation, but, since a duplicate picture of the air traffic would be available at the ground station, an operator located on the ground could keep track easily of all scheduled aircraft and broadcast a warning in case of a possible collision.

(*Continued on page* 124)

Fig. 4. Showing cathode-ray screen and map for instrument landing. It also would be possible to indicate the altitude of each aircraft on the same screen.



Television

By MILTON S. KIVER

Presenting the postwar television receiver—its design, operation, and installation.

Fig. 1. An RCA-Victor prewar television receiver. Although the cabinet design was modernistic, a larger viewing screen was very much desired.

TELEVISION for the American Home may be said to have started in 1939. In that year, several of the larger radio manufacturing companies put some models on the market for public sale. The reception accorded these was not widely enthusiastic for several reasons. First, the price of these receivers was far greater than what the average family can either afford to pay or cares to pay for a set. Secondly, people had been hearing so much about television for years without actually seeing a set that when one did appear, they approached it with a certain amount of skepticism. They assumed an "I'm from Missouri" attitude. And finally, but certainly not the least important reason, television as a form of entertainment does not compare with either the ordinary sound receiver or motion pictures. Even today there may be one, and at the most two or three television stations in our larger cities. These are generally on at night only, and then merely for several hours. It is true that the war has completely stopped television expansion, and had it continued at its prewar pace, might have reached a higher level of entertainment by now. Unfortunately, the purchaser is interested only in what he or she can obtain now, not what will be possible in the future. It is here that the greatest weakness of television lies and many millions of manufacturer's dollars will have to be spent before the public will respond with anything resembling enthusiasm.

The war has stopped the building of commercial television sets, but a definite amount of planning and experimentation is being carried on by many manufacturers in anticipation of the postwar market that will be available as soon as the war ends. Since it was felt that the radio serviceman and radio retailer in particular, and the rest of the radio public in general, would be interested to see just what some of the postwar television sets would look like, this article was written.

Radio Cabinets

Television receivers, in common with sound receivers, will become available in either console or table model cabinets. Fig. 7 is a photograph of the prewar table model television receiver, while Fig. 5 shows the possible design of the postwar model. The main difference between them is the size of the viewing screens, these being much larger in the newer models. This improvement will tend to remove to a large extent one of the biggest grievances the public voices against television. For continuous viewing, a large, clear screen is essential. For size, the cabinets probably will resemble some of our larger sound table model receivers. Certainly it can be appreciated that with a large cathode-ray tube, the

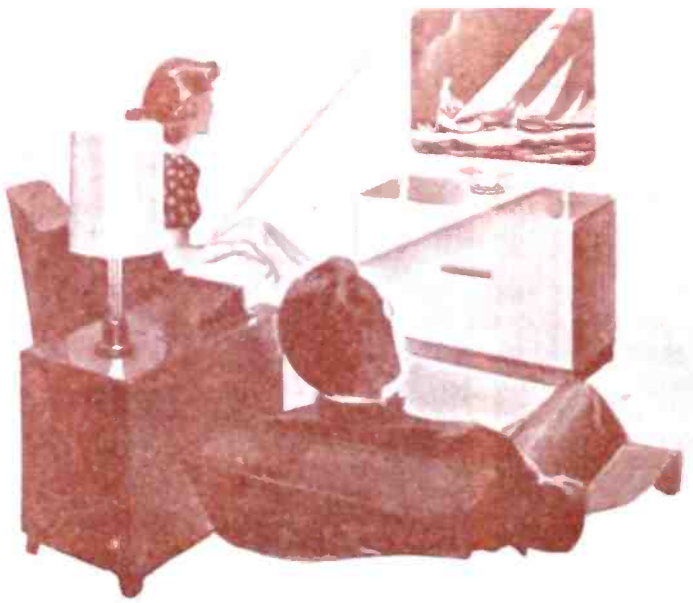


Fig. 2. Postwar television receiver proposed by GE that will permit the image to be projected onto a screen.

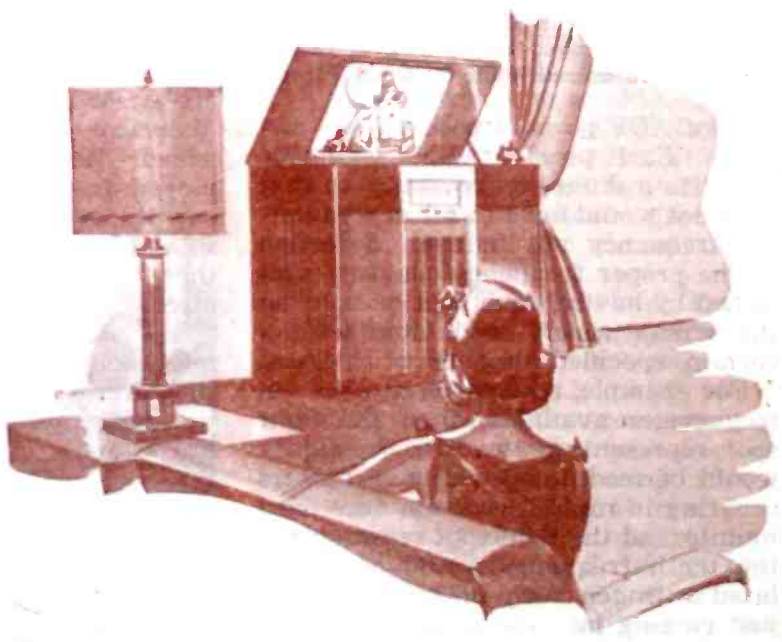


Fig. 3. Console television receiver proposed by General Electric. Image appears on uplifted lid.

RECEIVER DESIGN

Fig. 6. Console type television receiver that was marketed before the war by General Electric. The viewing screen proved to be too small for comfort.

depth and width of the cabinet will never reach the small 8" by 10" midgets we now have.

Inspection of Figs. 5 and 7 seems to indicate that no provision has been made for sound. In the prewar model of Fig. 7, sound was obtained by means of a separate unit. This, however, was not true of all prewar table models. Some, like the Andrea set, did contain both cathode-ray tube and speaker within one cabinet. The postwar trend will continue this, although the speakers will have to be of rather small diameter. However, since 90 per cent of the public seems perfectly happy with small 3 and 5 inch speakers in our present midget sets, this should prove no obstacle. With a large viewing screen, the speaker probably will be shunted to the side.

On the larger floor models, we find the same general trend toward larger, better illuminated screens. Figs. 1 and 6 are photographs of prewar television console cabinets. These larger sets have a greater number of controls (soon to be explained) than the smaller models, but these are kept around six for convenience in handling by the nontechnical, inexperienced layman who will use the set. Figs. 3 and 4 are views of the postwar models, built along similar lines as the above, but with a larger viewing screen. The set pictured in Fig. 4 also contains a record-player, giving it a wide versatility. It may, in addition, incorporate a small AM sound receiver and thus do away with the necessity for having several sets scattered about the room to serve various purposes. Compactness will add much to the value of these receivers.

The final postwar receiver represents a phase of television that has, in the author's opinion, greater possibilities than any of the preceding sets illustrated in this article. This is the set shown in Fig. 2. It contains a tube which will permit large images to be focused on a screen, or what is more preferable and practical, the wall of the room on which it is placed. This arrangement will allow greater pictures to be obtained, and may even lead to television replacing the movies to a large degree. Certainly many people would prefer to sit in the comfort of their own living rooms and view the latest motion picture rather than travel a certain distance to see it in a crowded public playhouse. However, whether or not this will ever occur is not of interest here. The important point is the fact that modern television has reached the stage pictured by the receiver of Fig. 2.

Number and Type of Controls

Since the television receiver will be used by everyone, its controls, of necessity, must be simple in operation. And yet, these controls must be sufficient to permit the user to vary the focus, brightness, and contrast of the picture image to his taste. These, of course, will be in addition to the usual volume and tone controls of the sound receiver. Little need be said of the already familiar purposes of sound volume and tone controls and these may be dispensed with no further explanation.

Of the new controls that will confront the user of the television receiver, perhaps the simplest to understand is the focusing control. By varying the position of this knob the picture on the screen may be brought into sharp focus. Once set for any station, or even all stations, it requires no further attention. Actually, in a well-designed cathode-ray tube, the only way that the picture may go out of focus is through variations in the direct current or voltage that are applied to the focusing electrodes. With a well-regulated power supply it is even possible to shift the position of the focusing control to some easily reached section at the rear of the chassis.

The contrast control for the television receiver may be compared, in a

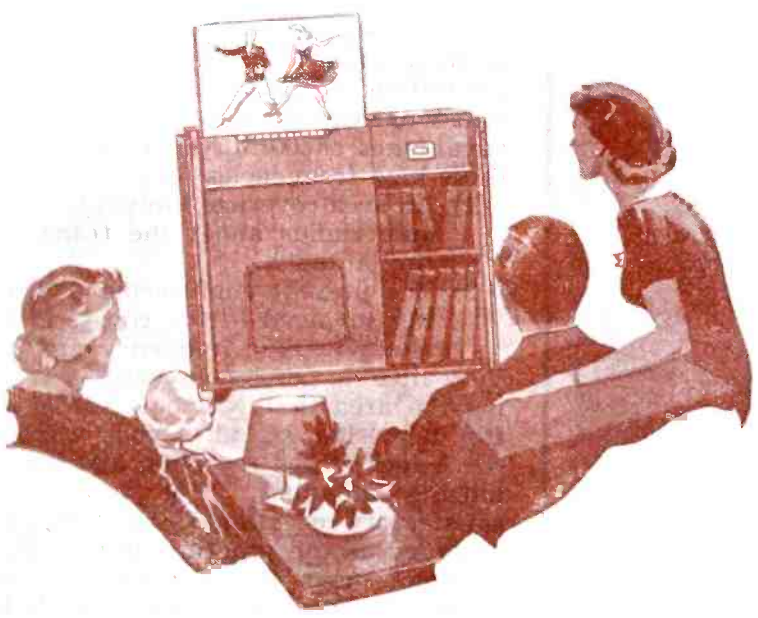


Fig. 4. Console-type television receiver proposed by General Electric for postwar market.

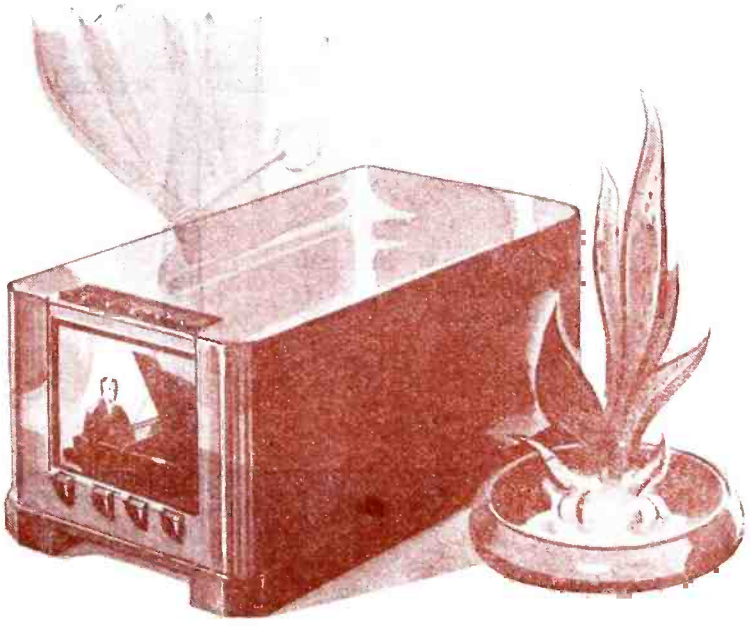


Fig. 5. Table model television receiver. Note the size of the screen, compared to the console type.

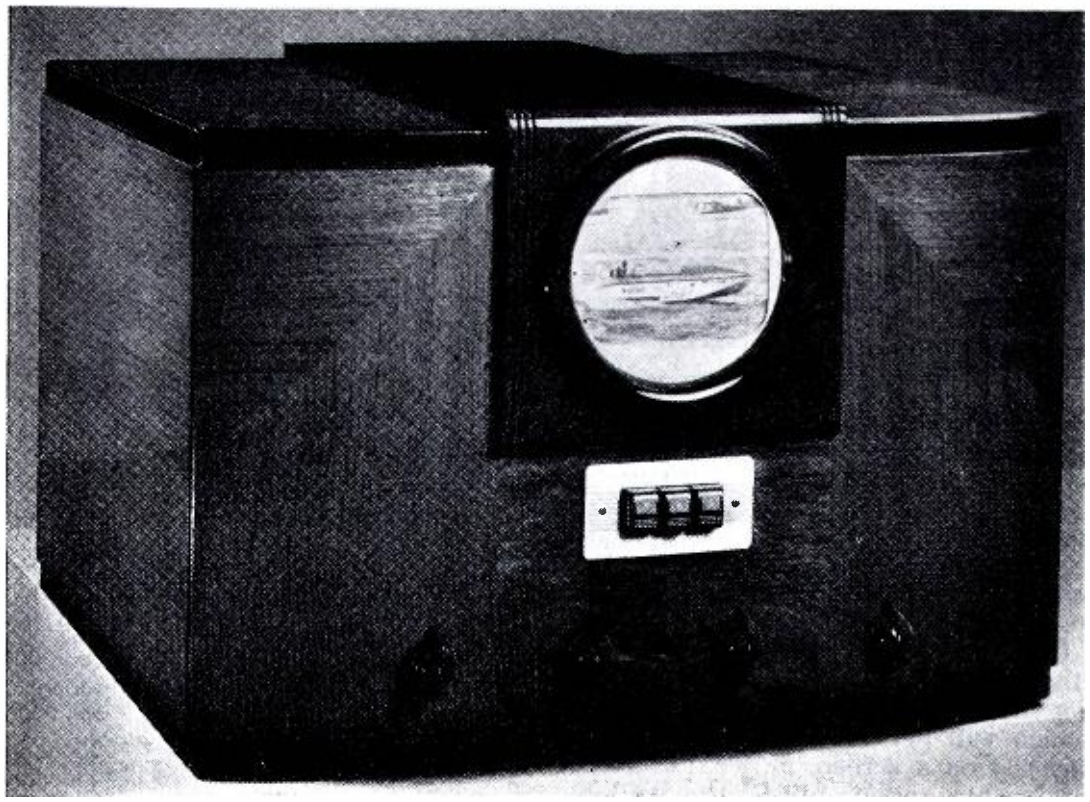


Fig. 7. Small, inexpensive table-model prewar television receiver.

sense, to the volume control of a sound receiver. Through its use, the observer may increase (or decrease) the intensity of the various elements of the reproduced image. As the control is advanced, the contrast between the bright and dark portions of the picture may increase somewhat, but the main object in increasing this control is to cause the picture illumination to become more intense. This would be necessary in a room where the average surrounding light is high. In the evening with the room semidark, the required picture brightness is not as great and it would be possible now to decrease the intensity of the image. The variation of the contrast control is related directly to the gain of the receiver, and most designers place this potentiometer in the grid bias circuit of one or more tubes. Raising the negative voltage on the grid of a tube will have the effect of lowering the gain of this stage.

A third control that is tied in with the adjustment of the contrast control, is the brightness potentiometer. The purpose of this knob is to bias the grid of the cathode-ray tube so that the electron beam is prevented from reaching the fluorescent screen whenever it moves rapidly from the right-hand side of the image to the left-hand side. The beam, if allowed to impinge on the screen during those periods when it is being brought back to the left-hand side of the image, would cause retraces to be visible on the screen. Since the signal, during these retrace periods, does not contain any picture information, it is cut off by blanking pulses. The proper adjustment of the brightness control will just bias the grid so that no retraces are visible.

The effect of an improper setting of the brightness control on the reproduced image may be seen by an example or two. Let us suppose that the contrast control is set at a low position. If the grid bias on the viewing tube is too high, as determined by the position of the brightness control, then not only will the electron beam be cut off when it is moving back to the left-hand side of the screen, but also at other times, when the darker sections of the video signal act at the cathode-ray tube grid. The effect, then, of too great an advancement of the brightness control is to decrease the contrast of the picture and eliminate (or obscure) some detail of the image. Another example already has been mentioned in the preceding paragraph where it was explained that too low a bias on the viewing-tube grid will permit the return traces to be visible to an observer.

These three controls have been described in detail because they are the most important video knobs on the television receiver. It is true that different manufacturers may provide others, but the above represent the necessary basic controls.

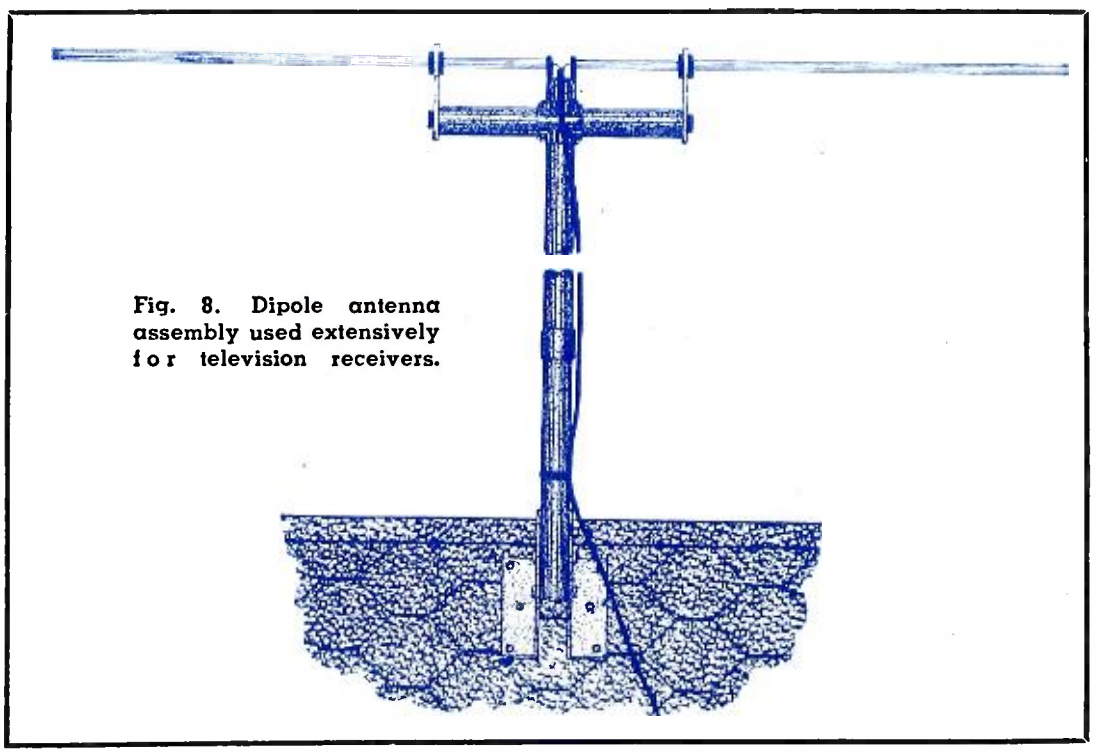


Fig. 8. Dipole antenna assembly used extensively for television receivers.

Tuning the Television Receiver

At present, a television signal, containing the video and audio carriers and sidebands, occupies a 6-megacycle bandwidth. Hence, stations must be separated by at least this frequency difference. The 5 channels that are in use at present have the following frequencies:

1) 50-56 mc.
2) 60-66 mc.
3) 66-72 mc.
4) 78-84 mc.
5) 84-90 mc.

To cover this range of frequencies adequately with one coil and condenser may be electrically possible, but not satisfactorily practical for television reception. Hence, switching arrangements or push-button tuning is adopted and this is seen by inspection of the models given in Figs. 1 through 7.

Use of these high frequencies for television is necessary because of the 6-mc. bandwidth that the signal occupies. Lower frequencies could be used, but other services already occupy most of these and, hence, television, which arrived on the radio scene last, had to take what was available. The big disadvantages encountered by the use of these high frequencies are:

1) An area coverage limited to a 75-mile radius about the transmitting antenna.
2) The present engineering difficulties involved in the construction of stabile high-frequency circuits.

Very little is possible toward increasing the area that will be affected by the television signal beyond raising the height of the receiving and transmitting antennas. For continuous satisfactory reception, 75 miles may be regarded as the practical limit. This does not mean that receivers placed beyond this distance will be unable to receive the signals of that particular

(*Continued on page* 144)

Television Industry Prepares for Postwar

By JAMES H. CARMINE

Vice Pres., Merchandising, Philco Corp.

The radio industry has invested approximately $25,000,000 in research and development to prepare television for the postwar public.

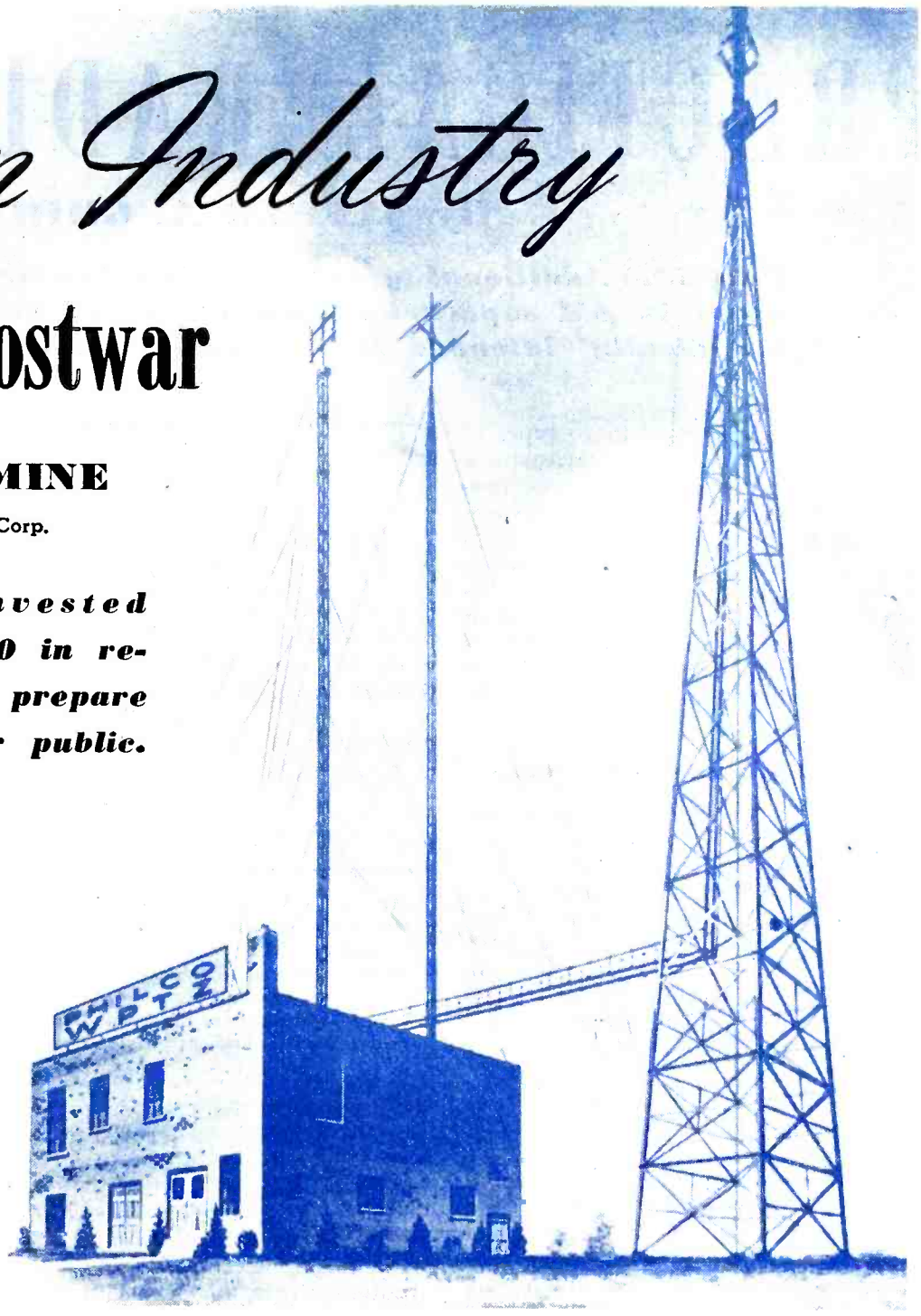
PROBABLY never before has the product of a great new industry been so completely planned and so highly developed before it was offered to the public as has television. The best evidence that the public thinks well of television is the universal response that comes from those who have a chance to see it. As soon as television receivers can be made and sold, the public most likely will eagerly buy them in tremendous quantities.

A recent consumer survey revealed that 86% of the people would like to have a television receiver in their homes. Few, if any, postwar wants are more general.

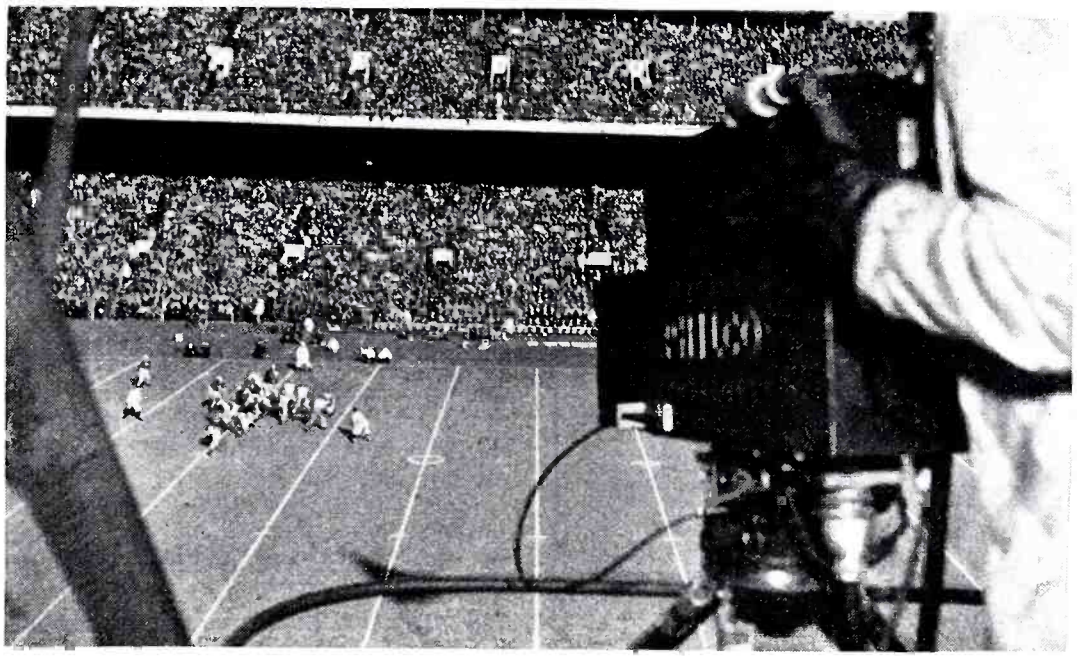
Because it is a highly technical scientific instrument, a television receiver, to operate properly, must be installed by skilled personnel and serviced by those who are especially trained in this work. Here again television will start off with a great advantage over automobiles, radios, and all our modern household appliances in that a large body of experienced personnel, who have had the benefit of Army and Navy radio and high-frequency training, will be ready to handle installation and service as soon as the war is over. It is estimated that the number of these experienced servicemen, who can be given the latest television information very quickly, is close to 20,000. Their availability and desire to get into television will give a tremendous stimulus to the video art.

Over and above its postwar employment opportunities, television will make great contributions to the public welfare in the fields of education and entertainment. By combining sight with sound, television is the ideal medium for the transmittal of ideas and intelligence. It is the next best thing to talking with a teacher face-to-face.

(*Continued on page* 128)



Philco Television Station, WPTZ, Philadelpha. Shown from left to right are the ultra-high-frequency relay receiving antenna; the New York sound receiving antenna; and the main WPTZ picture and sound transmitting antenna.



Station WPTZ picks up a football game at Franklin Field, Philadelphia. Philco has been televising these games for the past five consecutive years.

PRACTICAL RADIO COURSE

By ALFRED A. GHIRARDI

Part 30. Additional types of spurious interfering responses that can occur in AM superheterodyne receivers, including design features specifically intended to minimize these interfering signals.

THERE are several more types of spurious interfering responses that can occur in AM superheterodyne receivers unless proper precautions and preventative measures are taken in the design of the receiver. As is true for the types already discussed, the relative importance of each one depends upon the particular interfering-station conditions that exist in the locality where the receiver is to be operated.

Signal-Harmonic Interference

Because of the stringent regulations imposed by the Federal Communications Commission, the strength of the signals at harmonic frequencies emitted by modern broadcasting transmitters is very small in comparison with the power of the radiations at the *fundamental* carrier frequency. Consequently, in most cases the actual harmonics received *directly* from these transmitters cause little interference.

However, it is possible for the second harmonic of a strong incoming signal to be *generated in the receiver itself* through grid rectification taking place in either an r.f. tube or the mixer tube, if the incoming signal has sufficient amplitude to override the grid bias applied to the tube, thus causing it to operate over the lower bend of its grid voltage-plate current characteristic. This produces a distorted plate current signal waveform that contains an undistorted *fundamental* and a *second harmonic* frequency component, as illustrated in Fig. 1. The effect of this action will be exactly the same as if the harmonic

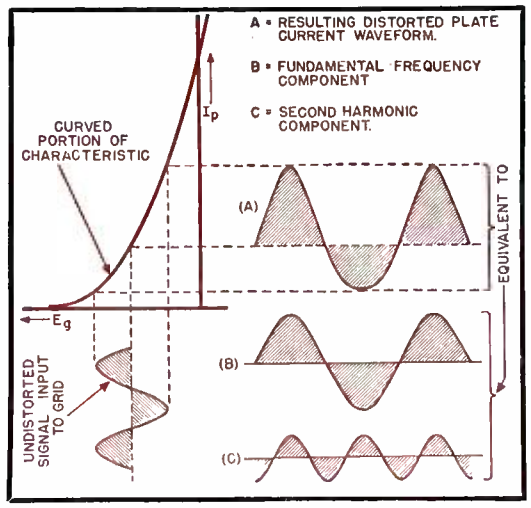


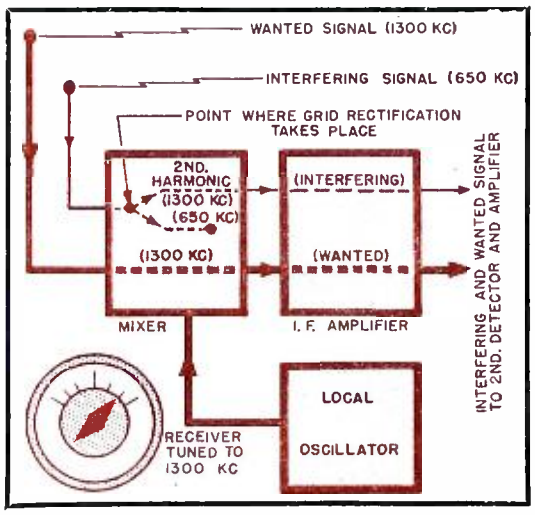
Fig. 1. How a distorted plate-current waveform (equivalent to an undistorted fundamental frequency and a second harmonic) is produced by an incoming signal strong enough to cause the r.f. or mixer tube to operate over the lower bend of its grid-voltage plate-current characteristic.

originated at the transmitter, except that such locally-generated harmonics will be produced only by the stronger incoming signals.

Spurious interfering responses may result through such harmonics beating with incoming signals, if the proper frequency relations exist. For example, as illustrated in Fig. 2, the second harmonic of a strong 650-kc. interfering-station signal would be 1300 kc.; and if the harmonic possessed a relatively strong intensity it could spoil reception from a 1300-kc. station to which the receiver might be tuned. The effect would be the same as simultaneously receiving two strong stations on the 1300-kc. channel, one interfering with the other. The second harmonic of a much higher frequency signal, say one of 1200 kc., would not cause such interference, for since its frequency (2400 kc.) is outside of the broadcast band it would not interfere with any other broadcast-band station being received.

Proper receiver circuit design, including the use of well-designed preselection and super-control type tubes in the r.f. stages, provide a satisfactory solution to the problem of preventing interfering harmonics from being developed within the receiver itself. Receivers so designed rarely are troubled by this form of spurious response. Also, it is advisable to restrict the r.f. stage gain to that amount giving adequate reduction of internal noise, as previously mentioned. Attention to oscillator design also is important.

Fig. 2. How interference may develop in a receiver, due to the production of the spurious second harmonic of an interfering signal, if grid rectification occurs in the r.f. amplifier or mixer tube.



In those unusual cases where the interfering harmonic signal originates at a transmitter, it arrives at the receiving aerial as actual *radiated* waves, and produces a signal current in it—this signal current appears in the antenna circuit along with that of the "desired" signal. Therefore, in such cases the interfering harmonic signal cannot be reduced in strength by any method at the receiving station without simultaneously and similarly reducing the strength of the wanted signal—since they both are of the same carrier frequency. Consequently, regardless of the receiver design, such an interfering harmonic signal will be passed through and reproduced by a receiver that possesses adequate sensitivity.

Occasionally a condition will be found where the second harmonic of a powerful local long-wave transmitter (the harmonic being either actual, or generated in the r.f. or tube circuit of the receiver) may fall within the frequency band accepted by the i.f. amplifier and thus cause code interference. For example, if a receiver employs an i.f. of 460 kc., a local 230-kc. station might be heard at all points on the tuning dial. This undesirable condition could be produced because the second harmonic of the 230-kc. carrier (460 kc.) gets through the preselector. A more likely situation is that the 230-kc. signal gets through the preselector, and the second harmonic of it is created by the mixer tube because of its rectifying action. This second harmonic, being of the i.f. value and carrying the modulation of the original code signal, passes through the i.f. amlifier and produces the code interference.

Oscillator-Harmonic Interference

In our discussions thus far, we have assumed that the local oscillator is feeding only its *fundamental* frequency of oscillation to the mixer or frequency-converter. This is substantially so for most well-designed superheterodynes. In many cases, however, especially when the oscillator and its coupling circuit are poorly designed, harmonics of the oscillator (usually only the *second* harmonic is comparatively strong) may reach the mixer or frequency converter. In such cases, various combinations of the oscillator fundamental frequency and its harmonics with the incoming signals result. Whenever the resulting frequency falls within the frequency band accepted by the i.f. amplifier, the

resultant output will pass through the i.f. amplifier, 2nd detector, audio amplifier, and loudspeaker—and will be heard as an interfering signal along with the desired signal to which the *fundamental* of the oscillator is beating. This form of interference is called *oscillator harmonic interference.* Because it is within the control of the receiver designer, in well-designed receivers it usually is less serious than the other forms.

Short-wave code or short-wave broadcast station signals often are received on the standard broadcast tuning band of superheterodyne receivers because of this action, and usually together with broadcast-band station signals. Interference results! Radio amateurs and short-wave broadcasting stations accordingly are blamed for spoiling the broadcast-band reception, when the real trouble lies in the fact that the broadcast-band receiver does not provide adequate preselection.

The following examples, and Fig. 3, will illustrate how this can happen in the case of a broadcast-band receiver employing an i.f. of 455 kc.—the receiver being assumed to be tuned to receive the signal of a 1,000-kc. broadcasting station.

Desired Signal:

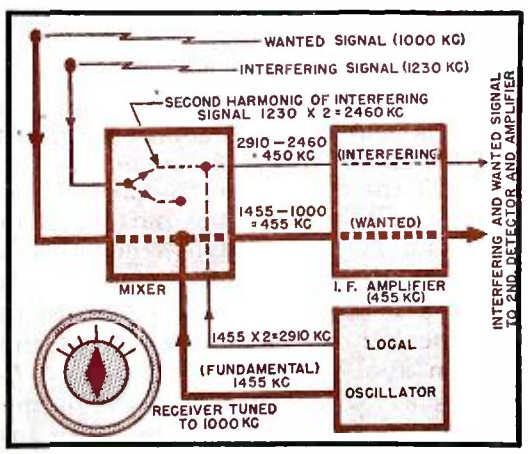
Oscillator	—	Signal	=	I.F.
(1,455 kc.)		(1,000 kc.)		(455 kc.)

The 2nd harmonic of the 1,455-kc. oscillator frequency = 1,455 × 2 = 2,910 kc. This 2,910-kc. oscillator output can beat with incoming signals of either of two frequencies to produce the required 455-kc. i.f. frequency, thus:

2,910 kc. — 2,455 kc. = 455 kc.,
and 3,365 kc. — 2,910 kc. = 455 kc.

Consequently, signals from stations of 2,455-kc. and of 3,365-kc. frequencies also can be received when this receiver is tuned to the signal of a 1,000-kc. station, and will be heard along with it if they are strong enough to get through the preselector with sufficient strength.

Fig. 4. How interference may develop in a receiver, due to the second harmonic of the local oscillator beating with the locally-produced second harmonic of an interfering signal, to produce a beat note equal, or almost equal in value to the i.f. frequency of the receiver.



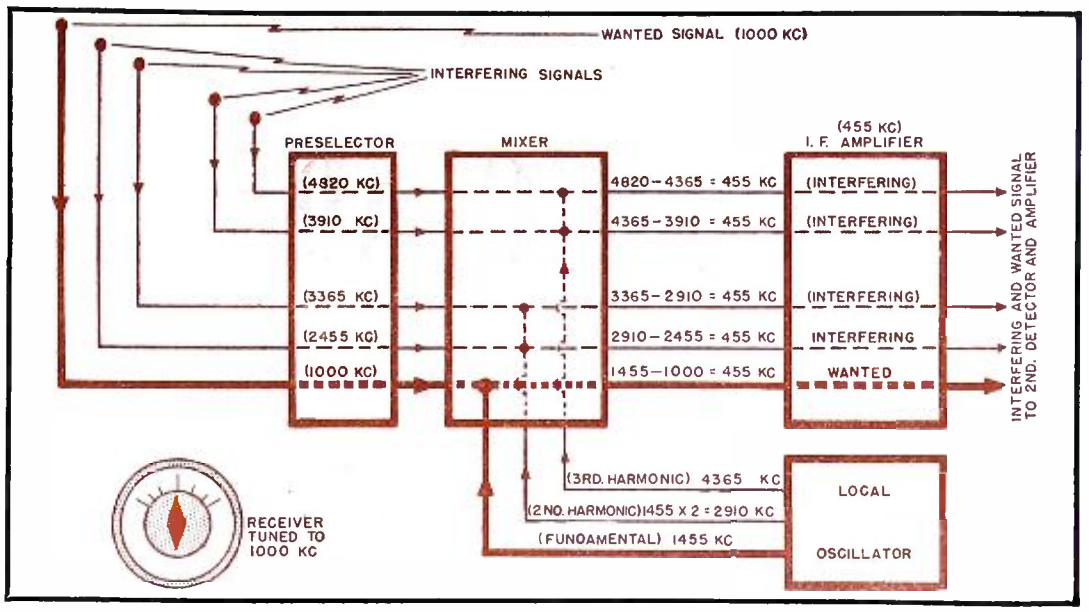


Fig. 3. Showing how interference may develop in a receiver, due to harmonics of the local oscillator beating with interfering higher-frequency signals that get through an insufficiently-selective preselector.

Similarly, since the 3rd harmonic of the 1,455 kc. oscillator frequency is 4,365 kc., we have also:

4,365 kc. — 3,910 kc. = 455 kc.,
and 4,820 kc. — 4,365 kc. = 455 kc.

Therefore, signals from stations of 3,910 kc. and of 4,820 kc. also can be received at the 1,000-kc. tuning dial setting if they get through the preselector with sufficient strength.

The received signals of these higher-frequency interfering stations, of course, will be greatly attenuated by the preselector, since there is an appreciable per cent difference between their frequencies and that to which the receiver preselector circuits are tuned. Consequently, the reception of interfering stations due to oscillator harmonics generally is limited to very close or powerful stations such as local amateur, police, commercial, or government code or phone stations whose signals may be able to get through the preselector with sufficient strength to cause interference.

Spurious reception of this type is most prevalent on receivers employing loop antennas, because *electrically* a loop antenna has the character of a long line having several secondary resonances in addition to its fundamental tuning resonance. The secondary resonance effects may fall into the proper short-wave frequency bands, thus helping to provide substantial gain at these frequencies and causing an appreciable level of interfering short wave signal to appear at the first stage of the receiver.

Oscillator harmonic interference can be identified by the fact that the frequency of the interfering signal is either *above* or *below* the second harmonic of the oscillator frequency by an amount equal to the i.f. (harmonics above the second are usually so weak that they may be neglected).

If the receiver employs a loop antenna, the following remedies should be tried.

(1) Orient loop for minimum pickup of interfering station.

(2) Realign loop circuit and other preselector circuits carefully.

(3) Substitute a conventional aerial-ground system and antenna coil for loop antenna.

It is apparent that preselection will reduce the magnitude of this form of interference by decreasing the magnitude of the unwanted components

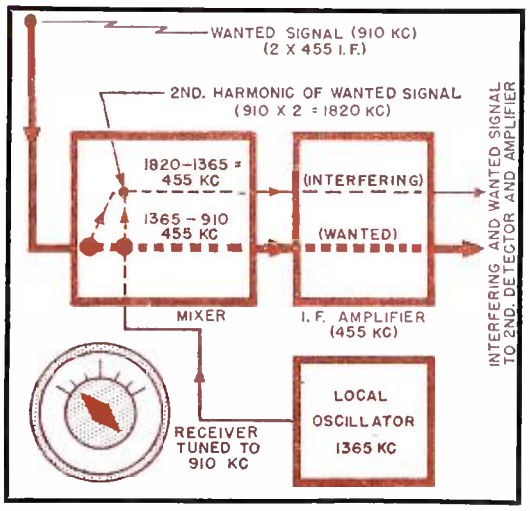


Fig. 5. Illustrating how interference may occur when receiving a signal whose frequency is twice that of the i.f. of the receiver, through the formation of a spurious second harmonic of the wanted signal.

prior to the process of frequency changing. Such components as will beat with the harmonics of the local oscillator are detuned from the fundamental by approximately $N \times 100\%$ (where "N" is the order of the local harmonics) so that the presence of a single tuned circuit will invariably remove this type of interference, or reduce it to negligible proportions. Aperiodic (nonselective) input circuits to the frequency-changer will, on the other hand, show this type of interference very strongly, even when elaborate care has been taken to reduce the oscillator harmonics to a minimum, and in such cases it may prove to be even more serious than image interference.

In cases where only a *single* station causes this type of interference in a

(*Continued on page* 88)

Servicing

PUBLIC ADDRESS EQUIPMENT

By WILLARD MOODY

Many radio service-dealers, employing skilled technicians, will find great opportunities in repairing and maintaining sound equipment.

THE elements of a public-address system are the sound pickup, amplifier, and sound radiators. Between each element there is a link, a cable which might be thought of as the fourth element. Any one, or all of these elements may break down in service and cause failure or unsatisfactory operation of the system. This discussion is intended to deal primarily with the *maintenance* of existing equipment, not *installation* problems. It is assumed that at one time or another the apparatus was functioning correctly and that now it has developed trouble. By cause and effect reasoning, a rapid, efficient solution may be reached to a servicing problem, in contrast with inefficient hit-or-miss methods.

The first step is recognition of the trouble and confirmation of the owner's complaint. In many cases this procedure will be absurdly simple: the owner may say, "My amplifier is dead." To him the amplifier may be dead, but to you the amplifier may or may not be and it is your job to discover the truth technically. It may be an open lead in a cable, an open voice coil circuit in a speaker, or, indeed, it may be something haywire in the amplifier. But whatever it is, localization of the trouble to the defective stage is necessary, and some means of performing that localization is required.

One simple and quite effective method involves the use of a technique commonly called "circuit disturbance testing." Referring to Fig. 4A, we have a block diagram of a typical, simple amplifier system. The sound waves striking the microphone diaphragm develop within the mike an electrical signal which is applied to the preamplifier input. This amplifier builds up the signal and feeds a succeeding amplifier, which further raises the energy level sufficiently high so that the signal can drive a loudspeaker. This block diagram could apply either to a very-low, medium, or high-power amplifier system equally well. In effect, we have an electrical chain and the signal goes through the system from input to output. If any link in that chain develops a defect, the signal will not pass through normally and satisfactory performance from the equipment, of course, will not be obtained.

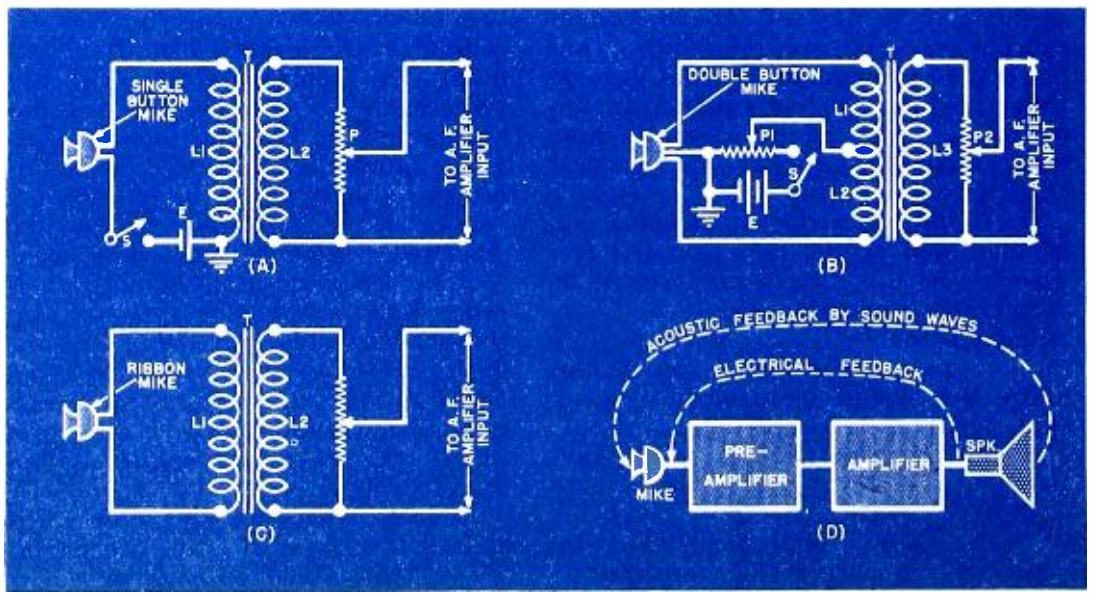
In making the circuit disturbance tests, you can work from the output back to the input, or you can work in the opposite direction from the input to the output. In servicing this equipment, it usually is faster to work from the input back to the speakers. For example, with the gain control of the amplifier turned to maximum, considerable background noise should be heard and if the mike is tapped lightly with your finger the resulting sound output from the loudspeaker, or loudspeakers if more than one speaker is used, will in many cases sound like rumbling thunder, or at least will be clearly audible.

Let us assume the complaint is that the equipment just is not working. Other faults, which will be discussed, are those of excessive hum level, oscillation (squealing and motorboating), and noise.

If no sound is heard when the mike is tapped with your finger, but a sound is heard when the first audio grid circuit is opened and closed, the defect probably lies in the mike circuit. Instead of tapping the mike, of course, you could simply speak into it or whistle into it. In the case of carbon button mikes, the carbon may pack, and tapping the mike lightly may restore operation, shaking loose the frozen carbon granules. In the case of ribbon mikes or other types, such troubles usually are not experienced and the defect may be simply a loose connection on the mike itself or a break in the cable connecting it to the equipment. When some unskilled person has tampered with the apparatus, look for a wrong connection of the cable to the amplifier, or some obviously simple and foolish defect, such as having the mike plugged into the wrong jack.

A basic single-button carbon mike circuit is shown in Fig. 1A. These mikes are not commonly used in modern public-address work because of their high noise level and comparatively poor fidelity. However, they have a high output voltage and may be used in some emergency equipment or other special apparatus where a great amount of preamplification is not desirable because of space limitations or other factors. In testing this circuit, with the amplifier on, if no sound is heard when the mike is tapped or spoken into, try disconnecting the leads of the mike from the circuit and then simply connect the battery *E* to the primary L_1 directly. When this is done, if the amplifier system is all right, a loud click should be heard in the speaker. The reason is that the sudden application of a voltage to L_1 causes a rise in current through the primary, with a rise in the flux in-

Fig. 1. Circuit diagrams showing method of connecting a single-button microphone (A); double-button microphone (B); and ribbon-type microphone (C). (D) shows how electrical and acoustical feedback could be obtained.



tensity, and a transient voltage is induced in L_2 and amplified by the remainder of the equipment. Note that the gain control must be set well up or you will not get the signal through the system.

Assuming that the click is not heard when you make and break the circuit, the trouble may be that L_1 is open or the battery E is very weak. By temporarily substituting a new battery, or checking the voltage across E with a voltmeter, you can determine whether the battery is all right. It also would be possible to make a rough test by connecting an ordinary earphone across E, and listening for a loud click, to determine the condition of E. To check the secondary circuit and the whole input system, the phone could be connected across L_2 and loud clicks should be heard when the primary source voltage E is connected and disconnected.

In servicing, a quick routine check of the windings could be made easily with an ohmmeter and would occupy only a few seconds of time. Very seldom do you find that the transformer windings are shorted; usually they are open when trouble exists. In some cases, the leads to the two end terminals of P may be shorted, killing the signal, and visual inspection or an ohmmeter test will show up that trouble. If the resistance of P is to be checked, one lead of L_2 is disconnected to prevent a shunting effect and an inaccurate reading.

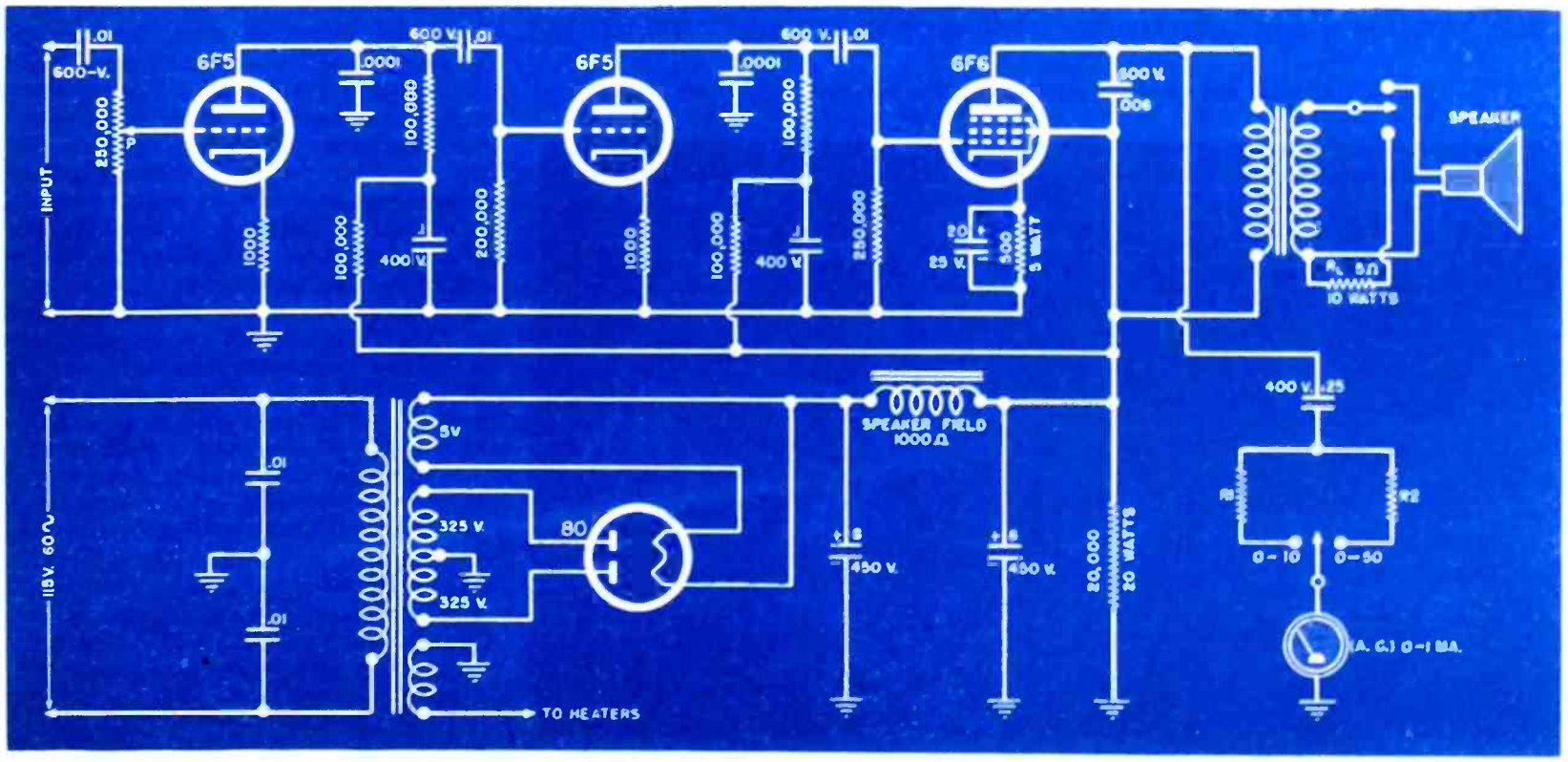
In many modern amplifier systems, velocity and other types of mikes are used, but before considering them, let us check briefly on that old standby the double-button carbon mike circuit. It is shown in schematic of Fig. 1B. The button current can be regulated by P_1 and the signal output voltage can be controlled by P_2. A simple way of producing pulses of current in the

Radio service-dealer, Mr. John Ragona of Philadelphia, Penna., finds that servicing and maintaining radio and electronic equipment is an important part of his business.

circuit is to open and close switch S. In some cases it may be found that the switch is open and it can be checked in any event by using an ohmmeter. The battery or voltage source should be out of the circuit when using the ohmmeter to prevent damage to the test instrument. The individual parts of the circuit can be checked quickly with an ohmmeter. With the buttons disconnected, a small battery may be connected first across L1 and then across L2. Clicks should be heard. If they are heard and the mike does not work ,the trouble definitely is localized in the mike.

In Fig. 1C, the ribbon mike is shown. The sound waves cause the ribbon to move and as the ribbon is part of a coil circuit, and the coil effectively moves in a magnetic path, voltage is induced in it. If the freedom of movement is impaired by a collection of dust or other foreign matter, such as small metallic splinters or particles, normal output voltage will not be obtained. To check the circuit, the mike may be spoken into or tapped lightly with your finger. If no sound is heard, the mike may be disconnected and a small 1.5 volt battery is then used for applying a potential to the primary L_1. If a click is heard, look for trouble in the mike. The 1.5 volt potential is much larger than that developed by the mike and the click

Fig. 2. Diagram of a test amplifier that can be used for checking the output of phono pickups, microphones, and other sources of audio signals. This unit will prove convenient when making outside calls.



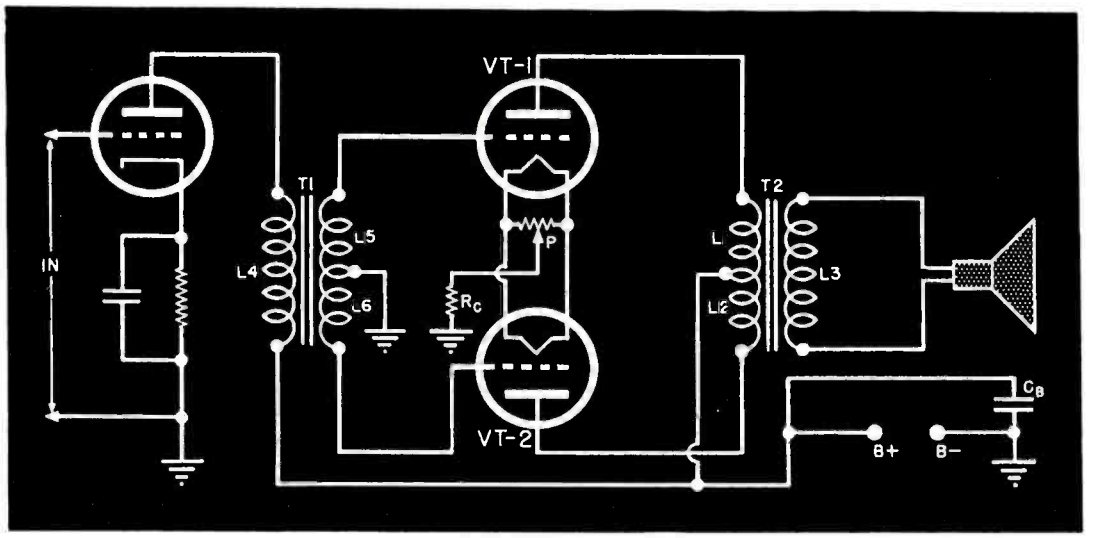


Fig. 3. Diagram of a push-pull output stage of a typical amplifier, used to illustrate proper procedure to follow when troubleshooting.

should be very strong. If it is not, look for a defect elsewhere in the system, and continue your tests.

In many cases, the fault may be in a cable connecting the mike to the amplifier input circuit, or in the plug and jack assemblies. Careful visual inspection often will result in localizing the trouble. However, a cable can be checked easily with an ohmmeter. This is illustrated in Fig. 6A. The cable is checked for continuity by shorting one end. Then, the actual resistance in the circuit can be measured. It should be low and will vary according to the size of the conductors and the length of the cable. Resistance values for various conductors can be found in any wire table, to serve as a guide, with sufficient accuracy for practical purposes.

If the cable is to be tested for an intermittent condition, it may be wiggled while the ohmmeter is left connected. Usually, if the cable has any appreciable length at all, an assistant will be required to do the wiggling of the cable, while you watch the meter. Checking for a shorted cable is illustrated in Fig. 6B. The resistance should be very high, usually above 20 megohms, if the cable is good.

Many amplifiers may use crystal mikes. These are high-impedence types and generally work directly into high-impedence grid circuits, as shown in Fig. 4B. By disconnecting leads A and B at the input and connecting a small 1.5 volt battery to C and D, making and breaking the battery connection, a series of loud clicks can be produced under normal working conditions. If these clicks are heard and the mike does not give any output, the trouble is probably in the mike itself or the connecting cable. About the best way of checking the mike would be to connect it to an amplifier which is in good condition. However, when you go out in the field it is not a very simple matter to have an amplifier convenient for test purposes unless you rig up a special job for yourself, as shown in Fig. 2. This equipment is not designed to cover a ball field or to do a public-address job, but is useful for checking the output of phono pickups, mikes, and other sources of audio voltage. It can be calibrated in your service shop.

An a.c. milliammeter with a full-scale deflection of 1 ma. may be used as an output indicator, or any standard copper-oxide rectifier-type instrument may be connected across the output to read the signal voltage. The potentiometer *P* (in Fig. 2) should have a small dial calibrated in numbers that can be read accurately. The knob pointer should fit closely to the dial face so that the settings can be noted accurately. Then, for a given setting and type of pickup you should have a definite amount of output voltage read on the meter *M*. The output meter preferably should read voltage, but only relative indications are necessary. For a given input voltage and test amplifier gain, a mark on the output indicator corresponding with the calibration should be obtained.

The audio signal may be heard on the 5-inch dynamic loudspeaker or the speaker may be disconnected and the signal voltage measured with the output meter. By connecting a phono pickup or mike to the input of the amplifier, in your shop, and noting how it behaves, you can secure a guide to expected reactions in the field. And, as a matter of fact, bringing it on routine installation checks you can try it out and in that way gain some idea of the performance of the unit. Good parts should be used in constructing the test amplifier. Do not make the common mistake of assembling together a lot of miscellaneous junk and then checking good equipment against the performance of that valueless material.

The values of R1 and R2 may be determined experimentally.

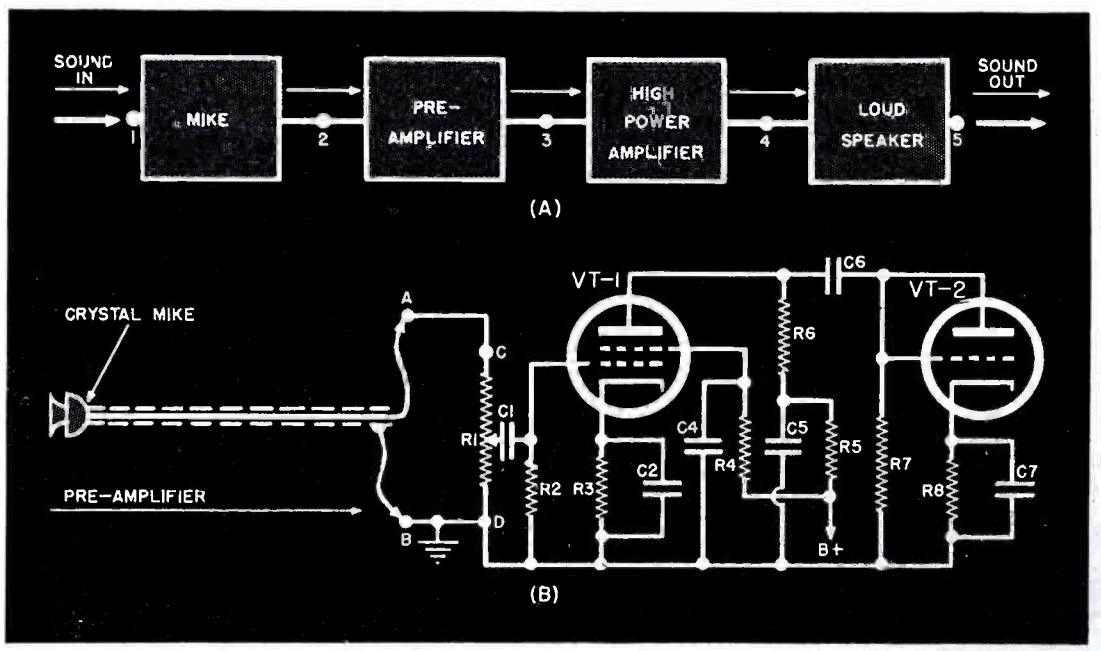
With a test cable fitted to the amplifier input, you may use the unit as an audio signal tracer for going through the circuits of a public-address system, and the input voltage can be controlled by potentiometer *P* to prevent overloading of the tubes in the unit. You can also check the relative gain of various circuits, since the input control can be calibrated in terms of input voltage, using an audio generator in your shop before the test unit is taken out in the field for actual servicing of public-address equipment.

Coming back to Fig. 4B, suppose that a signal voltage is observed between *A* and *B* when the mike is tapped with your finger or when you speak into the mike, but that no signal voltage appears across R_2. The trouble very likely would be a poor potentiometer connection or an open in C_1. You could check the condenser easily enough by connecting another across it. If the signal now appears across R_2, the trouble definitely has been localized. The important thing is that the signal-tracing instrument speeded up the work and it is particularly useful in the case of beginners who do not feel too sure of themselves and do not have the skill of a highly-experienced serviceman or engineer.

In some cases it may be found that the signal does appear across R_2 but that the amplifier response is weak. The purpose of C_2 is to keep the signal voltage appearing across R_3 low in value. If C_2 opens up it will not do this job and the gain will be reduced in the stage due to degenerative action or negative feedback. While the am-

(*Continued on page* 110)

Fig. 4. (A) Block diagram of a typical amplifier network. (B) Circuit diagram of an amplifier, used to illustrate possible points of failure.



Microphone INPUT CIRCUIT

By THEODORE E. CAMPBELL

Employing the cathode-follower circuit in microphone preamplifiers simplifies line impedance matching.

A NUMBER of public address installations present a problem today, when for any reason it becomes necessary to provide a long mike line. This difficulty shows up in the form of low output, poor frequency response, and high hum level. The latter is especially bad if the building has open wiring and the amplifier is of a high impedance input, designed to accept a microphone whose level is

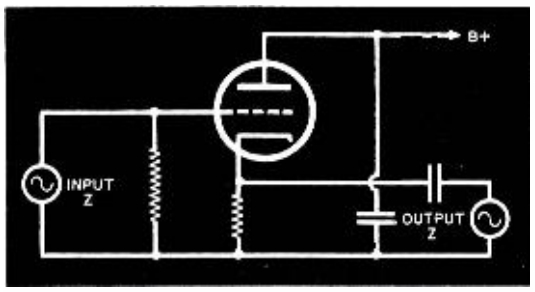


Fig. 1. The cathode-follower circuit.

very low, such as — 60 db. below reference level. The majority of amplifiers familiar to servicemen fall in this category.

Microphone manufacturers supply roughly 8 to 15 feet of cable with each high-impedance microphone, purposely limiting its length due to the capacity any additional cabling would place in parallel with the microphone. This shunt capacity, if enough cable is available to increase its length by four times, may reach a value as high as 590 $\mu\mu$fds, varying widely with types of cabling available. The impedance of this shunt capacity at the higher audio frequencies may fall as low as .1 or less than the impedance of a crystal microphone, thereby, by-passing these frequencies and resulting in a very low output plus poor frequency response. In extending the line we would subject it to electrostatic and inductive coupling, making a.c. hum a major problem as well.

In commercial installations a preamplifier is provided near the microphone to raise the level of the microphone by several hundred times or possibly 30 to 60 db.; then the output is transformed to some low impedance line and the signal is fed over this line to the main amplifier. Since the level is much greater with preamplification it is fed into a high-level input such as a phono input on p.a. amplifiers. This is to prevent overloading the input amplifier tube. The length of this line and the capacity existing across it has little effect due to its low value of impedance. To illustrate, we will determine what capacity must exist across the line to have any effect. In this case the line impedance will be 1000 ohms rather than the usual 500/250 ohms. The reason for the higher value of line impedance will be apparent later. Now in order to have some effect the capacity must present at least 2000-ohms reactance at some higher audio frequency; 10,000 cycles for instance:

$$X_c = \frac{1}{2\pi fC} \text{ or } C = \frac{1}{2\pi fX_c}$$

$$C = \frac{1}{6.28 \times 10{,}000 \times 2000} = .00795\mu\text{fd.}$$

Such capacity will not be present as it would take approximately 1000 feet of twisted telephone line to present it.

The solution then should be to transform our high-impedance microphone to some fairly low value of impedance or as in commercial practice, use a preamplifier near the microphone and then a low-impedance line to the amplifier. If the line connecting the amplifier and preamplifier is of reasonable length, we can work directly into the amplifier, providing we make our impedance transformation, since sufficient gain is available in the amplifier. An excellent method of making this

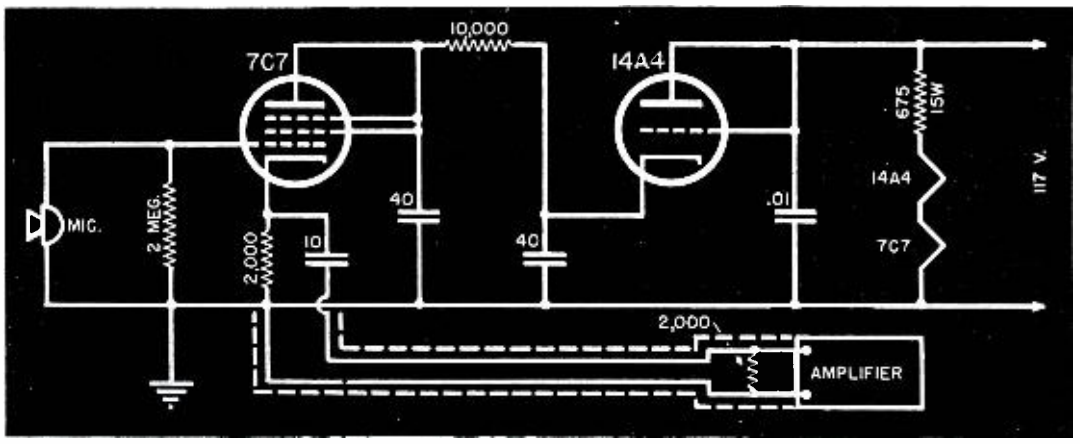
"Uniplex" cardioide crystal microphone, manufactured by Shure Brothers, gives high-quality reproduction from 30 to 10,000 cycles.

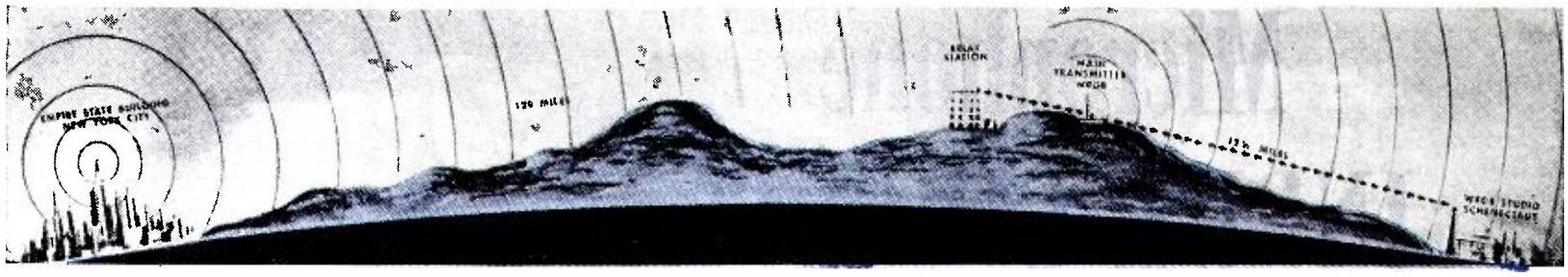
impedance transformation is through the use of a cathode-follower circuit, schematic of which is shown in Fig. 1.

The cathode-follower circuit is nothing more than a vacuum tube with the signal impressed on the grid but taken off at the cathode instead of the plate, and therefore effectively transforming the input from a high to low impedance. The output impedance will be the value of the cathode resistor in ohms or if tapped down on this resistor, any value lower than the full value of the cathode resistor. The total value of this cathode resistor must be such as to provide the correct bias to operate the tube as a class "A" amplifier at whatever plate voltage is applied. Because of this our maximum output impedance will never exceed several thousand ohms and can be less, depending on the type of tube used as the cathode follower, plate voltage applied, or by tapping down on the cathode resistor as explained before. The

(*Continued on page* 134)

Fig. 2. A.c.-d.c. preamplifier to be used in place of a long microphone cable.





Method of relaying television programs from station WNBT, New York City, to General Electric's station in the Helderbergs and from there to the Capital district. GE's studio, WRGB, at Schenectady, also relays programs to the main transmitter.

An Introduction to TELEVISION

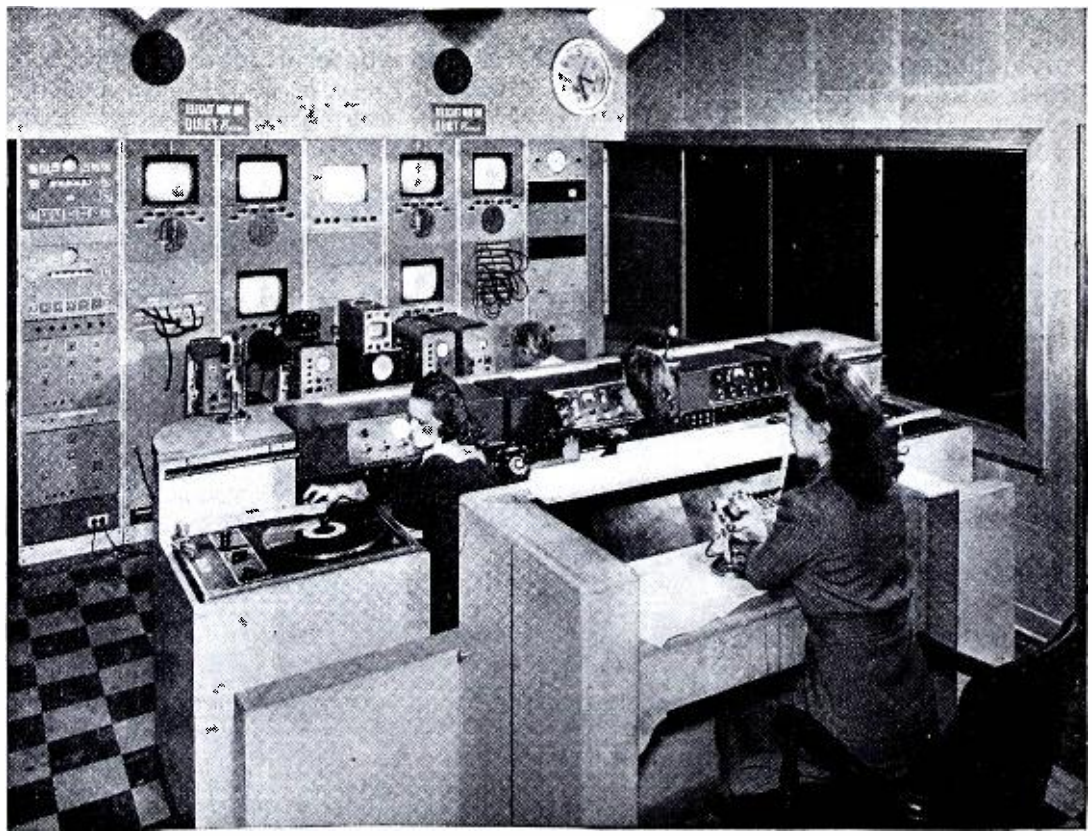
By EDWARD M. NOLL

The first of a series of articles to be presented to the serviceman on the subject of television, covering operational principles and servicing techniques.

ARE you prepared for television? Are you prepared to guide the television bandwagon when the television beam sweeps across the screens of a million television receivers? Manufacturers predict every major marketing area will be served with stations within a year after peace. Surveys of public opinion indicate extraordinary interest in television. You, Sgt. or Mr. Radioman, in the immediate postwar era, will be called upon to service, install, operate, or teach the principles of television equipment. You have been absorbing many new circuits and applications of vacuum tubes under the impetus of war—so why not, while you're in the stride, set aside a few hours each month to obtain a necessary background in a pioneer industry. What you learn about television now will not only aid you in your present activities (practically every radio concept manages to become involved in television at some point) but is an educational war bond to be cashed in at a later date.

Personnel with a working knowledge of television will be in demand. Personnel, not only to staff the production plants and the big stations but personnel to sell, adjust, and service receivers. The television receiver, in its present state, is critical of installation and adjustment. You can not throw a piece of antenna wire out the window, plug into the wall socket, turn the switch and expect to get a presentable picture. Your television receiver, no matter how well it is engineered, is useless without careful installation, a good antenna, and proper adjustment. You, Mr. Serviceman, must be able to do your part. The customer will not pay cash-over-the-counter for his receiver, pick it up and take it home. Final payment will be made when the receiver is properly installed and receiving a satisfactory picture. The television serviceman will have to bring out his glasses, light up his easy-chair pipe, and study a few hours every so often. The serviceman who knows "why" as well as "how" will be a faster trouble-shooter than the mechanical robot who knows how to handle a test panel but doesn't know what he's looking for. All of this demonstrates the need for trained personnel. Although the purpose of this series, primarily, is to present the television receiver to the serviceman, the first few installments will cover the complete system to unveil television in its entirety.

The control room at WBKB, Chicago. The program director, in the foreground, masterminds the production in the adjoining studio by means of an intercommunication system connecting her directly with each of the operating personnel.



Television Stations

The four classifications of television stations are commercial, experimental, remote, and relay stations.

1. Commercial stations are of two types: the large regional station with its high-power and elaborate facilities, and the small local station, with its limited facilities. The local station nevertheless will have the same high-quality broadcasts, as it will retelevise the larger regional station, augmented with the local broadcasts it can readily handle with its own limited facilities. A wide variety of programs have been broadcast from the nine licensed commercial television stations shown in Table I. The Philco station in Philadelphia has been especially successful

Predictions of the vastness of the future television industry, brought out by some of the major television interests. →

in handling sports events—particularly football. Not only is the picture clear but the operation of the system is fast enough to follow each play without difficulty. The General Electric station in Schenectady has obtained gratifying results in telecasting operas and stage plays. Its elaborate studio facilities have demonstrated what can be done in the production of first-rate stage shows. The New York stations broadcast many live talent shows—from instructions to air-raid wardens over the NBC station WNBT to the antics of a live duck over CBS station WCBW.

At present there are 70 applications pending before the FCC for commercial television stations. Many of these applications come from smaller cities. It is evident, wide television coverage is not too far off. The average cost of establishing a television station is approximately $200,000; cost, of course, is dependent on how elaborate the station is to be. The small town local with a relay connection to a larger station could begin with only a limited amount of equipment—perhaps only a small motion picture camera to handle local advertising and film broadcasts.

2. Remote stations will operate in conjunction with the commercial stations to handle the remote telecasts. The remote station generates its own signal at a very-high frequency which is picked-up at the main station and retelecast on the main transmitter. Remote telecasts have been very successful for both day and night events.

3. Relay stations permit the transfer of television programs from city to city bringing high-quality telecasts to the smaller cities and rural districts. Ordinarily, the small local station will not have the facilities to present a continuous stream of elaborate telecasts but will depend on his big city brother to give him additional talent. There are two successful relay systems on the East Coast. One is between NBC's New York station and the Philco station in Philadelphia; the other, between New York again and the General Electric station in Schenectady. The latter relay system has one jump of 129 miles which is considerably, beyond normal line-of-sight transmission.

Thus it appears that the wise use of directional antennas and proper choice of site will go a long way in extending the range of television transmission. General Electric is encouraging the use of a very low power combination local and relay station which will receive its energy on a highly directional beam from the larger station and retelecast it at a higher frequency for local coverage. The relay and local station will require a minimum of equipment and will be practically automatic in operation. Facilities will be available for handling local shows.

4. Experimental stations must be

JAMES L. FLY
Former Chairman, FCC.

"Demobilization day will find television a fully explored but wholly unexploited field. We can anticipate a widespread demand for consumer goods such as television sets, many factories able and ready to convert back from war production to such consumer goods, and all the other factors necessary for the most rapid postwar period television expansion.

"I think it quite likely that during the postwar period television will be one of the first industries arising to serve as a cushion against unemployment and depression. Radio broadcasting served that function in a measure during the 1920's, though at the close of the war wireless was far less developed than television will be at the close of this war. There is no reason now apparent why we should not aim at a 50,000,000-set television industry mirroring the present 50,000,000-set broadcast industry."

PHILCO CORP.

"Approximately $25,000,000 has been invested in television research and development by the radio industry to get television ready for the public. Probably never before has the product of a great new industry been so completely planned and so highly developed before it was offered to the public as has television. Through long years of research and development, the television art has been so perfected that the product itself and the service it renders will be ready for the public in a highly-developed state as soon as the war is over.

"The best evidence that the public thinks well of television is the universal response that comes from those who have a chance to see it. As soon as television receivers can be made and sold, the public will eagerly buy them in tremendous quantities. It may be possible to produce and sell table model television receivers for as little as $125 after the war. Larger 'projection type' sets, giving a picture 24 inches by 18 inches may cost up to $400."

GENERAL ELECTRIC

"As we see it there will be two major applications for television after the war. The first, and perhaps the most important is broadcast television which will add a new dimension to home entertainment and will provide one of the most powerful mass advertising media ever developed. Secondly, there is industrial television in which pictures and sound will be carried by wires or by radio transmitters from one point to another for various private commercial uses. For example—industrial television might be used as a powerful merchandising medium by a department store. The fashion show taking place on the eighth floor might be wired to display projectors located on all other floors of the store and in the show windows, enabling shoppers throughout the store to see the latest styles.

"Theater television may well be of the industrial variety. A live-talent program originated at a central point could be wired to a number of theaters and then projected on the regular theater screens. News and sporting events could be made available to the audiences of a large number of theaters by such a system."

COLUMBIA BROADCASTING SYSTEM

"Almost total military secrecy surrounds the surging story of electronic progress in the war. But the effect of this progress on U. S. postwar television—if the television industry will seize it—is well known to nearly every engineer who has worked, often around the clock, on the deadly electrons of war.

"Enough has already been done—developed, tested, proved, and put to work—to strike off the technical shackles that held prewar television to a relatively coarse-screen picture; enough to free television from the straitjacket of narrow-band, black-and-white transmission; enough to promise pictures twice as large and twice as rich in detail, as well as pictures in full and brilliant color. Enough, in sum, to make the 'good-enough' pictures of prewar vintage seem not good enough at all, in terms of postwar possibilities."

FARNSWORTH CORP.

"Television will enliven and broaden your life more than you can now appreciate. It will become part of your daily life just as radio is today.

"It will be housed in a handsome cabinet, differing from a radio cabinet only in that it brings you sight as well as sound of distant events while they are taking place! As with radio, you select and tune in the programs you want.

"Television is a new service with characteristics and powers peculiar unto itself. It combines qualities of movies, newspapers, radio, and stage. Television will bring you entertainment. . . . Broadway or Hollywood openings, operas, plays, movies, concerts.

"It will show news being made . . . spot news of fires, parades, politics, disasters, picked up by traveling television cameras . . . commentators who can illustrate maps and places and people.

"And it will bring you advertising, show you the products, how to use and care for them.

"Television will be your window opening on the world—a magic window that gives eyes to radio, and will give you a sense of personal participation in faraway events as they happen."

DUMONT LABORATORIES

"We are standing on the threshold of the Age of Television!

"Soon, imagination and genius, freed of wartime limitations, will be breathing vibrant life into television's magnificent promise.

"Television did not come to a technical standstill when America entered the war. When the new science of electronics was drafted for the creation of secret weapons, the technical progress of television continued in many specialized ways . . . resulting in countless refinements in high-frequency circuits, in precision methods of manufacture, and many hush-hush developments of important benefit to television which may not be discussed at this time."

LOCATION	CALL LETTERS	OWNER	FREQUENCY
New York	WNBT	NBC	50-56 megacycles
New York	WCBW	CBS	60-66 megacycles
New York	WABD	DuMont Labs.	78-84 megacycles
Phila., Pa.	WPTZ	Philco Corp.	66-72 megacycles
Chicago	WBKB	Balaban & Katz Corp.	60-66 megacycles
Chicago	WTZR	Zenith Radio Corp.	50-56 megacycles
Schenectady, N. Y.	WRGB	General Electric Co.	66-72 megacycles
Hollywood, Calif.	KTSL	Don Lee Bcstg. System	50-56 megacycles
Milwaukee, Wis.	WMJT	Journal Co.	66-72 megacycles

Table I. Tabulation of commercial television stations that are in operation.

TIME	NUMBER OF STATIONS	POPULATION OF SERVICE AREAS
Today	9 active stations	22 million
18 months after construction of equipment starts	A minimum of 40 active stations (based on licenses granted or applied for, March 1, 1944)	30 million
5 years	100 active stations	67 million

Table II. Chart showing the possible increase in television broadcasting stations.

given free rein in conducting experiments which will advance the television art. All the production plants and television broadcasters are to be commended in developing cathode-ray tube television to its present state. Furthermore, under the impetus of many war disclosures, television should rise to its technical heights.

The Columbia Broadcasting System advocates the use of higher frequencies to obtain greater picture definition, higher frequencies also being more adaptable for color television. The development of the art must not be impeded by rash business tactics and premature technical freezing. Experimental licenses should be granted freely for development work on the very-high frequencies. The radio amateur must be given a television channel, along with the educational institution which will introduce television to the radio jobber, serviceman, or the young engineer.

Television Frequencies

One television station is six megacycles wide; the entire broadcast band, one megacycle wide. The very wide bandwidth is necessary to transmit a clear and sharp picture. In fact, a picture transmitted on a still wider channel would be further improved. The Columbia Broadcasting System is a progressive advocate of higher frequencies and broader channels, recommending 16-megacycle channels in the frequency range from 450 to 950 megacycles. At present there are 18 television channels, each 6-megacycles wide, extending from 50 to 294 megacycles. However, only the first four channels, 50 to 84 megacycles, are occupied by commercial stations.

At a recent session of the television panel of the Radio Technical Planning Board the following frequency recommendations were prepared for presentation before the Federal Communications Commission.

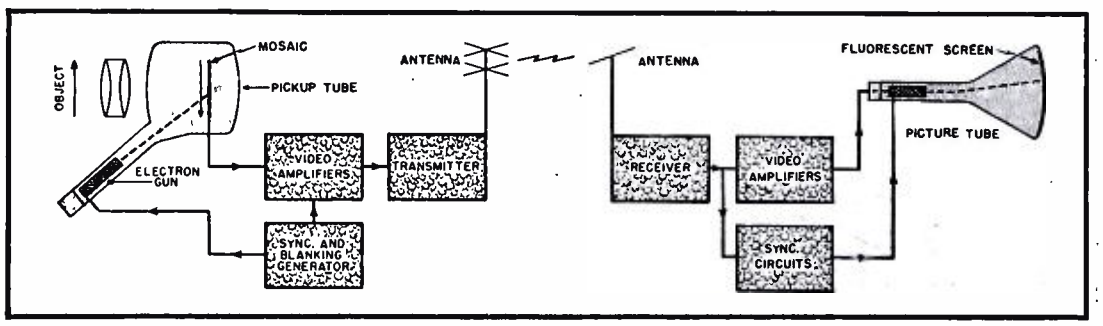
1. The use of 26 6-mc. commercial channels extending from 50 to 246 megacycles.
2. The use of a number of 12-mc. relay channels from 162 to 294 megacycles.
3. The use of 20 10-mc. relay channels between 300 and 1,000 megacycles.
4. The use of 20 20-mc. relay channels from 1,000 to 3,000 megacycles.
5. The use of 30 20-mc. experimental channels from 600 to 2,000 megacycles.
6. The use of additional allocations for experimental channels from 3,000 mc. to 10,000 megacycles and higher.

Television System

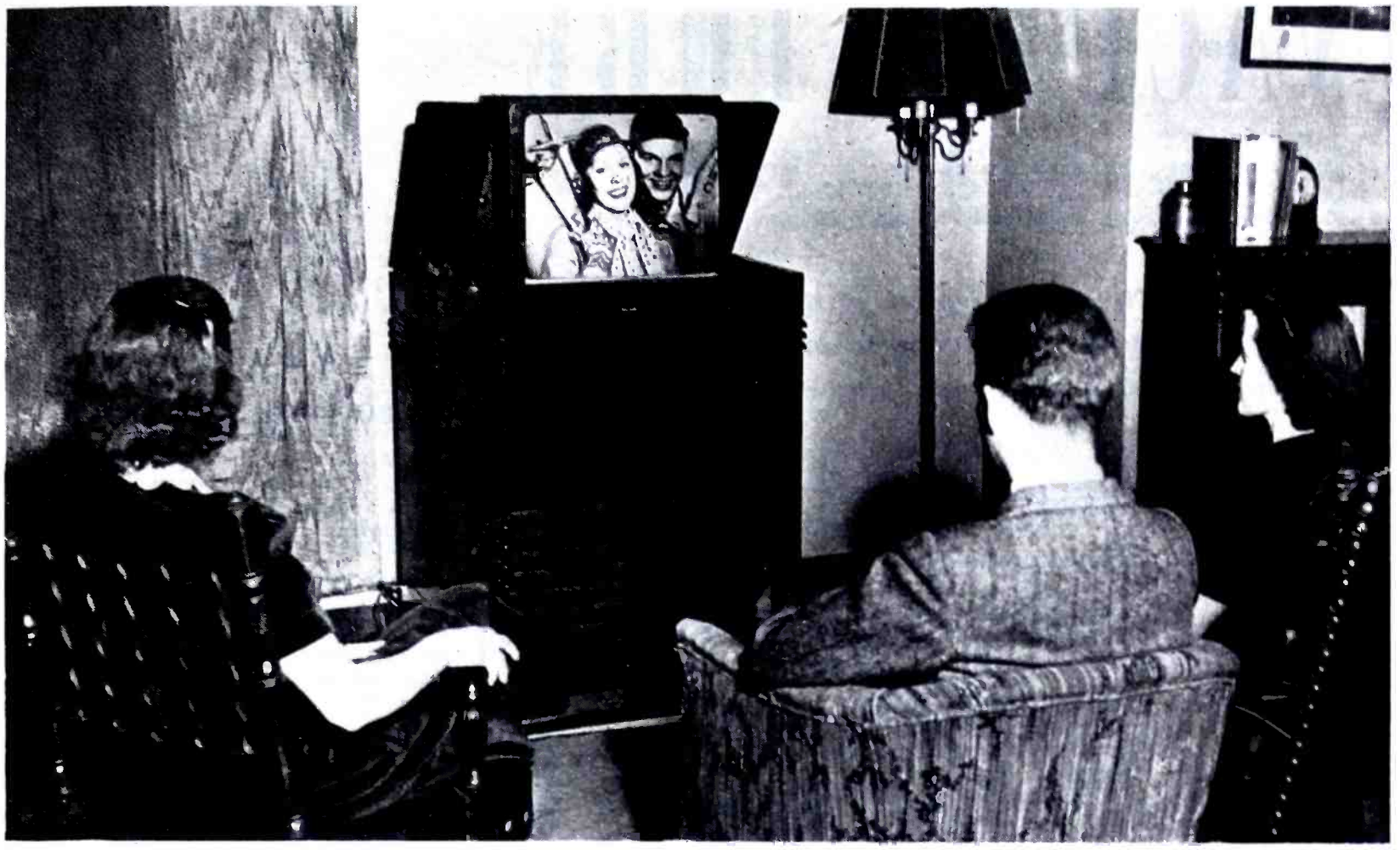
A televised scene is not transmitted instantaneously. It is transmitted as a progressive series of electrical charges, each charge representing the relative brightness of one tiny spot on the scene. Approximately 350,000 of these spots are required to mold one scene, and, to simulate motion in the picture, thirty complete scenes or frames are transmitted each second. As shown in Fig. 1 the object is focused through a lens system on the light sensitive screen or mosaic of the television pickup tube. The image on the mosaic, which is dotted with millions of tiny photoelectric particles, displaces electrons according to the light distribution of the image. This image is scanned by a pinpoint electron beam which races back and forth across the screen as directed by the electron gun of the pickup tube. When the beam scans one line on the mosaic a progressive series of very small charges (video signal) are released. The relative strength of each individual charge is dependent on the intensity of the light focused on the particular spot it represents on the mosaic. After one line is scanned the beam snaps back and scans another line beneath the previous one. This process continues until 525 lines are covered, representing one scene or frame. Then the beam returns to the top of the screen and scans the first line of a new scene. Point-after-point, line-after-line, and frame-after-frame, the television signal is transmitted in an endless stream from transmitter to receiver. At the receiver the same parade of charges excites the control grid of the picture

(*Continued on page* 141)

Fig. 1. Illustrating the progressive series of electrical charges during a television transmission. Each charge represents the relative brightness of one tiny spot on the picture tube. During transmission, the object being telecast is focused on the mosaic. The image appearing on the mosaic, after being scanned by a beam from the electron gun, is applied to the video amplifiers. Synchronizing and blanking pulses then combine with the picture signal and the composite video signal is applied to the transmitter and radiated by the antenna. During the receiving process the television signal is picked up by the receiving antenna and detected by the receiver. Picture signal and blanking pulses then pass through the video amplifiers to the beam-control grid of picture tube. Synchronizing pulses are applied to the synchronizing circuit to control operation of electron gun. Modulated picture beam scans the fluorescent picture-tube screen, reproducing the original image.



TELEVISION—for Industry and Home



Newly developed television receiver designed by RCA. The picture on the translucent screen is 13½ by 18 inches. The screen is retractable and slides down into the cabinet when not in use. The picture as it originally appears on the face of a kinescope is projected through a lens to the mirror on the underside of the cabinet's uptilted lid, from which point it is reflected to the viewing screen.

By WILL BALTIN

Secy.-Treas., Television Broadcasters Assn., Inc.

Television will occupy an important place in every conceivable phase of our industrial and social lives.

THERE is something about television that is going to make every city, town, and village in the United States a more democratic, more progressive, more closely knit community than ever before.

Television as an instrument of entertainment and information, similar to that of radio, is no longer a laboratory curiosity. The 40,000 televiewers in New York, New Jersey, Pennsylvania, and Connecticut areas and the thousands more who see televised programs in Chicago and Los Angeles can vouch for that.

But television, with its intimate and immediate approach, will go much farther than radio in cementing community relationship, instilling democratic ideals, and providing hitherto undreamed of avenues of enlightenment. Television has the wherewithal to change the living habits of millions of Americans, and it is likely to accomplish these changes within the next decade.

Most everyone who visited the New York and Chicago World Fairs had a glimpse of television and unquestionably sensed the great possibilities which it held as an instrument of entertainment in the home. This form of television most assuredly will sweep across the nation just as soon as wartime restrictions on the manufacture of television equipment is no longer necessary. As of October 1, 1944, there were 83 applications pending for new television stations in 27 states and the District of Columbia.

Yet television as an instrument of entertainment is but a fractional phase of this new and wonderful art. Television for use in industry, business, schools and colleges, by police and, most certainly, by theaters, will occupy an important place on the American scene in the years to come.

Industrially, television may be employed to link, via coaxial cable, scattered branches of any one company. An employer may speak directly to foremen in a dozen plants and he, in turn, can see them on a video screen in his office. Directors of industry can easily conduct Board meetings via television, providing offices of the Directors are linked with that of the Chairman of the Board. Innumerable uses for television in industry may be found, all of which can draw labor and management closer together.

Leading retailers throughout the country are eager for information about television. They sense the value of pictorial exploitation for effective retailing and plans are now afoot in the biggest department stores of the nation to install intrastore television equipment. Thus, a style show conducted on the fifth floor of a metropolitan department store can be watched on large television screens installed in the front windows of the establishment and scattered throughout the various other floors of the building.

Filene's Department Store in Boston; Bloomingdales and Abraham & Strauss in New York; and the Maison Blanche Company in New Orleans, La., already have signified their intention of using television, not only for

(*Continued on page* 101)

THE SAGA OF THE VACUUM TUBE

By GERALD F. J. TYNE

Research Engineer, N. Y.

Part 15. The early growth of the amateur fraternity, with the development and manufacture for public use of the Audion and crystal detector.

Fig. 167

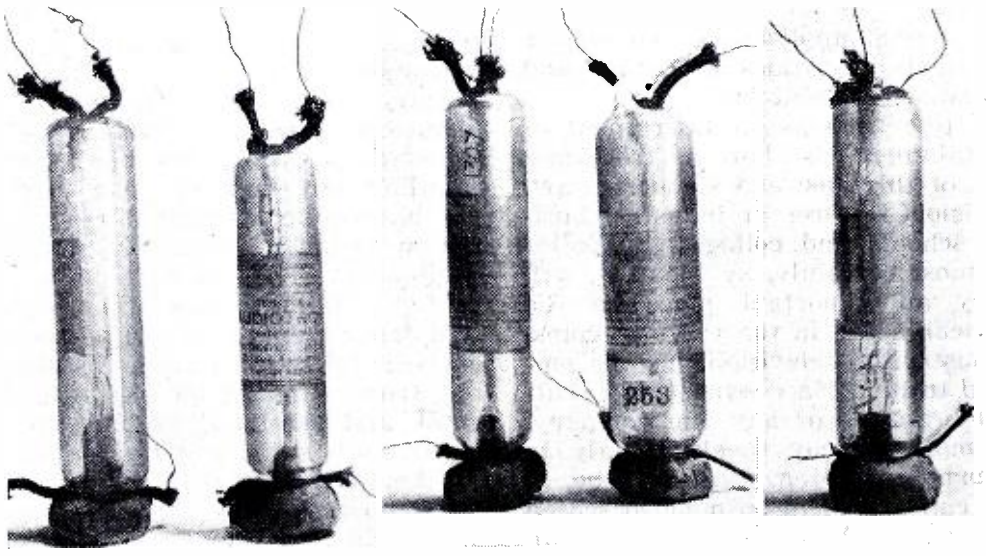


Fig. 168

THE amateur fraternity was small during the first decade of the twentieth century. Equipment was crude; progress was slow and beset with difficulties. Little factory-made equipment was available and reliable construction information was difficult to obtain. This situation was partly alleviated by the International Electrical Congress held at St. Louis in 1904, which became a clearing house for information along wireless lines as well as other branches of the electrical art. At this Congress papers describing recent advances in theory and practice of wireless were presented by John Stone Stone, Lee de Forest, J. A. Fleming, and others.

The de Forest Audion and the crystal detector both appeared in 1906-7. The crystal detector was adopted instantly by the amateur. It was simple, cheap, and sensitive, and in time came into almost universal use. It made the amateur receiver really usable. The Audion was expensive and short-lived, and required expensive auxiliary equipment. A dry-cell anode battery and a filament storage battery were needed. Small dry cells were short-lived and the problem of charging and otherwise maintaining a storage battery was not to be taken lightly. The Audions varied greatly in their characteristics, not only initially but with use. Hence they were not widely used.

In the early part of the second decade a number of factors tended to promote the use of the Audion. The ranks of the amateur fraternity were swelled by many hundreds of 'teen age boys (and older ones as well) whose interest in this fascinating avocation had been aroused by newspaper tales about rescues at sea. Stories of the rescue of survivors of the ill-fated *S.S. Republic* and *S.S. Titanic,* and the part played by wireless in the rescue work, all aroused widespread interest in this newest branch of the communications art.

Once the desire was aroused, the ingenuity of Young America was called upon to provide the necessary equipment for the home station. The family rolling-pin disappeared from the kitchen only to reappear later, disguised by the application of a layer of wire, as a tuning coil. Bits of wire, scraps of metal, odd chunks of wood, all provided grist for the mill which turned out the wireless set of the eager constructor. Practically everything except the headset could be made in the cellar workshop, and it usually was. It was the era of "haywire" and home-brewed apparatus, even for elaborate stations.

By 1915 the Audion was much better known, particularly on the West Coast. The opening of the transcontinental telephone line and the publicity attendant thereon, the Panama-Pacific Exposition with its displays of wireless equipment—both tended to promote knowledge of this device. It became the ambition of almost every embryonic Marconi to possess an Audion.

The problems of obtaining and main-

Fig. 169

Fig. 170

Fig. 171

Fig. 172

taining the requisite storage battery in the meantime had been lightened by the development and use of electric starting and lighting systems for automobiles. Better and cheaper batteries and charging equipment were available. In most cases, consequently, the chief problem confronting the amateur was that of obtaining the Audion itself, and here the ambition still outran the exchequer. The policy of the only legitimate source of supply, the de Forest Company, was to sell not "Audions" but "Audion Detectors" at a minimum of $18 each. The difference in name was not great, but the difference in effect on the amateur's pocketbook was fatal. True, Audions could be purchased for replacement purposes in Audion Detectors, but the initial outlay to obtain the latter would have been a crushing blow to solvency. A few fortunate amateurs in the vicinity of New York City were able to obtain Audions on an over-the-counter basis in New York, but such sales were in the minority.

This policy on the part of the de Forest Company had the effect that does sumptuary legislation. Other sources provided a supply of the article in demand, and the making of vacuum-tube detectors by "independent" manufacturers came into being. Some of these made an attempt to get around the de Forest "grid patent" by using a control electrode on the outside of the tube; others frankly infringed.

As readily may be appreciated, authoritative information on these early independent tubes is difficult to obtain. Manufacture and sale in many cases was carried on sub rosa, and practically the only method of tracing their evolution is through the advertisements which offered them for sale. As will be seen, these advertisements almost always made extravagant claims, probably because the manufacturer felt sure that there would be

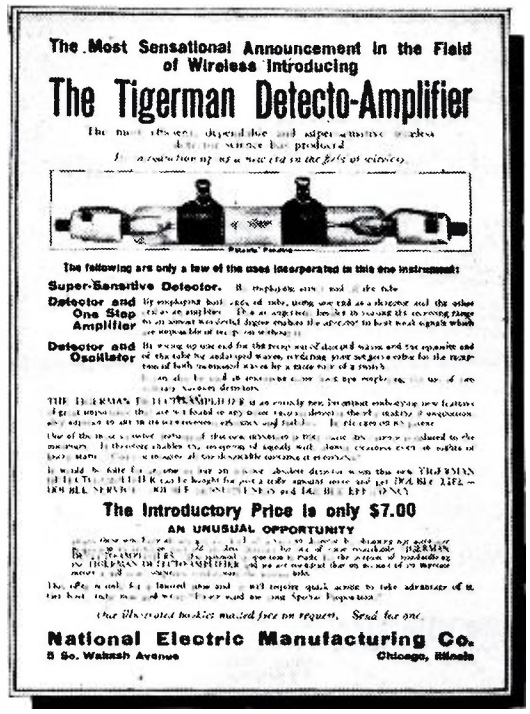


Fig. 173

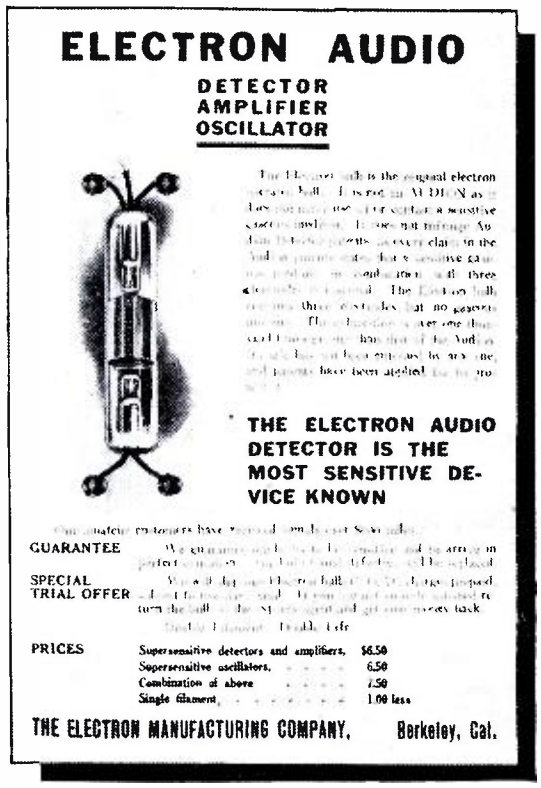


Fig. 174

Fig. 175

little comeback on the part of the purchaser. Hence, little reliable information on the characteristics of these tubes is available.

The first of these independent tubes to appear was also the last to disappear, and the most widely sold and used of all the early independent tubes. It was known as the "Audio Tron." This tube was the brain-child of Elmer T. Cunningham of Los Angeles. It was made at Oakland, California, and was first sold in August of 1915. It was first advertised for sale in November, 1915,[203] the advertisement being that reproduced as Fig. 167.

The original Audio Tron was a double-ended, cylindrical, unbased tube about ¾ inch in diameter and 4 to 5 inches long. It comprised a double tungsten filament, a coarse spiral grid of copper wire, and a cylindrical aluminum anode. The anode fitted rather closely the inside diameter of the glass, as will be seen from Fig. 168, which shows a group of these tubes. The Audio Tron sprang into instant popularity, particularly among those who could not afford the luxury of "all de Forest" equipment.

Steps were soon taken by de Forest to prosecute the "Audio Tron Sales Company" for infringement. In February, 1916 the de Forest Company filed suit against the Audio Tron Sales Company and others. The Audio Tron Sales Company filed bond on August 14, 1916 and continued the manufacture and sales of its product.[204] The suit was later settled out of court.

The de Forest Company, to meet this competition, brought out, in April, 1916, the "Type T" Audion,[205] similar in appearance to the Audio Tron but with a single filament, which could be purchased without the necessity of buying a complete expensive detector unit. The "Type T" was announced for sale at $5.50 and Cunningham promptly cut the price of the Audio Tron to $5.25 to meet this challenge.[206] See Fig. 169.

The advertisement of the Audio Tron in at least one publication was discontinued after the filing of the infringement suit,[207] but for a short time another tube, of the two element type, called the "Amplitron" was advertised in its place. See Fig. 170. This continued for only two or three months and subsequent advertisements of the Audio Tron Sales Company confined themselves to the suggestion that the readers write for information on their apparatus.

The war proclamation which ordered the dismantling and sealing of amateur apparatus was issued by President Wilson on April 6, 1917, hence the market for this apparatus disappeared.

After the war, however, we find advertisements for the Audio Tron reappearing, first in June, 1919, in one magazine,[208] and later in others.[209] These advertisements described the Audio Tron as having a thoriated tungsten filament, with a life of 2000 hours, and further stated that it was licensed under the de Forest patents for use as an amplifier in radio communication. It was described as "The Original Vacuum-Tube Amplifier" and priced at $6. Almost simultaneously there appeared for sale the "Marconi VT," made by Moorehead, and warning that the Audio Tron was not licensed under the Fleming patents.[210] These advertisements continued to appear for some time.

Meantime the Radio Corporation of America instituted suit against Cunningham in the U. S. District Court of the Northern District of California for infringement of the Fleming patents. Apparently Cunningham was capable of presenting a rather strong defense in this suit because it was settled by agreement out of court. This agreement,[211] dated June 15, 1920, gave to Cunningham a personal, non-transferable license under the Fleming and de Forest patents for a period of ninety days, to manufacture and sell tubes of not more than 5-watts output, and not more than 5000 tubes in all. These tubes were to be marked "For amateur and experimental use only" and to be made by Cunningham doing business under the name and style of "Audiotron Manufacturing Company." The tube at the extreme right in Fig. 168 is one so marked, the markings being etched on the glass.

(*Continued on page* 92)

By CARL COLEMAN

THE U. S. Maritime Commission is still looking for marine radio operators at this writing and, from all appearances, will be looking for men for some time to come. It had been expected that by this time there would be enough men to go aboard the ships, but it seems as though the number of men available has fallen short of the expected count by quite a bit.

There still seems to be openings ashore for radiomen but most of these outfits are seeking men with a goodly bit of experience and many are looking for men of engineering ability. From the way many of the larger companies are reporting, it looks as though they expect a good postwar future for the radio business ashore. Many of these industrial concerns in the past have looked for, and in some cases demanded men with marine experience for employees, having learned that ex-marine men make reliable workers with the "know-how" of getting their problems solved and their products through the assembly lines to their destination, which is what counts in winning a war as well as in making a profit during the highly competitive years of peace.

Ship construction actually has slacked off somewhat from previous tonnage but vessels being completed will continue to call for more radiomen. The merchant ship program has been tapering off at a slightly increased rate and new construction will be at a much slower rate than construction of the past two years, during which time everything that would float was equipped with an engine and named.

IT HAS been announced by Selective Service in Washington that its veterans assistance program is to be extended in order to aid former members of the Merchant Marine in getting back civilian jobs they left in order to join the merchant fleet in response to the demands of wartime shipping. It seems only reasonable that in this respect the men of the merchant fleet should be accorded the same privileges as the men of the armed forces. Many, in fact a very large proportion of these men, gave up jobs ashore paying good money in order to return to sea just for the reason that they were Americans and realized that they were more valuable to their country in the merchant fleet than in their job ashore.

Men in the early days of the wartime merchant fleet had much less chance than those in the armed forces. At least the armed forces had something with which to shoot back and that surely is more than a good many of the merchant ships had at the start of the war. Many of them sailed without proper protection in the days of large-scale sinkings and the men never complained, so the least that can be done for them is to return them to their peacetime jobs without their having to fight for same. It seems that it should be required by law that the men of the merchant fleet be given the jobs they left to go to sea, or at least to be given a chance to take them back and at the same rate, or if the job has increased in value, at the new rate paid to present employees in the same type of position, the same as is being done with the armed forces veterans. A good many marine radiomen went to sea under the above circumstances after having been with a firm ashore for years and will naturally want to return to these jobs after the war.

AT LEAST some persons see prospects for a bright future in postwar merchant shipping for the U. S. Merchant Marine. The Office of War Information, in a recent statement, declared that vessels of U. S. registry will carry at least fifty per cent of this nation's foreign trade after the war and will be greatly benefited by a large-scale boom in postwar traveling. OWI reports that our American shipping may begin to return to somewhat normal operations between six months and two years after the end of hostilities. Most sources close to the U. S. Merchant Marine seem to believe that there will be continued large-scale shipping for many months and possibly several years after the war.

However, for continued success of the U. S. Merchant Marine, labor and industry must be willing to continue the working agreements of the past. This point was brought out by F. J. Taylor, president of the American Merchant Marine Institute in urging extension of the no-strike and no-lockout agreement by leaders of maritime labor and management into peacetime.

Taylor said that "labor and industry must continue to co-operate if we are to maintain our rightful place on the seven seas as carriers of America's commerce. The pledge given shortly after Pearl Harbor that our shipping would not be hampered by labor disputes has been kept. This never-ceasing flow of supplies and men is one important reason why victory in Europe is close at hand. It will continue until after the Japs are defeated."

If our merchant marine is to continue its position as the largest afloat, maritime labor and industry must continue to solve their problems in a peaceful manner where no time is lost.

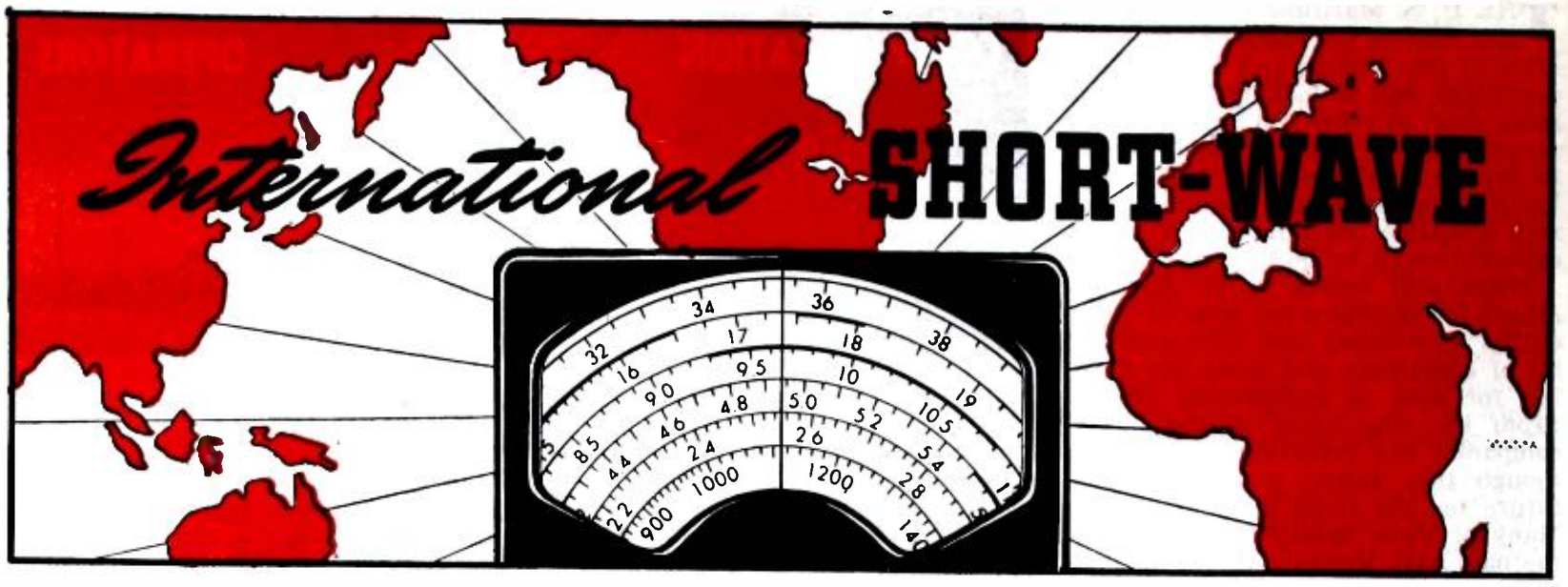
"On second thought, maybe you'd better not have any more Tom and Jerries until you've finished repairing the radio!"

JONES C. FANBUS is with Isthmian and reports that he has a new Scott HF to make life more complicated, as it certainly is getting to be aboard some ships these days. Just try to change your mind in a shack aboard a Liberty now that a new HF Xmtr. has been added and you will find that it's necessary to either step outside or go in the battery room, and that's no joke—just ask the boys on the ships!

O. Thomson is with the same old ship and was in recently asking about the gang. H. Laxdal has gone fishing, we understand. A. Bannister and R. Islam were in recently on their respective cargo vessels at an East Coast port. Leroy L. A. Ruetz writes from aboard his Navy craft, where he is RT 1/C and is very interested in the merchant marine business.

Carl Amato was in the big city recently on a short leave. Carl is still at a Signal Corps school and is getting "in the know"

(*Cont. on page* 102)



Compiled by **KENNETH R. BOORD**

THROUGH the courtesy of G. V. de Freitas, manager, we are able this month to furnish readers of RADIO NEWS with details concerning the activities of the British Guiana United Broadcasting Company, Ltd., Luckies Chambers, Georgetown, Demerara, British Guiana, which operates short-wave station ZFY.

This year The British Guiana United Broadcasting Company, Ltd., is celebrating its tenth year of continuous short-wave broadcasting in British Guiana, although there was a short-wave transmitter in operation there as far back as 1928.

ZFY, "The Voice of Guiana," operates on 6.000 megacycles (50 meters), using 1 kilowatt (potential); actual output varies seasonally. The antenna employed is a doublet, center-fed, running N.E.-S.W., 80 feet high (half-wave).

ZFY's schedule is as follows (EWT):

Weekdays, 6:45-7:45 a.m.; 10:45 a.m.-12.45 p.m.; 3.45-8.15 p.m. (Monday through Saturday); Sundays, 6:45 a.m.-12:45 p.m.; 2.45-8:15 p.m.

Signatures include opening all transmissions with the playing of "Rule Britannia," closing of all transmission with the playing of "God Save the King"; in the evening transmissions, "God Save the King" is preceded by Ted Lewis's rendition of the "Goodnight Waltz."

Station announcements are made before and after each program, usually every 15 minutes, depending on the length of the program. The slogan used is "This is ZFY, the Voice of Guiana, a short-wave broadcasting station in the service of the United Nations."

As to coverage, the primary territory served is British Guiana (counties of Demerara, Berbice, and Essequibo); secondary territory, British West Indies from Antigua down to Trinidad, and French and Netherlands Guianas; extraterritorial reception is regularly reported in the Eastern United States, the British Isles, and Northwestern Europe.

ZFY uses three types of material: Local, BBC (London rebroadcasts and recorded programs), and OWI and Armed Forces Radio Service (U. S. War Department); also Anglo-American Caribbean Commission's West Indian Radio Newspaper is rebroadcast from Washington (via WRUL or WRUW, Boston, Massachusetts), Sunday to Friday, inclusive, at 6:15 p.m. EWT.

It is interesting to note that *British Guiana time* is 1¼ hours ahead of *Eastern Standard Time* and 3¾ hours behind *Greenwich Mean Time.*

Incidentally, your short-wave editor has been hearing ZFY quite well, 6:45-7:45 a.m., and sometimes during the early evenings, 6:30-8:15 p.m. From Bloomington, Illinois, William Shadid reports hearing ZFY at 5:45 p.m. with a fair signal (R-6 at times). Good reception of ZFY is also reported by Adrian Richards, Snyder, New York. He hears this station, 5:30-8:15 p.m.

The station manager advises that verification cards are sent to those who mail an International Reply Coupon with their reception reports. I have just received such a neat little card, printed in black and red on white, and giving the station's address as ZFY, "The Voice of Guiana," The B. G. Broadcasting Company, Ltd., P. O. Box 272, Georgetown, Demerara, British Guiana.

* * *

The complete schedule of KROJ, Los Angeles, California, Armed Forces Radio Station.

EASTERN WAR TIME	FREQUENCY (Mcs.)	BEAM
Midnight — 3.45 a.m.	9.8975	Orient
4:00 a.m.— 9:00 a.m.	6.100	Australian
9:00 a.m.—Noon	Off air—Maintenance	
*Noon — 2:45 p.m.	9.8975	Orient
*3:00 p.m.— 4:45 p.m.	9.8975	Australian
*5:00 p.m.— 8:45 p.m.	15.190	Orient
9:00 p.m.—11:45 p.m.	17.760	Australian

*Saturday only—Noon to 1:30 p.m., 9.8975, to Alaska (Orient); 1:45 to 5:30 p.m., 9.8975, to Australia; and 5:45 to 8:45 p.m., to Alaska (Orient).

WEST COAST REPORT

August Balbi, Los Angeles, keeps us up-to-date on short-wave stations in Asia and Oceania with the following report this month (EWT):

VLC6, 9.615, Shepparton, VLG, 9.58, VLG2, 9.54, Melbourne, VL19, 7.28 Sydney, Australia, are all in parallel to Asia, 10:15-10:45 a.m.; English news, 10:15 a.m. (These are heard well in the East now.—*Editor.*)

ZNR, 12.11, Aden, Arabia, is heard 12-1:15 p.m. in native language; uses English announcements; fair signal.

Delhi, India, 11.76, is heard 10:30-10:45 p.m. to Malaya with English messages; good, irregularly; 9.63, is heard 10 a.m.-12 noon, with English news at 10:50 a.m., and BBC news relay, 11 a.m. (this transmitter is QRM'd by CBFX, Montreal, Canada); 7.24, is heard 10-11 a.m., native languages only, fair signal; 6.01, is heard 9-10:30 a.m., native languages only, fair signal.

JLT, Tokyo, Japan, 6.19, heard 9-10:40 a.m., and 11 a.m.-2:40 p.m., native language, with English news at 2 p.m., strong signal; JLT3, 15.225, JVU3, 11.897, JZJ, 11.80, JZI, 9.535, heard 11 p.m.-4 a.m. to the West Coast of the United States, with English news at 11:40 p.m., 1, 2, and 3 a.m.; JZK, 15.16, JVU3, 11.897, heard 8:30-10:45 p.m. in Home Service; JVZ, 11.815, JZI, 9.535, heard 4:15 a.m. on to Europe, in German at 4:15 a.m.

XGAP, 6.10, Peiping, China, heard 4 a.m.-12 noon in Home Service; the 10.24 frequency is not being used at present.

MTCY, Harbin, Manchukuo, 6.03, heard 4-9:30 a.m. in Home Service.

Java, 18.13, Djarkata, heard 9-10:30 p.m.; news, 9 and 10:15 p.m.; weak, fading now.

U.S.S.R., 15.11 and 15.23, Komsol-

OHMITE EXPERIENCE

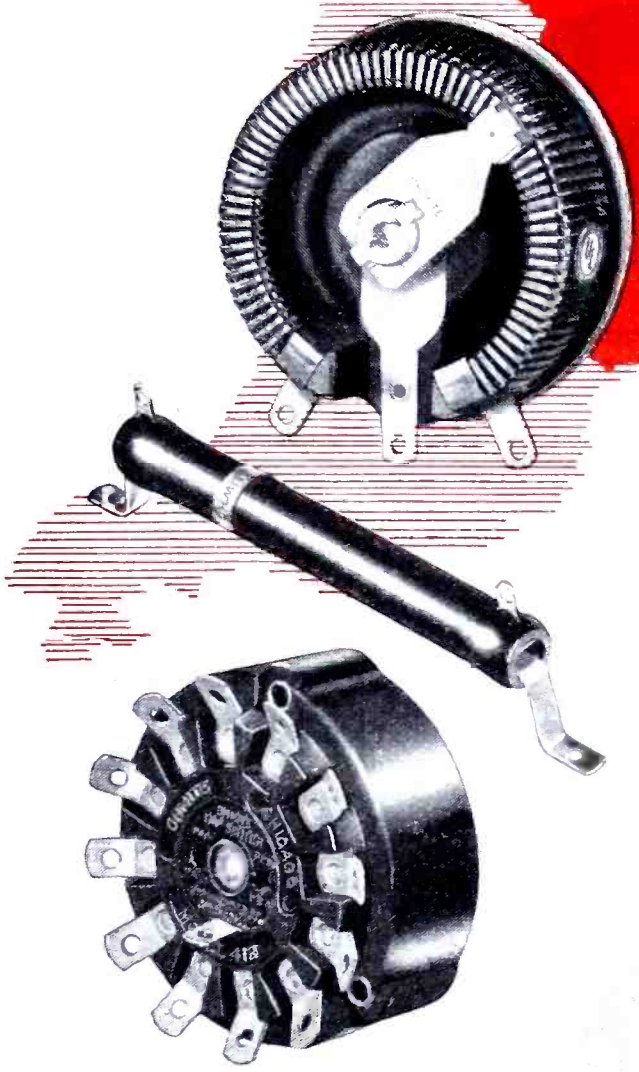
in all types of Current Control Applications

Brings Time-Proved Benefits

1 The Right Rheostat, Resistor, or Tap Switch for Each Job

2 Consistently Accurate, Dependable Control

3 Long-Service Economy Under Varied Conditions



What better assurance of these important benefits than the record itself! . . . The record of Ohmite experience in pioneering new rheostat, resistor and tap switch developments—in producing the widest range of types and sizes—in meeting the varied requirements of innumerable applications with high quality units that have proved their reliability and long-service economy.

In designing for war or postwar . . . remember Ohmite experience. Consult our engineers on your control problems.

OHMITE MANUFACTURING COMPANY
4883 FLOURNOY STREET • CHICAGO 44, U. S. A.
Foremost Manufacturers of Power Rheostats, Resistors, Tap Switches

Send for Handy Ohm's Law Calculator

Helps you figure ohms, watts, volts, amperes, —quickly. Solves any Ohm's Law Problem with one setting of the slide. Send only 10c in coin to cover cost of handling and mailing.

Be Right with OHMITE
RHEOSTATS • RESISTORS • TAP SWITCHES

movsk, heard 6:47-7:20 p.m. to U. S.; news, 6:47 p.m.; fair signal, improved lately; no signal on 15.75 audible here; 5.30 heard irregularly, 3-10 a.m., at intervals in Home Service; fair signal; 6.07, heard irregularly, 1:45-2 a.m. and 5-6 a.m. in Home Service, with strong signal.

CSW7, 9.74, Lisbon, Portugal, heard 9-10 p.m. now to South America in Portuguese; signal is fair.

DJL, 11.77, and DJ?, 9.59, Berlin, Germany, heard 11:30 a.m.-2 p.m. to Africa, with news in English at 11:30 a.m.; DXX, 6.13, heard to North America, signoff at 12 midnight; bad QRM, weak to fair.

GWP, 9.66, London, England, heard 10 a.m. and on in English, fading out at 11 a.m.

Mr. Balbi reports that VLC4, 15.315, Australia, is heard nightly, 9:45-10:45 p.m. EWT beamed to the East Coast of the United States, lately rather weak. "I doubt if it can be heard on East Coast now," he comments. (NOTE: Your editor has not received VLC4 the past few months, although prior to that time it came in very well in the East, both at his listening post and according to reports of monitors throughout the East and Midwest.)

Since there seems to be a question as to the location of KROJ, the Armed Forces Radio, Mr. Balbi informs us that the station is located in the vicinity of Los Angeles, and is not located in San Francisco, as some DXers believe. Programs to American Forces Abroad from KROJ, Press Wireless, Los Angeles, are beamed as follows (PWT): 9.890, 9 p.m.-12:45 a.m., 9 a.m.-1:45 p.m.; 6.10, 1-6 a.m.; 15.29, 2-5:45 p.m.; 17.76, 6-8:45 p.m.

For West Coast listeners, Mr. Balbi reports that London is heard best over Leopoldville, Belgian Congo, 9.783, 6:30-9:45 p.m. PWT.

He reports that messages from American prisoners of war in Japan are broadcast now at 2 p.m., 12 midnight, and 2:30 a.m. EWT, over the stations that are transmitting at those times, as listed above.

* * *

MOSCOW CHANGES

From L. Pavlov, of the Information Bulletin, Embassy of the U.S.S.R. in Washington, we have information which brings up-to-date the schedule of English transmissions from Radio Center, Moscow, which recently has effected several changes in frequencies and schedules.

The current operating schedule (EWT) of Radio Center, Moscow, with regard to English transmissions beamed to the United States, follows:

7:40 a.m., 15.75, 11.8, 10.44, and 9.5; 8:20 a.m. 15.75; 12 noon, 15.75; 2:30 p.m., 11.94; 6:47 p.m., 11.94, 15.1, and 15.2; and 8:00 p.m., 11.94 and 9.48 megacycles.

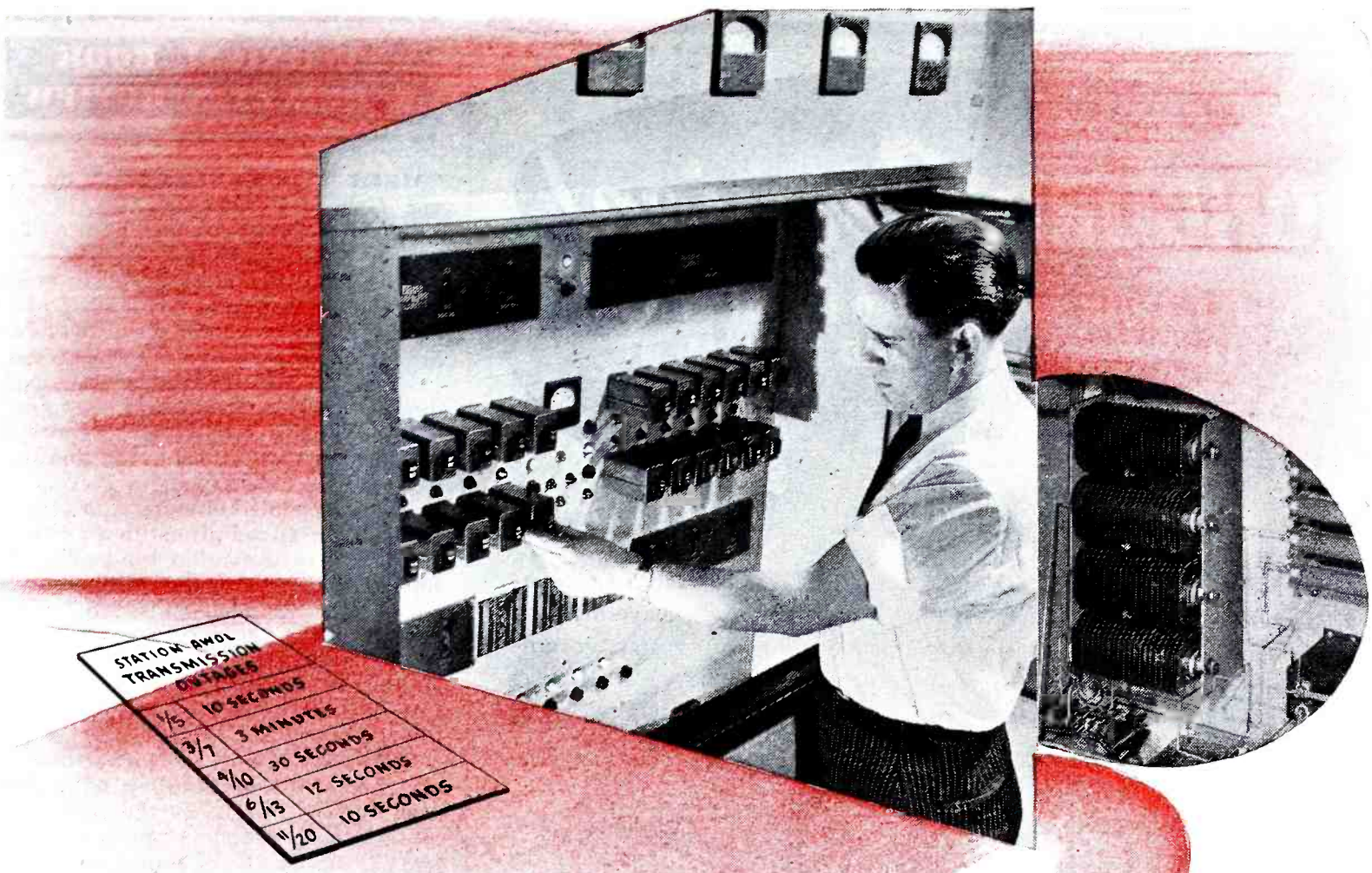
* * *

BBC NOTES

The BBC's North American Service is now heard as follows:

GVZ, 9.64, 5:15-8:45 p.m.; GRH,

(*Continued on page* 116)



CONSIDER *Continuity of Operation* WHEN YOU SELECT A NEW TRANSMITTER

Off the air, right in the middle of a program—that's the nightmare of operating a radio station. That's when seconds seem like hours, and minutes like eternities. As though you didn't know!

Westinghouse Transmitters have been designed to cut program outage down to an almost unbelievable point. For example:

1. *Indicator Lights* show at a glance which circuit suffered an overload—even though the transmitter has returned to the air . . . making circuit checkup easy.
2. *Conservative Operation of All Tubes*—greatly increases reliability . . . lengthens tube life.
3. *Air-Cooled Tubes*—eliminate complicated and unreliable water cooling equipment.
4. *Surgeproof Metal Rectifiers* eliminate low voltage rectifier failures.
5. *Tube Life Meter* indicates the end of reliable tube life.
6. *Circuit Breakers* supply full overload and undervoltage protection automatically reducing length of outage.

We'll gladly give you complete information on these features, as well as other important advantages of Westinghouse Transmitters, such as: ***Low Operating Cost, Simplicity of Control, 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-08079

Westinghouse RADIO DIVISION
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

A M • E L E C T R O N I C S • F M

TECHNICAL BOOK & BULLETIN REVIEW

"MEET THE ELECTRON," by David Grimes. Published by *Pitman Publishing Company,* New York. 120 pages. Price $2.00.

This small book is a posthumous publication by David Grimes who lost his life in an airplane crash over Ireland about a year ago.

In it Mr. Grimes describes fundamental electron theory in the language of the layman. The simplest concepts of electron motion, behavior, and usefulness are described in terms of masses of people behaving in a certain manner due to definite stimuli.

The style throughout the book is informal and chatty, and while only a small part of electronics can be discussed in 120 pages or 120 times that many pages, Mr. Grimes has managed to impart a considerable amount of information regarding this most talked of subject.

This book is not for the technically trained, or those familiar with electron theory, but is, as the publishers state, a book for alert minds of six or sixty. The book is amusingly illustrated by pen and ink sketches by J. Riegel, Jr.

"INSTRUMENT FLYING AND RADIO NAVIGATION," by Holland L. Redfield. Published by the *Ronald Press Company,* New York. 189 pages. Price $3.00.

This book is for the flying enthusiast who wishes to learn the techniques of using the radio navigational aids with which many modern planes are now equipped.

The author does not discuss the equipment used or the maintenance of radio equipment but rather its operation in relation to the flyer who is using the radio beam systems for operational flying and landing.

An explanation of directional beams and their use in determining "on course" positions is given in some detail with diagrams illustrating various methods of maintaining proper positions for landing and take-off.

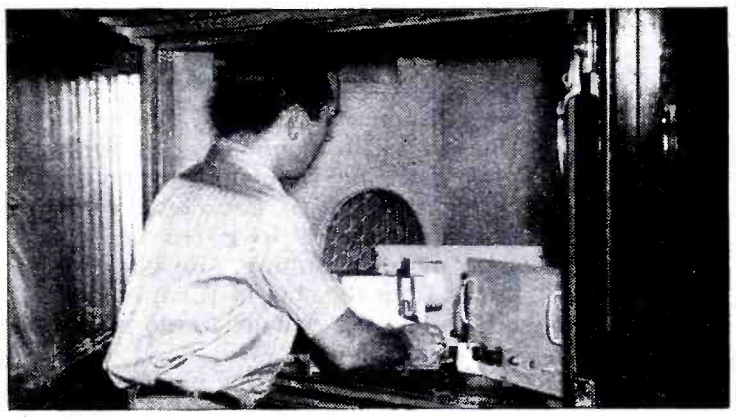
Locating the range station, utilizing the radio range orientation systems and let-down procedures are covered by Mr. Redfield in this text. The radio direction finder is explained in some detail and is of interest from the viewpoint of the flyer whose life may depend on this instrument.

The book is not elementary in that the reader should be familiar with flying techniques before tackling the information given herein. Much of the material outlined will be utterly incomprehensible to the layman, hence the book is recommended for the advanced flying student whose work has progressed to the point where instrument and radio navigation are the next step in his training

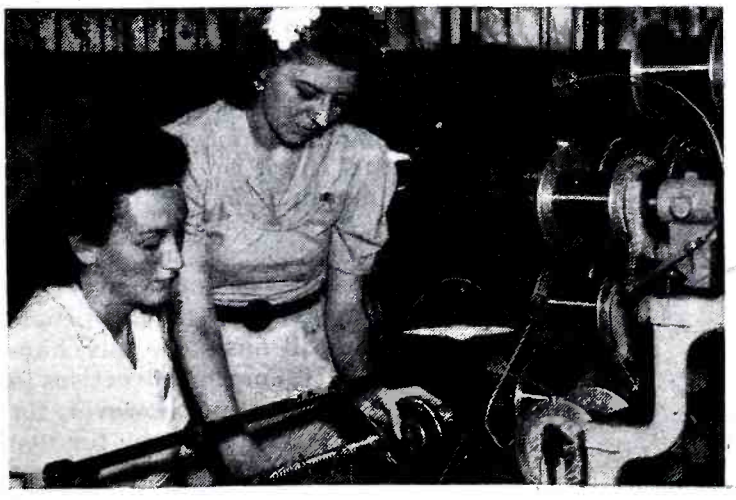
—30—

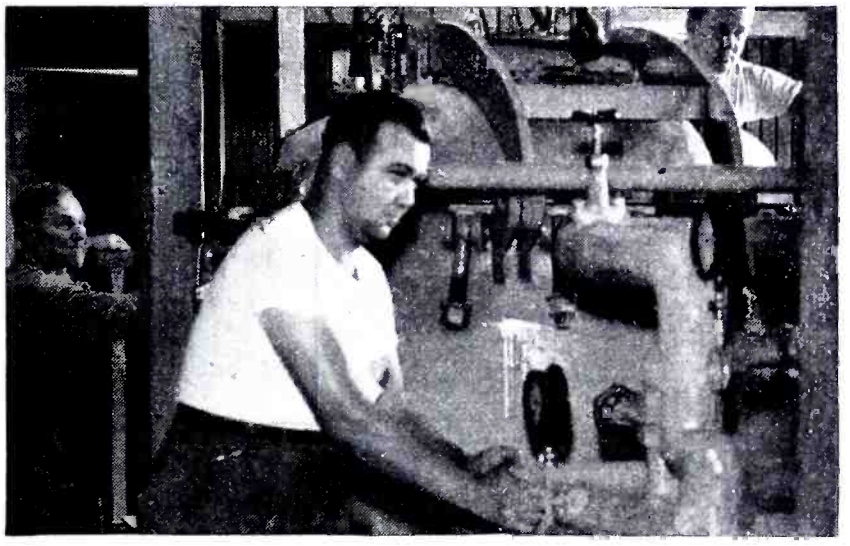
CAMERAMAN TRACKS DOWN A TRADITION

Come war or high water, there is one tradition in the radio industry that continues to stand the test of time! It is the traditional quality for which every Meissner product is famous. With this in mind, our roving photographer recently made another trip to Mt. Carmel, Ill., just to track down the source of this priceless asset. Part of the answer he found in busy experimental laboratories and in superior manufacturing equipment. But most of all he found it in the skill of workers on the long assembly lines or in the care and pride revealed by every individual Meissner craftsman. Shown above is a typical Meissner production line.



Interesting, intricate are words which might well describe some of Meissner's highly specialized equipment (above and below) but "precision-el" is the one word which fits the company's highly trained personnel.





Father and (right background) son are typical of the way Mt. Carmel families have turned to electronics for lifetime work. Meissner is Mt. Carmel's leading industry.

SERVICE NOW—SALES LATER

By CHAS. N. TUNNELL

Servicing has been found to be both necessary and profitable when conducting a successful radio-retailing business.

THE conception that some radio-shop operators have that radio service is just a necessary evil and that they must keep up their service work so that they will be in business when new merchandise again is available, has been exploded by Charles Deason. This radio retailer has this to say: "I just wish that our business would continue to be as good as it has been for the past two years. We aren't kicking about the repair profits; we are making money in this end of the business—we buy a little and make a few sales. Some day new merchandise again will be available and we expect to do a big and profitable volume of business—but we never expect to lose sight of the repair field as a profitable part of the radio and refrigeration business."

Mr. Deason owns the Deason Radio Company, 102 Navarro Street, San Antonio, Texas. He has been in business for 18 years, and was the first man in that city to get started in the automobile-radio sales and service field. He still services automobile radios, but because he feels that home sets are more essential, he does a much larger volume in the home-set field. This shop owner does, however, repair auto radios when they are left for repairs.

A good organization, with plenty of "know how" plus a genuine desire to give an intelligent radio service to good customers, is the simple but effective formula used by this dealer. Although San Antonio once may have had the reputation of being a town of low wages, Deason has always paid good salaries, and on a flat basis, to his repairmen. One of his men has been with him for 8 years, some of the others for a number of years. His assistant in the front is a girl who has been with the company for nine years.

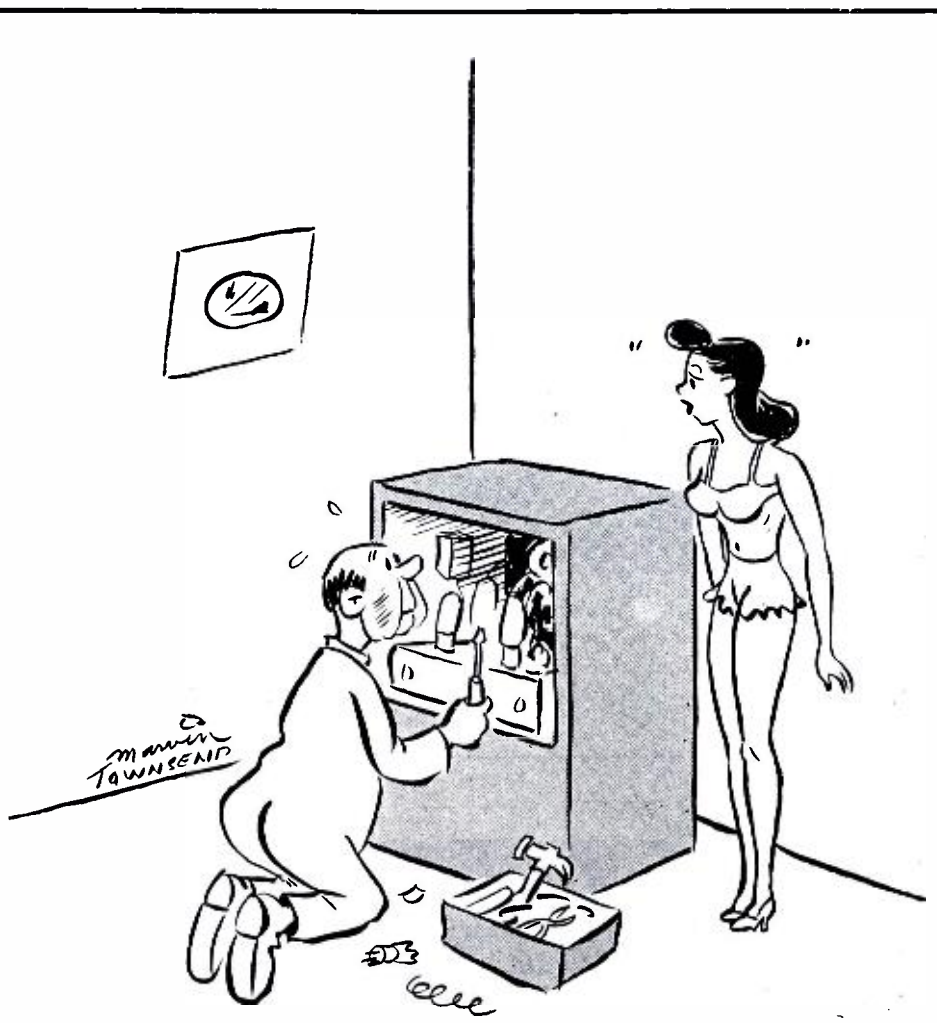
"I would much rather pay a radio serviceman $50 a week than to pay one $30," says Deason. He continues, "We have five good men—could use more and could get more, but we want experienced men. Our boys really turn out the jobs at a rapid fire rate—but each of these men is capable not only of doing a first class job, but of meeting the public and making the customer feel confident that he is getting the best possible workmanship. We let our customers talk to the man who is going to do the job; and even if it is for as little as $1.50, we want this customer to feel that the man who does the job is a skilled technician."

It is not hard to understand why Deason's men stay with him. The foreman keeps the time in the shop—or the men help him keep it. They get full pay when sick and they get paid holidays. If they take off any time for personal reasons, they work a few hours at night and make up the time . . . they are treated just like Deason would expect to be treated if he were a mechanic instead of the owner.

This shop owner is apt to leave the store in the afternoon and take his wife and children out to their farm which has one and one-half miles of river front and a fine bathing beach. This family puts in some time living as well as working. On such days when the boss is gone, the girl must stay in the store until six p.m. . . . but she doesn't come down early the next day. Deason will telephone her at 10:30 the next morning to wake her up so she can get ready to get down to work. When she needs to go to the beauty shop or go shopping, she goes on the boss's time for she, in turn, has stayed late some afternoon to do whatever had to be done.

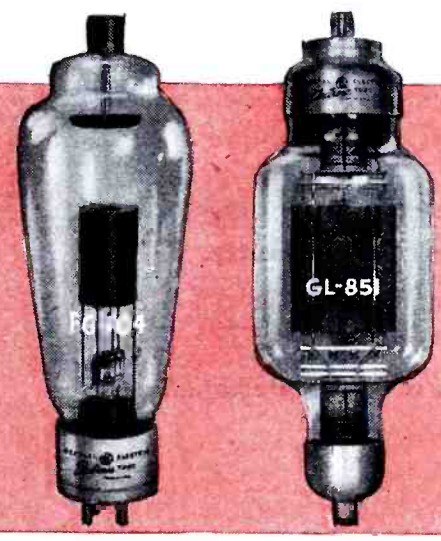
A free war bond for each worker is not an uncommon monthly bonus to the shop boys as well as the girl at the front in this radio shop. One recent month the crew divided a $60 cash bonus between them; in 1942, they cut a $900 Christmas bonus; in 1943 they divided $750 . . . $150 going to the girl, who had been there the longest and $75 going to a boy in the Armed Services who had been on the payroll only six months before bonus time. Some months there isn't any bonus—but every month is a month of hard plugging by all and plenty of enthusiasm to keep the business successful.

Deason runs an occasional advertisement on Sunday just to let people know that he still has some merchandise to sell. He never advertises a radio-phono combination, however, for such an ad jams his telephone for two days. His best advertisement however



"Am I bothering you, Mr. Franklin?"

G-E electronic tubes supply the high-frequency power for this industrial heating application.



Electronic heating makes it possible to localize heat where you want it . . . both the heated area and the depth of the heat-affected zone can be controlled within close limits.

One large manufacturing company uses the feature of localized heating with a G-E electronic heater to anneal the ⅛-inch tip of small thumbscrews while the rest of the screw remains hardened to the far end of the thread. By conventional heating methods, it was difficult to confine the heat to the tip. Costs were high. Now, with a single electronic heater, 100,000 thumbscrews are annealed per day — at one-half former cost and with exceptional uniformity of product.

Two G-E electronic tubes—the GL-851 power-oscillator triode and the FG-104 rectifier — supply the high-frequency waves for this heating application.

Electronic heating is divided into two broad classes. Induction heating can be used in the treatment of metals to harden, anneal, braze, and solder. Dielectric heating can be used for heating non-conductive materials such as plastics.

Electronic heating eliminates waste heat, cuts heating time-lag, minimizes scale, improves working conditions. It does many heat-treating jobs faster, better, and in most cases at lower cost.

To designers, manufacturers, and users of electronic-heating equipment, General Electric offers a complete line of electronic tubes for all applications. Through its nation-wide distributing system, General Electric is prepared to supply users of electronic devices with replacement tubes.

For information on electronic tubes for all applications, write *Electronics Department, General Electric, Schenectady 5, New York.*

Tune in General Electric's "The World Today" and hear the news from the men who see it happen, every evening except Sunday at 6:45 E.W.T. over CBS network. On Sunday evening listen to the G-E "All Girl Orchestra" at 10 E.W.T. over NBC.

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

GENERAL ELECTRIC

162-C13-6850

is his 18 years of contact with a fine clientele and his very fine location on a busy street. His sales room is snow white inside—glass on two sides, so for a small amount each month, he keeps the inside brilliantly lighted all night, every night.

This dealer faces the usual shortages of material, especially popular tubes. But the boys change up and convert, adapt and adopt to such an extent that 95 per cent of all sets brought in are repaired. Right now an average of five-day service is being given; at one time they got 20 days behind. No estimates are given immediately. Deason or the girl will handle the front and tell the customer that they are not sure that the radio can be fixed or if they have the material, but that they are able to fix most. They tell the customer that it will be a week before they can check the radio . . . that the customer can call back or leave a telephone number and be called before the set is fixed. Deason insists on giving the customer the price, but once the owner is given the price over the telephone, he is told that he can have his set within two hours time. "When we once check the set, we have the soldering iron right there and are ready to do the job quickly," Deason says. "And, in most instances, price is not much object to the customer. We generally get the set repaired a few days before the customer expects it. Although we don't tell the customer, we do let essentiality determine to a large extent when we will finish a set. If we know the customer has only one radio, we get it out within a few days. If it is an automobile radio or if the customer has several others, it comes out last."

Two of the Deason Radio Company mechanics are very good on radio combinations. These jobs generally bring in a good price for, in most instances, they have been taken around to various places and the undoing amounts to more than the repair. The Deason crew repairs a great many combinations—they do a few juke boxes for some regular customers, but this business is not cultivated as there are too many calls at midnight when some drunk drops a slug into a juke box. Deason doesn't like these night calls, personally; he does not expect his boys to do what he doesn't like himself.

A little loud speaker and sound work is done in the way of repair, but Deason likes to stick to radio in service and sales. However, when merchandise is available, he will push radio and refrigeration sales and service. At one time he had a silver Packard and speaker equipment which he rented, but he doesn't believe there is enough of this business to make the investment profitable.

Ninety-five per cent of the radios brought into this shop are repaired, with the customers not complaining about prices. Ways and means must often be found to get the set into operation, but it is done correctly or not at all. Although Deason gave a low estimate fee of 75c, when many get $1.50

in his territory, this low price seldom comes into play for most everyone bringing in a set is sold a repair job that is as complete as necessary.

"We do anything to repair a radio which we believe will stand up and give service," says Deason, "but we don't weld tubes and make a charge, for we can't depend upon the job. We will take a tube and put it on the tester. It may show 50 and we run it up to 70, welding it this way, and then we hand it back to the customer without charge. We refuse to make a charge for this service, telling the customer it may last an hour, maybe six months. But we do hold the respect of our clientele, 85 per cent of them being people that we have served before."

All merchandise that has been sold from this firm is sold from the floor—there has never been an outside salesman, and all merchandise has been sold on one basis, "If you are not satisfied, return it and get your money back."

When Victory comes, Charles Deason will be selling radios and refrigerators in his store. He does not intend to lose sight of the service end then as a sales builder as well as a money maker, for this radio-shop owner makes a profit on service.

—30—

TUBE SUBSTITUTIONS

EVERY radio shop is either piling up a great many sets they cannot repair for lack of tubes such as the type 12A8 GT, etc., or they just return them to the customer with the explanation that this particular tube is not available and that consequently, the radio cannot be repaired at the present time, perhaps for the duration.

In order to get these idle sets off the shelves, Mr. E. J. Schmidt of St. Cathrines, Ontario, Canada, has devised the following trick for repairing such sets with the least expenditure of time and money, allowing the serviceman to make a reasonable profit.

The 12A8 GT tubes are out, so we have to substitute. We find that there is no 12-volt tube we can purchase that will replace the 12A8 GT, but if we take the 7A8 type of loctal tube, we can get satisfactory service as follows. Take your bad 12A8 GT and cut off the base with a hack-saw so that you have only the bottom of the tube left with the prongs still intact. Next break out the key, or center part of the base, enlarging the hole enough to let the key of the loctal type 7A8 pass through (a notch is filed into the hole at the proper spot). You will find that this makes a snug-fitting adapter for the new tube, all the prongs of the loctal tube fitting nicely into the hollow prongs of the loctal tube base.

Next comes the problem of rewiring socket connections. The changes are as follows: Connect 2 to 1, 3 to 2, 4 to 5, 5 to 4, 6 to 3, 7 to 8, 8 to 7, grid cap to 6. Besides these changes we have to insert a 60-ohm, 2-watt resistor in series with one of our heater leads; this can go on either prong 1 or 8 of the socket. Theoretically, the value of this resistor should be lower but it is desirable to keep the heater voltages down as low as possible in order to save tube life.

—30—

After The war, MORE than before!

COUNT ON THE FAMOUS N. U. EQUIPMENT PLAN

Of course, you'll need new shop equipment to cope with the vastly increased peacetime demand for radio, television and industrial electronic service. You'll want fine, modern instruments, tools, meters. And you'll want them, as before, on the easy-to-get basis provided by the famous N. U. Equipment Plan. Fifty thousand times this plan was Ok'd by service dealers who used it to equip their shops in the years before the war. So plan now to re-equip for peacetime service, the exclusive N. U. way.

DEPARTMENT B
NATIONAL UNION RADIO CORPORATION
NEWARK 2, NEW JERSEY

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

AIR CORPS
Radio Phraseology Training

By 2ND LT. BYRON A. SUSAN
Air Transport Command

Specially-designed amplifier for use in teaching students proper phraseology during tower-to-plane communications.

Lt. Susan, phraseology instructor.

A BIT of ingenuity, a broken-down radio set, and two hand mikes normally used in aircraft, enabled the construction of an effective training aid for the author's course in radio phraseology.

In the business of flying, where more and more the correct use of the right word at the right time gains in importance, this clever training aid enables the student to learn the correct way as well as familiarize himself with checking in and out with radio control towers.

A mike in the hand of the instructor, who acts as the tower, and another mike in the hand of the student, as the pilot, enables them to simulate conditions as they would be encountered in actual flight. As their voices are heard, the entire class acts as the critic.

A few months past, when the British and U. S. Governments got together and agreed on one set of radio phraseology, it became necessary to instruct our pilots in the new vocabulary. Not that the words were new, but words which had been picked up and had gained common usage, were dropped in cases where they failed to mean what they stated. For example, *over* is now used when one desires the other transmitting to come in. *This is* has been substituted for the former *from* which was difficult to understand. *Say again* is now used instead of *repeat*, as the latter is an artillery term used to repeat a salvo. These are but a few examples of the many term changes that necessitate the course in radio phraseology.

This training aid, though extremely simple, is highly effective and is daily proving its advantages to enthusiastic classes. The amplifier has been assembled on a small chassis, large enough to accommodate the component parts. No specific arrangement of parts need be specified due to the fact that there are no parts which would be adversely affected by inductive pickup. Since the microphone input circuit is of low impedance, there is no pickup due to the field of the power transformer.

By incorporating the constants as

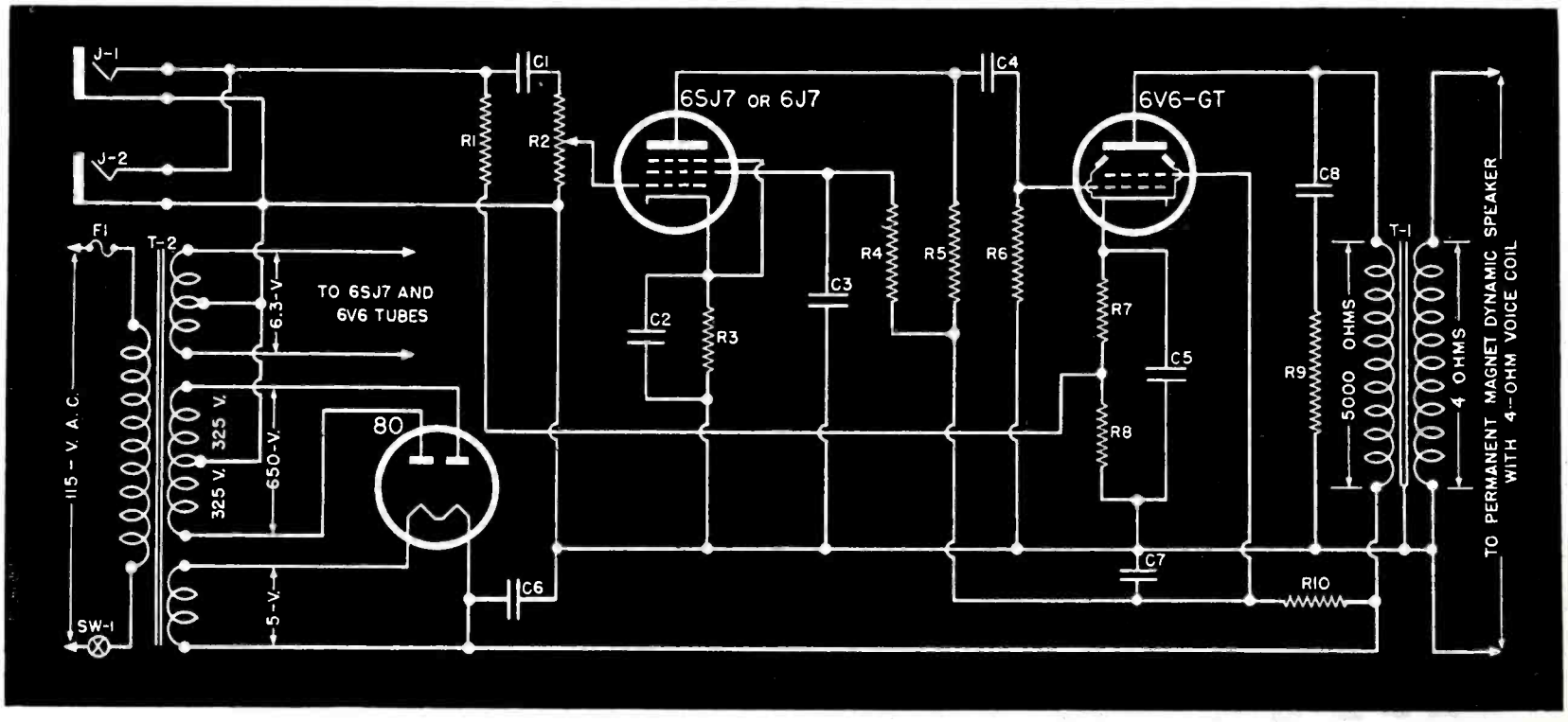


Fig. 1. Circuit diagram of amplifier. An Army aircraft microphone, connected to a two-conductor plug, is used.

R_1—500,000 ohm, 1 w. res.
R_2—.5 megohm, pot.
R_3—2200 ohm, ½ w. res.
R_4—1 megohm, ½ w. res.
R_5—200,000 ohm, ½ w. res.
R_6—300,000 ohm, ½ w. res.
R_7, R_9—150 ohm, 1 w. res.
R_8—100 ohm, 1 w. res.
R_{10}—25,000 ohm, 1 w. res.
C_1—.1 μfd. @ 400 v. tub. cond.
C_2, C_5—25 μfd. @ 25 v. elec. cond.
C_3—.25 μfd. @ 600 v. tub. cond.
C_4—.1 μfd. @ 600 v. tub. cond.
C_6—80 μfd. @ 450 v. elec. cond.
C_7—20 μfd. @ 450 v. elec. cond.
C_8—.005 μfd., mica cond.
T_1—Output trans., 5000 ohm to 4 ohm
T_2—Power trans., 325-0-325 v. @ 90 ma., 5v. @ 2a., 6.3v. @ 2a.
J_1, J_2—Single circuit jacks
S_1—S.P.S.T. toggle sw.
F_1—2 amp. fuse

KEEP UP WITH RADIO TELEVISION and ALLIED ELECTRONICS

Get in on the new developments in the fast expanding Radio Industry. Take your place in the field of Television. Make more money as a Modern Service Expert. Own and operate Your Own Business. Learn the latest Trade Secrets and Short Cuts through

SHOP METHOD HOME TRAINING

Don't waste time! Radio, F.M., Video (television), and the whole field of Electronics is changing fast. If you are in the radio business now you know what you are up against—**new methods, new techniques, new equipment.** You know how fast the field is growing. Today you must solve NEW problems in servicing and repairing F.M. receivers. Tomorrow there will be thousands upon thousands of Television Receivers to handle. Right after the war science promises NEW Electronic devices for household, factory and business.

ALL THIS MEANS NEW OPPORTUNITY FOR YOU IF YOU ARE READY

The thing to do is to GET READY right now. Find out about the marvelous new method of preparation—SHOP METHOD HOME TRAINING. **Fill out and send in the coupon now.**

Keep In Step With Shop Progress

Here IS the truly modern system of training. It matches the RAPID PROGRESS CONSTANTLY BEING MADE in Radio, Television and Electronics. It is up to date in every way because it comes right from the busy radio training shops of National Schools where experiments and developments are being carried on—where discoveries are being made all the time.

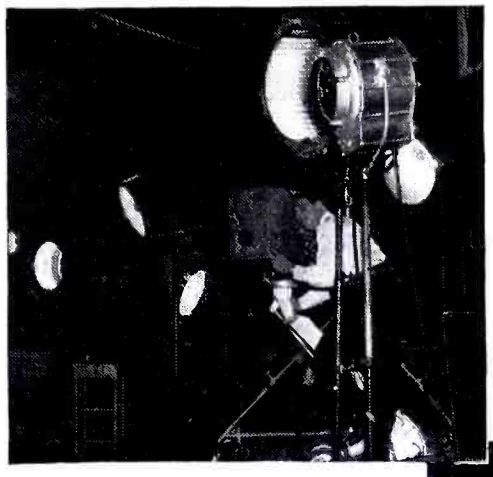
It is based on real shop methods—on the handling of real shop jobs. Only National can offer you SHOP METHOD HOME TRAINING because only National has the big busy shops to develop this method.

And it is time tested too. National Schools has been training men for industry, for government, for business for **more than a third of a century.** In essence you get at home—in your free time—the very same kind of instruction that has helped thousands upon thousands of ambitious men to more pay and greater opportunity — that has set thousands of men up in business with little or no capital. You owe it to yourself to read the book "Your Future in Radionics"—sent to you FREE if you fill out and mail the coupon.

Make Extra Money Right from the Start

You get ahead fast with National Training. Many beginners make good money on the side fixing radios and doing service work. You can turn your knowledge into cash after the first few lessons. Progress is rapid. You can actually SEE YOURSELF GET AHEAD, because the National Shop Method is so sound and practical.

Now, right now, is the time to grasp the opportunity of today—a successful career for tomorrow. Get into the big money, rapid advancement, a position of importance. A BUSINESS OF YOUR OWN. Radio, television and the whole field of electronics invites you. The industry is crying for trained men everywhere. A rapidly expanding industry—probably the greatest in history — holds out the promise of a rich future—prosperous security.



GET THE REAL EXPERIENCE *BEFORE* YOU TACKLE A JOB

Walk into a brand new job and go to **work with assurance**—the assurance that comes with knowing how—that comes with handling the tools — with working with and operating actual electronic equipment sent to you from the laboratories and shops of National Schools. There's nothing to equal learning **by doing.** In your National training you build real sets—a superheterodyne receiver, a signal generator — literally scores of various electronic devices with your National equipment.

Learn basic principles—FIRST THINGS FIRST. Get your knowledge and experience first hand under the personal guidance of seasoned, practical National instructors working personally with you. **You know the very how and why of Radio—Television, Electronics.**

Not only do you gain marvelous actual experience by this method of learning but you have valuable equipment you will use on the job in the practice of your profession as an electronics expert. Mail the coupon and learn what this means to you.

AFTER THE WAR WHAT?

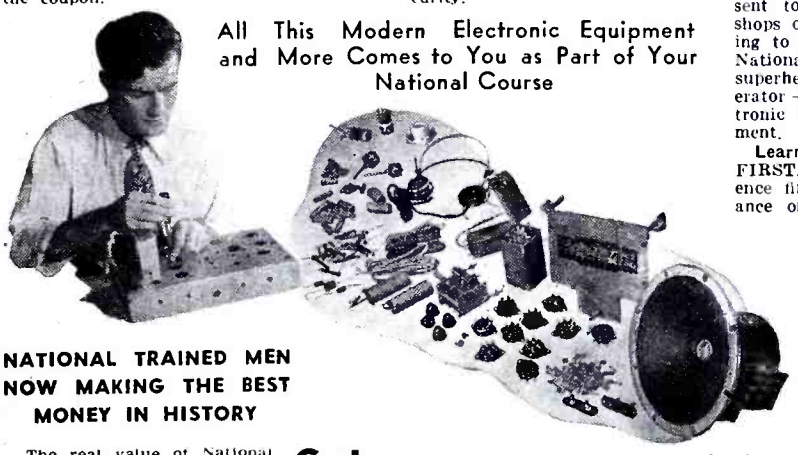
Face realities now! Is the job you're doing going to last? What is its future and yours? How are you going to meet conditions when the world returns to civilian production? There's no use in fooling yourself. Radio is a BIG, SOUND, WELL ESTABLISHED BUSINESS.

There are millions of sets in the Country that need reconditioning right now. There is a big demand for millions more that have to be built—largely by trained men. F.M. is here to stay. BUT RADIO IS ONLY ONE FIELD OF ELECTRONICS. Television is sure to come. Sets must be built. Installed, serviced and repaired. Who's going to do it? Make up your mind that you are—and at a great big profit—for years and years to come.

What about facsimile? That has been proved and approved for use by newspapers, communication systems — industry as a whole. And the great new field of industrial electronics? It is established — here to stay. IT NEEDS MEN — RIGHT NOW!

When you hang up your uniform—when your war job folds up will you step out proudly into a new field—an essential established industry—perhaps into a business of your own?

The above pictures were made in and around a modern television studio. Think what new opportunity is open to you in this great new field if you are ready for it. Prepare now. National training includes a good foundation in Television and F.M. Get the facts. Send the Coupon.



All This Modern Electronic Equipment and More Comes to You as Part of Your National Course

NATIONAL TRAINED MEN NOW MAKING THE BEST MONEY IN HISTORY

The real value of National training shows up in the quick progress our men make on the job. Joe Grumich of Lake Hiawatha, N. J., turned down a job most men would welcome. He writes: "My latest offer was $5,800.00 as radio photo engineer, but I am doing well where I am now engaged. I am deeply indebted to National."

Ely Bergman, now on Station WOR, told us: "My salary has been boosted considerably and at the present time I am making over $3,000.00 per year, thanks to National Training." And from the far-off Hawaiian Islands, Wallace Choi sends this: "I am averaging $325.00 a month. I will say that I honestly owe all this to the excellent training I had at National."

National is proud of the progress graduates are making all over the world. Read about their records yourself in the books we send you FREE.

Get This FREE LESSON

Get a FREE lesson from National. Study it over at your convenience. See for yourself how thorough, how sound and how practical—yet how amazingly easy it is to learn and understand. NO SALESMAN WILL CALL ON YOU FROM NATIONAL SCHOOLS. National points out the opportunity—offers you the training and experience, prepares you for greater things in life. But it is up to you to act for yourself. And the first step is to fill out the Coupon and mail it. Get FREE lesson, the big Radio Book, and then decide.

NATIONAL SCHOOLS

LOS ANGELES 37, CALIFORNIA EST. 1905

MAIL OPPORTUNITY COUPON FOR QUICK ACTION

National Schools, Dept. 1-RN
4000 South Figueroa Street, Los Angeles 37, California

(Mail in envelope or paste on penny post card)

Mail me FREE the two books mentioned in your ad including a sample lesson of your course. I understand no salesman will call on me.

NAME..... AGE.....

ADDRESS .....

CITY..... STATE.....

Include your zone number

shown in Fig 1, the average gain of the amplifier is approximately 56 db. from 500-ohm input to 4-ohm output. The amplifier gain control will provide for adequate output level to cover a class of 50 men in a room 15 by 30 feet when in the two-thirds open position. (Audio-Taper control is used.) The undistorted output with a plate voltage of 300 and a screen voltage of 250 is 5.0 watts when the speaker is matched correctly and the tube is feeding into a load resistance of 5,000 ohms.

It is to be noted also, that the polarizing voltage for the microphone is obtained from the bias resistors in the output stage. No filtering other than that shown is required. Low polarizing voltage eliminates acoustic feedback to a large extent. The original model was built in a small wooden cabinet with no controls other than the switch and volume control on the front panel. The two microphone jacks were also located thereon. One mike with a standard length cord is plugged in and is used by the instructor. A second mike is also plugged in, through two or three six-foot extension cords, as required, and passed out to members of the class. When plugged in and turned on, the device becomes the medium through which the entire class may hear the two-way conversation between the instructor and student, who, alternately become pilot and ground-station operator.

The classroom practice, with the use of this unique training aid, has made the 20th Ferrying Group's radio phraseology course one of the most interesting, as well as informative phases in the curriculum of students attending the Ferrying Division training school at the Nashville, Tenn. base.

—30—

SIGNALMEN IN NORMANDY

MANY stories of U.S. Army Signal Corps men in Normandy have now seeped in to the home front and they build a picture of courage and quick wit in front-line communication service which confirms the long tradition of American Signalmen. Prominent in the picture are infantry wire patrol crews and airborne Signalmen.

One of the earliest stories, in point of time, is that of a patrol crew of eleven enlisted men led by Second Lieutenant Paul J. O'Reilly of Brooklyn, New York. The crew landed on a Normandy beach in the first stages of the invasion and immediately, in the face of enemy fire, set up intercommunications lines tying together the various invasion units in that area. As fast as the enemy knocked out the lines they jumped in and repaired them.

On the third day they were working right beside a large oil dump when enemy strafers began peppering the region with bullets. They jumped on a passing truck to escape but presently jumped off again faster than they had boarded the vehicle. One of the men noticed a big red sign on the side of the truck: *High Explosives*. In the words of one of the patrolmen, "We were plenty scared before, but we practically died of shock when we saw where we had taken 'refuge'." The fright and "practical death" did not prevent them from going right on with their incessant job of laying wire.

As the invasion army grew in strength and covered more of Normandy the wire network grew to fantastic proportions. Hundreds of local lines ran along every country lane and crisscrossed every orchard and barley field. All telephone wires were checked four times a day by trouble shooters, using portable Signal Corps telephones and so efficient was this service that the trouble shooters could inform the wire patrol crews of the exact point—that is, between two stated poles—where any break occurred. Then, in a matter of only a few minutes, a lineman would be at the spot to fix the break. French cement poles, usually placed much too close to the road to permit easy passage of large Army vehicles, had to be used at first, but gradually these were replaced by larger wooden poles shipped from American lumber yards. Small "rapid" pole lines were erected at intervals between the larger poles, to take up the slack of the innumerable dangling wires so that they would not be broken by passing trucks, especially in wet weather when the trucks tend to slip badly on the mud of country roads.

The airborne Signal Corps men landing in Normandy by parachute and glider were as active as the wire patrol crews of the infantry. Signalmen of the 82nd Airborne Division, for instance, are reported to have gone to work in the early hours of D-Day from the very moment they "dropped in" on France. Veterans of the Sicilian and Italian campaigns, they knew from grim experience how to lay wire, repair radios, deliver messages and supply necessary signal equipment in the face of almost continuous enemy fire. As merely one of their activities they laid 3000 miles of wire; and as another they repaired 85 radios and returned them in fit condition to operating units.

The battle names that flashed into world headlines and then were mercifully lost to sight as the battle lines advanced, were all scenes of active and very dangerous work on the part of the Signalmen. During the first days after the landings on the Cotentin Peninsula they were frequently under direct fire from enemy antitank guns, and in danger also from mines and booby traps. At St. Sauveur le Vicomte two telephone teams dashed across the Douve River directly on the heels of the assault troops. They set up wire lines and then repaired breaks in them as fast as enemy fire knocked the lines out.

At Pont l'Abbé they crossed the same river in assault boats and performed the same hazardous work. At La Haye de Puits they advanced over roads which were known to be heavily mined. Every step was an invitation to death but the Signalmen figured that if the assault troops could risk it they also could risk it.

One of the dramatic incidents involving Signal Corps men occurred when Sergeant Paul Czereinski of West Allis, Wisconsin, who won a Silver Star for gallantry, saw a German .88 nearby and deliberately charged it with his jeep. This was a modern and motorized version of David attacking Goliath; and it worked. The little jeep knocked out the heavy .88. —30—

SPRAGUE TRADING POST

A FREE Buy-Exchange-Sell Service for Radio Men

. . . from all of us to all of you!

To all our friends, old and new; to those in the armed forces; to all who have entered war work; and to those still on the job at the old stands . . .

Our best wishes for the 1944 Yuletide and our sincere hope that the year 1945 will see the dawn of a peaceful, better, happier world.

SPRAGUE PRODUCTS CO.

FOR SALE — Two 0-7 d-c voltmeters (Weston) $4 ea.; one 0-25 d-c ma. 5", $10; Radio Physics Handbook & Radio Troubleshooter's Manual, $3.50 ea.; FBXA and 40 meter coils, no speaker or power supply. Want EC-1 or NC-200 or Sky Buddy, also an all-wave signal generator. Will pay cash. Harry Emanatian, 663 Pawling Ave., Troy, N. Y.

WANTED — Rider's Perpetual Troubleshooter's Manuals Vols. 4, 5, 6, 7, 8, 9, 10, 11, 12 or Rider's Abridged in place of 4 and 5. Philip P. Goldstein, 288 Ave. P., Brooklyn 4, N. Y.

FOR SALE — Weston galvanometer 0-30 each side center (22 micro-amps per division); Weston 0-2 a-c rectifier-type milliammeter; Weston 0-5V a-c ditto; Triplett 0-1 MA. d-c; Triplett 0-1 a-c ammeter; Jewel 0-1 MA. with following shunts & multipliers: 0-15-150 MA.; 0-7½-75-300-600v; Jewel 0-1 RF thermocouple ammeter; GR 1000 cycle tuning fork type oscillator; 6' heavy steel channel relay rack. Karl Neuwirth, 16 May Place, Nutley 10, N. J.

WANTED — Battery sig. generator, also Paragon Radio R-A-10 receiver with D-A-2 detector-amplifier or what have you? R. E. James, Box 187, Seligman, Arizona.

SWAP OR SELL—Have hot water car heater; Motorola Golden Voice #80 car radio; electric hair clippers, etc., for sale or trade. Want radio test eqpt. or short wave receiver, condition not important.

FOR SALE—One Million Model SY Signalizer practically new, $35; one 2v 135v B and one 1½v 90v B a-c power packs, new, $13.50 ea.; one 140 watt ⅜ tip Drake soldering iron, never used, $7.50. Will ship C.O.D. A. B. Eatherly, 1504 Bernard Ave., Nashville 4, Tenn.

TUBES FOR SALE — Write for list & prices. Bill's Radio Repair Shops, 2038 Washington St., Roxbury, Mass.

FOR SALE—Rider's Manuals, Nos. 2 and 3; RCA 156-D tube checker; 6v motor generator, Philco, 250v. Chas. H. Peacock, 85 Church St., Bridgeton, N. J.

WANTED FOR CASH—Echophone EC-1 or EC-3. James H. Jackson, 215 West 32nd St., Oklahoma City, Okla.

WANTED—Superior #1280, #1240, #1250, #1110, #1180-S; Readrite #720; #421-422; #710, #720A, #430; Dependable #303-A, #304, #501; Franklin #H-33; Confidence Special Model C; Triplett #1125, #1220. I. W. Stubblebine, 238 W. Elm St., Reading, Pa.

FOR SALE—Will sell for $50 cash or swap, 2 RCA 803 tubes used only about 4 months, condition guaranteed perfect. Can use combination tube tester, V-O-M, RCA Voltohmyst, or other service equipment. Vassar Radio Service, 2634 Berkeley Terrace, Fresno, Calif.

WANTED—Sylvania Stock Boy cabinet; R-F milliammeter 0-500 ma. Fox Radio Service, 435 So. 5th St., Richmond, Ind.

URGENTLY NEEDED—Tube tester and AC-DC V-O-M or combination in fair condition. Tube tester need not have sockets for miniature or loctal tubes. Robert Moe, 8950 So. Harvard Blvd., Los Angeles 44, Calif.

WANTED—Following tubes: 1A7, 1A5, 0Z4, 6A7, 6A8, 7A8, 12v series, 35v and 50v series, 117Z6, etc. Also need Rider's Manuals. All letters answered. Buckeye Radio Service Co., 9405 Buckeye Rd., Cleveland 4, Ohio.

WANTED—Test eqpt. to open service shop. Please state condition and price. Charles T. Mewborn, 503 Second Ave., Albany, Ga.

WANTED—Signal generator, range from 100 to 30 megs., fundamental. Also 3 amp. a-c ammeter. Leyden Radio Sales & Service, 9651 Franklin Ave., Franklin Park, Ill.

FOR SALE—Triplett #1601 analyzer and deluxe set tester in new condition with adapters for loctal and octal tubes, also operating instructions, free point testing feature, $65. Solar condenser tester and capacitor analyzer CB160 in new condition with instructions, $35. All letters answered. James Covington, 249 W. 131st St., New York 27, N. Y.

FOR SALE OR EXCHANGE — Portable transmitter parts; 6v DC and 115v AC power pack; 6v vibrator pack; 80 W speech amp. & mod.; Astatic JT-30 mike; 160 and 75 meter Xtals; Garter genemotor; TCS-225X Hammarlund transmitting condenser; 1000v, 2 mfd. filter condenser; Rider manuals 6, 7, 8 and 9. Want condenser tester and Colt .22 Woodsman. D. L. Hansen, Box 273, Coleraine, Minn.

WANTED—Communication receiver, preferably Hallicrafter's with "S" meter. Sgt. J. H. Fairfield, RCAF Station, Yarmouth, N. S., Canada.

FOR SALE—Good used tubes, including 01A, 16, 19, 24, 26, 27, 30, 32, 35, etc.; also later types, including 6K6, 6K7, 6A7, 6A8, 6F5, 6SA7, etc. Weir Cove Radio, 508 Garden Way, Holidays Cove, W. Va.

WILL TRADE — RCA all-wave chassis and speaker, with tubes, for sig. generator, V.T. voltmeter or what have you? Also want National 5-B-100 tank, for cash. G. Boles, 315—51st St., Brooklyn 20, New York.

WANTED—Rider manuals #11, 12 and 13—also sig. generator, tube tester and set analyzer combination or other test equipment. S. Stargatt, 485 Pelham Rd., New Rochelle, N. Y.

FOR SALE—Gardiner Levering "S" automatic code sender, 115v, 50/26 cycles AC, with ten tapes. $10. Howard A. Fischer, 1510 Washington St., Wisconsin Rapids, Wis.

WANTED—Radio City 802 tube and set tester or equivalent, or separate tube checker and V-O-M. Arno L. Fahsholtz, Linn, Kansas.

FOR SALE—Jewell #116 DC voltmeter to check B eliminators, $15. A. Saybell, Electric Appliance Rental and Sales Co., 324 West 42nd St., New York.

FOR SALE — Weston #682 tube tester and Dayrad # 46 tube tester. Pvt. Walter E. Locy, 11 Prospect St., Canton, N. Y.

WANTED—Late model tube tester and analyzer, in A-1 working order. S. W. Sutberland, Box 446, Caeburn, Va.

WILL TRADE—Late model, small size 17-jewel Illinois pocket watch for 1, 12, 35 and 50 volt tubes. L. R. Benorden, Box 52, Llano, Texas.

WANTED—Professional type portable recorder with amplifier and mike, preferably 16" cutter with dual speed control, and 15 to 30-watt amplifier with 2 phono inputs, 2 mike inputs, and separate bass-treble tone controls. Donald Dove, 405 Elbon Ave., Akron 6, Ohio.

FOR SALE—Jensen 14" auditorium speaker cone assembly (also fits 18"), $5, f.o.b.; Deluxe coil winder, $3; National UR-13 coil form assembly, $1.50; BM vernier dial, $1.50; also many Mallory #1300L switches. M. S. Schaefer, 280 Wadsworth Ave., New York 33, N. Y.

WANTED — Any quantity dead phono pickup crystal cartridges, 20 cents each, plus postage. Dependable Radio Service, 1635 West Jefferson Street, Phoenix, Arizona.

FOR SALE—Astatic X-26 crystal cutter, $6; Bruno "Long Cable" WS mike, $9; new RCA electronic capacity relay (original carton and tubes), $12. W. J. Arthur, 501 Ruffner Ave., Charleston, W. Va.

FOR SALE OR TRADE—6-110 V. 15-watt amplifier system, I.F. transformers and speakers, and tenor banjo. Want 3" oscilloscope. Cash if desired. I. Howard Miller, R.F.D. 3, Forest, Ohio.

WILL TRADE — Beede 2½" Ill. dial, cal. 0-1 DC. 1 milliameter, value $10; and Weston #506 type 117 0-7 DC. voltmeter, value $3. Want 12SA7, 35Z5, and 50L6 tubes, or good AC-DC radio. Wm. B. Moore, 1921 W. 7th St., Muncie, Ind.

WANTED—12 v. or higher tubes; must be new in sealed cartons. Leading Radio Service, 114 East 3rd St., Mt. Vernon, N. Y.

URGENTLY NEEDED—Up-to-date tube tester and sig. generator. Must be A1. W. N. Rodgers, 1701 Holladay St., Portsmouth, Va.

FOR SALE—100 new tubes in sealed cartons at O.P.A. list; 200 good tested used tubes at 30% off O.P.A. list. What do you need? H. Mason Radio, 114 East 3rd St., Mt. Vernon, N. Y.

FOR SALE—65 misc. radios, $600. Consoles, table models, auto sets, etc. Some playing, others need tubes and repairs but none stripped. Fairbanks Tryon, 214 W. Okla., Guthrie, Okla.

WANTED—Large outdoor Neon sign; also Supreme bench model 599 tube tester, V-O-M and battery tester combination. Phoenix Radio Service, 519 W. Forsyth, Jacksonville, Fla.

FOR SALE—Complete stock from radio shop at 40% off list. 685 tubes, $891.50 list; condensers, $355.02; w.w. resistors, $91.12 list; speakers, cabinets, transformers, etc., $913.75. Will sell as one unit. Tyburski Radio Sales, 12 Canal St., Chicopee, Mass.

YOUR OWN AD RUN FREE!

Send us your Sprague Trading Post advertisement today. We'll be glad to run it free as part of our special wartime advertising service to the radio profession. WRITE CAREFULLY OR PRINT. Hold it to 50 words or less. Different Trading Post ads appear regularly in RADIO RETAILING-TODAY, RADIO SERVICE-DEALER, SERVICE, RADIO NEWS and RADIO-CRAFT. Please do not specify any particular magazine for your ad. We'll run it in the first available issue that is going to press. Sprague, of course, reserves the right to reject ads which, in our opinion, do not fit in with the spirit of this service.

SPRAGUE PRODUCTS CO., DEPT. RN-15, *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. OFF.

WHAT'S NEW IN RADIO

New products for military and civilian use.

SOLDERING IRON

A soldering iron which heats in 90 seconds is being offered by the *Sound Equipment Corporation* under the trade name of Vanatta Kwikheat.

This iron, which has automatic heat control, is available with 6 types of interchangeable tips to facilitate soldering various jobs. The iron itself weighs 13 ounces and is equipped with a cool protected handle with a safety grip. The tips are equipped with a heavy precision thread connection to provide good heat contact inside the iron.

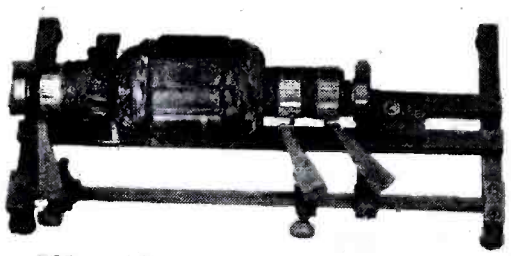
This unit is equipped with a 6-foot cord and molded rubber plug of approved construction.

Soldering irons or more complete details may be obtained by addressing *Sound Equipment Corporation,* 3901 San Fernando Road, Glendale 4, California.

COMMUTATOR GAUGE

The testing of three or more commutators at one time is accomplished by means of a new Multi-Gauge checker which provides accuracy up to .0001 inch.

Under usual methods, each commutator is tested separately, however, with the new type tolerance gauge, the armature is set into the jig and rotated. Indicating gauges applied to the commutators, read the deviation from true in thousandths of an inch. The sections which do not meet specifications can then be easily adjusted.



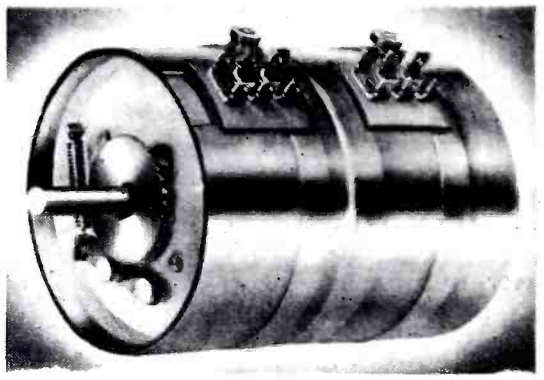
Since the armature is tested complete with bearings, a comprehensive check of the entire assembly is possible in a few minutes.

Complete details of this equipment are available upon request to *Carter Motor Company,* 1608 Milwaukee Avenue, Chicago, Illinois.

DUAL-UNIT ATTENUATORS

The *Daven Company* has announced a new improved model Dual-Unit Attenuator. This construction incorporates features which make it of value in balanced "H" attenuators, ladder, "L" and rheostat types. This unit is made up of two units, one mounted behind the other, the respective shafts of each meeting in a lap joint within a long snug bushing, which provides for each separation of the units. This is done by loosening a knurled nut and releasing the snap-on fitting, without dismounting the front unit from the instrument panel.

The attenuator has been treated



with antifungus preparation to resist fungus and mildew.

Further data will be forwarded to engineers and manufacturers upon request to the *Daven Company,* 191 Central Avenue, Newark, New Jersey.

D-20 MICROPHONES

The *Universal Microphone Company* of Inglewood, California, is presenting its first new model since 1940 with the introduction of the new D-20 series.

This dynamic microphone has a response of 50 to 8,000 cycles. It is streamlined in appearance with a brushed satin chrome finish case which is equipped with the new "micro-adjust" swivel. A dustproof hood and 25-foot cord are included with the unit. The D-20 will be available in four impedances.

Universal is also resuming production of some of its other microphones, including the KD and 15MM, dynamics, and the 200 series, a dynamic handimike and X-1 and XX, carbons.

Distribution will be made through the usual trade channels of *Universal's* factory representatives and parts jobbers.

NEW V.T.V.M.

A versatile vacuum-tube voltmeter, the Model 450, is being offered by the *Reiner Electronics Company, Inc.*

Of its many new features, the most important are the wide frequency range a.c. voltmeter which measures from 50 c.p.s. to 50 megacycles, the six d.c. voltage ranges with input capacitance of less than 2 $\mu\mu$fds. and input resistance of 11 megohms for all ranges, d.c. current ranges from 50 microamperes to 1 ampere in six ranges.

This new unit has a single zero adjust for all a.c. and d.c. ranges which eliminates delays during operation. The 100-ohm to 1,000-megohm ranges are covered without using the battery. The battery is used only for measurements below 100 ohms. A voltage regulated power supply provides stable operation.

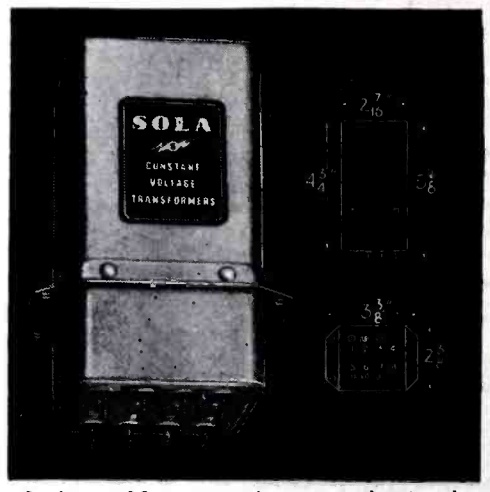
Complete details of this v.t.v.m. will be forwarded to interested persons upon request to *Reiner Electronics Company, Inc.,* 152 West 25th Street, New York 1, N. Y.

SOLA TRANSFORMER

A compact, hermetically sealed constant voltage transformer for through-chassis mounting has been designed by the *Sola Electric Company* for television, FM, v.t.v.m., photometric equipment and other similar applications.

At any reasonable transformation ratio of input to output, this unit will provide a single output voltage constant to within ±1% of rated requirements regardless of line voltage variations as great as ± 12 to 15%.

This unit is available in capacities up to 15 v.a., 60-cycle operation and is supplied with a separate capacitor unit for external mounting. The transformer has no moving parts, requires no manual supervision or adjustments



and is self-protecting against short circuits.

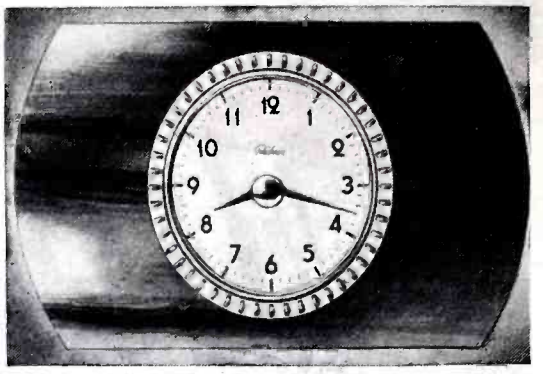
A new bulletin, No. 2CV-105, describing this line of transformers is available on request to the *Sola Electric Company,* 2525 Clybourn Avenue, Chicago, 14, Illinois.

RADIO TIMER

A new low cost timer which permits any radio program on a given band to be selected is being announced by *Warren Telechron Company.*

This unit permits the radio to be turned on at a certain time, and turned off at other predetermined periods. This unit is particularly applicable to medium priced receivers, is completely automatic and has a large and legible dial.

The keys around the clock face permit the unit to be set for a period as long as 10 hours in advance. There are 48 keys, indicating 15 minute time intervals. The keys automatically set



to "off" after timing periods are passed.

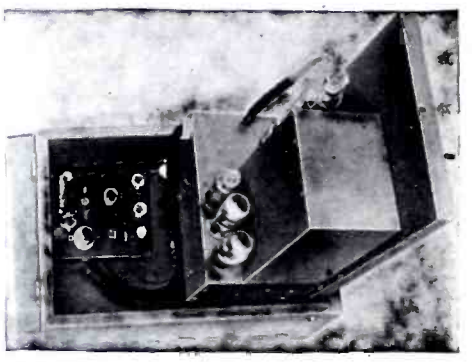
Various styles and colors are available in accordance with the manufacturer's requirements.

WELDING CONTROL

A new electronic timing unit for use in controlling resistance welding operations is being offered by *Electrical Industries, Inc.*

Since most manufacturing operations involve the use of welding in some phase, the application of this unit is widespread. The manufacturers claim a substantial increase in the quality and quantity of a.c. welding operations by means of this control.

The control is applied easily to either existing or new installations. One knob gives instant time control from 1 to 28 cycles in steps of one cycle. The welding current is electronically



switched, with absolute freedom from contactor uncertainties, maintenance, arcing and pitting.

Further information on the timing unit will be furnished by *Electrical Industries, Inc.,* 42 Summer Avenue, Newark 4, New Jersey.

CONNECTOR TOOL

A new tool has been added by the *Burndy Engineering Company* to their line of equipment marketed under the trade name Hytool.

This instrument simplifies the installation of Hyseal thimbles used on Navy insulated electrical cable. The Burndy Hyseal Thimble, with which this new tool is used, is the integral combination of the Navy thimble and a shroud for sealing the end of the cable. When this shroud is compressed a seal is formed which prevents the entry of water into the cable even under high pressure.

KEITH THOMAS

History of Communications Number Seven of a Series

EARLY COMMUNICATIONS BY AIR

While electronics use the ether and other media, one of the most speedy methods of communications in the early days was through the air by carrier pigeon. With a finely printed note fastened to the leg, these birds faithfully reached home to bring in the latest news events and stock market reports.

Today news commentary reaches into your homes in a flash of a second via electronic voice communications making use of the various types of Universal broadcast microphones. This being a modern age, the battle front is brought into the homes of the informed peoples of the democracies via military microphones such as those now being manufactured by Universal for the Allied Armed Forces.

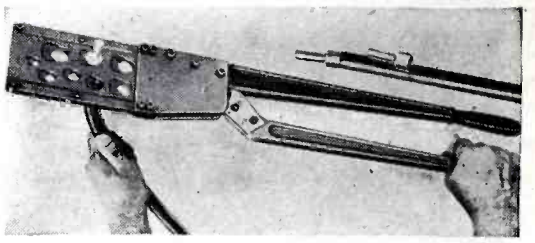
< Model 1700-UB, illustrated at left, is but one of several military type microphones now available to priority users through local radio jobbers.

UNIVERSAL MICROPHONE COMPANY
INGLEWOOD, CALIFORNIA

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

The Hytool eliminates the necessity of a separate pair of dies for each thimble size such as is required in hydraulic presses. The "spade" of the new tool carries a series of holes or "dies" which provides for the installation of a number of thimble sizes, so that no parts have to be changed. One stroke of the handle completes the watertight sealing operation.

Two sizes of the tool are available. The smaller, No. MYG150N, is used for installing Hyseal Thimbles on Navy



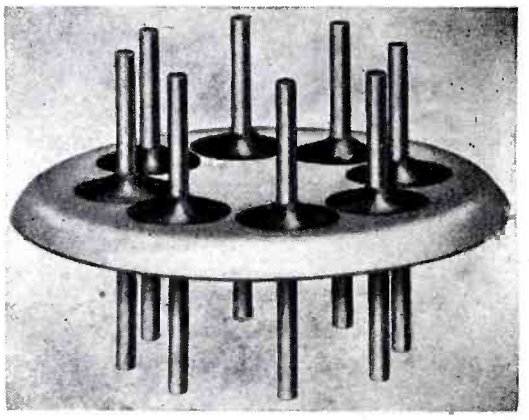
cable Types DHFA, THFA and FHFA, sizes 14 through 150 and also on Types SHFA and SHFL, sizes 4 through 125.

The larger unit, the No. MYG400N installs thimbles on Navy cable DHFA, THFA and FHFA, sizes 200 through 400 and also on Types SHFA and SHFL, sizes 150 through 400.

Complete details of the applications of this equipment is available upon request to the *Burndy Engineering Company,* 107 Bruckner Blvd., New York 54, N. Y.

HERMETIC SEALS

One solution to the problem of providing hermetically sealed transformers is being offered by the *Cincinnati Electric Products Company* who have



developed a method for bonding cold-rolled steel and glass into a terminal panel.

The terminal, marketed under the trade-name Fusite, is capable of withstanding moisture and thermal shock, provides insulation qualities at 2500 volts, and maintains its high electrical resistance leakage as well as being easy to install.

As high as nine terminals can be fabricated into one integral unit, with one soldering operation taking the place of many individual operations.

Further applications of this product are being investigated by the company and manufacturers who have sealing problems are invited to get in touch with the *Cincinnati Electric Products Company,* Carthage at Hannaford Avenue, Cincinnati 12, Ohio.

—30—

THAT SIGN IN YOUR WINDOW, MR. DEALER, WILL ASSURE BOTH PROFIT AND PERMANENCE

After the war—just as soon as radios for civilian use are produced—it's going to be easy for you to sell almost any radios you can lay your hands on. We know, however, that the alert, far-sighted retailer must be looking far beyond that initial public stampede and planning to link his store to products that assure both Profit and Permanence. That's why it will pay you to "team up with Temple" from the very start of selling activities.

DISTRIBUTORS

Are invited to communicate with us regarding territorial representation.

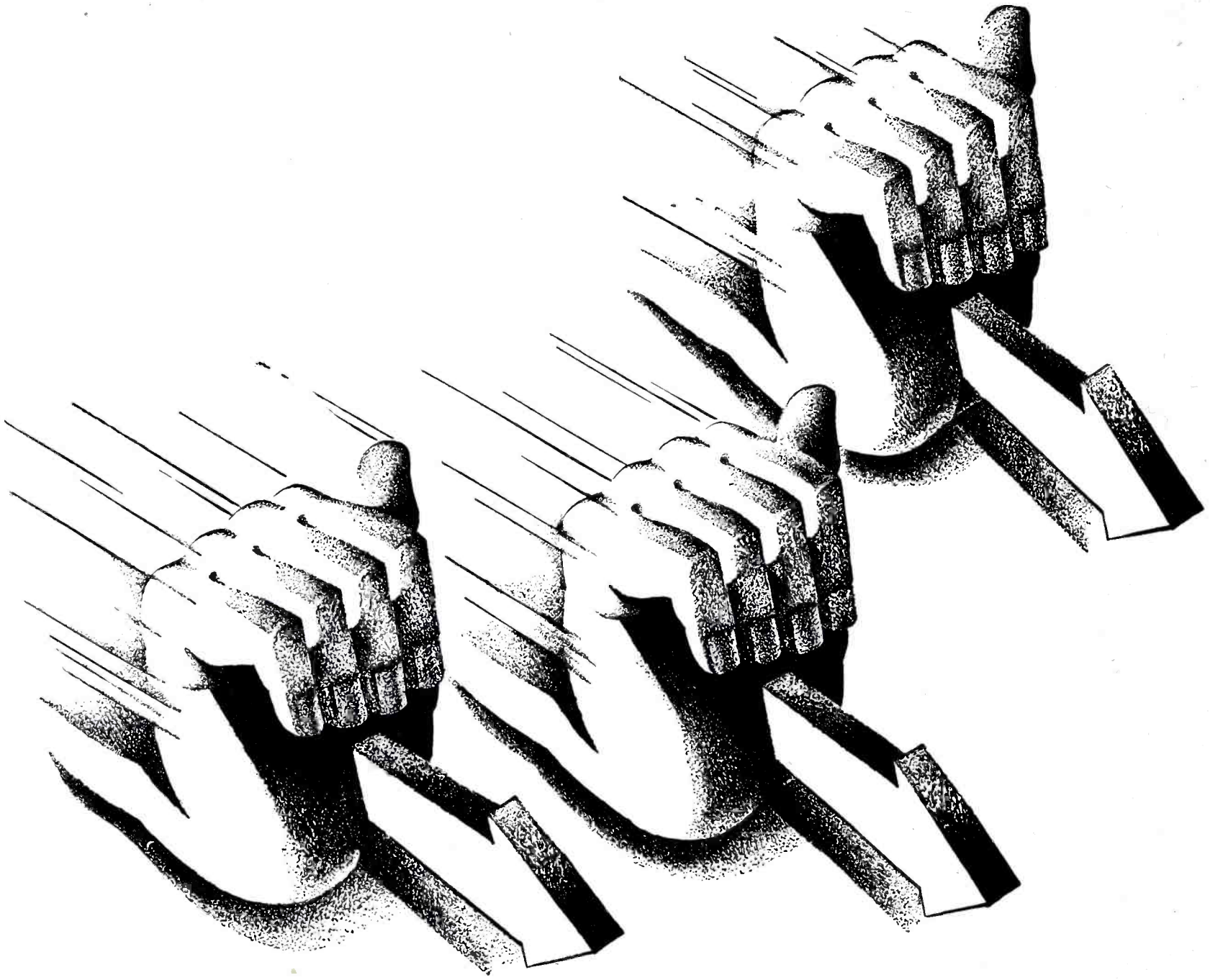
TEMPLETONE RADIO MFG. CORP.

NEW LONDON, CONN.

"WHERE FM WILL ALSO MEAN FINEST MADE"

Licensed under Armstrong and RCA Patents

THREE NEW PARTNERS . . . GOING



TERMINAL TOWER
CLEVELAND, OHIO

AHEAD WITH DRESSER

DRESSER INDUSTRIES now number ten.

Formerly, we were seven companies helping to bring basic services to the user more efficiently.

Our three new partners, each a specialist in its fields, both round out and broaden Dresser's scope of usefulness. This larger Dresser group can now serve industry and consumers with more products and greater experience.

The new Dresser members are bulwarked by an organization that assures their customers continued progress in product improvement, greater wherewithal for pioneering research and steady maintenance of service.

Dresser Industries, Inc., has progressed through the management principle of giving to alert, independent know-how an adequate backing and pooled resources. From these, each member draws teamed strength far greater than it could enjoy alone. The three new members of Dresser Industries, Inc., increase opportunities for mutual aid among the teammates, and at the same time, draw from the group advantages for those they serve.

MEMBER COMPANIES

Dresser Manufacturing Division
Bradford, Pa.

The Bryant Heater Co.
Cleveland, Ohio

Clark Bros. Co., Inc.
Olean, N. Y.

Pacific Pumps, Inc.
Huntington Park, Calif.

Bovaird & Seyfang Mfg. Co.
Bradford, Pa.

Dresser Mfg. Co., Ltd.
Toronto, Ont.

Van der Horst Corp. of America
Olean, N. Y. Cleveland, Ohio

PLUS

*International Derrick & Equipment Co.
Columbus and Marietta, Ohio
Torrance, Calif. Beaumont, Texas

*Roots-Connersville Blower Corp.
Connersville, Ind.

*Stacey Bros. Gas. Construction Co.
Cincinnati, Ohio

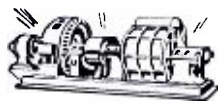
DRESSER Pipe couplings and repair devices for pipeline systems. Rings and forgings.

BRYANT Gas-fired boilers, winter air conditioners, furnaces, unit heaters and conversion burners for residential, commercial and industrial heating.

CLARK Engines and compressors for oil production and refining. Marine and stationary Diesel engines.

PACIFIC Hot-oil charging pumps; boiler-feed pumps; general-service pumps for the petroleum and other industries; oilwell plunger pumps; deep-well turbine pumps.

INTERNATIONAL DERRICK Oilwell pumping units, derricks and masts, drawworks, rotary tables and drilling units. Airport, communications and electric-power-line equipment and prefabricated steel buildings.



ROOTS-CONNERSVILLE Positive displacement and centrifugal blowers, exhausters, boosters and compressors. Air and liquid pumps and meters.

STACEY BROS. Storage holders, tanks and pressure vessels for the gas, oil, chemical and food industries.

BOVAIRD & SEYFANG Pumping engines, jacks, "powers", storage tanks and allied supplies and equipment for oilfields.

VAN DER HORST PORUS-KROME—a patented process of applying chromium lining on cylinder walls, piston rings and crankshafts—for longer wear.

DRESSER INDUSTRIES
INCORPORATED

News From Overseas . . .

By KENNETH R. PORTER

RADIO NEWS War Correspondent

A compilation of many interesting news items emanating from the European Theater.

THE ever-increasing part played by radio and electronics in the shaping of destinies on and over the battlefields of the European Theater of Operations is illustrated by the release by the military censorship of the information that radio-beam glider bombs, radio- and rocket-controlled torpedoes and radio-directed driverless miniature tanks recently have put in an appearance, thus adding to the already large variety of vaunted robot weapons used in this war. None of these contraptions, however, appear on examination to exhibit brand new ideas but merely to constitute modifications and improvements of types used previously with much, little, or no effect.

* * *

The radio-beam steered glider bomb, carried on the underside of a glider and propelled by rocket action, is apparently of the pick-a-back type and is an improvement on the older type used chiefly in attacks on shipping by the Germans. The bomb is released from a parent aircraft and controlled and directed to its target by the glider pilot who can see by the lights carried by the bomb whether or not it is deflecting from its set course and, if necessary, correct the course by the aid of radio. This new type can be employed against static as well as moving land and sea targets from a considerable distance.

* * *

A missile, similar in appearance, construction and operation to the Royal Air Force's radio-controlled Queen Bee pilotless target aircraft, is the German rocket-propelled aerial torpedo fitted with short wings. It belongs to the armor-piercing type of torpedoes and was used at one time ineffectively as a short-range weapon against the Allied fleet off Salerno. The modifications incorporated in the control apparatus of the improved type enables it to operate at longer range. It is launched from under the fuselage of the parent plane and directed by a dual system of rocket and radio control to its target.

* * *

Another example of Germany's perverted ingenuity is the mine-sweeping tankette—a pocket-sized and driverless little monster directed and exploded by radio from a larger tank moving up behind—which first was thrown into action, prematurely and unsuccessfully, at the Anzio Beachhead. An improved version was recently found abandoned in a ditch on one of the sectors of the Siegfried Line. It contained an unexploded cargo of 500 lbs. of high-grade explosives, weighed about 1,000 lbs., was 5 feet in height, and had a speed of 15 m.p.h. and a killing range of up to 300 feet.

* * *

Warsaw's heroic struggle against overwhelming odds is recalled by the release of the story of Poland's Voice of Freedom, the radio station inside the Polish capital which contributed materially in prolonging the siege. In vain, German reconnaissance planes honeycombed the ruins of Polish strongholds in an effort to strangle the voice. The radio station moved about continuously to evade the pursuers, and maintained close contact with other parts of the country as well as with the Polish Government in London. Broadcasts appealing to the Allies for weapons, food and ammunition were sent out at regular intervals and picked up in London and elsewhere. Allied planes bringing these supplies were directed by radio to the places where the insurgents could get hold of them without interference.

* * *

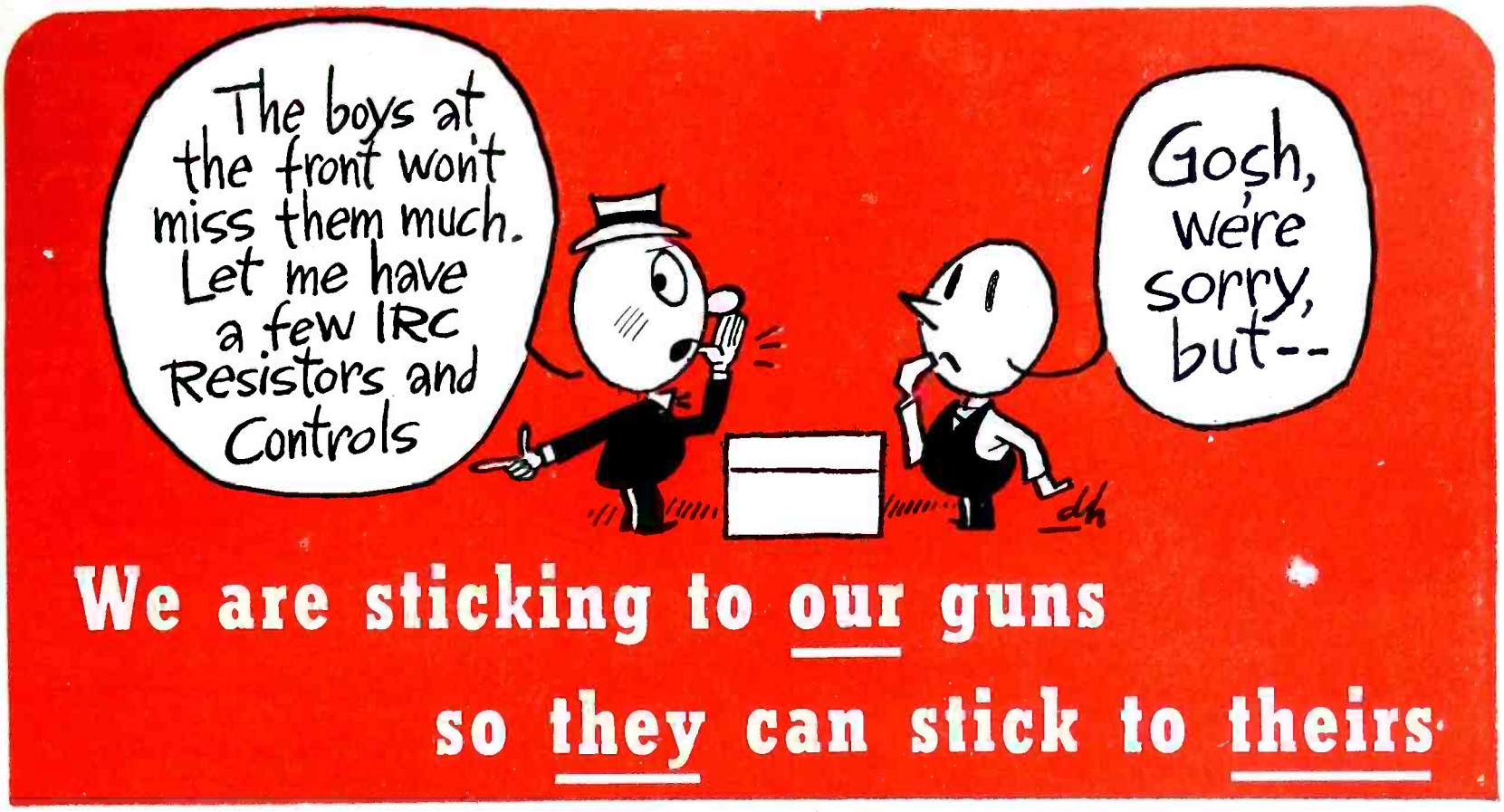
Considerable progress has been made, too, with the application of wartime scientific, technical, and production developments in the field of radio and electronics to the affirmation of peace.

Radio beams in the form of a network of grids will span the postwar world and act as pathways on which radio-controlled aircraft will operate. According to Richard Lonsdale Hands, British industrial designer, plans have been worked out by him, and a model —called the 1968 Model—which operates on beam traffic lines, is ready. This is a super-streamlined, jet-propelled, wingless transport aircraft designed to be capable of horizontal and vertical flying with a maximum speed of approximately 2,000 miles an hour.

* * *

Postwar television and electronic devices also will come to the rescue of the harassed housewife and reduce to a minimum her daily drudgery of shopping, cooking, cleaning, and making fires in the winter. Meat, vegetables, etc., will be chosen by television

"He says his Radar has picked up a very interesting object—five feet four inches—one hundred ten pounds."



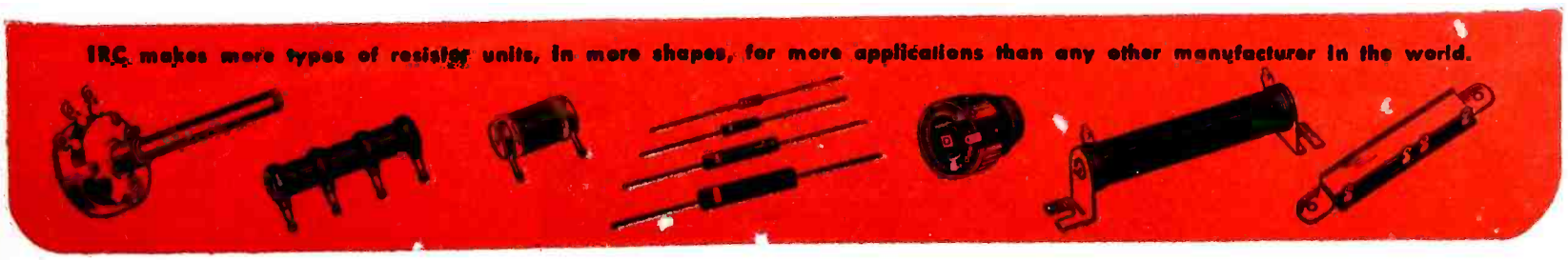
We are sticking to our guns so they can stick to theirs

It's a temptation to us. We'd love to begin to get into our post-war stride and cultivate and renew friendships by slipping old and new customers just a few IRC wire wound resistors and controls out of our current shipments to the armed forces. Surely the lads wouldn't miss them too much! ● Would you have us do THAT? We don't believe there is a single jobber or serviceman in America — if he stops to think about those guys out there — who will hold it against us for answering Uncle Sam's cry for more, more, more IRC resistors and controls. ● As peace approaches, we know that there'll be a scramble for your business. Very likely IRC resistors won't be the first to be available to you. But we're mighty proud of the fact that we happen to be able to make resistors and controls of a quality that Uncle Sam wants. In short, we're drafted. We're stuck for being so darned good! ● Please don't blame us. And if you have to sit under the apple tree with somebody else momentarily, please save your heart and your finger ring for us. Our intentions are matrimonial, and we look forward to many years of pleasant life with you after the war.

PREFERRED FOR PERFORMANCE
IRC
FIXED & VARIABLE RESISTORS

INTERNATIONAL RESISTANCE CO.

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



and cooked, or rather electrocuted, on three-minute cookers operated by the same short-waves with the aid of which doctors now heal deep-seated diseases, rheumatism, etc. Houses will be cleaned by specially-adapted ventilators and warmed by induction heating used at present for processing metals and smelting materials. Thermionic tubes will be incorporated in all these domestic devices varying in size from 4 feet long and 1 foot in diameter and capable of handling 400,000 watts to one inch long and ¾ inch in diameter for the reception of very high frequencies.

* * *

This outline of some of the things to be expected in the sphere of postwar consumption may appear somewhat unreal at present but British radio and electronics experts nevertheless have predicted them.

—30—

Television in Great Britain

(*Continued from page* 34)

transmission and also to increasing the number of lines to that which is optimum for the increased modulation bandwidth." Tentative figures proposed are 525-lines (gross, interlaced) and 3.25-mcs. modulation frequency.

In general, the B.I.R.E. advocates "a television service broadly of a prewar character, having characteristics in common with 1939 standards," and "a conservative policy regarding the assignment of new frequencies."

In concluding, the Institution reminds the chairman of the Television Committee that television is "the radio product that probably will be of the utmost importance commercially, as judged by the immediate volume of business."

Postwar Applications Equipment

In spite of predictions that television may doom the motion picture theater, the British film industry expects television's advent to boost cinema-going. At least that is the opinion of Mr. Oliver Bell, the director of the British Film Institute and Vice-Chairman of the British Councils' Films Committee.

"People get far more kick out of being in a large company at the movies than looking at television in a small group round the fireside. Besides, you cannot pick and choose as much with a television program transmitted from a broadcasting station as you can at a movie theater which runs a continuous performance. Rather, it will add attraction to the cinema in somewhat similar fashion as the Wurlitzer," this cinema expert stated.

The British film industry is confident about the future. Elaborate plans have been prepared for the alignment of the postwar cinema with television by at least one leading British company of cinema-equipment makers and will be implemented as soon as conditions are favorable. An

WHO is This Man?

HE'S purchasing agent, technical adviser, expediter, merchandiser all rolled into one. He's your Mallory Precision Products Distributor—carefully selected for integrity, knowledge and qualities of leadership to give you outstanding service. His stock is the finest that Mallory makes—as complete as wartime conditions permit. And his experience is yours for the asking: to help you with ALL your radio procurement problems.

Your Mallory distributor is a good man to know and do business with. He's an *expert* on saving you time and money.

...and What Does He Offer the Service Engineer?

1. A complete line of Mallory replacement parts . . . many of them first developed by Mallory research . . . ALL of them guaranteed against premature failure by years of service in the field.
2. A program of standardization that meets the maximum number of application needs with the minimum number of parts . . . reduces investment, simplifies replacement, speeds up delivery.
3. Efficient service . . . backed by detailed information on prices, parts, catalog numbers . . . promptly applied whether orders are large or small . . . especially effective in meeting emergencies.
4. Technical service helps . . . bulletins, booklets, catalogs, letters, with complete data on what to use and where to use it . . . special publications on radio fundamentals and new developments.
5. A background of personal experience . . . acquired through years of service in radio . . . helpful in solving difficult or unusual problems . . . effective in training dealer personnel.
6. Commercial "know how" . . . implemented by sound methods of keeping your business on the beam . . . with special attention to promotion devices that help sell your story to the public.

The Part Your Mallory Distributor Plays Is Important TODAY—to YOU!

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

More than ever—ALWAYS INSIST ON

P. R. MALLORY & CO. Inc.
MALLORY
APPROVED
PRECISION PRODUCTS

VIBRATORS • VIBRAPACKS* • CONDENSERS
VOLUME CONTROLS • SWITCHES • RESISTORS
FILTERS • RECTIFIERS • POWER SUPPLIES

ALSO MALLORY "TROPICAL"* DRY BATTERIES, ORIGINALLY DEVELOPED BY MALLORY FOR THE U.S. ARMY SIGNAL CORPS, NOT PRESENTLY AVAILABLE FOR CIVILIAN USE.

*Trademarks

official of the company concerned said that they were prepared to risk their money to effect the cinema and television tie-up and that they already had largely solved the multitude of technical problems connected with the installation and operation of equipment in cinemas.

It appears, therefore, that the British cinema of tomorrow will be a "Telema," linked by coaxial cables with the transmitting station or central studio and equipped with apparatus picking-up on prearranged wavelengths "live" television films and "hot" news items. These will be actual occurrences televised on-the-spot and projected onto huge viewers for the entertainment and information of the audience.

Another of the uses to which television equipment is to be put is crime detection, the extensive employment of miniature television pick-up and projection apparatus having been recommended by the British Home Office Committee on Postwar Development of the Police to Mr. Herbert Morrison, the British Home Secretary.

This report calls for the training of selected constables in the operation and maintenance of television equipment and the building of special projection theaters where police officials can study televised films of scenes of crimes and life-size replicas of known criminals.

In view of these recommendations, as well as of the progress in television devices, the time may not be far off, one London "Bobby" intimated when he hoped to be reclining in a comfortable swing-chair in the viewing room of the police station and keeping a televised "eye" on the welfare of the law-abiding citizen in the capital of the British Empire.

Television, it is taken for granted over here, also holds much promise in store for the expansion of Britain's postwar production capacity, although the industrial branch of television engineering in this country, like in the United States, is at present still in its infancy and the application of television devices to speed up industrial processes is regarded as a laboratory day-dream.

Some idea of the shape of things to come, however, can be gauged by the fact that variations of Zworykin's original Iconoscope are already being used for quality control and routine inspection in several branches of the chemical industry.

It is anticipated, that these and most of the other "hush-hush" applications which were the outcome of wartime research, will be revealed at the time of the changeover from war to peace production.

Still another phase of television, which may be expected to benefit by the lifting of wartime restrictions is the work of the British television amateur.

The British television "ham" had just about managed to elbow his way into the short-wave fraternity and was still struggling for official recognition when the outbreak of hostilities sounded the knell.

According to Mr. Geoffrey Parr, the secretary of the British Television Society, this country's 400 television experimenters affiliated to his society are hopeful about future developments.

Nevertheless, what the lot of the television "ham" will be after the return to normal conditions in the wavelength spectrum or which, if any, bands of frequencies will be allocated to him, remains a source of speculation as long as the Television Advisory Committee's report continues to be held in abeyance.

In assessing current opinion about this country's television future in the transitional and postwar periods, one gathers the impression, with some justification, that among the developments which may be expected is the replacement of the present-day radio set by the pre-1939 television receiver, fundamentally unchanged, in the British home within a year or two after the last restrictions have gone; in what quality or at what cost, however, there is no means of knowing at this stage.

Furthermore, it appears to be fairly certain, too, that after the elapse of another few years, say somewhere around 1950, this black and white television receiver will be ousted, in turn, by a receiver giving three-dimensional pictures in real color.

—30—

RCA

Westinghouse

Doolittle RADIO, INC.

Signal Corps

Federal Telephone and Radio Corporation

SPERRY GYROSCOPE COMPANY, INC.

GENERAL ELECTRIC

CROSLEY

WILCOX ELECTRIC COMPANY

WEBSTER ELECTRIC

RAYTHEON MANUFACTURING COMPANY

Western Electric

THE BEST KNOWN NAMES ON THE WAR PRODUCTION FRONT DEPEND ON THORDARSON QUALITY

Throughout the trying periods encompassed by 3 wars . . . and in all the intervening years of peace since 1895 . . . Thordarson leadership has been accentuated by its association with the most outstanding concerns in America.

Especially on the present world-wide war fronts...where the marvels of research laboratories and the handiwork of production geniuses may be seen in action...there also will be found the results of Thordarson experience and Thordarson engineering ability.

Thordarson Transformers and Amplifiers are "good right hands" to a host of America's leading organizations who are concentrating on winning the war as quickly as possible. Thordarson products are helping to do everything from making communications easier and more accurate to conducting fatigue tests which insure more dependable airplane propellors. All of these services and experiences, now devoted to war, will enable us to serve you better when peacetime needs are again paramount.

ARMY (E) NAVY

THORDARSON

TRANSFORMER DIVISION
THORDARSON ELECTRIC MFG. CO.
500 WEST HURON STREET, CHICAGO, ILL.

Transformer Specialists Since 1895
. . ORIGINATORS OF TRU-FIDELITY AMPLIFIERS

Practical Radio Course

(*Continued from page* 45)

receiver, an antenna-circuit wave trap tuned to the frequency of the interfering station may be installed to eliminate it.

An effective, supplementary, line of attack would be to eliminate the oscillator harmonics altogether. Although this cannot be completely effected in practice, they may be kept to a minimum by careful design of the local oscillator--by avoiding excessive regenerative coupling and losses in the oscillator circuit itself. In existing receivers, the oscillator excitation may be decreased by;

(1) Shunting the tickler winding section with a resistor of suitable value.
(2) Taking turns off this winding.
(3) Decreasing the oscillator plate voltage.

Signal-Oscillator Harmonic Combination Interference

Although seldom actually causing trouble in AM superheterodyne receivers of modern design, using modern mixer or frequency-converter tubes and the higher intermediate frequencies, it is perfectly possible for the harmonic of an undesired station carrier to beat with the harmonic of the local oscillator to produce an undesired i.f. signal of frequency value which falls within the frequency band accepted by the i.f. amplifier of the receiver. This undesired spurious i.f. response causes interference with that of the desired signal. Because directly-received signal harmonics (even if they are of only the *second* harmonic order) have much less amplitude than the fundamental frequencies, such responses are generally quite weak and anyway will be greatly attenuated by the preselector in most receivers.

However, as we learned during our study of Signal-Harmonic Interference, it is possible for strong harmonics of an undesired powerful local-station signal to be generated in the receiver itself through grid rectification in either an r.f. tube or the mixer tube (the incoming signal in such cases having sufficient amplitude to override the grid bias applied to the tube, thus causing the tube to operate over the lower bend of the grid voltage-plate current characteristic). This results in a distorted signal plate-current waveform that contains strong harmonic-frequency components. When this occurs and the oscillator also delivers strong harmonic signals to the mixer, this type of interference may result if the difference frequency between the harmonics of undesired signal and oscillator is equal (or almost equal) to the receiver i.f. This condition is illustrated in Fig. 4.

As we shall learn in a later lesson, due to the fact that many FM superheterodyne receivers have not used automatic volume control, depending instead upon the "limiter" to maintain a uniform signal at the second detector, this type of interference often occurs in them. Under such conditions, particularly when a high-gain r.f. amplifier is employed, even relatively low-intensity signals will be built up so they override the grid bias on the tube and generate signal harmonics. Even with a.v.c., such harmonics may be generated by an undesired signal of high intensity when the receiver is tuned to a weaker desired signal, and if the difference between the harmonics of signal and oscillator is equal to the receiver i.f., a spurious response and interference will occur.

Second-Harmonic-of-I.F. Interference

When a signal is being received whose frequency is *twice* that of the nominal i.f. of the receiver (or within a range of ± 10 kc. of twice the i.f.) there will appear in the output of the mixer stage:

(1) The normal i.f. signal.
(2) A spurious signal due to the second harmonic of the signal combining with the oscillator fundamental.

This is illustrated in Fig. 5. Since the normal i.f. signal and the spurious i.f. signal vary at different rates as the receiver is being tuned to the incoming signal, a whistle will be heard when tuning a station having the same frequency as a harmonic of the i.f. This is known as *second-harmonic-of-i.f.* interference. The selectivity of the receiver cannot discriminate against this type of whistle, as only a single signal is involved.

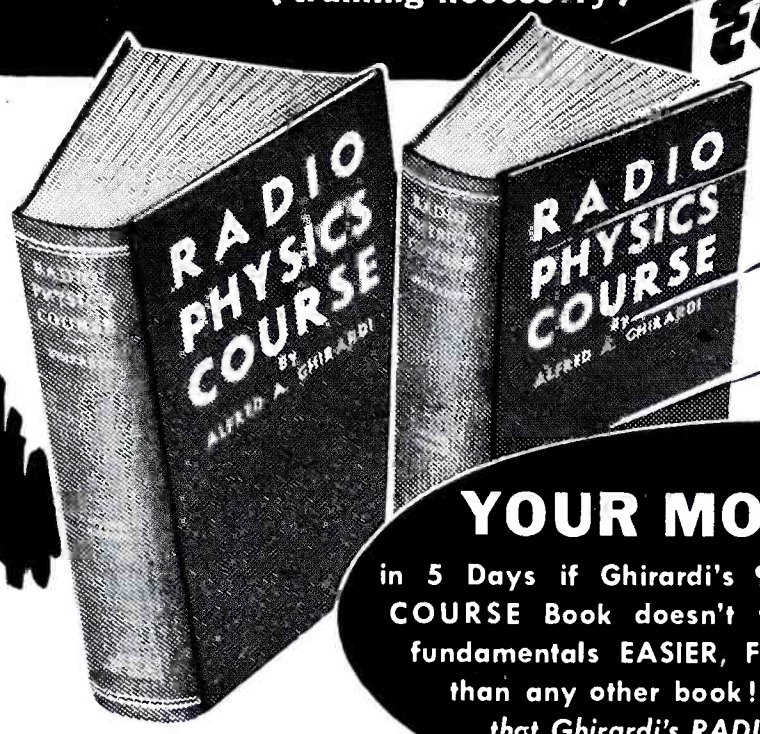
Since the number of cities having stations which operate on carrier frequencies equal to the second harmonic of the i.f. frequencies used in superheterodyne receivers at the present time is limited, this type of spurious response and interference is not widespread but applies only to the particular localities where a station of such frequency is situated—or to localities where the signal of a distant but powerful such station is received with sufficient strength to cause this condition.

This source of interference may be minimized during the design of the receiver by careful shielding of the second detector from the input circuits and by attention to diode load filtering, but may sometimes be avoided by proper choice of intermediate frequency. If, for example, a 450-kc. i.f. is used, a whistle may be heard in some instances while tuning through the vicinity of 900 kc. (the *second* harmonic of this i.f.) and occasionally 1350 kc. (the *third* harmonic). The standard practice several years ago of using 175 kc. as the i.f. in most broadcast-band receivers, minimized this type of interference in broadcast receivers, as the second and third harmonics then fell *below* the broadcast band while those of higher order were correspondingly weaker and therefore not troublesome. However, because

THE WORLD'S MOST FAMOUS BOOK FOR RADIO-ELECTRONIC BEGINNERS (No previous training necessary)

A. A. GHIRARDI

Let Radio's most widely-read technical author help you start training NOW for a fascinating, profitable future!



LEARN RADIO-ELECTRONICS EASIER BETTER FASTER for Only $5.

YOUR MONEY BACK

in 5 Days if Ghirardi's 972-page RADIO PHYSICS COURSE Book doesn't teach you Radio-Electronic fundamentals EASIER, FASTER and at LESS COST than any other book! *That's how sure we are that Ghirardi's RADIO PHYSICS COURSE is the very best in the field!*

HERE'S HOW TO REPAIR RADIOS THE EASY WAY!

A Definite Guide for Diagnosing, Locating and Repairing Radio Receiver Troubles

Radio servicemen everywhere say that this big 3rd edition of A. A. Ghirardi's RADIO TROUBLESHOOTER'S HANDBOOK helps them turn out twice as much work in a given time! Radio "tinkerers" and beginners who like to fix their own home sets and those of friends find this big book a quick, easy way of locating and repairing receiver troubles without extensive shop equipment! Nine times out of ten, it tells exactly how to make the necessary repairs—without any elaborate testing whatever!

NOT A "STUDY" BOOK

Actually, this big, 744-page manual-size RADIO TROUBLESHOOTER'S HANDBOOK is a complete guide to the trouble diagnosing, locating and fast repairing of PRACTICALLY EVERY TYPE OF RADIO RECEIVER NOW IN USE. It isn't a "study" book. You simply turn to it whenever you want to fix a particular type of trouble in a particular make of radio. Its 404-page Case History Section gives full details on common trouble symptoms, their causes and remedies for OVER 4,000 DIFFERENT RADIO RECEIVER MODELS. It describes the trouble exactly — tells exactly how to repair it. It eliminates extensive testing—helps you do two jobs in the time normally required for one—repair cheap sets at a profit—substitute tubes and parts profitably — train new helpers, etc., etc.

In addition, hundreds of other pages are devoted to the most modern tube chart you've ever seen; tube and parts substitution data; I-F alignment peaks for over 20,000 superhets; a big section on I-F transformer troubles—and dozens of charts, graphs, helpful hints and data compilations — all carefully indexed so you can find exactly what you need in a jiffy.

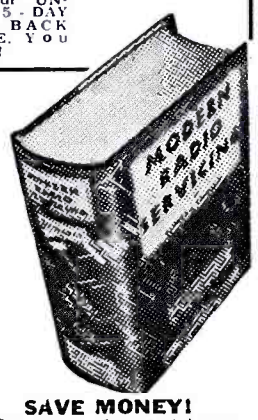
This big, beautifully bound HANDBOOK is only $5 ($5.50 foreign)—on our UNRESERVED 5-DAY MONEY-BACK GUARANTEE. You cannot lose!

HERE'S HOW TO LEARN MODERN RADIO SERVICE WORK

. . . . without an instructor!

A. A. Ghirardi's MODERN RADIO SERVICING is the only single, inexpensive book that gives a complete, easily understandable course in modern radio repair work in all of its branches. Written so simply you can understand it without an instructor! Read from the beginning it takes you step by step through all phases of the work—or, used as a reference book by busy servicemen, it serves as a beautifully cross-indexed work for "brushing up" on any type of work that may puzzle you.

Included is a thorough explanation of all Test Instruments, telling exactly how they should be used and why; (it even gives all necessary data for the construction of test equipment for those who prefer to make their own!); Receiver Troubleshooting Procedure and Circuit Analysis; Testing and Repair of Components; Installations; Adjustments, etc., etc.—also How to Start a Successful Service Business. 1300 pages; 720 Self-Testing Review Questions; 706 helpful illustrations and diagrams. Only $5 complete ($5.50 foreign) on our 5-Day Money-Back Guarantee.



SAVE MONEY!

See coupon for special combination offer on Modern Radio Servicing and Troubleshooter's Handbook—over 2040 pages of helpful service data!

Ask the men who KNOW what's good in Radio Training—the men who have had to learn Radio quickly and from scratch, in the Armed Forces; the men who already have obtained good-paying Radio-Electronic jobs in industry! Nine out of ten of them (as proved by a recent survey) will tell you that Ghirardi's famous RADIO PHYSICS COURSE is their first choice as the easiest-to-learn from, most thorough and inexpensive Radio book on the market.

MOST POPULAR FOR ARMY-NAVY AND CIVILIAN RADIO TRAINING

This same inexpensive book has given more people their basic Radio-Electronic training than any other ever published. It is more widely endorsed by men who know. Because of its sheer merit, it is more universally used for home study, and more widely employed in U. S. Army Signal Corps, Navy and civilian schools and colleges than any other book on the subject. Would you want any better proof than this?

EVEN IF YOU DON'T KNOW ANYTHING ABOUT RADIO!

Even if you've had no previous Radio or Electrical training or experience, it's easy to learn from Ghirardi's RADIO PHYSICS COURSE! Everything that can be done to make learning easy has been done for you. It painstakingly explains everything in detail so you cannot fail to understand. Over 500 specially prepared illustrations help you to visualize every action. You don't have to know a single thing about Radio in advance. All you need is a little spare reading time and a desire to get started RIGHT for a profitable future in any of Radio-Electronics' many branches—from service work to aviation, military, broadcasting, manufacturing, public address and many others.

SCOPE OF 36 COURSES IN ONE

Actually, RADIO PHYSICS COURSE gives you the scope of 36 different courses in one convenient, inexpensive big book. Nothing is left out. Nothing is condensed. Nothing is left to chance. You learn all you need to know. You don't need to wait for monthly lessons. You progress as rapidly as you wish in your spare time and in the comfort of your own home.

A $50 VALUE FOR $5 COMPLETE

RADIO PHYSICS COURSE is acclaimed everywhere as the "biggest bargain" available in Radio-Electronic training. If it were broken into sections and sold as a course, you'd regard it as a bargain at $50 or more—but you actually buy it all here complete in one big 972-page handsomely bound book for only $5 ($5.50 foreign) and with our absolute 5-Day MONEY-BACK GUARANTEE. Get the book and see for yourself. Compare it with any other book or course on the market—at any price. See how much more complete it is, how much better illustrated, how much easier to understand! You be the judge! You cannot lose!

WARNING! *Paper shortages may make it impossible for us to continue meeting the tremendous demand for all Ghirardi Radio Books. Don't take chances! Order yours today while they're still available. Use this Order Form.*

RADIO & TECHNICAL DIVISION OF MURRAY HILL BOOKS, INC.
Dept. RN-15, 232 Madison Ave., New York 16, N. Y.

Enclosed find $_____ for books checked; or ☐ send C.O.D. for this amt. plus postage. If I am not fully satisfied, I may return the books within 5 days and receive my money back.

- ☐ RADIO PHYSICS COURSE $5.00 ($5.50 foreign)
- ☐ 3rd Edit. RADIO TROUBLESHOOTER'S HANDBOOK $5.00 ($5.50 foreign)
- ☐ Special "MONEY-SAVING" Combination MODERN RADIO SERVICING with the HANDBOOK $9.50 ($10.50 foreign)
- ☐ MODERN RADIO SERVICING $5.00 ($5.50 foreign)

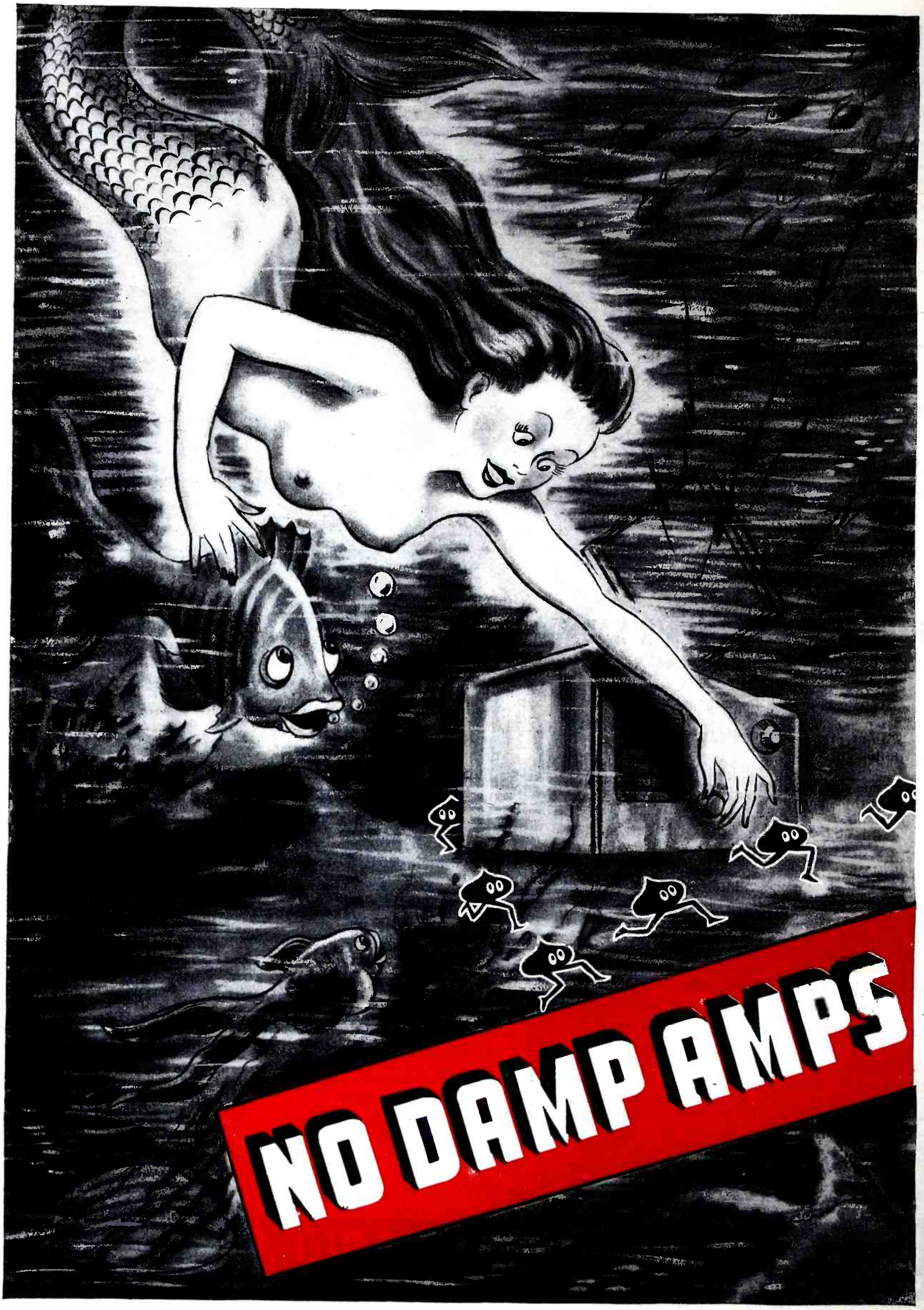
Name .....

Address .....

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

REPAIR ANY KIND OF RADIO EQUIPMENT

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


NO DAMP AMPS

the more important "image" and other forms of interferences increase when such low values of i.f. are employed, they are no longer widely employed in broadcast receivers and, so harmonic-of-i.f. interference is now possible in some localities.

Realignment of the i.f. stages of any existing receiver thus affected, is the usual field cure for trouble of this sort. It should be carefully noted and checked as to whether the signal operating at the second harmonic of the i.f. is being picked up on the under-chassis wiring of the receiver, in addition to the antenna. In this case the whistle produced will be aggravated. In extreme cases, it is possible to eliminate the whistle by providing a wave trap tuned to the second harmonic of the signal and placed in the circuit feeding the mixer stage.

(*To be Continued*)

Saga of the Vacuum Tube

(*Continued from page* 56)

A second agreement,[212] under the same date, between the Radio Corporation of America and Cunningham provided that when the ninety day license had expired the Audiotron Company would discontinue the manufacture and sale of vacuum tubes, and would sell Radio Corporation tubes, until the expiration of the de Forest patent No. 879,532 on February 18, 1925. These tubes were to be marked as Cunningham desired, and no Radio Corporation markings were to appear. The agreement gave to Cunningham not less than 25,000 tubes per month and not more than 280,000 tubes total during the period which the agreement covered. These tubes were to be sold to Cunningham at a discount of 20% below the lowest net price quoted to anyone else. Deliveries were to begin September 15, 1920, or as soon thereafter as possible.

As a result of the first agreement noted above, subsequent advertisements[213] of the Audiotron Manufacturing Company, successor to the Audio Tron Sales Company, stated that the Audiotron was now free from all restrictions. The first agreement was modified, on September 13, 1920, and the license period extended to October 15, 1920. The advertisements continued up to November, 1920.

With the December, 1920 advertisement,[214] however, the effects of the second agreement begin to appear. This advertisement announced the "Audiotron Detector Type C-300" with four-point base at $5 and the "Type C-301 High Vacuum Navy Type Amplifier" at $6.50. The tubes were "Guaranteed by E. T. Cunningham, trading as the Audiotron Manufacturing Company."

The next advertisement, in January, 1921,[215] refers to "Cunningham Audiotron Tubes" in the heading, but "Cunningham Tubes" in the body of the advertisement.

The following month reference is made[216] to the "Cunningham Detector Tube Type C-300" and the word Audiotron has completely disappeared except for the retention of the firm name of "Audiotron Manufacturing Company."

The next advertisement[217] offers for sale the "Cunningham Power Tubes C-302, C-303, and C-304" and admits that these tubes are the product of General Electric Company research.

From then on the prominence given to the name of the company grows less, until in December, 1922 the word "Audiotron" completely disappears, and the concern is renamed "E. T. Cunningham, Inc."[218]

The success of the Audio Tron appears to have served as encouragement to other manufacturers. Shortly after its rise there appeared another tube, enough like the Audio Tron to have been cast in the same mold. This was the Roome "Oscilaudion," first advertised[219] in January, 1916 (see Fig. 171) by Harry V. Roome of Los Angeles. Roome had been advertising wireless apparatus for some time, but this was the first mention of vacuum tubes. Two months later, in March, 1916, the advertisement reappeared,[220] this time for the "Oscilaudion Bulb and Cabinet." No further advertisements appeared until July, 1916, when the "Thermo Tron" was advertised by "The Thermo Tron Company" from the same address as Harry V. Roome. This advertisement,[221] reproduced in Fig. 172, is very ambiguously worded, making no mention of any restrictions as to use. Since it appeared in a wireless magazine, however, the reader might be pardoned for assuming that it was intended for wireless use. However, when the purchaser received the device, orderd by mail from the advertisement, he received with it a descriptive leaflet which contained no ambiguous statements whatever, but described it as an "experimental hot-cathode apparatus designed for the study of the Edison effect, thermionic currents, pure electron discharge, passage of electricity through electrons (sic), and other scientific phenomena." It also carried the following warning:

"It is distinctly understood by the purchaser that the Thermo Tron is sold for the purpose of scientific study to be used with the circuits shown in this bulletin. If the Thermo Tron is used for commercial work in wireless telegraphy as a detector, amplifier, or oscillator, or if the Thermo Tron is used for commercial work in an Armstrong circuit, or if the Thermo Tron is used in any way as an infringement of any patent, the Thermo Tron Company assumes no liability whatever."

It might be suspected that the change from the "Oscilaudion," which was frankly sold as a wireless detector, to the "Thermo Tron," a pure scientific device, was perhaps motivated by the legal action initiated by de Forest against the Audio Tron at about the time this advertisement was being prepared. The success of the Audio Tron Sales Company in staving

VOICE-COIL IMPEDANCE MATCHING TABLE

AS many radio servicemen have some output transformers around their shops and do not know the type of tubes and voice coils with which they can be used successfully, Mr. Ralph W. Wilson of Falmouth, Kentucky, has sent us the following chart, which he has found very useful.

Mr. Wilson said that this chart is simple to use, all that is required being a low-range a.c. voltmeter and a 115-volt a.c. source. Connect the primary or plate winding to the 115-volt a.c. source and the voltmeter to the secondary or voice-coil winding. The reading of the meter may be found on the chart under several voice-coil impedances or very near them. For instance, a reading of 2.9 volts could be used from 3000 ohms to 2 ohms or from 6000 ohms to 4 ohms; also from 10,000 ohms to 6 ohms or 12,000 ohms to 8 ohms. This, of course, gives the proper turns ratio. Of course the transformer should be properly designed and large enough so that it will not reach magnetic saturation.

The chart is figured for 2, 4, 6, and 8-ohm voice coils. For other impedance combinations the following equation can be substituted:

$$E = \frac{\sqrt{Zs}}{\sqrt{Zp}} \cdot E_L$$

in which E = Meter reading on secondary; Zs = Impedance of voice-coil winding; Zp = Impedance of plate winding; and E_L = line voltage applied to primary.

Voice-Coil Impedances

Primary Impedance	2 ohm	4 ohm	6 ohm	8 ohm
25,000	1.02 v.	1.45 v.	1.77 v.	2.04 v.
15,000	1.33 v.	1.87 v.	2.30 v.	2.66 v.
12,000	1.48 v.	2.09 v.	2.56 v.	2.96 v.
10,000	1.63 v.	2.30 v.	2.82 v.	3.26 v.
8,000	1.82 v.	2.57 v.	3.15 v.	3.64 v.
7,000	1.94 v.	2.74 v.	3.36 v.	3.88 v.
6,000	2.10 v.	2.97 v.	3.64 v.	4.20 v.
5,000	2.30 v.	3.25 v.	3.99 v.	4.60 v.
4,000	2.57 v.	3.63 v.	4.45 v.	5.14 v.
3,000	2.97 v.	4.20 v.	5.14 v.	5.93 v.
2,000	3.64 v.	5.15 v.	6.30 v.	7.28 v.
1,000	5.14 v.	7.25 v.	8.89 v.	10.28 v.
500	7.27 v.	10.28 v.	12.60 v.	14.54 v.

off an injunction and continuing business as usual is perhaps reflected by the next advertisement,[222] appearing the next month, in which the name of Roome again appears, and the "Super-Sensitive Oscilaudion" is boldly advertised for use as detector, amplifier, or oscillator.

With the Oscilaudion the purchaser received a leaflet, of the same size and typography as that supplied with the Thermo Tron, and using the same cut for an illustration, but setting forth the virtues of the Oscilaudion as a wireless device.

This was the last time this tube was advertised, as far as the author has been able to determine, and it is probable that the source of supply disappeared. The author understands that Harry V. Roome was at that time a high school boy in Los Angeles, and that he obtained the tubes he sold from a San Francisco manufacturer, who would supply him with only a limited number, and who eventually refused to sell to him at all.

There were a few other prewar independent tubes on which little information is available. One of these was the "Tigerman Detecto-Amplifier," advertised [223] in 1917 by the National Electrical Manufacturing Company of Chicago. Fig. 173 is a reproduction of the advertisement which announced this tube. It was a double-ended tube with two sets of filament-anode electrodes, one at each end. The control electrodes were applied on the outside of the glass and were simple metallic bands clamped around the tube, which was about 5 inches long and had a candelabra base on each end. Apparently it was not sold to any great extent, since an advertisement in April, 1917 [224] offered them for sale "while they last" at $5 each.

The "Electron Audio," another tube similar in construction to the Audio Tron, was made by the Electron Manufacturing Company, and was first advertised in July, 1916.[225] The initial advertisement claimed that it was "formerly the Audio Tron," and the next advertisement,[226] reproduced in Fig. 174, showed a tube of the same construction as the Audio Tron. The "Electron Audio," however, could be obtained with either a single or a double filament. It quickly lapsed into obscurity, and probably had a limited sale, although it was regularly supplied by at least one manufacturer as a part of a radio receiver. In this receiver the tube was inserted into an "autotransformer," which was claimed to be of "remarkable importance to our undamped wave apparatus since its magnetic field oscillations are absolutely in synchronism and consequently stimulate the periodical electron discharge from the filament and the ionization of the gas within the bulb by the heat of the filament"! [227]

Two others of the same type were advertised by the Radio Apparatus Company of Pottstown, Pennsylvania. One was the "Type 36 Electron Detector" [228] and the other was the "Liberty Valve." [229] The Liberty Valve is shown in Fig. 175. Since this company also advertised the Audio Tron at the same time,[230] it may well be that the Liberty Valve was the Audio Tron with a different label.

Still another tube called the "Oscillotron" was advertised [231] briefly just after amateur activity was resumed following the end of World War I. This was advertised by the G & M Specialty Company of Cleveland, Ohio, but no information is available on it.

There were also two other tubes on which the author has been unable to obtain information. One of these was the "Bartley" tube, which was sold about 1919,[232] and the other was the "Corcoran" tube which is alleged to have been made at Lynn, Massachusetts, about 1914 or 1915.

The only other early independent tubes of which the author has knowledge were those marketed by O. B. Moorhead, which will be covered in a subsequent article.

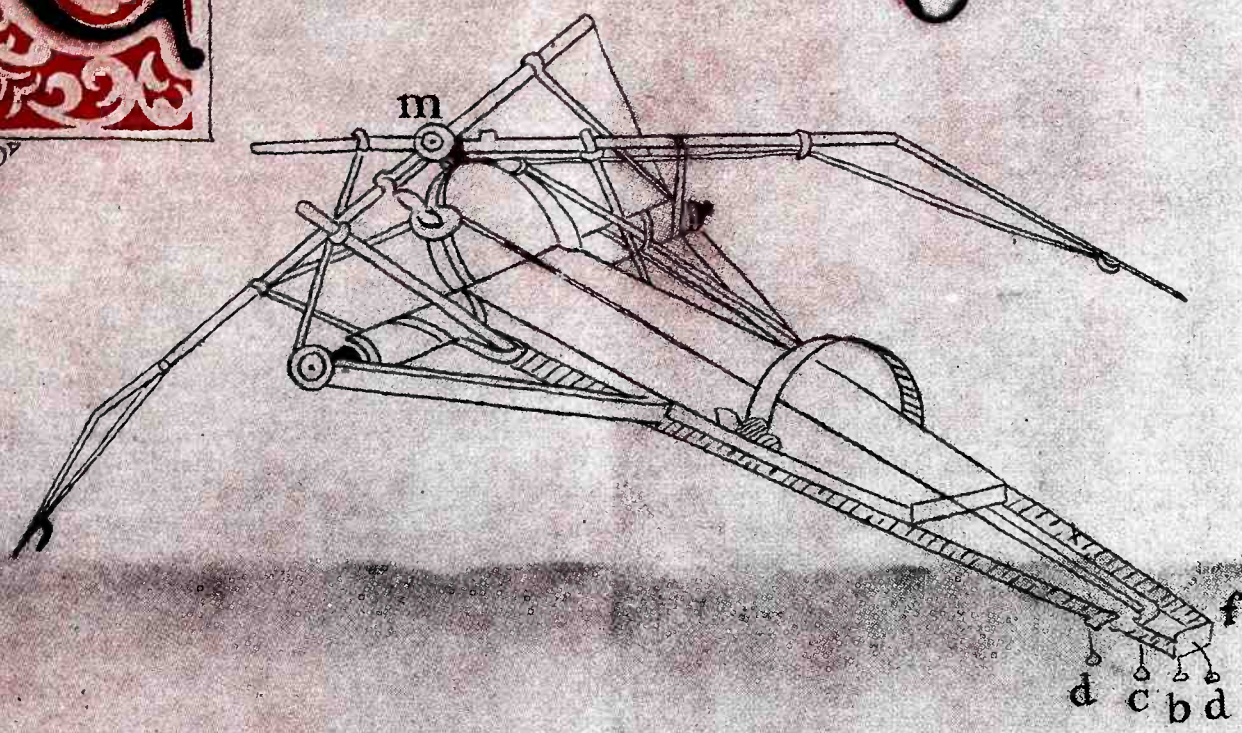
CAPTIONS FOR ILLUSTRATIONS

Fig. 167. First announcement of the Audio Tron. Reproduced from Popular Science Monthly and The World's Advance.

Fig. 168. Audiotrons. The second from the left has label printed in black ink. Third and fourth from left have labels printed in red ink. Tube at right has markings etched on glass.

Fig. 169. Advertisement giving price

Experience Counts



In 1500, Leonardo da Vinci had a fine idea—a flying machine!

His 16th Century Flying Fortress had a dandy arrangement of stirrups and pulleys which operated oars supposed to propel the craft through the air. Leonardo's machine didn't work and it didn't work for one simple basic reason . . . There wasn't enough knowledge and experience to develop a flying machine. Had da Vinci the benefits of our experience he could have built a *flying* flying machine.

There is a very significant moral to that story—**Experience Counts!**

For years, **WARD PRODUCTS CORPORATION** has been the leader in the design and manufacture of sectional and one-piece antennas. This position was established and maintained because **WARD** has the *Experience* that *Counts*. **WARD** has pioneered many of the design changes that have become accepted standards in the industry . . . For the finest sectional and one-piece antennas for automobile and home applications—Look to **WARD!**

Send for our attractive new 1945 calendar.

THE WARD PRODUCTS CORPORATION
1523 EAST 45TH STREET
CLEVELAND 3, OHIO

WARD *Antennas*

BUY WAR BONDS

reduction on Audio Tron to meet de Forest competition. Reproduced from Electrical Experimenter.

Fig. 170. Advertisement for Amplitron. Reproduced from Electrical Experimenter.

Fig. 171. Announcement of Roome "Oscilaudion." Reproduced from Wireless Age.

Fig. 172. Advertisement for Thermo Tron. Reproduced from Electrical Experimenter.

Fig. 173. Announcement of Tigermann Detecto-Amplifier. Reproduced from Electrical Experimenter.

Fig. 174. Announcement of "Electron Audio." Reproduced from Wireless Age.

Fig. 175. Liberty Valve. Photograph courtesy Bell Telephone Laboratories.

References

203. *See advertisement in Popular Science Monthly and the World's Advance, Vol. 87, No. 5, November,* 1915, *p.* 120.
204. *"The Vacuum Detector Patent Situation," Pacific Radio News, Vol.* 1, *No.* 5, *May,* 1917, *pp.* 203-206.
205. *See advertisement in Electrical Experimenter, Vol.* 3, *No.* 12, *April,* 1916, *p.* 726.
206. *See advertisement in Wireless Age, Vol.* 3, *No.* 10, *July,* 1916, *page I; and Electrical Experimenter, Vol.* 4, *No.* 4, *August,* 1916, *p.* 282.
207. *Gernsback, Hugo—"De Forest vs. Electrical Experimenter," Electrical Experimenter, Vol.* 4, *No.* 11, *March,* 1917, *pp.* 808-809.
208. *See advertisement in QST, Vol.* 2, *No.* 11, *June,* 1919, *p.* 29.
209. *See advertisement in Radio Amateur News, Vol.* 1, *No.* 8, *February,* 1920, *p.* 441; *also QST, Vol.* 3, *No.* 9, *April,* 1920, *p.* 81.
210. *See advertisement in Radio Amateur News, Vol.* 1, *No.* 8, *February,* 1920, *p.* 396; *also Pacific Radio News, Vol.* 1, *No.* 7, *February,* 1920, *inside back cover; also QST, Vol.* 3, *No.* 8, *March,* 1920, *p.* 78.
211. *See Exhibit Z-1, Report of the Federal Trade Commission on the Radio Industry—Government Printing Office*—1924.
212. *See Exhibit Z-2, Report of the Federal Trade Commission on the Radio Industry—Government Printing Office*—1924.
213. See RADIO NEWS, *Vol.* 2, *No.* 1, *July,* 1920, *inside front cover; also QST, Vol.* 4, *No.* 2, *September,* 1920, *p.* 61.
214. *See* RADIO NEWS, *Vol.* 2, *No.* 6, *December,* 1920, inside front cover; also QST, *Vol.* 4, *No.* 5, *December,* 1920, *p.* 101.
215. *See* RADIO NEWS, *Vol.* 2, *No.* 7, *January,* 1921, *inside front cover; also QST, Vol.* 4, *No.* 6, *January,* 1921, *p.* 93.
216. *See* RADIO NEWS, *Vol.* 2, *No.* 8, *February,* 1921, *inside front cover.*
217. *See* RADIO NEWS, *Vol.* 2, *No.* 9, *March,* 1921, *inside front cover.*
218. *See* RADIO NEWS, *Vol.* 4, *No.* 6, *December,* 1922, *inside front cover.*
219. *See Wireless Age, Vol.* 3, *No.* 4, *January,* 1916, *page I.*
220. *See Wireless Age, Vol.* 3, *No.* 6, *March,* 1916, *page I.*
221. *See Wireless Age, Vol.* 3, *No.* 10, *July,* 1916, *page III; also QST, Vol.* 1, *No.* 8, *July,* 1916, *p.* 188; *also Electrical Experimenter, Vol.* 4, *No.* 4, *July,* 1916, *p.* 193.
222. *See QST, Vol.* 1, *No.* 9, *August,* 1916, *advertising section; also Electrical Experimenter, Vol.* 4, *No.* 4, *August,* 1916, *p.* 283.
223. *See Electrical Experimenter, Vol.* 4, *No.* 8, *December,* 1916, *p.* 602.
224. *See Pacific Radio News, Vol.* 1, *No.* 4, *April,* 1917, *p.* 182.
225. *See Wireless Age, Vol.* 3, *No.* 9, *June,* 1916, *page* III.
226. *See Wireless Age, Vol.* 3, *No.* 10, *July,* 1916, *page* II.
227. *"Mignon Undamped Wave System," Pacific Radio News, Vol.* 1, *No.* 2, *February,* 1917, *p.* 79.
228. *See QST, Vol.* 2, *No.* 5, *April,* 1917, p. 83.
229. *See QST, Vol.* 3, *No.* 6, *January,* 1920, *p.* 48.
230. *See Wireless Age, Vol.* 6, *No.* 10, *July,* 1919, *p.* 45.
231. *See QST, Vol.* 3, *No.* 5, *December,* 1919, *p.* 64.
232. *"Fleming's Valve and Up," Radio Craft, Vol.* 9, *No.* 9, *March,* 1938, *p.* 582.

(Continued in March Issue)

Within the INDUSTRY

ADMIRAL CORPORATION of Chicago has announced several organizational appointments through its president, Ross D. Siragusa.

Wallace C. Johnson has been named Midwest Regional Manager for both radios and appliances. His headquarters will be at 444 Lake Shore Drive, Chicago.

United Distributors, Inc., will serve as distributors of Admiral radios, refrigerators, electric ranges and home freezers in the Boston area and part of Vermont, while Appliance Merchandisers Company of Peoria will handle the company products for central Illinois.

The Bimel Company of Cincinnati will handle the appliances in the Cincinnati area and Griffith Distributing Corporation will take care of the company's business in Indianapolis.

* * *

Z. V. THOMPSON, who has been serving as a Major in the U. S. Army Air Corps, is returning to civilian status as a sales representative for Tung-Sol's Indiana territory. Mr. Thompson, who held a reserve commission as Second Lieutenant upon his graduation from Clemson College in 1928, returned to active duty with the rank of Captain in August, 1941. His promotion to Major was effected February, 1942.

* * *

RAYTHEON MFG. COMPANY has launched the coast-to-coast sponsorship of the "Meet Your Navy" program which is heard on Saturday evenings, features Navy personnel broadcasting from the Great Lakes Naval Training Station.

Rear Admiral Arthur S. Carpender, Commandant of the Ninth Naval District, and Mr. L. K. Marshall, president of Raytheon, were special guests at the first performance under Raytheon's sponsorship. Lt. Clint Stanley is the producer of the Navy show.

* * *

FARNSWORTH TELEVISION AND RADIO CORPORATION has outlined postwar plans for its dealers through General Sales Manager, Mr. E. H. McCarthy. The distribution structure will be a strong distributor-dealer operation, with the distributors to be selected after exhaustive survey of potential sales outlets in each area.

Fifty distribution agencies already have been appointed under the new plan and new appointments will be announced from time to time.

* * *

SAM PONCHER of the Newark Electric Company of Chicago was elected president of the Chicago chapter of the National Electronic Distributors Association at a meeting of that organization held in Chicago. Various trade problems were discussed and an election of officers took place, resulting in the election of Mr. Poncher, and Ralph E. Walker of Walker-Jimieson, Inc., to the post of Secretary-Treasurer.

* * *

THE HALLICRAFTERS COMPANY, makers of the SCR-299 mobile radio communications unit, dedicated a radio ham "shack" to the achievements of the nation's amateur radio operators. The "shack" is located at 643 N. Michigan Avenue, Chicago, and is stocked with a display of the company's products. There are an estimated 25,000 "hams" in the military services at the present time and the dedicatory program is centered about their work.

A service flag, commemorating the "ham's" military service was presented by Chet Horton, member of the Hamfesters Radio Club of the Chicago area, to the A.R.R.L. Carol K. Witte, acting communications manager of the A.R.R.L., accepted the service flag for the League. More than 50 members of the Hamfesters Club were present at the ceremony.

* * *

H. V. MYSING is the new manager of sales and engineering service for RCA's Auto Radio Department, according to the announcement made recently by Thomas F. Joyce, General Manager of RCA's Victor Radio, Phonograph and Television Department. Since the outbreak of the war Mr. Mysing has been serving with a group of RCA engineers working with the U. S. Army Signal Corps on an engineering development contract in connection with combat radio communications problems. His headquarters will be in Detroit.

* * *

STEWART-WARNER CORPORATION has appointed George Johnson to handle sales promotional work pertaining to civilian postwar radios. His duties will also include radio distributor relations.

Mr. Johnson comes to the company

AMPHENOL offers you a
COMPLETE INSERT REFERENCE CHART

You may have this helpful chart. You can in an instant find the correct insert that fits your particular combination of conductors, voltage and current requirements.

First advantage—this chart organizes for the eye the most complete line of AN inserts made by any one company—arranged and divided according to number of contacts—readable from top to bottom and left to right. Each insert is illustrated full size on this 38" x 50" chart. A table gives the mechanical spacing of contacts and other valuable information.

All it takes to get this chart is a request on your company's letterhead.

Also included are two ringbook charts. One shows all connector shell types and styles including the special purpose shells—pressure-tight, moisture-seal, explosion-proof, light-proof. The other clearly explains the numbering system for connectors.

AMERICAN PHENOLIC CORPORATION
Chicago 50, Illinois
IN CANADA • AMPHENOL LIMITED • TORONTO

Connectors (AN, British, U.H.F.) • Fittings • Conduits • Cable Assemblies • U.H.F. Cable • Radio Parts • Plastics for Industry

with more than 25 years' experience in advertising and sales promotion work in Chicago. For 12 years he was contact manager for William H. Rankin Advertising Agency. In his new capacity, he will take an active part in organizing Stewart-Warner's postwar radio distribution program.

* * *

ROYAL VILAS, former WPB official is one of two new managers announced by Bendix Radio Division recently. He will serve the Atlanta area, with headquarters in that city. The second appointment is that of Samuel Rochester as manager of the Middle Atlantic area. Mr. Rochester has been serving as a buyer for the Radio Division and will have headquarters in Baltimore.

* * *

CARTER MOTOR COMPANY of Chicago has appointed the 100-year old firm of Frazar and Hansen, 301 Clay Street, San Francisco, California, as export agents for China, the Philippines, and the Far East to handle the company's line of various types of motors for portable communications equipment.

This firm which will also act as the company agents in Australia, New Zealand and India was founded in 1834 by Capt. George Frazar who started trade with China in that year.

* * *

ED. BERLIANT is the new manager of the Atlanta Branch of the Concord Radio Corporation of Chicago and Atlanta. This company which recently changed its name from Lafayette Radio Corporation, is well known as a distributor of parts and equipment. Mr. Berliant is well known in the radio, radio jobbing, distribution and amateur fields, having held positions with several well-known manufacturers and distributors.

* * *

TAYLOR TUBES, INC., has announced the appointment of William Shaw, W9UIG, formerly an engineer for General Electric X-Ray Corporation, to the post of Chief Inspector for the company.

Mr. Shaw will assume some of the duties now being cared for by Mr. James Fillmer, Chief Engineer. Due to the company's expanded production of tubes, this addition to their engineering staff will permit Mr. Fillmer to devote his time to development work.

* * *

ADMIRAL CORPORATION, through its president, Mr. Ross D. Siragusa, has announced that it has a home set ready for production. This unit is a combination of television, FM, standard broadcast, short-wave, automatic record changer and home recorder, housed in a single cabinet.

The working model of the set was demonstrated at the company's convention of their national distributors last month. This eight-in-one instrument will probably retail from around $625 to $1,000. The cabinet is 43 inches high, 40 inches wide, and 24 inches deep, which dimensions compare favorably with the dimensions of the average deluxe radio-phonograph combination sets now in use.

Standard television reception will be offered with the image 5½x8 inches in size.

* * *

JOHN J. MOFFATT has been appointed to the post of Pacific Coast Appliance Manager for the Westinghouse Electric Appliance Division. Mr. Moffatt succeeds J. F. O'Donnel who has been transferred to Mansfield to take charge of the Contract Sales Department. Mr. Moffatt joined the company in 1927 as a graduate student and has held various posts during his employment.

* * *

HOFFMAN RADIO CORPORATION of Los Angeles, has appointed a New Products Committee to suggest and develop postwar plans for the manufacture of products other than household radio receivers.

The committee is headed by G. G. Davidge, executive assistant; Walt Taylor, of engineering, vice-chairman; other members of the committee include, Dick Throckmorton, Clint Saxton, Bill Green and Bill Blue of the production, model shop, engineer and outside production departments respectively.

* * *

J. LEE CONOVER, who has been on a leave of absence from the Crosley Corporation, resumes his post as manager of the company's New York branch. Mr. Conover will make his headquarters temporarily at the company's service department at 35th and Eleventh Avenue, in New York. Crosley's greatly expanded program for the postwar sales of home appliances makes this appointment timely.

* * *

GALVIN MANUFACTURING CORPORATION, peacetime producers of Motorola Radios for the home, car, and farm, have announced the appointment of Thurow Radio Distributors for the state of Florida. With branches in Tampa, Miami, West Palm Beach, Orlando, Jacksonville and Tallahassee, Galvin is thus assured of complete dealer coverage of the Florida Area. -30-

COLONEL JOHN CASEY, *Manager,*
Chicago Municipal Airport . . .

Colonel Casey said, "The growing complexities of airport traffic make it ever more important that private planes and regular operating passenger aircraft be equipped with up-to-date, reliable two-way radio, if high standards of safety are to be maintained. One important factor is . . ."

"A FOOLPROOF POWER SUPPLY FOR AIRCRAFT RADIO OPERATION"

Colonel Casey, Electronic Laboratories has long been aware of the need for reliable power supplies especially adapted for aircraft use. One of E-L's exclusive developments along this line involves vibrators operating in parallel which assures a reserve power source for extra protection. These Vibrator Power Supplies—both light and heavy duty—are specially designed for complete reliability at very high altitudes.

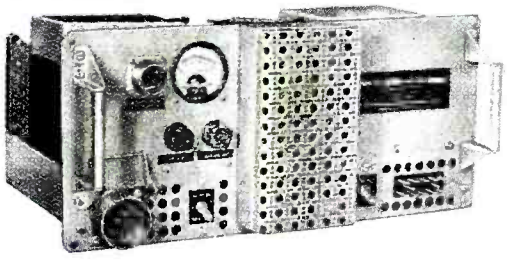
The life of E-L Vibrator Power Supplies is far beyond the customary overhaul requirement. With these units maintenance time is cut to a minimum—only a small fraction of the time previously required.

Other E-L developments for the aircraft field include units for flashing wing lights and for instrument panel illumination. This equipment has wide application for the light plane field as well as for large aircraft.

The economy and versatility of Vibrator Power Supplies are also available to the marine field—where units have been designed to provide fluorescent lighting, radio-telephone operation and electrical appliance use—as well as many other fields where it is necessary to convert current to specific voltage and type requirements . . . Let E-L engineers consult with you on your power supply problem.

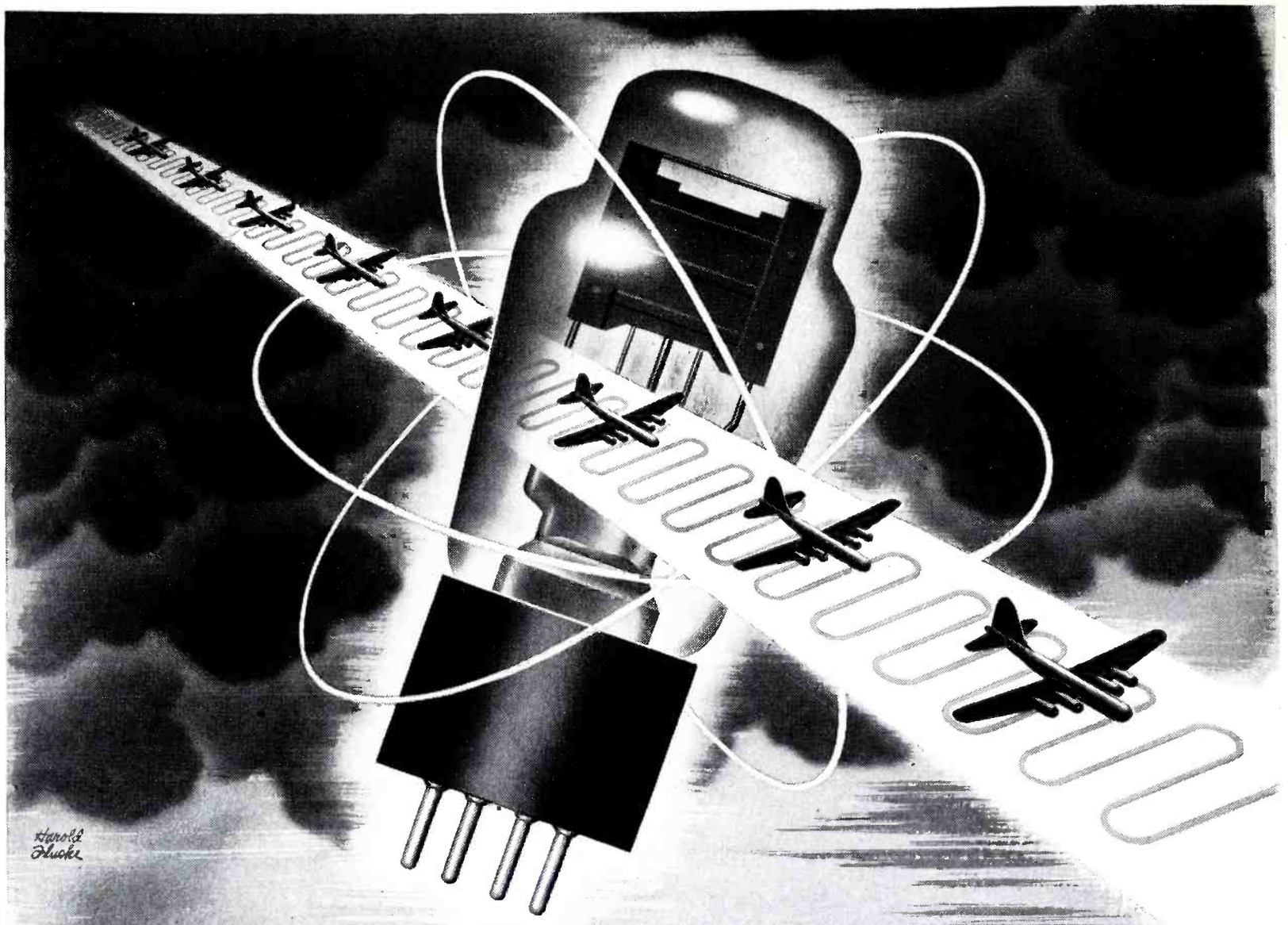
STANDARD POWER SUPPLY
MODEL SC-1096

Model SC-1096 is a typical E-L Vibrator Power Supply which meets the requirements of aircraft radio use. This unit was designed for the Canadian Signal Corps to operate radio transmitters. Input voltage: 12 volts DC, or 110-117 volts AC at 50-60 cycles. Output voltage: 2000 volts at 125 ma., 400 volts at 25 ma., 250 volts at 10 ma., 250 volts at 5 ma., 10 volts at 5 amps., 12 volts at 1 amp. Output power: 480 watts. Dimensions: 17" x 12⅜" x 7¾".



Electronic LABORATORIES INC.
INDIANAPOLIS

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



Delco Radio Products Mean Fine Performance

From compact auto radio sets to highly intricate radio and electronic equipment for the armed forces, Delco Radio products are distinguished by fine performance. Each unit reflects care and competence in engineering; each part represents advanced techniques in production accuracy. Tomorrow's civilian needs, like today's military demands, will benefit from Delco Radio's engineering vision, manufacturing precision.

Delco Radio Division, General Motors Corporation, Kokomo, Indiana.

Put Your Dollars in Action—BUY MORE WAR BONDS

Delco Radio
DIVISION OF
GENERAL MOTORS

Modulated Signal Generator

(*Continued from page* 37)

EDITOR'S NOTE: *It was the original intention of the author to construct this instrument as a portable unit, with a single shielded output lead to be used for both the r.f. and a.f. signals. This could be done by employing a single-pole double-throw switch in the input circuit of the R5 potentiometer. By means of this switch, either the r.f. or a.f. signals could be obtained by employing only a single output lead.*

The original idea was dispensed with as the author felt that for his personal use the unit constructed for direct mounting onto a test panel would be more suitable. In so doing he dispenses with the switch arrangement and uses two separate leads extending from the unit; one for the r.f. signal, which is variable in intensity, and the other for the a.f. signal, which is constant in intensity.

The photographs clearly indicate a four-wire cable emanating from the chassis. This cable consists of the r.f. and a.f. outputs, common ground, and a high-voltage d.c. output. This high-voltage was taken directly from the d.c. power supply and is used, in his particular case, to operate another test unit. In this way the author can operate two units directly from one power supply.

Although the r.f. lead emanating from this chassis, as shown in the photograph, is not shielded, it is advisable to shield this lead to prevent radiation and hum pickup.

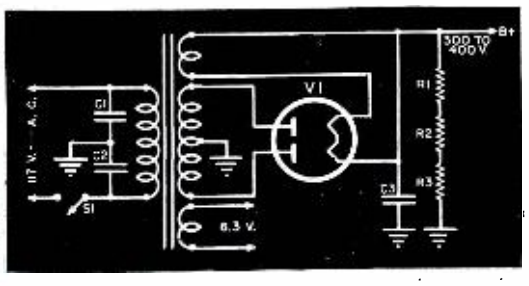
In the construction of this unit many builders will find other variations that are more suitable to their particular needs.

Calibration

With the unit completely shielded and ready for operation, the last step is calibration. This is done easily with the aid of a broadcast receiver and the harmonics of the oscillator. Feed the output of the generator into the receiver through the shielded cable. Set the receiver to 600 kc. and pick up the second harmonic of the generator fundamental of 300 kc. To be sure you have the generator set to 300 kc., tune the receiver to 900, 1200 and 1500 kc. and pick up the 3rd, 4th, and 5th harmonics respectively. If the signal is picked up between any of these points, it indicates that the generator is not set to 300 kc. and this point should be located by the above method. The 300-kc. point should be marked on the dial of the unit. The fundamental frequency of 455 can be located on the dial by picking up the second harmonic at 910 on the receiver. Other desired frequencies also can be calibrated in the above manner. For other frequencies in the broadcast band it is suggested that the second harmonic of 300 kc. be used to locate the 600 point on the dial of the receiver being aligned. For the frequency of 1400 kc. it is suggested that the fourth harmonic of 350 kc. be used.

The signal generator is now ready for use. —30—

Fig. 2. Diagram of power supply.



C_1, C_2—.05 μfd. @ 400 v. cond.
C_3—8 μfd. elec. cond.
R_1, R_2, R_3—50,000 ohm, 1 w. carbon res.
V_1—Type 80 tube, or any full-wave rectifier

Television for Industry and Home

(*Continued from page* 53)

intrastore merchandising, but for general telecasting as well.

Every school in large and small communities can be connected via coaxial cable to provide the basis for the greatest means of mass education ever devised. School assemblies need no longer be restricted to individual gatherings. Superintendents and principals can sit in their offices and address thousands of children and teachers while they look at the televised images on large screens in school auditoriums.

Civic lessons in school rooms would become exciting and interesting sessions if meetings of borough or township officials were transmitted directly to the classes.

Sprawling college campuses can be reduced to a small area if television is employed in bringing lectures, musical programs, scientific demonstrations and other events directly into the classrooms, rather than have the students parade from one building to another in an endless waste of time and effort.

The power of television eventually will lash out and choke off the elements that contribute to crime and juvenile delinquency. Use of television by police officials throughout the country will pay handsome dividends in crime prevention and crime reduction. Each police station may be linked via coaxial cable with state police and in turn be connected directly with offices of the Federal Bureau of Investigation.

Just recently, Commissioner Edward J. Hickey of the Connecticut State Police, speaking at a meeting of the New York State Association of Chiefs of Police, expressed the hope that police lineups will be televised from a central station to various precincts to familiarize all officers with the law-breakers under current custody. Commissioner Hickey said he hoped such facilities might be available to combat a possible postwar crime wave.

The writer introduced the use of television by police in New York City

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

WELDING DATA

A new engineering bulletin which describes in detail the practical and scientific tests made to determine the effects of using an antispatter fluid in welding has been issued by the *Midland Paint and Varnish Company.*

Complete information on the process and suggested methods of keeping welding jigs free from spatter are included. Fully illustrated laboratory reports on tests for determining weld strength and weld soundness are given, along with data concerning the suppression of fumes during welding.

The bulletin is available from the *Midland Paint and Varnish Company,* 9115 Reno Avenue, Cleveland 5, Ohio, upon request.

PLASTICON CONDENSERS

The *Condenser Products Company* of Chicago is offering a new bulletin covering their line of plastic-film capacitors to interested persons.

This four-page, two-color booklet contains performance charts and engineering data of interest to the engineer. Comparison data for specific applications is provided in order that the correct unit may be selected for the job.

Recommended applications include television, fluorescent-lamp ballasts, radar and directional equipment, transmitters, welders, constant-voltage transformers, and amplifiers and intercoms, to mention a few.

The booklet and engineering data for specific applications may be obtained by writing direct to *Condenser Products Company,* 1375 N. Branch Street, Chicago 22, Illinois.

CARBIDE TOOLS

A new catalogue and price list covering tantalum-tungsten carbide tools and blanks have been issued by the *Vascoloy Ramet Corporation* for general distribution.

The company's line of cutters includes straight turning tools, offset turning tools, lead-angle tools, and offset facing tools, in their standard units as well as various items for special application.

The catalogue, VR-330 may be secured by writing direct to *Vascoloy Ramet Corporation,* North Chicago, Illinois.

"FREQUENCY ETCH"

A six-page illustrated brochure describing the etching solution, "Frequency Etch," has been released by the *Hudson American Corporation* for distribution.

The government regulations requiring the etching of crystals have necessitated the development of new techniques and products to perform this operation. Specific data on etching as well as a series of graphs showing the relation between etching time and the increase in frequency of BT crystals is given.

The bulk etching method is described for the benefit of those companies who are mass-producing quartz oscillator plates.

The brochure will be sent to persons interested in this method of etching upon request to *Hudson American Corporation,* 25 West 43rd Street, New York 18, N. Y.

CUTTER CATALOGUE

The company's complete line of adjustable cutting tools is covered in the new catalogue just issued by the *Robert H. Clark Company* of Beverly Hills.

This catalogue presents diagrams and photographs of actual applications as well as complete specifications and prices.

This new catalogue, No. 44, now is available for distribution and copies may be had by writing to *Robert H. Clark Company,* 9330 Santa Monica Blvd., Beverly Hills, California, Dept. RN-1.

CATALOGUE SUPPLEMENT

A four-page folder, No. 96, featuring many hard-to-get radio components is now available from the *Concord Radio Corporation* (formerly Lafayette Radio Corporation) as a supplement to their regular catalogue.

In addition, the company is offering a tube substitution chart as part of their free catalogue No. 94. In this chart are found the most frequently-used types together with suitable connections which will permit the use of some of the less scarce tubes.

Both of the items mentioned in this announcement are available free of charge by writing to the *Concord Radio Corporation,* 901 West Jackson Boulevard, Chicago 7, Illinois.

KATO RELEASE

A new line of revolving field generators is being announced by the *Kato Engineering Company* in a four-page release currently available.

These generators, series 667 and 670, are built in sizes 5, 10, 15, and 25 kw., 4-pole (1800 r.p.m.) and in sizes 10, 15, 25 kw., 6-pole, (1200 r.p.m.). The units can be furnished as independent, two-bearing generators suitable for belt or coupling drive or as single bearing generators designed to fit standard SAE engine bell housings.

After Victory... WHAT?

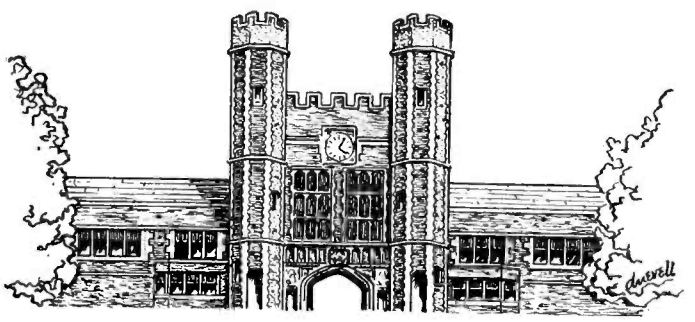
When Victory is ours, and Peace returns to the land . . . will YOU be snug in your own paid-for home—with security against illness, provision for retirement, education for your children—all ASSURED BY BONDS?

Or will you be one of those "too busy" people who "meant to buy Bonds tomorrow"? Who find themselves entering the postwar period empty-handed . . . facing the future with uncertainty? The choice is yours.

For, wherever you are, in the service, the factory, the farm, the office, YOU and that family you love so much *can* be provided for—or can be neglected . . . it's up to *you*.

Yes, actually! It all depends on what *you* do. On what you do *before* the war's over; on what you do, in fact, TODAY!

You must know by now that the best, the safest investment in the world—the one with the most liberal terms—is United States' WAR BONDS. What you may not know is that they are the best insurance policy there is. If you regularly invest a percentage of your weekly income in bonds—and also buy them with your savings or extra earnings, NOW—you can accumulate that very Nest Egg which spells security for your family . . . easily, painlessly, right away. And, in just ten short years, you'll have *4 DOLLARS FOR EVERY 3 you invest!*



We guess that makes War Bonds just about the best darn buy there is. You're helping the boys to come home sooner—and you're *insuring* a bright, safe future for those you love. *When you invest in Bonds, the full faith and credit of the United States Government is behind that future of yours!*

THE MARK OF *EXCELLENCE*

If You Believe in America . . . BUY BONDS!

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.

The line described is of the semi-enclosed, drip-proof design. Removable end-bells facilitate inspection of the commutators, brushes and collector rings.

Persons interested in receiving a copy of this release should request Katolight Revolving Field Generator Bulletin, *Kato Engineering Company*, Mankato, Minnesota.

TAYLOR TUBES

A new catalogue of *Taylor Tubes* is now being prepared for early distribution to dealers and other persons using the company's line of transmitting tubes.

The catalogue will contain full information on all tubes manufactured by the company in the past as well as some of the newer tubes engineered for war. There will be a 16-page section devoted to tube characteristics and another large section will provide technical data on transmitters and transmitter tubes.

Several new tubes for ultra-high and very-high frequencies are announced in this catalogue.

The catalogue will be available without charge at local distributors, but a charge of 25 cents will be made for the catalogue when ordered direct from *Taylor Tubes*, 2312 Wabansia Avenue, Chicago, Illinois.

ONAN LITERATURE

A catalogue covering the Onan line of electric generating plants has been issued by *D. W. Onan and Sons.*

These generators, one of which powers the Hallicrafters SCR-299, are used where commercial power is not available or for standby units in the event of commercial power failure.

Different types, with varied power ratings, may be adapted for use in farm homes, remotely located ranches, schools, service stations or trailers. In these applications the proper sized unit will furnish power for the operation of refrigerators, communications, lights, water pumping and other jobs.

The large sized units capable of delivering 35,000 watts, 115 volts, 60 cycle are adaptable to industrial uses and the operation of machinery, lights and other equipment.

The booklet will be forwarded upon request to *D. W. Onan and Sons,* 39 Royalston Avenue, Minneapolis 5, Minn.

HALLICRAFTERS CATALOG

The new 1944-45 catalog of *The Hallicrafters Company,* prewar manufacturers of amateur radio equipment, is just off of the press and available for distribution to interested persons.

The company's complete line of u.h.f. and v.h.f. receivers, as well as FM receivers is covered in this 31-page booklet. Marine radio equipment and accessories for the amateur are described as well as the comprehensive line of transmitters which the company manufactures.

Copies of Catalogue No. 36 will be forwarded upon request to *The Hallicrafters Company,* 2611 S. Indiana Avenue, Chicago 16, Illinois.

-30-

VISUAL SIGNALS

VISUAL signaling still serves as a means of communication in the Southwest Pacific Area, despite the predominance of wire and radio there as in all other war theaters. Its chief use is to guide bomber pilots by designating enemy targets and friendly front lines. Australian forces have used it with considerable success and our own Signalmen have experimented with it on a number of important occasions.

Some specific instances of the use of visual signals may be cited by way of example. At Shaggy Ridge, New Guinea, flares from planes indicated the end of the air attack, and similarly flares from ground mortars indicated the end of the artillery preparation. Our attacking troops knew that the enemy had been "softened" and that the moment was ripe for an all-out attack.

On another occasion on the same ridge an elaborate arrangement was worked out for airmen, guided by visual signals, to support a very difficult assault on Jap positions. The ridge was so narrow that the air attack had to be delivered by means of a column of single planes. There were 36 of them, stretching out in a long file some 70 miles. The pilots were prepared by means of terrain description and marked photographs and were led to the ridge by a reconnaissance plane. From that point visual signaling "took over." A ground panel was prepared and pyrotechnic signals of different colors indicated the position of our troops and that of the enemy target. Perhaps no other form of signal could have served as well over terrain of that type.

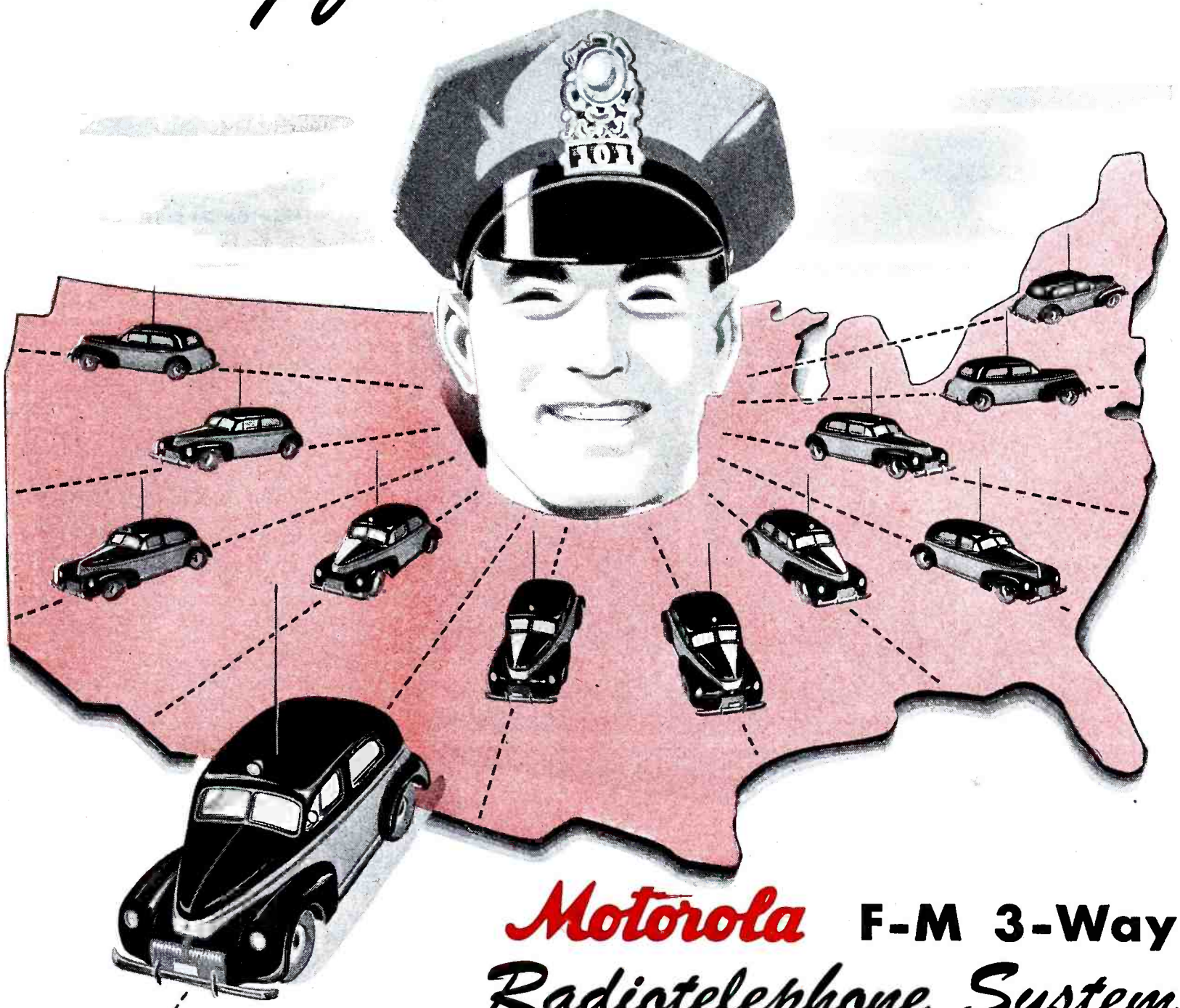
Panel arrows were used to mark the battle positions on the Kokoda Trail in New Guinea and the arrows were supplemented by bomb lines marked with smoke grenades. These were highly successful; so much so, in fact, that the Japs went to great efforts to try to destroy the markers. One result was an advantage scarcely foreseen by the Signalmen. Numerous Jap patrols tried in turn to wipe out the guiding arrows, and these therefore came to be regarded by our men as so many decoys. Many Japs were killed as a result of rash sorties, and the arrows thus proved almost as valuable in serving as death traps for the enemy as in guiding our bomber pilots to their proper targets.

In a ravine near Dumpu (New Guinea) an arrow panel and a bomb line of smoke were used to indicate a pocket of Japs cornered in the ravine. The airmen saw and read the signals easily and then attacked.

In a number of other cases similar panels and lines have been used effectively. Flame throwers also have been tried out as visual signals and various forms of pyrotechnic flares. For New Guinea and other islands of similar contours maps are of dubious value, since hundreds of ridges and ravines look alike. Verbal description likewise is of little help since words, like maps, cannot distinguish among geographica objects that resemble each other like peas in a pod.

-30-

Serving from COAST to COAST



Motorola F-M 3-Way *Radiotelephone System*

PROVES ITS EFFICIENCY

You'll now find 29 State Police Organizations using complete Motorola F-M Radiotelephone Systems. In addition, there are over 500 Counties and municipalities employing Motorola systems to preserve law and order, combat crime and reduce juvenile delinquency. Reasons are efficiency, reliability and simplicity.

The "Handie Talkie", an exclusive Motorola Radio *first*, is now being used by our fighting forces on every battle front. This portable, battery operated, five and one half pound, two-way radio will be available for police and fire departments when our obligations to the armed forces have been fulfilled.

MOTOROLA DELIVERS IN ANY TERRAIN

The radiotelephone system best for your community depends on many factors, and every factor should be thoroughly considered. Shore lines, hills and mountains, swamps, deserts, lake country, city skyscrapers and sprawling factory towns, all involve problems that Motorola Radio has successfully solved. Take advantage of Motorola's tested police, fire and railway radiotelephone systems.

Write today for full details to:

GALVIN MFG. CORPORATION · CHICAGO 51

vertisers and their advertising men, the performers and the writers, and the would-be telecast station owners and operators who want their boot training now. In postwar commercialized television the selling of station time will follow pretty much along the same lines as present sound broadcasting, and the present free time, associated with the closing days of pioneering, will be a thing of the past.

The trained personnel is ready for action. The television equipment is fully designed, based on long and hard experience, and ready to be built when war restrictions are lifted. And capital is already in evidence, rarin' to go. Dozens of stations are already scheduled for equipment, with many more dozens to follow, as the television boom opens up in a postwar world.

—30—

Servicing P.A. Equipment

(*Continued from page* 48)

plifier is operating, it is a simple enough matter to check the relative signal voltage across R_3 with the signal tracer or with a high-sensitivity a.c. voltmeter, or even by using a high-impedance head phone such as a crystal headphone. Then, if the signal is large, a by-pass condenser can be shunted across C_2. If results are better, it is clear the by-pass definitely is required and a new one is installed.

C_5 and C_7 can be checked in similar fashion, by checking the signal voltage appearing across the terminals of each, and by trying the shunt method of testing. If C_5 opens up, the trouble is likely to be motorboating, squealing, or oscillation and excessively high gain—not lower gain as in the case of the open by-pass condensers. It may be found, in some cases, that there is a form of stability obtained by shifts in opposite directions. That is, the excessive gain due to regeneration tendencies, as the result of opening of C_5, may be compensated by losses due to opening of C_2 or C_7, or both, so that the net gain is close to normal. In servicing, by substituting a new condenser for C_2 or C_7 it may be found that the amplifier works *worse* than previously because of a defect in C_5 that had previously gone unnoticed. The trouble may be corrected, of course, simply by replacing the defective C_5. In other cases, the regenerative action may be due to other causes, but first let us go through the system on the assumption that the trouble is a dead or weak response, and return to other troubles later on.

In Fig. 4B, a simple method of creating an electrical disturbance in the circuit is to connect a .1 μfd. condenser to the plate of the tube VT-1 and the other end of the condenser to the cathode. When this is done, current flows and a pulse is generated. A click should be heard. It also would be possible to produce the same effect by momentarily shorting the plate of the tube to the chassis or "B–". In high-power circuits, this method should never be used, particularly when there is a coil in the plate circuit which may be damaged by the overload. A 1,000 ohms-per-volt voltmeter may be connected between the plate and cathode and the connection intermittently broken to produce the circuit disturbance. In any event, suppose that we find the signal is not getting through from the plate to the next grid in Fig. 4B. The trouble very likely would be an open in C_6 and the condenser could be checked by trying a new one. The voltages, resistances, and standard servicing practice, just as in the case of radio receivers, could be used to investigate further the nature of the trouble.

The important thing is that a stage-by-stage technique be used. In Fig. 4A, if creating a disturbance in the system results in a signal getting through from *3* to the output, *5*, but no signal is heard when a disturbance is created at point *2*, look for trouble between *2* and *3*. In the same way, using the reverse method, if a signal injected or set up at point *4* is heard but no signal gets through from *3* the trouble is localized in the section *3-4*.

In some cases the signal may get through but will not be as strong as it would be normally. In an output stage of the push-pull type, one defective output tube may result in weak response or hum and distortion troubles. Output tubes may be checked by substituting new ones or by using a tube tester. If no other means is available, the plate current of each tube in the push-pull stage may be checked with a milliammeter and the readings per tube should be the same within a tolerance of 20% plus or minus. By referring to a tube manual, you can determine approximately what the plate current should be for a given plate voltage and bias.

Hum voltages can be checked with a signal-tracing instrument. For example, in Fig. 3, the hum voltage between each output tube plate and ground can be checked. The hum voltages should be about equal. If they are not, hum may be induced in the secondary of T2 and will be reproduced with high intensity by the loudspeaker. If equal hum currents flow in L_1 and L_2, the fields will be out of phase and will buck out, so that the hum induced in the secondary circuit will be cancelled. With an unbalance, due to a weak emission tube or an incorrect setting of potentiometer P, the hum will be heard. If L_5 opens up and L_6 remains intact, the bias voltages will be different for the two grids and not only distortion but excessive hum as well may be experienced. An open in C_B would result in excessive hum voltages developing across the terminals of this condenser and accordingly a larger than normal amount of hum current would flow in L_1 and L_2. C_B could be checked using the signal tracer or an a.c. voltmeter and also could be tested by the shunt method. However, connecting a high-capacity condenser in a circuit—suddenly—

causes a high-level transient current to flow, and a better test would be to disconnect C_R with the amplifier power off, install a new condenser temporarily and again switch on the power, observing the results. If the hum level is down, the new condenser may be installed permanently.

If the stage seems all right but the signal is not getting through to the speaker or speakers, the output system should be checked carefully with an ohmmeter. The secondary L_3, for example, would be tested. A very-low resistance should be found; in many cases, it will be below 1 ohm.

The plate-current swing may be quite large in a fair sized amplifier, and for that reason, if the output system is to be checked by the circuit disturbance method, a 22.5-volt or 45-volt battery may be connected temporarily to the winding L_1 or L_2 in Fig. 3. If the signal is heard, the trouble may be a defect in the output stage, in VT-1 or VT-2, or in some preceding circuits. If the signal is not heard, the trouble may be in the loudspeaker, or loudspeakers if more than one speaker is used, and, in many cases, in the cables which feed from the amplifier to the speaker voice coils. Often the output transformer is located at the amplifier, instead of at the loudspeaker itself (contrary to the usual practice in radio receivers).

In Fig. 5, a typical multiplex loudspeaker system is shown. A 250-ohm or 500-ohm line may be used. A number of speakers are connected to the line. Matching transformers are used to secure proper matching of impedances. All of these speakers may connect to a common junction board, such as *C-D*. If a break in the electrical chain exists between points *A-B* and *C-D*, none of the speakers will receive power and a pulse signal will not get through from *A-B* to *C-D*. Suppose, however, that this signal *does* appear at *C-D*, as indicated by earphones or an a.c. voltmeter, or a signal tracer. If the speakers do not respond, the trouble may be a lack of field coil excitation.

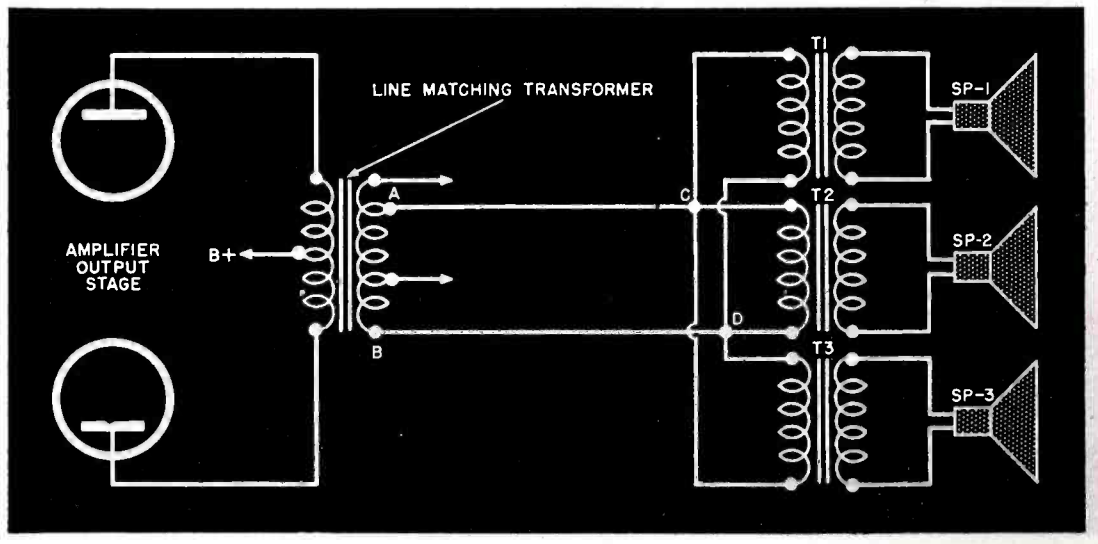
The power supply and field circuits may be checked with a volt-ohm-meter to run down that trouble. If permanent magnet dynamic speakers are used, field coil problems and auxiliary power supply problems do not come into the picture and in the diagnosis of trouble the special circuits mentioned are ruled out as possible causes of unsatisfactory operation. Then, you might find an open or break in one or all of the voice coil or transformer circuits. When the speakers have been used outdoors for any length of time it is not uncommon for several to fail at about the same time, especially if they were all new to begin with and were installed at the same time. The advantage of using a battery of the 45-volt type equipped with a 22.5-volt tap for testing, is simplicity. Such a battery should not be used, of course, in checking voice coil circuits directly, because of the very-low resistance, and in any event should be connected for only a brief instant, to develop a surge of current in the line, transformer, or other circuit. In that way, a pulse or signal is created.

While the troubles dealt with thus far are more or less common, and to be expected, regeneration and instability due to feedback may also be a problem. This is illustrated in Fig. 1D. Sound waves coming from the sound radiators—the loudspeakers—may feed back into the mike, and thus form a feed-back loop, giving rise to excessive gain and distortion. Usually, the effect is one of squealing or "singing," and is anything but pleasant. In mild cases of feedback, the distortion may be the most prominent characteristic. If the waves are out of phase, cancellation effects may be observed and the feedback will not be so troublesome, but it is seldom, if ever, possible to control the phase shifts.

As the higher-frequency sound waves are more directional than the lower-frequency waves, cutting the high-frequency response of the amplifier or equipment may result in better stability and greater freedom from oscillation. However, this reduces the range of frequencies covered, destroys the high-fidelity feature so much in demand and, therefore, is unsatisfactory.

The electrical form of feedback may occur when you feed energy back in

Fig. 5. A typical multiplex loudspeaker system. A line-matching transformer is used to properly feed a 250- or 500-ohm line.



NEW AUDIO OUTPUT TRANSFORMER

by FOSTER

* Also available in same case size and style are new microphone input transformer, and modulation transformer.

Only 1-inch in diameter by 1⅝ inches long, this small, compact transformer* is Foster-designed for a longer life of steady, dependable service. Terminals are loop-shaped for easy hook-up and hermetically sealed against widely varying temperature and moisture conditions by VITROSEAL, the sensational new Foster development in hermetic sealing.

And this is only *one* of *more than a thousand* types of transformers designed and custom-built by Foster during the past year.

Wherever transformers of a specialized function or design are involved, it may well be worth your while to consult Foster Engineers or a Foster Representative, who are ready now to consult with you on either present work or post-war planning.

REPRESENTATIVES

BOB REID	810 EAST 57TH STREET,	INDIANAPOLIS 5, IND.	TELEPHONE: BROADWAY 2725
BAUMAN & BLUZAT	2753 WEST NORTH AVE.	CHICAGO 47, ILL.	TELEPHONE: HUMBOLDT 6809-10-11-12

SPECIALISTS IN BUILDING TRANSFORMERS SINCE 1938

A. P. FOSTER COMPANY

TRANSFORMER ENGINEERS & MANUFACTURERS

719 WYOMING AVENUE, LOCKLAND 15, OHIO (SUBURB OF CINCINNATI)

the proper phase from the output circuit to the input circuit. This transfer of signal energy may be due to electric or magnetic coupling between the mike input cable and the output cable of the amplifier. By keeping the distances between the cables as great as possible this form of coupling can be reduced and accordingly the intensity of the oscillation will be reduced. If the shielding of the mike cable is not properly grounded, the oscillation may be severe and in addition excessive noise may be picked up. This noise may be present in nearby power conductors or other wiring. The shielding of the cable, when it is visible, should be checked by inspection. If the shielding is covered with rubber or some other material you will not be able to tell when you have a break in the shielding if you depend only upon visual inspection. However, referring to Fig. 6A, you can check the shielding for continuity by using an ohmmeter. If the cable is short, it is practical to check from end to end, but if the cable is long—and very often that is the case—the indicated method is more practical and proves satisfactory.

The electric and magnetic fields about the output wires vary according to the current intensities. The line current will be heavier when the line impedance is low, and the fields will be more intense for that reason, so far as the magnetic components are concerned. Therefore, in some cases, it may be found that a lowering of the tendency to oscillation follows when the coupling is reduced effectively by using a higher value of line impedance for the loudspeakers.

Still another mode of attack is to use at the input of the system a cardioide pickup which has a heart shaped directivity pattern, in place of the usual nondirectional crystal mike or the bidirectional ribbon mike. Then, the low pickup side of the mike may be placed facing the audience in the theater or wherever the p.a. system is used, and the feedback will be minimized. In setting up the mike, the useful signal tracer and generally-handy test amplifier illustrated in Fig. 2 may be used. If the regular amplifier is used and there is some form of acoustic feedback, having the mike connected will result in squealing and the adjustments on the amplifier or the loudspeakers cannot be made. If the mike input is changed over, temporarily, to a phono input, and a signal is fed into the amplifier, the signal intensities can be judged by connecting the regular mike to the test amplifier. Turning the mike about on its axis, or trying it in different positions in the theater or wherever it is used, the best mike location can be found.

The amplifier in Fig. 2 can be fitted with a long, flexible power cable and the entire unit can be carried in its case by means of a handle attached to that case. If desired, earphones may be used to read the output of the test amplifier and may be connected in

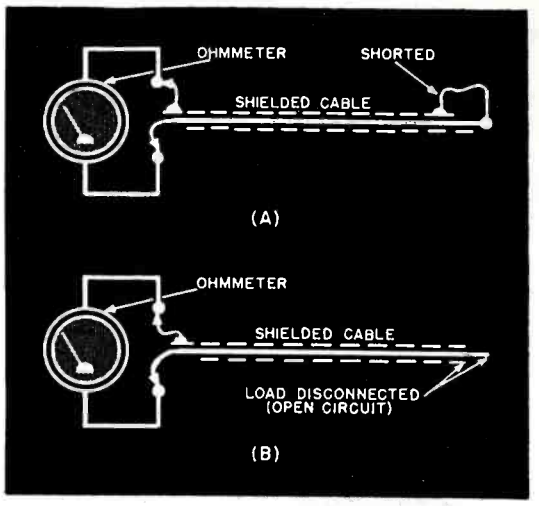


Fig. 6. (A) Ohmmeter being used in making continuity test of microphone cable. (B) Checking same cable for short circuit.

place of the output indicator. If high-impedance crystal phones are used they may be connected directly across the amplifier output without affecting the response to any great extent, and the speaker can be cut out of the circuit by using the switch shown on the diagram.

When the output is a minimum, the sound picked up by the mike is a minimum. The amplifier then can be fed by the regular mike and tests run to determine just how it is working. If you can advance the amplifier gain control reasonably well up without squealing or distortion, the installation has been checked and is all right. A little experience working with the setup will soon show what to expect.

The portable sound intensity meter, for that is what it amounts to, can be fitted with a crystal mike and taken to all parts of the theater or room to check the intensities at various spots, and by means of the loudspeaker self-contained in the unit also the quality of the sound readily may be checked. Of course, if you are testing the hearing at a particular point in an auditorium, you can use your own ears for determining the intensity and the quality, but the output indicator on the test device always is a good check.

The exploitation of the sound intensity meter by public-address men is something that has lagged greatly because scientific apparatus is out of the price range of many men engaged in this type of work and also because no demonstrated need for it has been indicated strongly enough. Once it is used, the serviceman will find that it is a great help in getting more precision into sound work, just as an output indicator is a valuable aid in aligning a radio receiver or in measuring the power output of a receiver a copper-oxide instrument is useful. The results are visual, accurate, and clearly apparent.

In general, in all cases, first familiarize yourself with the layout of the equipment and make every effort to obtain and use the manufacturer's technical data covering the equipment. Then, servicing p.a. amplifier installations will be made considerably easier.

—30—

BELL TELEPHONE LABORATORIES

Exploring and inventing, devising and perfecting for our Armed Forces at war and for continued improvements and economies in your telephone service

RESEARCH, in the Bell Telephone System, has always been an expanding activity, growing with the scientific knowledge of the times and contributing to that knowledge. Upon it have been based important inventions and developments.

The telephone, itself, was invented in the laboratory where Alexander Graham Bell was carrying on researches in speech and hearing and laying the foundation for the electrical transmission of speech. As time went on the telephone research program expanded to cover every science which gives any promise of improved telephony and every engineering art which applies to the development, construction, installation and operation of telephone facilities.

These researches and development studies now cover electrical communication of speech—both by wire and by radio—the transmission of pictures (television)—and many important projects for war.

There Is No End to Progress

Every new research gives rise to new inventions and to new lines for development and design. New inventions indicate new lines for more research. Research and development work, invention and design go hand in hand. In the early years, this work was carried in part by the American Telephone and Telegraph Company and in part by the Western Electric Company, the manufacturing unit of the Bell System.

For many years, however, this work has been assigned to a specialized unit, Bell Telephone Laboratories, Incorporated. Theirs is the responsibility for the technical future of the industry. They carry their developments from the first faint glimmerings which basic researches disclose to the final design of equipment and the preparation of specifications for its manufacture. And after manufacture and installation, they follow their products in operation; and continue development work to devise still more perfect equipment, less expensive, more convenient and of longer useful life.

These policies and procedures of Bell Telephone Laboratories are distinguished by two characteristics. In the first place the Laboratories design for service. The consideration is not the profit of a manufacturer through first sales and replacement models but the production of equipment which will give the best service at the lowest annual cost when all factors are considered, such as first cost, maintenance, operation, and obsolescence. The Laboratories make no profit and the equipment they design is owned and used by the telephone companies; and the emphasis is upon that use.

Organized Co-ordinated Research

In the second place the Laboratories design always with reference to the complete communication system in which the particular equipment is to play a part.

Reliable, economical telephone service, which is the product of its efforts, is not so much an assemblage of excellent apparatus as it is an excellent assembly of co-ordinated equipment—all designed to work together reliably and economically for a larger purpose.

It is not enough that Bell Laboratories shall design a new piece of electronic equipment which has merit or a new cable or telephone receiver. They must design with reference to all the other parts of the communication system so that the co-ordinated whole will give the best possible service.

4600 People in Bell Laboratories

Bell Laboratories contributions to the Armed Forces derived in large part from the technical background that the Laboratories had acquired through their steadily maintained program of research. The Laboratories had special knowledge, skill and techniques which could instantly be diverted to war problems.

At the time of Pearl Harbor, over a quarter of the 4600 people in the Laboratories had twenty or more years of service. This breadth of background made possible many engineering developments outside the strict field of communication and these have been of value to the Armed Forces. So far the Armed Forces and the O.S.R.D. have engaged the Laboratories on over a thousand major projects. The majority of these assignments have been completed; and have contributed to our victories on many fronts.

Most of the Laboratories developments, of course, have been in the field of electrical communication. Communication, not simply between individuals as in ordinary telephony, but between mechanisms—as in the electrical gun director. The Laboratories techniques and electronic researches have produced many secret weapons for our country's Armed Forces.

Leader in Electronic Development

For those problems the Laboratories had a remarkable background of experiences in research and development. In World War I, they pioneered by developing radio telephone systems for talking between planes and between planes and ground stations. They also contributed methods and devices for locating enemy planes, submarines, and artillery.

In this war, Bell Laboratories have pioneered in the field of electronics. The Western Electric Company, which manufactures the designs of the Laboratories, is the largest producer of electronic and other war communication equipment in the United States and is now engaged almost exclusively in the manufacture of this equipment.

In war, Bell Telephone Laboratories devote their work to the needs of our Armed Forces. In peace, they are constantly exploring and inventing, devising and perfecting for continued improvements and economies ir telephone service. Centralized research is one of the reasons this country has always had "the most telephone service and the best at the least cost to the public."

BELL TELEPHONE LABORATORIES

Short-Wave

(*Continued from page* 60)

9.825, 5:15 p.m.-12:45 a.m.; GSU, 7.26, 5:15 p.m.-12:45 a.m.; GSL, 6.11, 5:15 p.m.-12:45 a.m.; GRC, 9 p.m.-12:45 a.m.; and via Leopoldville, 9.78, 9:15-10 p.m. and 10:15 p.m.-12:45 a.m.

During the daytime, programs beamed from the BBC in London to North America are carried on GRG, 77.68, 6-8 a.m. and 2:15-5 p.m.; GSP, 15.31, 7:15 a.m.-3 p.m.; and GRX, 9.69, 3:15-5:15 p.m. (All times are EWT.)

* * *

NEW ENGLAND REPORT

From Gilbert L. Harris, North Adams, Massachusetts, this month we have the following detailed report:

10.065—Cairo, Egypt, heard on a recent Sunday at 2:15 p.m.; news in English, 3 p.m.

10.040—DZB, Berlin had news in English at 2:16 p.m., Sunday.

9.980—Radio Brazzaville, heard a recent Sunday in French, 3:20 p.m.; signed off at 3:25 p.m.

18.45—An unidentified station was heard on a Friday recently from 11:15 a.m. to 12:29 p.m., when it signed off; broadcast was in Italian, French, and German. A gong was sounded at 11:24 a.m. and 12:25 p.m.

15.225 and 11.897—Radio Tokyo heard with news in English at 6:20 and 7:20 p.m.; heard 40 db. above S-9.

11.72—CKRX, Winnipeg, had English news at 7:30 p.m.

6.47—WMI, Lorraine, Ohio, heard talking to someone at 8:26 p.m. recently; signed off at 8:28 p.m.

8.550—German-controlled Italian station was heard at 11:10 a.m. a recent Sunday.

7.832—WLWR, Cincinnati, had news in English a recent Sunday at 12 noon and 1 p.m.

12.115—ZNR, Aden, Arabia, heard 11:45 a.m.-12 noon, Sunday with music; good signal.

11.405—Radio Dakar, heard signing on at 2:45 p.m., Sunday.

9.670—British Mediterranean Station, heard a recent Sunday with news in English from 1:45 to 1:59 p.m. Harp signal was heard at 1:59 and 2:15 p.m.

10.005—Voice of Free Arabs, heard Sundays, 2:15-2:30 p.m.

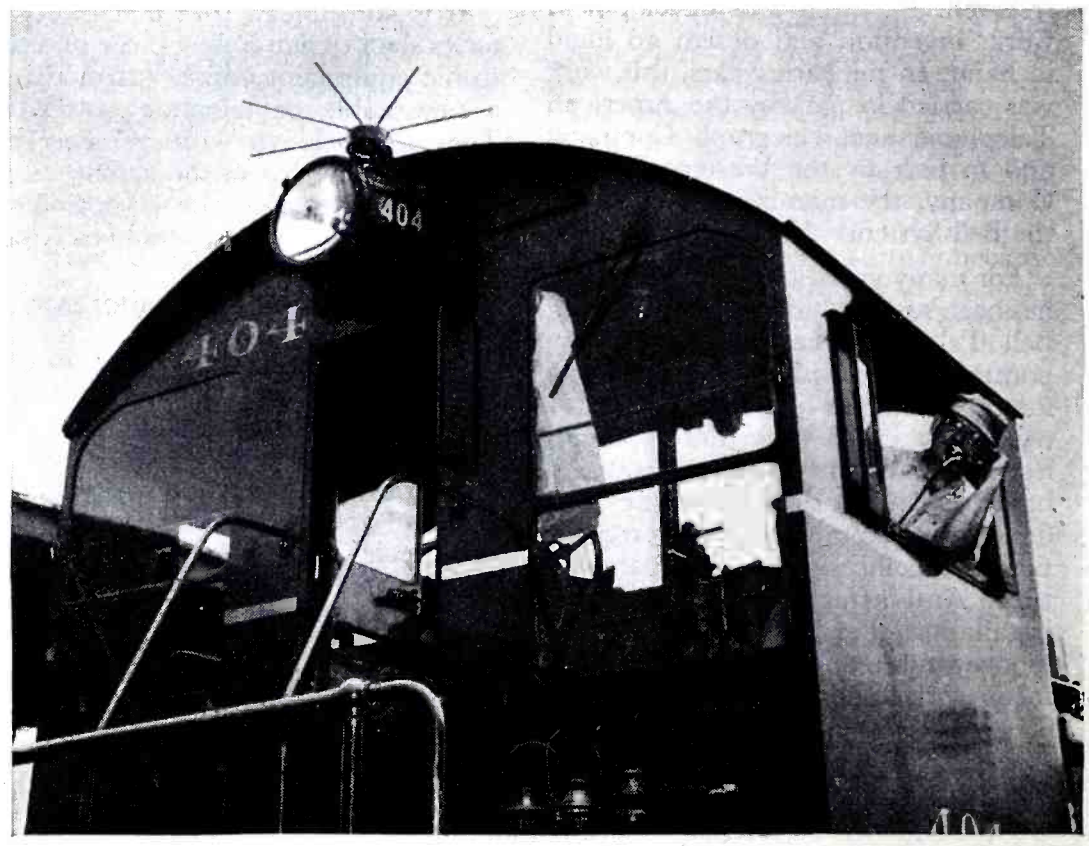
11.040—CSW6, Lisbon, Portugal, heard Sunday, signing on at 3 p.m. instead of the usual 2 p.m.

V.H.F. RADIO INSTALLATION FOR B & O RAILROAD

CONSIDERABLE interest has been shown in the design and operation of various types of radio equipment to be used for railroad yard and train operations. The Baltimore and Ohio Railroad is operating a trial installation of radio equipment designed for use at the very-high frequencies (v.h.f.).

The photograph shows Engineer Ambrose Miller receiving a train order by radio in the cab of the Diesel-switch engine. The v.h.f. antenna of the mobile transmitter - receiver is shown mounted on the roof directly above the locomotive sidelight and is connected to the transmitter-receiver by means of a flexible cable. The Diesel-switch engine and caboose are each equipped with Bendix Radio Company v.h.f. mobile 5-watt transmitters and receivers.

In the locomotive the transmitter-receiver is powered directly from the storage batteries of the engine. In the caboose, power is taken from a set of storage batteries installed solely for this purpose. On both engine and caboose a loudspeaker is installed so that calling signals will override the high noise levels encountered when traveling at high speeds. —30—



11.635—Hungarian Nations Radio, heard a recent Saturday from 9:15 to 9:29 a.m.; good signal.

7.42, 9.80, and 9.93—Radio Atlantik, all heard around 1:30 p.m.; also heard recently at 9:15 p.m. on 9.80 and 9.93.

6.212—Radio Atlantik, heard recently at 5 p.m.

8.930—San Francisco, heard signing off at 1 p.m., Sunday.

8.190 or 8.200—An unidentified station was heard a recent Sunday from 3:30 to sign-off at 6:43 p.m.; broadcast appeared to be in French; some music; both a man and a woman announced in French.

7.82—WOOW, heard a recent Sunday at 6:15 p.m.

17.76—KWID, San Francisco, heard 7-7:15 p.m. with news in English; signoff was at 7:45 p.m.

17.780—WNBI, New York, heard signing off at 7:32 p.m. recently.

15.355—KWU, heard Sunday, with news in English at 7:45 p.m.

9.615—VLC6, Australia, heard at 10:15 a.m. with news in English; signoff was at 10:45 a.m.; came on again at 11 a.m.

9.958 and 12.455—HCJB, Quito, Ecuador, heard recently at 9:45 p.m. with music; both R-9 plus.

9.610—Rio de Janeiro, Brazil, heard at 9:47 p.m. a recent Saturday; R-9 plus.

11.720—Rio de Janeiro, Brazil, heard R-9 plus at 10:05 p.m.

9.630—CBFX, Radio Canada, Montreal, Quebec; heard recently signing off at 12:06 a.m.

9.835—Hungarian Nations Radio, heard Sunday, 3:15-3:29 p.m.; R-9 plus.

9.735—CSW7, Lisbon, Portugal, heard a recent Sunday, 9-10 p.m.; R-9 plus.

11.705—Montevideo, Uruguay, heard a recent Sunday at 10:40 p.m.; R-9 plus.

21.470—GSH, London, heard recently at 11:15 a.m.

15.750—Radio Center, Moscow, heard with music at 8:15 a.m.; signoff was at 8:20 a.m.; back on at 8:21 a.m. with news in English; final signoff was at 8:52 a.m.

10.780—SDB2, Stockholm, Sweden, heard recently at 11:48 a.m.; R-9 plus.

15.155—SBT, Stockholm, Sweden, heard recently 12 noon to 12:32 p.m. signoff.

15.220—"Voice of Free India," heard recently, 10 a.m.-12 noon.

9.66—LRX, Buenos Aires, Argentina, heard Sunday, 10:15-10:45 p.m.; R-9 plus.

9.595—Radio Eire, heard signing on at 5:01 p.m.; news in English; sport news at 5:13 p.m.; left air suddenly with no closing announcement, 5:16 p.m.

* * *

BEST BETS FOR BEGINNERS

SOUTHWEST—From Tulsa, Oklahoma, Don Brewer sends along this list of best bets for beginners in the Southwest:

GVX, London, 11.93, 5:15-7 p.m.

Radio Brazzaville, Brazzaville,

(*Continued on page* 129)

····· LETTERS ·····

FROM OUR READERS

SERVICE REPAIRMEN

"...I LIKE the magazine very well but would like to inform Mr. Art Becker who wrote the article 'Problems of a Radio Serviceman' that we have some pretty good radio repairmen in the Navy and Marine Corps and I guess the Army has some good ones too, or else the Signal Corps would break down. If he thinks we are trying to cause him headaches by doing repair jobs on civilian sets for some of our buddies, that's too bad. I have never talked to any serviceman on the outside who thought he was going broke because of too little business. . . .

Thanks for a good magazine."

S/Sgt. D. L. Niblack, U.S.M.C.
Somewhere in the Pacific

"OUR squadron just received your August issue of RADIO NEWS and reading it I find some very interesting subjects.

"I have one complaint to make and that is on the article written by Art Becker. The paragraph I did not like seems to be his biggest headache—that of men trained by the army not being capable.

"I have gone to 8 months of radio school in the army and anybody who thinks an Army School is a snap, I personally wish they would be drafted and sent through one, and if they did not learn anything it sure would not be the fault of the Army.

"I feel I am capable of fixing any radio he has in the shop and think that many of my buddies feel the same. I give credit to the Army for my schooling and experience and do not like to hear anybody knock it down.

"We are lucky we have the best test equipment and no trouble securing parts, but I am sure we have more complicated sets including v.h.f. sets than any radio serviceman would get in his shop.

"I intend to have my own shop after this war the same as many other men in the service and then we will see if the Army men are capable or not. I think that a great percentage of men trained by the Army will become the best radio servicemen we have ever had."

Pfc. Miles V. Wolhowe
San Bernardino, California

"I WISH to object to articles such as 'Problems of a Radio Serviceman' by Art Becker, appearing in the August issue. I am wholeheartedly in favor of such articles if they live up to the title, but when they present such nearsightedness and prejudice, I think they ought not be printed.

"Specifically I refer to a sentence '. . . the (person) who, because of training received in the armed forces, feels qualified to repair his or his neighbor's radios. This means a real repair job when sets are brought in. . . . The busy shop . . . should educate their customers (not to) permit any untrained but well-intentioned persons to attempt the job.'

"Come now, Mr. Becker, surely the Armed Forces turn out better radio technicians than you imagine. I shudder to think of the thousands of sets ranging in size from a walkie-talkie to a SCR-284 that would be inoperable, if Armed Forces technicians were as you pictured.

"I also dislike Mr. Becker's attitude of not selling any tubes over the counter but keeping all of them to replace faulty tubes in sets brought in for servicing. Thus, if a person has a set with a burnt-out 35Z5GT, instead of being able to get one across the counter at the ceiling price of 85 cents, he has to pay $3.85 for 'inspection,' 'overhaul,' 'cleaning out chassis,' 'oiling' and 'replacing a 35Z5GT.' Shame on you, Mr. Becker, for black marketing and shame on you, RADIO NEWS, for printing such articles.

Very truly yours,
T. Bullockus
Washington, D. C.

Mr. Becker has evidently "put his foot in it" according to our readers. We know that future articles by practical servicemen will present the other side of the question.

* * *

COVER CORRECTION

"THE cover of your July issue of RADIO NEWS shows a Sgt. operating a field radio. The radio is not turned *on.*"

Sgt. Marvin Greenbaum
Somewhere in England

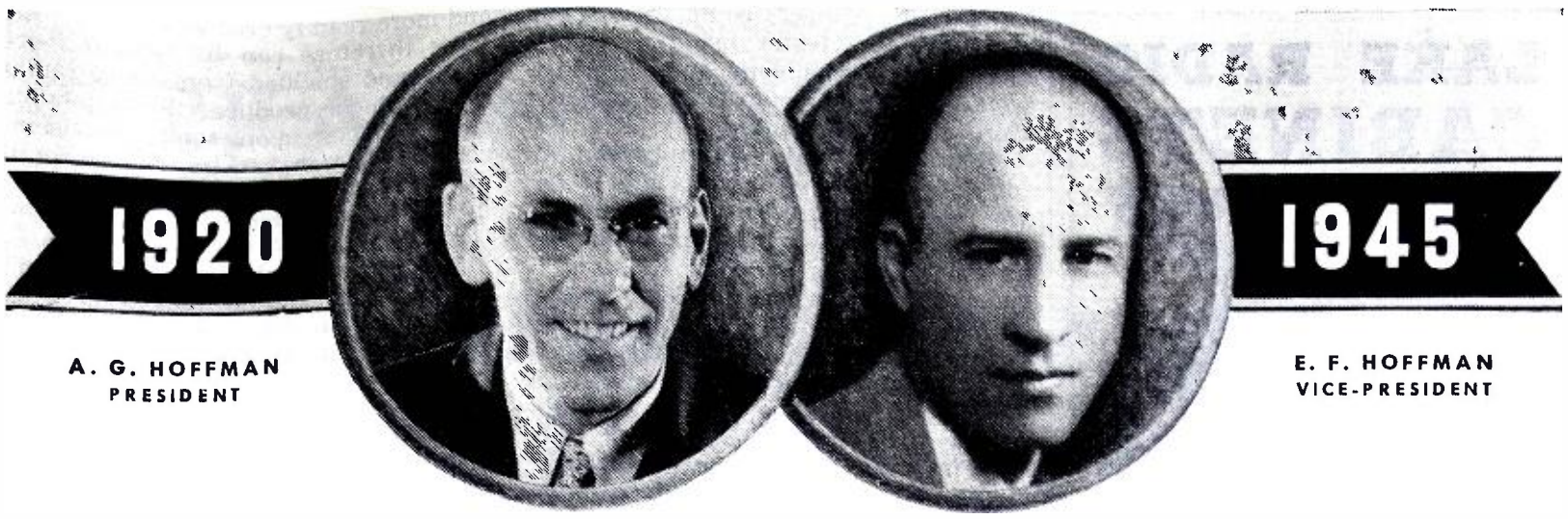
Unfortunately, what we considered to be a very realistic cover photo has let us down badly. Thank you for your correction, Sgt.

* * *

DOWN UNDER

"...YOUR technicians produce some very helpful and instructive articles and I would like to know if it would be possible to show a good-valve (tube) tester having a minimum number of working parts, either using separate element switches or a 3-4-5 ganged 15-16-17 stud tapping switch and filament switch as well, of course.

"I made up one using a 4-ganged 17-point switch but would like a late model covering late valves and a table showing settings of switches for various valves. Many years ago one such type was published and several have been shown in later years but mostly tied in with signal chasers.



A. G. HOFFMAN
PRESIDENT

E. F. HOFFMAN
VICE-PRESIDENT

MIDWEST RADIO CORPORATION

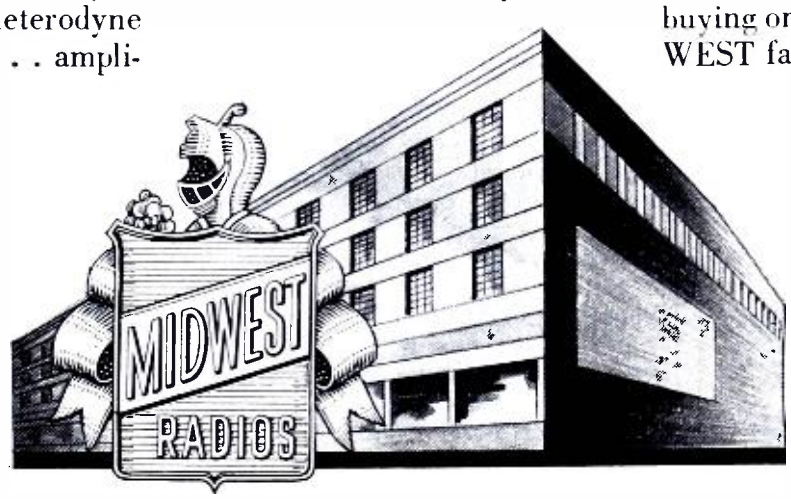
BEGINS ITS

Silver Anniversary Year

This year of 1945 marks the 25th Anniversary of the Midwest Radio Corporation. It has been a quarter-century of pioneering, of progress, of achievement, of leadership in the field of radio. Very few radio manufacturers can match the unbroken record of continuous manufacture and of faithful adherence to high quality standards which MIDWEST RADIO has established and maintained for the past twenty-five years.

Since its establishment in 1920, Midwest Radio Corporation has figured prominently in the pioneering of many outstanding radio developments. Among them: Single dial, 3-gang condenser battery sets . . . all electric radios . . . superheterodyne . . . screen grid . . . amplified and resonant AVC . . . dual speakers . . . 2400 meters band . . . shielded switching . . . noise-reducing antenna system . . . push button tuning . . . ceramic porcelain insulation . . . reinforced capacitors . . . prebalanced coil assembly . . . acousti-sonic louvres . . . 9-Band dial . . . and others too many to mention.

Today—although still engaged exclusively in the production of electronic and radio instruments for our Armed Forces—Midwest is planning new and finer radios for the postwar period. And when the new MIDWEST RADIOS are again available you may be sure that you can once again save up to 50% by buying on the famous MIDWEST factory-to-you plan.



MIDWEST RADIO CORPORATION

DEPT. 11-M . . . ESTABLISHED 1920 . . . CINCINNATI 2, OHIO

"If your engineers could show some such separate tester using a simple circuit and components, I feel sure it would find favor among many servicemen.

"I have forwarded my subscription for another twelve months and hope you receive it in time to continue without a break. The radio course running in RADIO NEWS is also very good and I wish to pass my thanks along to the author. Another article which would be very popular is the construction and servicing of electrical instruments. I myself, do rewinding, repair, and adjustment of radio instruments and have my own methods, but those used by the manufacturer would be an added help.

"The article 'The Saga of the Vacuum Tube' is most interesting. . . . "

Norman N. White
Bluff, New Zealand

We have asked Mr. Turner to prepare an article on an up-to-date tube tester. This article should be ready shortly. Thank you for your suggestions for topics.

—30—

Television As I See It

(*Continued from page* 35)

shaped glass chrysalis of the cathode-ray tube, and spread its newly formed wings wide upon the screen wall, there to be beheld, not by a few huddled heads, but in the comfort of arm chairs and sofas at convenient distances, in the living rooms of ten million homes. And like a gorgeous butterfly, the new television picture will glow in brilliant natural colors — not always — there will be abundant black and white scenes—but from the more elaborate, somewhat costlier sets will be projected those fascinating motion pictures in color which now make Technicolor productions and Kodachrome home movies so incomparably more natural and attractive than drab black and white can ever be.

How, you ask, can these things come to pass? By the enlightened rulings of the Federal Communications Commission which will give to the telecasting industry coveted niches in the upper regions of the radio spectrum, away from a great deal of interference which formerly plagued its audiences, regions where there exists abundant room for video band frequencies 20 or more megacycles wide. This calls for video carrier-wave frequencies well above 150 megacycles, perhaps as high as 700, or even higher. It now has been proven that powerful television transmitters operating on such frequencies not only can be constructed, but these have demonstrated a radiation efficiency in excess of those heretofore attained with much longer wavelengths, of the standard order of 5 meters.

The receiving antenna for use with these new fractional meter wavelengths are smaller, less conspicuous, and more readily erected and serviced. They therefore can be located more easily and shielded from stray radiations which produce the annoying ghost images upon some television-receiver screens. Also, these small antennas are more immune to pick-ups from extraneous, manmade interferences.

From them small coaxial cables will lead the picture and audio ether signals down to the receiver cabinet whence the picture will be projected to the viewing screen; either a translux one, attached to cabinet for "rear projection" from the Kenetron tube, or on to a beaded screen hung upon the wall, or suspended from a tripod, as with the home-movie projector.

This new-era television probably will grow up alongside of the oldfashioned prewar type and standards (a 525-line picture radiated on what we now must regard as "long" wavelengths—of the order of 5 meters). The existing "television plant," comprising those large companies, which deserve much of the credit for developing this art from its inception, have many millions of dollars invested in their prewar transmitter stations. Also there are some thousands of prewar receivers, and the radio manufacturing companies are all set up to turn out their "archaic" types of television receivers in mass production, to operate with existing transmitters. The evolving situation, however, will resemble much the manner in which FM is growing up alongside of its older brother, AM, there being identical programs on both. Telecasting stations will send out the same picture program from both the old and new type of transmitters, low- and high-carrier frequencies; moderate definition pictures for direct tube-end viewing; and high definition, 700 to 1000 line, pictures for screen projection, comparable in every way with our 16-mm. motion pictures. The prewar standards are wholly ill-suited for three-color pictures, whereas color attachments for use with the new, projection type of c.b. tubes will be so small and simple as to add but slightly to the cost of the black-and-white receiver instruments. Synchronism has proven to be no problem.

So it would appear that the not-too-distant future of television in the home is indeed promising. We *know* now how this vastly important advancement of the art actually can be realized. Only the element of time required for its realization remains undecided. But we know this need not be long. Two years should be more than ample; 1946 should witness this vastly significant transformation.

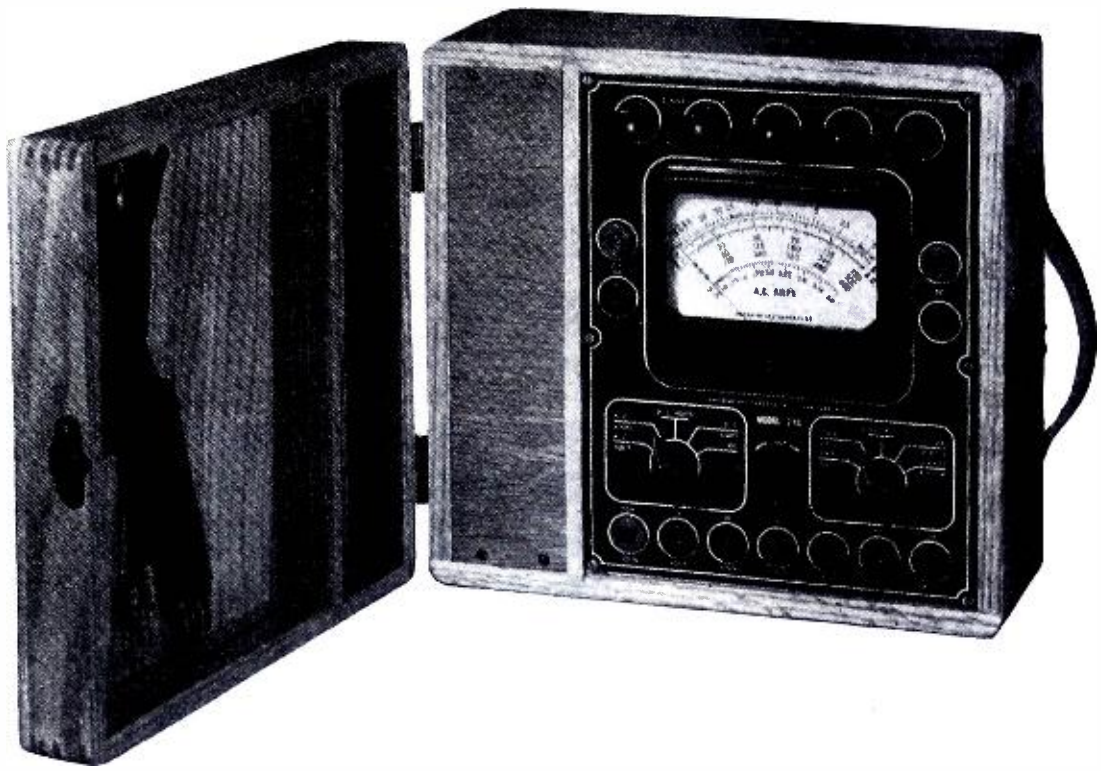
And now a word as to the economics involved. Lacking a highly desirable, well-deserved, governmental "lend-lease" television policy, the new industry obviously must "lift itself up by its boot-straps." I mean, before it can pay for the *live spot* entertainment that will cause millions to view, and continue to view, their television screens, the industry must go into the

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..... **$34.50**

SUPERIOR INSTRUMENTS CO., Dept. R.N.

227 FULTON STREET NEW YORK 7, N. Y.

financial *infrared*. The high cost of producing good, live, nightly shows, creditably enacted by skilled name artists—shows which are perfectly rehearsed at high expense, then flashed on the screens of but a single city, or even two or three, only once, and then vanish forever—such cost would swiftly bankrupt any broadcasting organization. This situation would last at least until the audiences could be built up, by relay and coaxial chains, into the millions which alone will interest lavishly paying sponsors. And each telecasting chain will cost enormously in coin and time.

The economic solution of this "insoluble" paradox is quite simple—to some executives uninterestingly commonplace and undramatic. It resides in celluloid! The necessary telecasting chains exist already—the postal service, railway and air express—and the humble tin film-carrying can!

And here is where the motion-picture industry stands complete, all ready to help solve this ridiculous riddle. Erect television transmitters (new type) in 50 cities (already more than that number of applications are before the FCC). Produce your entertainment in the motion picture studios—shorts and semilongs, all of good quality—made perfect for presentation by cutting and splicing, like in any moving picture. Ship the prints to every transmitter, to be used whenever desired and as often as desired, passing them on from city to city so that the rapidly swelling audience volume will be kept entertained constantly. Thus, any television picture will be viewed by such numbers as to be interesting to the commercial sponsors. The cost per viewer thus will be so reduced that profits in the making and telecasting processes soon will become apparent—and very enticing.

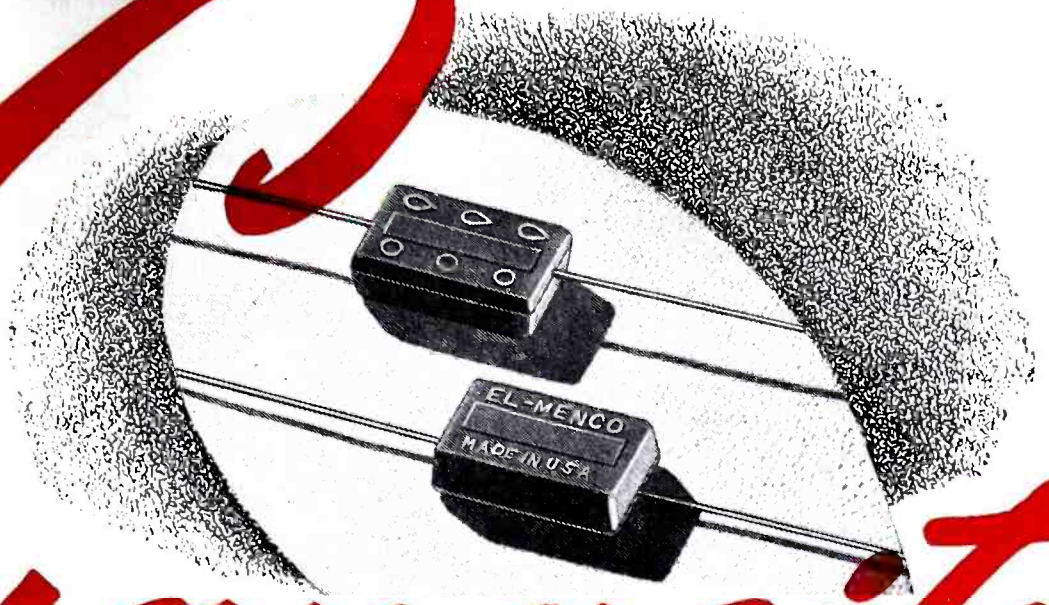
Nine-tenths of television entertainment will be from film—which factor at once eliminates a host of problems, financial and otherwise.

Spot news, athletic games, horse racing, unusual events, providing these chance to occur at suitable hours, will prove intensely interesting to theater audiences, of course, as well as the viewer at home. But this quality of "simultaneity" in television has been vastly overstressed. Who fails to be interested or delighted in a motion picture simply because they know that the figures on the screen had enacted that scene many months before? Far better a good picture than a low-quality show. The film is certain to play in television an even more vitally important role than does the transcription and phono-record in broadcasting. Vastly more, for upon film entertainment will depend the very life of television.

One word more covering television in the theater. Cinema screen television pictures have long been a demonstrated fact—in New York by R.C.A. and in London by Scophony and Beard.

The new projection tubes now under development will throw upon the theater screen pictures almost as bril-

Capacitors

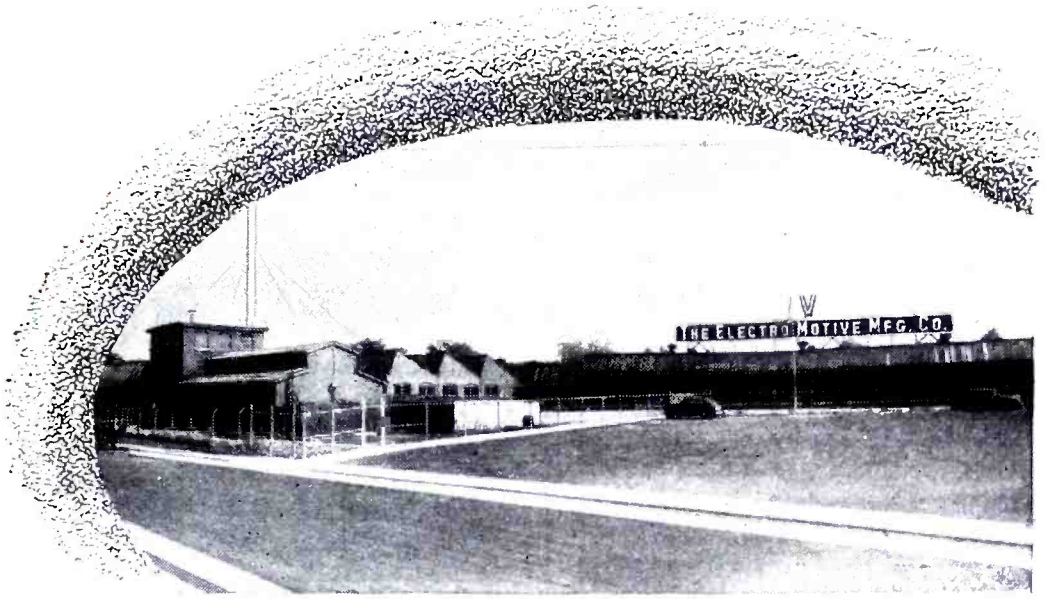


MOLDED MICA—MICA TRIMMER

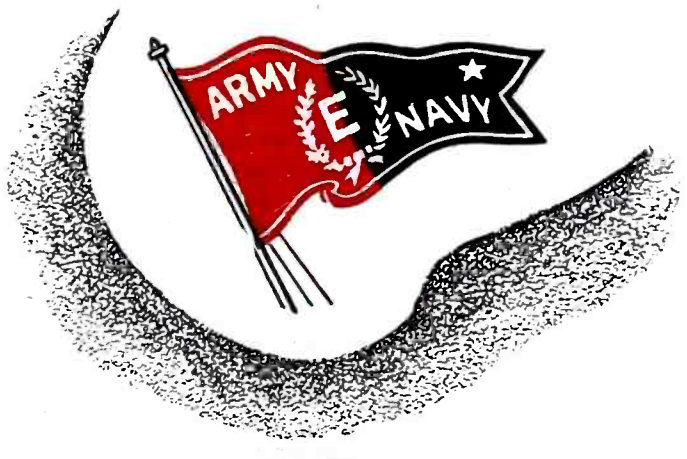
Units to fit any requirement.

MADE BY

El-Menco



HONORED BY



El-Menco

At countless vital points in army and navy communications equipment, El-Menco Capacitors serve unobtrusively, but with efficiency that has become a recognized standard. Electronic Equipment Manufacturers: Send today—on firm letterhead—for new El-Menco catalog.

THE ELECTRO MOTIVE MFG. CO. WILLIMANTIC, CONN., U. S. A.

liant as we now see thereon. I have in mind one such tube which will permit the use of the regular theater projection arc light, instead of depending on a terrifically bombarded, short lived, fluorescent projection area.

Such an optical device will enable us to place brilliant pictures in all the richness of living, natural colors before the eyes of large theater audiences. For color in television will soon dominate that art, even as Technicolor is now rapidly assuming a capital importance in the motion picture industry. For the theater also it will readily be possible to register the incoming telecast picture upon film, so that the evening audiences may witness the same exciting horse-race finish, or football game which had thrilled the afternoon audiences a few hours earlier. Thus, the home owner will have a permanent record, perhaps an exclusive one, for his ensuing audiences. The possibilities along these lines are a challenge to our imagination.

Science will provide all the needed implements. It will be up to the motion picture industry amply to employ them.

Therefore it well behooves the great motion picture industry to look well, and now, to television. For this new instrument is most emphatically certain to play a heavy role in that industry, and at an early date. They had best book this show, for it can help or harm them "colossally"!

Like the sound-on-film, television cannot be suppressed, dare not be ignored. Let the film magnates forget not the lesson learned in the late twenties, or television will cost them plenty!

—30—

Airway Traffic Control

(*Continued from page* 39)

The same system, of course, could be used to effect instrument landings at the respective airports. For landing purposes, the ADF for obtaining the longitudinal distance component (ADF No. 1) would be located, say, two miles lateral to the runway, while the ADF for obtaining the lateral component would be located just beyond the inner or the outer end of the runway and in line with it. Fig. 4 illustrates the cathode-ray viewing screen with map that could be employed for landing. This map of course would contain all helpful landing information on it.

While the results indicated here are almost what one might expect in the "Buck Rogers" air age, they are by no means impossible. In fact, such results are to be expected in the not too distant future. When this can be done with lightweight, inexpensive equipment, the air age in which every man who owns a plane can depend on it in any weather, indeed will be made possible.

—30—

Spot News

(*Continued from page* 20)

sages over a distance of 2900 miles.

Samuel Ostrolenk, a patent attorney for Finch, reported that a home recording unit for as low as $50 can be made.

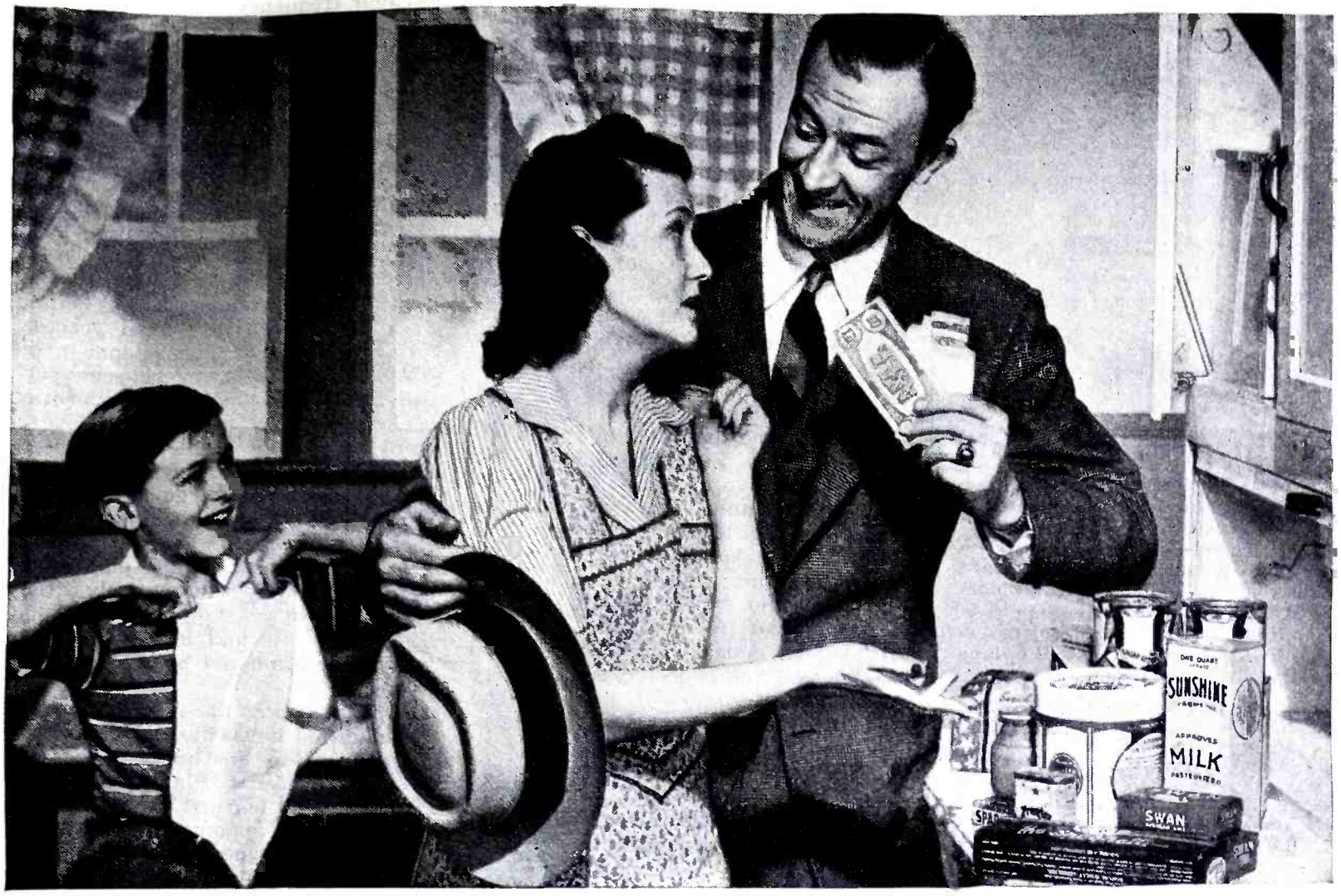
William H. Halstead, president of Halstead Traffic Communications, also took up the cause of facsimile at the hearings. He said that this service could be applied to duplicating of carloading lists for truck lines. The farmer could benefit, too, he said, by receiving a printed record of current market prices and other reports.

The Boards of Education also will find facsimile very useful, according to Morris S. Novik, New York City director of communications. He said that facsimile would permit the transmitting of school outlines, current material, maps and charts to classrooms and to the executive offices of the school authorities. R. R. Lowdermilk of the U. S. Office of Education supported Mr. Novik in the widespread application of facsimile for educational purposes.

T. A. M. Craven, former FCC Commissioner and at present with the Cowles Broadcasting Company did not favor the superimposition of facsimile signals on FM or television frequencies. He said that facsimile should have its own frequency: 50-kc. channels between 52 and 56 mc. and between 475 and 480 mc., or a total of 180 facsimile channels. He said that facsimile should be operated at speeds so as to produce pages of print at the rate of a foot a minute or more. John V. L. Hogan opposed the Finch recommendation for multiplex transmission only. He said that 20 channels should be set aside for simplex facsimile.

RADIO CHANNELS OF THE REGIONAL FREQUENCY TYPE are essential to the independent telephone services, emphasized B. C. Burden, who appeared on behalf of the United States Independent Telephone Association, at the hearings. A service of this type, he said, could play an important supplementary part in our toll systems, which would not only be in the public interest, but also would fit into the future requirements of television networks.

Discussing needs of such a service, he said that while we provide the business executive or government official traveling in an airliner or train with the world's finest communication system up to the time they are in motion, we have waived all further responsibility for their communications needs until they reach their destination. The cattle raiser enroute to a city market, the long distance trucker, or other travelers are in a similar predicament, stressed Mr. Burden. Accordingly, he said, it would be prudent to provide for six primary applications of radio channels in the telephone field. These are common



What good is a $10.00 raise ...if it then costs you $12.00 more to live?

SURE WE ALL want a raise . . . but raises today are bad medicine. Bad medicine for you. Bad medicine for everybody else. And here's why . . .

Suppose you do get a raise . . . and a lot of others get one, too. What happens? The cost of manufacturing goes up. Naturally your boss has to add this increase in cost to the price he asks the retailer. And the retailer, in turn, raises his price to the consumer . . . that's YOU.

Multiply these hundreds of items that everybody has to *pay more for* by the thousands of other workers who want raises . . . and by the thousands of business men and farmers who want more money for their products . . . result . . . you and all the others need another raise to make ends meet.

And so it goes . . . wages and prices chase each other up and up . . . until prices get so high that your dollar isn't worth a dollar any more.

So what good is a raise if your living costs go up even faster? And there's so little you can buy today anyway . . . with most factories in war production.

Of course it's hard to give up the luxuries of life . . . and even harder to give up some of the necessities. But this is War! And when you think of the sacrifices our fighting men are making . . . many of them giving up their lives for us . . . no sacrifice we can make should be too great.

So if you want to be able to enjoy the good things of life in the peaceful days to come . . . if you want to speed victory and thus save the lives of thousands of fighting men . . . start doing these seven things now . . .

1. Buy only what you need. Take care of what you have. Avoid waste.

2. Don't try to profit from the war. Don't ask more than you absolutely *must* for what you have to sell . . . whether it's *goods* or your own *labor* you're selling.

3. Pay no more than ceiling prices. Buy rationed goods only by exchanging stamps. Otherwise, you're helping the black-market criminals, hurting yourself and all other good Americans.

4. Pay taxes willingly. They're the cheapest way of paying for the war.

5. Pay off your old debts—all of them. Don't make new ones.

6. If you haven't a savings account, start one. If you have an account, put money in it—regularly. Put money in life insurance, too.

7. Buy and hold War Bonds. Don't stop at 10%. Remember—Hitler stops at nothing!

Use it up . . . Wear it out. Make it do...Or do without.

HELP US KEEP PRICES DOWN

A United States War message prepared by the War Advertising Council; approved by the Office of War Information; and contributed by the Magazine Publishers of America

carrier emergency service; common carrier urban mobile service; common carrier highway mobile service; special situation short haul toll trunks; special situation rural telephone service; and long haul toll trunks, involving intermediate repeater stations.

To serve isolated communities and families where there are only one or two telephones and where it is not feasible to construct or maintain wired telephone lines, radio would be quite helpful. Even a single telephone channel of the radio type would be of assistance in calling for such emergency services as medical, fire, police, etc. Others who will find such a service useful, according to Mr. Burden, would be mining and lumber camps, and offshore islands. Farmers, ranchers, and others who live at distances from existing wire lines, also would find a radio service useful. Individuals in automobiles, boats, trains or planes would certainly welcome the facilities that a radio system might provide, explained Mr. Burden. He said that it does not appear that the day is too far away when pedestrians will carry vest pocket radio telephones. The greatest need, of course, for such service, is to serve mobile activities.

Explaining how the service might work with a train or automobile, he said that it would be necessary to divide the country into zones and install in each of these zones a fixed transmitting and receiving outfit. In carrying on telephone conversations from New York to an automobile enroute from New York to Chicago, the regular toll circuits would carry the call to the exchange nearest the area in which the auto might be in motion. At this point, the telephone operator would connect the landline to the zone radio circuit and signal the automobile. And if the automobile were not in a zone call, the operator would extend the call on the regular toll lines to other zone points along the route. Operating zones of this type would be roughly 20 miles in diameter. Mr. Burden estimated that 32 frequency assignments would be adequate to provide service of this type. Of course the service would extend primarily along the main trunk highways.

The use of permanent emergency radio-telephone channels was also stressed by Mr. Burden. He said that for some time we have been using radio telephone channels to temporarily restore service on toll lines which have been damaged by severe storms.

It is desirable, therefore, to provide for a planned approach to this emergency program, and allot special channels for this work. These channels would restore a circuit pending repair of the regular toll line facilities; provide a dispatching circuit between emergency repair crews and the central office; and furnish additional talking channels into a community during some unusual condition. It would only be necessary to have two telephone and two telegraphic channels for such work, explained Mr. Burden.

To provide for this telephone service, four frequency range assignments were requested. These are 2-8 mc.; 50-200 mc.; 150-175 mc.; and 300-15,000 mc. Widths of channel required for these allocations were: 40, 75, 100, 120, and 150 kc. For the very-high frequencies, widths of 20 megacycles will be required, said Mr. Burden.

DOCKET 6651, which was the official title of the FCC allocation hearing, was concluded by an impressive statement by James Lawrence Fly, who has since resigned as FCC chairman to enter private legal practice. Mr. Fly said that ". . . seldom in the history of regulatory agencies has such full, frank, and unstinting cooperation been offered by industry to government . . . I have frequently expressed the hope that some day, somehow, it would be possible for government and industry to sit down together, go over the entire spectrum, channel by channel, and come up with a plan which even though it does not entirely satisfy everybody, at least appeals to everybody as a fair and honest structure within the limits set by the spectrum itself."

In announcing his resignation, Mr. Fly said that he is entering the private practice of law and his offices will be at 30 Rockefeller Plaza, New York City. It was learned later that Mr. Fly had been appointed chairman of the board of American Mutual Publishers, which has as a subsidiary, Muzak. He will also serve as general counsel. This is the same group, headed by William B. Benton who is vice-president of Chicago University, that proposed the radio subscription procedure described in last month's column. Incidentally to manage this new subscription service proposal, a company known as Subscription Radio, Inc., is now in the process of formation.

The important Fly post will be filled by former CBS attorney Paul A. Porter, who recently served as the director of publicity on the Democratic National Committee. Until Mr. Porter's confirmation by the Senate, Commissioner E. K. Jett is serving as interim chairman. Mr. Jett was formerly chief engineer of the FCC and is an outstanding authority on communications engineering.

THE MULTIMILLION DOLLAR SURPLUS tube allotment revealed by W. L. Clayton, surplus war property administrator, soon will be back in the plants of the original manufacturers. Thus far, half of this allotment, worth over $6,000,000, is on its way back to the tube plants. According to Mr. Clayton, this tube stock, which was turned over to the RFC by the Army, will be sold for the account of the government. Tubes have constituted the only major surplus item turned back. A report on surplus war radio property, made by the RFC a short while ago, indicated that the RFC had only $254 worth of radio broadcast receiving equipment, $1900 broadcast transmitting apparatus, $129,000 special communications equip-

ment, and miscellaneous communications devices worth about $20,000, on hand.

The Navy has not declared any surplus to the RFC as yet. . . . In one instance a manufacturer received a contract from the Navy to disassemble many large pieces of equipment to salvage usable parts. These parts are being stored and used on new contracts.

No definite decision has been made yet as to the disposition of lend-lease radio equipment and other large quantities of war communications properties.

THERE WILL BE NO FM BROADCASTERS' MEETING in 1945. Originally scheduled for January, 1945, New York City, the meeting was cancelled at the request of the Office of Defense Transportation.

Television

THE PRESENT AND FUTURE STATUS OF TELEVISION BROADCASTING received feature billing at the FCC hearings during several days of testimony by over a score of specialists. Views on the use of the ultra-high and very-high frequencies were sharply divided. Defending the present very-high frequency arrangement, O. B. Hansen, vice president and chief engineer of NBC, said that the present system of television had reached the state of technical practicality and deserved to be launched as an expanding broadcasting service to the American public. He said that the prewar pictures were good but continuing developments already have assured pictures of better definition, greater brightness and contrast, and larger picture size, all within the recommended standards of the present system.

Greater multipath and shadow interference prevails on the ultra-high frequencies, according to T. T. Goldsmith of DuMont. He said that wide band television is still in the research development stage and two years may elapse before any definite and useful solutions are provided. He stated that the public can get satisfactory 6-megacycle television six months after the war, and it is not just to ask the public to wait six years or more for an unknown quantity.

The ultra-high frequency program was defended by T. A. M. Craven. He said that aviation and radio broadcasting are now in competition for space between 30 and 1000 megacycles. There is not enough room for both to expand in this area, he explained. And since commercial and military aviation, important services involving safety of lives, already have a heavy investment in equipment in these frequencies in comparison to commercial broadcasting, it is quite logical, he stated, that aviation will be accorded preference over television immediately above 100 megacycles. He explained that television needs from 30 to 40 channels if the FCC is to provide adequately for frequency modulation, aviation, and facsimile below 300 megacy-

cles. Therefore there will not be room for even fifteen 6-megacycle channels. However, said Mr. Craven, between 480 and 1000 megacycles there is plenty of room for 30 or 40 wideband television channels.

Supporting this ultra-high frequency approach further, Mr. Craven said that the Cowles interests have applied for an experimental u.h.f. television license in Washington, and they hope to put the station on the air within 18 months after the manufacturer starts design and production. And, incidentally, the manufacturer is Westinghouse. He said that this transmitter will operate with 525 lines of color and 735 lines of black and white on about 750 megacycles, with a channel width of at least 13 megacycles. The same carrier will be used for both audio and video. Mr. Craven also revealed that 25 receivers, capable of picking up these signals, will be built by Zenith Radio.

If a temporary compromise allocation must be made, the 40- to 108-megacycle band might be divided up into four units, said Mr. Craven. That is between 40 and 52 megacycles, eighty 50-kilocycle wide channels should be provided for FM; the 50- to 56-megacycle band should have eighty 50-kilocycle wide channels for facsimile; 56 to 60 megacycles should be appropriated for amateurs; and 60 to 108 megacycles set aside for television, using 6-megacycle channels.

In concluding his statement Mr. Craven said ". . . we strongly recommend that the Commission make a specific allocation to commercial television broadcasting somewhere between 400 and 1000 megacycles. . . . Although we have no objection to a short period of experimental operation, we believe that a time limit should be set within which the Commission will adopt standards for commercial television operation on these higher channels."

IN A DISCUSSION ON TELEVISION IN THE THEATER, Paul J. Larson, appearing before the Commission as a representative of the Society of Motion Picture Engineers, said that television offers another means of bringing visual and oral presentations to a theater. He pointed out that the motion picture industry has a definite and legitimate interest and stake in television. If television broadcasting comes into the home, the motion picture industry through the theater must be prepared to present some material related to that given in the home and additional material on a larger scale, said Mr. Larson.

Mr. Larson pointed out that major companies in the motion picture industries have indicated that at the end of the war or as soon as wartime permits, they will enter into experimentation with production and exhibition of theater television programs. To present theater television to the public with somewhat the same picture quality as present film presentations, Mr. Larson pointed out that it will be necessary to have 20-megacycle channel widths suitable for 525- to 800-line definition for black and white transmission, and 40-megacycle channel widths suitable for higher definition black and white and for 3-color transmission of approximately 750-line definition.

There may be eventually 25 independent producing and exhibiting agencies in areas like New York City. These agencies probably will produce and distribute one television program to local theaters. To provide this service, it will be necessary to have an intracity studio transmitter station, which will use a fixed studio to transmitter channel and a cleared mobile transmitter channel. It will also be necessary to have a cleared transmitter channel for private multiple directive transmission from a single transmitter to a group of specific theaters within the service area of a transmitter. And, in addition, an

(*Continued on page* 140)

Industry Prepares for Postwar

(*Continued from page* 43)

Properly used, television can do much to make the people of the United States better informed and better educated than ever before. In the entertainment field, it opens whole new vistas which courageous pioneers are now spending time and money to explore and develop in anticipation of the day when television stations will cover the whole country and a tremendous audience will exist.

Present television broadcasting would be within the reach of about 25,000,000 persons if receivers were available. If all the stations for which permits have been requested are constructed, television coverage would expand to 70,000,000 people—more than half the population of the country. The New York-Philadelphia relay link sets a pattern whereby the stations in different cities can be tied together to begin a national hookup and make the outstanding shows and news events of the country available to the television audience.

As many people already know, television is now becoming international, and construction of a transmitter in Mexico City is being considered.

In popularizing television and giving it the initial impetus it needs to get underway, the most important thing is to let people see it for themselves. Television itself is many times more powerful than any words that can be said about it. Even today, only an infinitesimal number of people in the whole United States have seen television. What the industry needs to do, as quickly as possible, is to give demonstrations all over the United States. If this is done, such questions as demand, price, production, and markets will almost solve themselves. The public response will surprise everyone in its enthusiasm and spontaneity.

—30—

CANADA SUPPLIES UNITED NATIONS WITH RADIO EQUIPMENT

CANADA'S radio and electrical communications equipment has grown in volume in 1944 to $200,000,000 as compared to $16,000,000 in prewar years, according to a report just released by the Department of Munitions and Supply. Canada's radio and electrical plants are now producing not only 100 types of signal equipment for the Canadian Armed Forces, but also equipment for Great Britain, Russia, China, India, Africa, New Zealand, Australia, and the United States.

Production includes radar equipment, of which it has been disclosed officially that Canada is making 20 major types. The largest of these is for antiaircraft use, has 60,000 parts including 270 radio tubes, and is mounted on several large trucks.

Canadian production-simplification technique has reduced the 256 types of tubes for signal equipment to 56 types and has cut the 50 types of microphones produced to three types. Average daily production of plants throughout Canada includes 200 transmitter-receivers, 100 radio receivers, 25 radio transmitters, 100 wavemeters, 200 control units, 200 charging sets, 50 generator sets, 50 switchboards, 100 signalling lamps, 100 amplifiers, six cable layers, and 300 miles of field cable, as well as many small component parts.

—30—

Short-Wave
(*Continued from page* 118)

French Equatorial Africa, 11.97, with English news from 7:25 to 7:45 p.m.

VLC6, Shepparton, Australia, 9.615, 8-8:45 a.m.

DXL25, Berlin, German, 7.28, 7-8 p.m.

HCJB, Quito, Ecuador, 12.445, English until 7 p.m.; English news relayed from San Francisco, 6 p.m.

MIDWEST—Maurice Siskel, Indianapolis, Indiana, offers readers in the Midwest the following best bets for beginners:

9.783, Leopoldville, Belgian Congo, relaying BBC, 9:15-10 p.m. and 10:15 p.m.-12:45 a.m.; strong signal with a little fading; identifying words, "Radio National Belge."

9.615, VLC6, Shepparton, Australia, 8-8:45 a.m., beamed to eastern North America; very good signal. Closes down with playing of "Star Spangled Banner" and "God Save the King."

9.360, CBFX, Montreal, Quebec, Canada, Monday through Saturday, 7:30 a.m.-11:30 p.m.; Sunday, 9 a.m.-11:30 p.m. Shuts down with playing of "God Save the King" and "Star Spangled Banner." Good signal, slight interfering hum.

7.38, Bern, Switzerland, 9:30-11 p.m., daily except Saturday; fair to strong signal, depending largely on weather conditions.

11.645, Leopoldville, Belgian Congo, news at 8:30 and 9:10 p.m.; weak.

7.28, DXL25, Berlin, heard after 9 p.m.; usually shuts down at 1:15 a.m.,

sometimes at 12 midnight; weak, some fading.

* * *

AUSTRALIAN CHANGE

On October 7, the evening transmission beamed to the east coast of North America, 9:45-10:45 p.m. EWT, by VLC4, 15.315, Australia, was changed to 11.84 megacycles. On October 18, Australia returned to VLC4, 15.315, from 9:45 to 10:45 p.m. EWT, in parallel with a station on 11.71 megacycles. Then, on October 29 and 30, from 8:30 to 9 p.m. EWT, the Australian Broadcasting Commission tested for an evening transmission to the eastern states of North America on VLC4, 15.315.

On November 7, the Australian News and Information Bureau in New York City advised your short-wave editor that the ABC is "at present using 15.315 megacycles for its 9:45 to 10:45 p.m. EWT transmission to the eastern States of North America." They continued, "We have had some reports that reception is 'reasonably good,' and would be glad to know if you are ever able to pick it up."

As mentioned elsewhere in INTERNATIONAL SHORT-WAVE, a report from the West Coast indicates that this transmission is heard nightly there, but is weak. While your short-wave editor heard VLC4, 15.315, with a strong signal most of the summer, none of the frequencies that have been used 9:45-10:45 p.m. EWT have been heard at his listening post in West Virginia this fall and early winter.

The ABC would appreciate reports on this transmission over VLC4; they should be addressed to the Australian News and Information Bureau, 610 Fifth Avenue, New York 20, New York.

* * *

SWITZERLAND MAKES CHANGE

The Swiss Broadcasting Corporation is now using 6.345 megacycles, replacing 9.185 megacycles, on its nightly broadcast to North America, 9:30-11 p.m. EWT. Reception on 6.345 is better than on 7.338 megacycles, the latter being used along with 9.539 megacycles at present.

* * *

REPORTS FROM READERS

NEW YORK—From the Army Experimental Station, Pine Camp, New York, Pvt. Martin Weissman recently wrote:

"I have been listening to foreign broadcasts using a midget Philco Transitone, 5-tuber, equipped for the short-wave bands between 6 and 18 megacycles. Reception with this small set in this locality is almost unbelievable.

"Bern, Switzerland, comes in every night with great volume and without interference. Generally, Bern on 7.38 mcs. comes in best; 9.539 mcs. is usually poor to unreadable.

"Leopoldville on 11.64 mcs. comes in loud and clear; reception is excellent.

"Brazzaville on 11.97 mcs. also puts in a very strong signal.

"Berlin, Germany, is not too reliable. Their signals on 11.77 mcs. and 6.03 mcs. range from poor to good—some nights they are not heard at all. The 11.77 mcs. frequency is heard fairly well from 7 to 8 p.m., while 6.03 mcs. is heard best between 9 and 10 p.m.

"The BBC stations pound in on all bands between 6 and 18 mcs. and always are heard well.

VLC4, Australia, is heard weakly around 10:30 p.m. Their signal is clear, but the volume is too low.

"Canadian stations are heard well, especially CKRX, Winnipeg, 11.720 mcs.; CBFW, Montreal, 6.090; CKNX, Halifax, N. S., 6.130 mcs. These are received between 7 and 9 p.m.

"In South America, Brazil's PRL8 has an excellent signal at 10 p.m. on 11.72 mcs. They have another transmitter at about 10.7 mcs. which also puts in a reliable signal.

"HCJB, Quito, Ecuador, is on the air between 10:30 and 11 p.m. and their output is not quite as good as PRL8 here.

"San Francisco's KGEI, 15.290 mcs., is invariably heard with an excellent signal from 6 to 10 p.m.

"Radio Belge, Leopoldville, Belgian Congo, recently indicated that 'Free-Belgian' stations are now back on the air *in* Belgium. One of these was announced as Radio Brussels on the air beginning September 4 on 483.9 meters.

"My antenna is simply a piece of wire about 60 feet long. Since my receiver is about the poorest ever for DX, I feel that the static-free conditions where I am located are responsible for the reception obtained. There is little interference encountered here."

INDIANA—Mrs. John M. Hart, Anderson, Indiana, who uses a Hallicrafter Skyrider Marine S22-R, 4 bands, with a 16½-foot vertical antenna, lists the following *new best bets for beginners* in her locality:

11.645, Leopoldville, 8:10 p.m.; 12.445, Quito, Ecuador, 5 p.m.; 11.970, Brazzaville, French Equatorial Africa, 1:45 p.m.; 11.720, Rio de Janiero, Brazil, 9 p.m.; 15.225, Tokyo, 5:15 p.m.; 11.720, Winnipeg, Manitoba, Canada, 4:30 p.m.; 9.87, London, 4:15 p.m.; and 9.615, Melbourne, Australia, 10 a.m. (CWT).

"I still am able to receive Moscow on various days on 15.740 at 11 a.m. CWT; this comes in very strong," writes Mrs. Hart. "Heard Brazzaville signing off recently at 4 p.m. CWT in English on its 11.970 frequency."

ILLINOIS—Paul H. Massey, River Forest, Illinois, writes:

GSU, 7.26, London, is heard well, 5:15 p.m.-12:45 a.m., beamed to North America, daily; good to excellent signal in evening.

PRL8, 11.72, Rio de Janeiro, Brazil, heard 10-10:45 p.m., daily, except Sunday, beamed to North America; excellent signal.

DJD, 11.77, Berlin, Germany, is beamed to Africa, 11:15 a.m. to about 4:45 p.m.; news in English, 2:15 and 4.30 p.m.; good until about 3 p.m., then fair to closedown.

DXJ, 7.24, Berlin, Germany, heard beamed to North America, 6 p.m.-12 midnight, with news in English on the hour; best from 7 to 9 p.m.

Bern, Switzerland, 7.380, heard beamed to North America, 9:30-11 p.m., with news about 9:30 p.m.; poor signal.

FZI, 11.970, Brazzaville, French equatorial Africa, heard with news in English at 7:25 p.m.; excellent signal.

OHIO—Charles S. Sutton, Toledo 12, Ohio, who uses a Sky Champion S20-R receiver with an S-meter, and Brush crystal phones, says he has recently heard JANX, 12.27; JBC, 18.135; PMA, 18.160; Madagascar, 12.27; China, Japan, Australia, Europe, South America, North America, and Africa. No Indian, New Zealand, or Fiji stations have been heard so far this year.

NEW YORK—J. B. Yates, Amityville, New York, writes us that Radio Debunk is on 7.203 rather than 7.195; he has not heard this station since August, however, he states. He informs us that Berlin on 7.240 has not been heard evenings since November 1. The Berlin frequency of 7.280 has been used to South America in Spanish and Portuguese, but has not been heard lately. He reports that 7.270 is the only transmitter in the 41-meter band with English news during the evenings now. Berlin used 7.290 to South America now. Cuba has been heard the past 90 days on 8.700, 8.730, 8 930, 8.955, 8.985, 9.030, and 9.185. Turkey is heard on 9.465. Although not heard since August, Berlin-Denmark transmitter was heard during the summer on 9.520. Australia, 9.540, is heard at 8:30-9 a.m.

Other frequencies reported by Mr. Yates include: 9.555, Mexico; 9.560, Berlin; 9.610, Brazil, regular evenings; 9.615, Mexico; 9.640, Uruguay; 9.650, Berlin; 9.685, Guatemala; 9.720, Bra-

Scophony Director Warns Films Should Co-Op on Television or Hold the Bag

URGING motion picture producers to unite in a determined effort to play their part in television, Earle G. Hines, head of General Precision Equipment Corp., and a director of Scophony Corp. of America (television), stated that some such over-all plan appears essential if the film business is to attain its proper position in the television industry. He implied that the industry, as a whole, should start soon on a comprehensive program, with the cost split among interested companies, so that picture companies later on would not find themselves playing second fiddle in the matter of station allocations.

Hines cited many reasons for the picture business to get into television now, not the least of them being that the motion picture industry has by far the greatest supply of material, such as studios, stars, sets, directors, cameramen, and sound technicians, plus the highly important fact that it has that most vital ingredient—showmanship. He expressed his belief that the bulk of telecasting would be from film. Hines also was convinced that if the whole television field was not appraised and the picture industry interests protected now, it might soon be too late.

Holding that there is a too natural assumption that radio broadcasters will inherit the presentation of television broadcasts, he said that, even if they are permitted to do so, they can succeed only with the help of the film industry. Hines said the reason for this is that the step from radio to television broadcasting is a much greater one than the picture business faced in the transition from silent to talking pictures, and that that change was epochal. He said only the fact that technical knowledge of apparatus required for television now resides in the radio industry gives broadcasters their now accepted "first" in television. However, Hines termed this "first" a bit fallacious since material for programs is principally in the picture industry and press, and also because there are sources of technical knowledge required for television outside radio, which are available to film producers.

The way Hines outlined the proposal for unified industry effort, motion picture producers should join with one another. He advocates employing engineers and experts to evaluate all known methods, patents, processes, and allocations for telecasting. Such a program would pick the best types of equipment and methods, choose locations for telecasting stations to be owned by film producers and aid in planning the over-all participation of the film industry in television.

Additionally, this program would incorporate building the required equipment by proper sources when needed and arrange a continuous paid consulting relationship with an organization possessing adequate engineering knowledge and personnel. Hines cited that there is at least one group now in the field fully capable of doing this latter work. He estimated it might require two to four years for film producers to formulate and implement the program as outlined.

Hines explained there is going to be television, but that the type acceptable in the picture theater might take several years to get going or to grow out of the novelty stage. He was equally convinced that film would have to be used for telecasting, explaining that televising from stages with living actors is too expensive and unwieldy for the programs which apparently will be required.

Going into the progress made to date with wide-screen television suitable for the theater, Hines claimed that the mechanical method, employing the Skiatron (which Scophony has developed) is the best that General Precision has uncovered. This Scophony wide-screen method has a storage valve, is compact enough to place in the average picture theater projection booth and gives the sharp definition and good sound required in regularly operated theaters, he said. He indicated that it did not require a corps of experts to operate. This method, too, does not carry the huge voltage necessitated by other methods, Hines explained. Unlike cathode-ray tube television, image from the Scophony method has no fringing results or glow from the fluorescent material of cathode tubes, he said.

Both 20th Century Fox and Paramount have a stake in Scophony, the former via General Precision's holdings in 20th and Paramount through one of its subsidiaries. —30—

zil, very good now; 9.735, Uruguay; 9.760, DKSA, off last few weeks; 9.880, Mozambique; 9.897, KROJ, Los Angeles; 9.958, Quito, Ecuador, an old standby; 10.130, Haiti, ties in with CBS at times; 10.220, Brazil; 11.625, Havana, Cuba (I tune at 11.616 as checked on my graphed log).

Mr. Yates uses a SX-28 with an RME 9D as a standby. He reports that he keeps a careful check on all London stations audible since he finds they make good check points for graphing his log.

MASSACHUSETTS—Jules P. Sussman, Belmont, Massachusetts, reports hearing "Deutscher Kurtzwellen Sender Atlantik" on approximately 7.05 mcs. at 02:25 GMT. Berlin has been coming in well, especially on 6.03. Their 41-meter band stations are QRM'd badly by London and other stations. Brazzaville puts through a strong signal on 11.97 most of the afternoon and signs off with the news in English, 7:25-7:45 p.m. EWT. At 8 p.m. they return to the air with the news in French. London always comes in good here. Berlin comes in good most of the time except for QRM which decreases toward the early morning hours. San Francisco puts through a signal that sounds almost local. The strongest United Network stations are on 15.29 and 15.330. Australia comes in fine from 1 to 2 a.m. COK, Havana, Cuba, comes in with an excellent signal throughout the evening. During the summer, Melbourne came in on 15.135, R-9, S-9 at times, 9:45-10:45 p.m. Tokyo comes through very rarely; has not been heard for quite some time now.

TEXAS—From Beaumont, Texas, Milton Teel reports he recently picked up VL12, Sydney, Australia, 11.870, at 1:15 a.m. CWT. Radio Tokyo came in at intervals the same night around 2 a.m. CWT on 11.725. He has been trying to pick up Berlin at different times, but with little success.

* * *

ABOUT "RADIO ATLANTIK"

From Bob Hoiermann, Alliance, Ohio, we have the following timely information concerning the activities of much-talked-about "Radio Atlantik":

"I have been listening to the clandestine 'Radio Atlantik' for over a year now, and I shall give you some of the information as to frequencies, times, type of programs, et cetera, which may be of interest to the readers of RADIO NEWS. Since we have ousted the Nazis from France, this station now announces itself as 'Soldaten Sender West Angeschlossen der Deutsche Kurzwellen Sender Atlantik.' They did announce themselves as 'Soldaten Sender Calais', et cetera. 'Soldaten Sender West' operates on 410, 360, and 321 meters in the broadcast band, and in conjunction with 'Deutscher Kurzwellen Sender Atlantik,' operates on the following shortwave frequencies: 9.93, 9.80, 7.42, and 6.22 megacycles.

"During the afternoon and early evening the frequencies in the 31-meter band are the only ones I can

hear. After 6 or 7 in the evening, the 31-meter band fades out and I have to listen to those on 7.42 or 6.22 mcs. Their signals are pretty well QRM'd by jamming stations and aircraft, 24 hours a day, but they skip in here about 1 or 2 o'clock at night. About half of an hour's program is music which is mostly popular dance music, much of it American. Their recordings sound like very high class ones. The other half of their time is devoted to news and comments. They have special programs for the Luftwaffe, Navy, the soldiers on the Western Front, in Norway, et cetera. These may be announced as, for instance, 'Meldungen Unseres Drahtlosendienstes,' 'Nachrichten für die Kamaraden der Luftwaffe,' 'Kamradschaftsdienst für die Marine,' 'Luftwaffe Meldungen,' 'Meldungen der Inneren Front,' 'Wehrmacht Meldungen,' and the like. Of course, all this is in German for the German armed forces and the German 'home front.'

"While Dr. Goebbels always refers to the Russians as Bolsheviks, I have noticed that DKSA, like the American and English short-wave stations, refers to the Russian army as Soviet or Red army. In the latest Russian offensive into East Prussia, DKSA reported the exact number of towns and inhabited places, and the number of people captured by the Russians. When our bombers have bombed towns in Germany, I have heard DKSA give the exact names of streets, et cetera, that were bombed out in these towns, and perhaps the number of people killed in certain factories that we had bombed. That is certainly revealing information that I'm sure the Nazis wouldn't want to be known!"

* * *

ACKNOWLEDGEMENT

Since INTERNATIONAL SHORT-WAVE was started in June, 1944, the reports received each month from readers and monitors throughout the country, as well as reports from stations throughout the world, have been invaluable. We regret, however, that space does not permit listing all reports.

Address reports to Kenneth R. Boord, % RADIO NEWS, 540 North Michigan Avenue, Chicago 11, Illinois. —30—

Microphone Input Circuit

(*Continued from page* 49)

signal output is in phase with the signal on the grid. No voltage gain results, the signal transfer being near unity providing all the signal is taken off the cathode resistor.

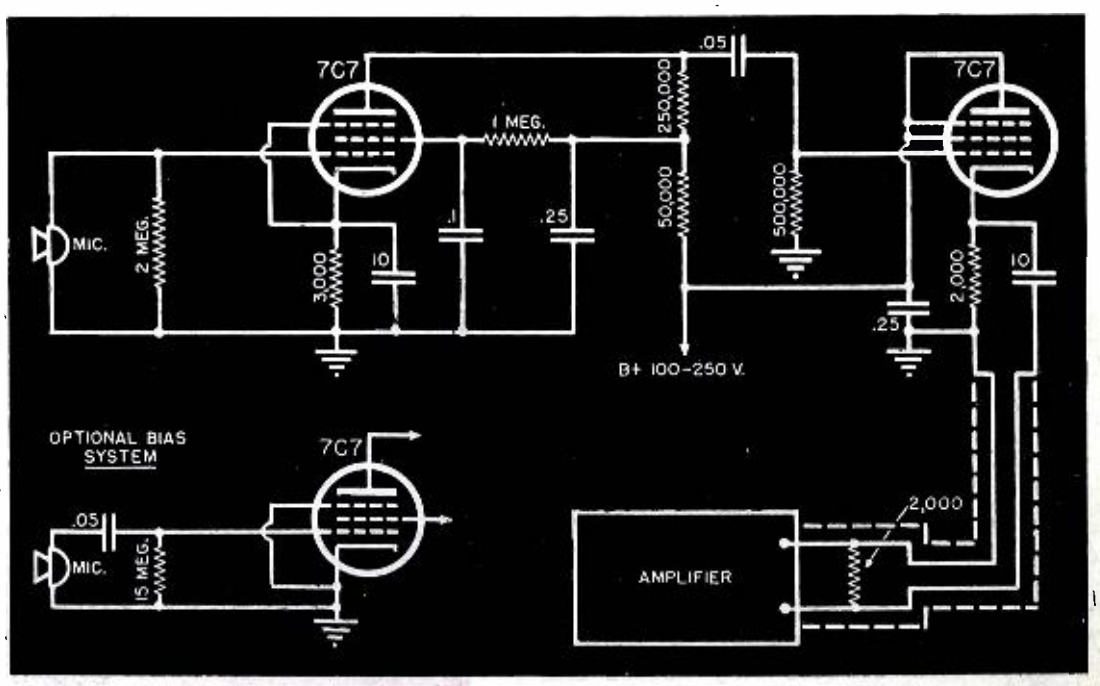
In selecting a tube for a cathode-follower circuit, at microphone level, care must be taken to select one with low hum. The selection here is rather wide if we use sharp cut-off pentodes, such as 6C6, 77, 6J7, and 7C7, connected as triodes.

A practical application is shown in Fig. 2. This unit can be made very small. Care need only be taken to keep the input from mike to grid well shielded. A necessary precaution is to remove any ground attached to the main amplifier before placing the unit into operation. Reverse the a.c. line plug for least hum as one would with any a.c.-d.c. unit. Least hum will occur when the ground side of the 110-volt a.c. line is connected to the ground side of the preamplifier, in which case the microphone cabling and metal chassis will not be at a 110-v. potential.

If the line is very long or a more permanent installation is desired, some amplification should be provided ahead of the cathode follower. Such a unit is shown in Fig. 3.

Be sure and include the line-terminating resistor near the main amplifier input. No detrimental effect occurs from working the amplifier input across the line. —30—

Fig. 3. Preamplifier with a single stage of amplification preceding the cathode follower. This circuit should be used where a long transmission line is necessary.



COLORADO OFFICER HEADS FIFTH ARMY COMMUNICATIONS SYSTEM

IN 1908, a thirteen-year old boy strung his own telegraph circuit across the town of Florence, Colorado. In 1944, as Signal Officer for Fifth Army, Brigadier General Richard B. Moran is still vitally concerned with communications.

General Moran was born in Florence and received his early education there as a student in the Florence High School. He was even then interested in electricity and was determined to become an electrical engineer. As a youth, he gained practical experience with the Mountain States Telephone and Telegraph Company, a Bell subsidiary.

In 1914, General Moran entered Colorado State College at Fort Collins. Campus activities (he was secretary and treasurer of his class and business manager of the college annual) did not prevent him from continuing to gain actual experience in his chosen field. He supervised a sub-station for the Northern Colorado Power Company.

The general was enrolled in College ROTC, entering the infantry because there were no signal courses offered. He was commissioned a first lieutenant of infantry in the Officers Reserve Corps in 1916 and was called to active duty the following year.

In December, 1917, General Moran joined the 329th Infantry, 83rd Division, then stationed at Camp Sherman, Chillicothe, Ohio. He sailed for England in May, 1918, and later went to France. He subsequently was with the 108th Engineers, 33rd Infantry Division, which formed part of the Army of Occupation in Luxembourg.

General Moran returned to America in 1919, going to Fort D. A. Russell (now Fort Francis E. Warren) Wyoming. He entered the Regular Army in 1920. After a tour at Fort Benning, Georgia, as an instructor in the Infantry School, General Moran took the course as a student. Thereafter he was ordered to Fort Monmouth, New Jersey, where he took the company officer's course in the Signal School, completing it in 1924. Following some months as infantry liaison officer at the Signal School, General Moran transferred to the Signal Corps in 1925. During 1926-29, he was post executive officer at Fort Monmouth.

Upon completion of a tour of Panama where he served as Signal Officer of the Pacific Sector, General Moran entered the Army War College, graduating in 1939. This was followed by duty with the Chief Signal Officer in Washington where General Moran became Chief of the War Plans and Training Division of that office. Other tours were performed with GHQ and later, with the Army Ground Forces. During the performance of those duties, General Moran was observing the signal communications employed by troops on maneuvers, and he made a detailed study of signal units throughout the United States.

In December, 1942, General Moran was requested by the Fifth Army Commander. He joined the Fifth Army Planning Group in Algiers and upon activation of the Army, he became its Signal Officer. He has been awarded the Legion of Merit and Croix de Guerre for various achievements, in his recent position.

-30-

RADIO NEWS • 1944

INDEX TO VOLUMES 31-32

AMATEUR
(See also—Transmitters)

Dispersion Transmitter (Kline) ..... 28 Dec.
Great Spiderweb, The (Colson and Fleischman) ..... 37 Oct.
Hams in Arctic Service (Shuart) ... 53 July
Modulating Class "C" Amplifiers (Post) ..... 38 Dec.
Panoramic Reception (Read) ..... 35 Mar.
Radio Amateurs—In War and Peace (Shuart) ..... 24 June
Radio Law and Regulations (Winter) ..... 70 Dec.
25 Years of Amateur Radio Progress (Read) ..... 43 July

ANTENNAS

Mast Support for V.H.F. and U.H.F. Antennas (Cohen) ..... 30 June

AVIATION

AACS Airways Radio Station ..... 31 May
Approach Control for Aircraft (Gilbert) ..... 25 Dec.
Automatic Radio Compass (Eddy). 27 Apr.
Aviation Radio (Yeager) ..... 208 Feb.
Future Automatic Air Traffic Control Devices (Gilbert) ..... 21 Mar.

BOOK REVIEWS

A Start in Meteorology (Spitz) .... 86 Jan.
Basic Radio (Boltz) ..... 48 June
Beloved Scientist (Woodbury) ..... 46 May
Direct-Current Circuits (Morecock). 60 Dec.
Electrical Essentials of Radio (Slurzberg and Osterheld) ..... 74 July
Electronics ..... 48 June
Electronics Today and Tomorrow (Mills) ..... 60 Dec.
Experiments in Electronics and Communications Engineering (Schulz and Anderson) ..... 40 Jan.
Fundamentals of Telephony (Albert) ..... 40 Mar.
Fundamental Radio Experiments (Higgy) ..... 86 Jan.
How to Pass Radio License Examinations (Drew) ..... 72 July
Illustrated Technical Dictionary (Newmark) ..... 46 May
Maintenance and Servicing of Electrical Instruments (Spencer). 44 Apr.
Marine Radio Manual (Strichartz). 76 July
Music in Industry ..... 64 Sept.
Plastics in the Radio Industry (Kouzens and Wearmouth) ..... 46 May
Police Radio-'Phone Operating Procedure Manual ..... 62 Nov.
Practical Radio and Electronics Course for Home Study (Beitman) 110 Apr.
Primer of Electronics (Caverly) .... 72 July
Radio Amateur's Handbook, The .. 44 Apr.
Radio Audience Measurement (Chappell and Hooper) ..... 60 Aug.
Radio Engineers' Digest ..... 62 Nov.
Radioman's Guide (Anderson) .... 114 June
Radio Servicing Course Book ..... 62 Dec.
Radio Servicing Made Easy (Beitman) ..... 64 Sept.
"Roger Wilco" A B C of Flying (La Borde) ..... 110 Apr.
Shop Job Sheets in Radio I (Auble) 74 July
Shop Job Sheets in Radio II (Auble) 60 Aug.
Short-Wave Wireless Communications (Locknet and Stoner) ..... 40 Jan.
Successful Soldering (Taylor) ..... 113 Mar.
Technique of Radio Design, The (Zepler) ..... 40 Mar.

BROADCASTING

Broadcast Stations as Frequency Standards (Dexter) ..... 32 Mar.
Preconstruction Requirements for Local Broadcast Stations (Hodgkins) ..... 38 Aug.
Standard Frequency Broadcast Service ..... 50 Apr.

CHARTS

Audio-Frequency Power Output Chart ..... 40 June
Nomographic Evaluation of Complex Numbers ..... 29 Mar.
Pentode Amplification Chart ..... 45 Apr.
Resistance or Capacitance Chart .. 31 Jan.
Ripple Factor Evaluatoin Chart .... 40 May

CODE

Code Practice Oscillator (Cool) .... 95 Oct.
Conquering the Bogey Mixed Code (Velten) ..... 50 June
Fast Keying Audio Oscillator (Bertram) ..... 41 Jan.
Photronic Code Machine (Morse) .. 25 July

COMMUNICATIONS

Communications (Stoner) ..... 157 Feb.
Military Communications (Clark) ... 76 Dec.
Radio Communication in the Field (Gadler) ..... 42 Oct.
Radio Intelligence (Read) ..... 25 Oct.
Transport Communications for Highways (Curtis) ..... 37 Sept.
U. H. F. vs. Microwaves—in Two-way Radio Communications (Freedman) ..... 24 May
Wired Radio—Circuit Designs (Turner) ..... 29 Apr.

CRYSTALS

Axis Quartz Crystals (Whitehead). 203 Feb.
Crystal Processing (Garrison) ..... 25 Aug.
Crystals for S. C. Sets ..... 202 Feb.

ELECTRONICS

Electronic Life Detector (Orton) .... 70 Nov.
Electronic Microscope (Smith and Picard) ..... 41 Nov.
Electronics at Work (Hague) ..... 40 Dec.
Electronics in Medical Science (Turner) ..... 32 June
Electrons at Work ..... 37 Aug.
What Is Electronics? (Ryder) ..... 23 Aug.

ELECTRO-OPTICS
(Photoelectric Equipment)

Colorimetry (Shurkus) ..... 25 June
Electro-Optics (Shurkus) ..... 26 Mar.
Fundamental Optics (Shurkus) .... 24 Apr.
Radiometric Elements (Shurkus) ... 32 July

EQUIPMENT (TEST)

A-F Signal Tracers (Turner) ..... 36 Jan.
Adapters for VoltOhmyst Junior (Dexter) ..... 35 June
Amateur's Frequency-Deviation Meter (Turner) ..... 42 Dec.
Direct-Reading Capacity Meter (Turner) ..... 40 Sept.
Fast Keying Audio Oscillator (Bertram) ..... 41 Jan.
"Limits Bridge" for Production Testing (Silver) ..... 40 Oct.
Low-Distortion Audio Oscillators (Turner) ..... 41 May
Master Tube Tester (Burnett) ..... 34 Oct.
Modernize Your Oscilloscope (Mayo) ..... 48 Dec.
Multivibrator for Checking Receiver Sensitivity (Silver) .... 30 July
Q.-Jig, The (Edwards) ..... 35 Jan.
Serviceman's VTVM-Capacity-Ohm Meter (Flaherty) ..... 48 Nov.
Simple Square-Wave Generator (Turner) ..... 30 Mar.

Versatile Test Gadget (Merten).... 47 Nov.
Wartime V.T.V.M. Circuits (Turner) 47 July

FREQUENCY MODULATION

Educational FM Broadcasts (Nathan) ..... 48 May
FM in World War II (Marks).... 243 Feb.
FM Station, WWZR (Utter)..... 21 June
Recording FM Bursts for Observation (Read) ..... 31 Nov.

GENERAL OR MISCELLANEOUS

Latest in Telephone Toll Service (Glanzer) ..... 53 Oct.
Mathematics in Radio (Turner).... 79 Nov.
Noise Suppression on Small Boats (Davis) ..... 47 Oct.
Observations of Postwar Radio-Electronics (Frank) ..... 92 July
Radio and the Blitz (Orton)..... 62 Aug.
Radio between Two Wars (Harbord) ..... 39 July

INDUSTRY

Electronic Industry ..... 44 Mar.
Mass Production of U.H.F. Transmitting Tubes (Coleman)..... 36 Nov.
Milestones in the Radio Industry (de Forest) ..... 36 July
The Radio Industry.....240 Feb.
Tropical Factors Affecting Electronic Products (Dytrt) ..... 32 Dec.
Wartime Production of Radio Equipment (Glanzer) ..... 66 Sept.
Weather-Testing Walkie-Talkies... 32 Aug.

INSTRUCTION (COURSES)

Practical Radio Course (Ghirardi)
Part 20—Positive and Negative Feedback ..... 49 Jan.
Part 21—Inverse Feedback .... 47 Mar.
Part 22—Inverse Feedback .... 51 Apr.
Part 23—Inverse Feedback .... 38 May
Part 24—Inverse Feedback .... 41 June
Part 25—Superheterodyne Receivers ..... 72 Aug.
Part 26—Superheterodyne Receivers ..... 72 Sept.
Part 27—Superheterodyne Receivers ..... 66 Oct.
Part 28—Preselector Circuits ... 52 Nov.
Part 29—Interference ..... 51 Dec.
Theory and Application of U.H.F. (Kiver)
Part 2—Velocity Modulation ... 32 Jan.
Part 3—U.H.F. Oscillator Tubes. 41 Mar.
Part 4—Transmission Lines .... 46 Apr.
Part 5—Transmission Lines .... 50 May
Part 6—Wave Guides ..... 53 Aug.
Part 7—Wave Guides ..... 58 Oct.
Part 8—Cavity Resonators ..... 56 Dec.

METAL LOCATORS

Mine Locators (Chappell)..... 34 Mar.

METEOROLOGY

Meteorology (Arford) .....204 Feb.
Radiosonde .....207 Feb.
Weather and War Above the Clouds (Thickstun and Blanc)... 25 Nov.
Weather Maps for Radio Broadcast (Reichelderfer) ..... 21 Apr.

MILITARY

Alaskan Theater (Carothers).....155 Feb.
American Forces Network (Porter). 32 Apr.
Amphibious (Brandstetter) .....195 Feb.
Army Pictorial (Lawton).....130 Feb.
Army Pictorial in ETO (Jervey)...129 Feb.
Britain's Commando Communications (Barnard) ..... 48 Apr.
Civilians in the S. C. (Compton)..235 Feb.
Communications in Pictures..... 26 Jan.
Communications Score D-Day Triumph (Porter) ..... 23 Oct.
Depots (Clewell) ..... 96 Feb.
Distribution (Back) ..... 94 Feb.
Engineering (Colton) .....116 Feb.
European Theater (Rumbough)....148 Feb.

Inspection Agencies (Harris)..... 118 Feb.
Japan's Wireless War (Kiralfy).... 40 Apr.
Jungle Broadcast (Hill)..... 38 Mar.
Lend-Lease ..... 214 Feb.
MP Radio in the ETO (Talley).... 212 Feb.
Maneuvers ..... 198 Feb.
Marine Battle Broadcast System.. 56 Sept.
Mediterranean Theater (Washburn) ..... 151 Feb.
Military Personnel (Matejka)..... 125 Feb.
Operations (Meade) ..... 121 Feb.
Operational Research (Everitt).... 161 Feb.
Organization (Code) ..... 88 Feb.
Pacific Theater (McIntyre)..... 153 Feb.
Photographic Center (Herr)..... 249 Feb.
Pigeons (Meyer) ..... 248 Feb.
Plant Engineering Agency (Parker) ..... 244 Feb.
Procurement ..... 92 Feb.
Radio in a Theater of War (Porter). 21 May
Radiomen in Iceland (Aguero).... 36 May
Radio—On a Flying Fortress (Porter) ..... 21 Jan.
Radiophoto (Hatch) ..... 218 Feb.
Rock-Radio (James) ..... 49 June
Signal Corps Wac, The (Hobby).. 246 Feb.
Signals in Britain's Army (Reid).. 56 Oct.
Signal Supply in the ETO (Shearer) ..... 115 Feb.
Signal Unit Survey Branch (Stafford) ..... 216 Feb.
Sioux Falls Broadcasting System (Minoff) ..... 44 May
Soldiers in Mufti (Sontheimer).... 239 Feb.
Vehicular Radio (Messer)..... 210 Feb.
V-Mail (Snyder) ..... 126 Feb.
Waterproofing (Hildreth) ..... 250 Feb.
Wire to Tokyo (Wharton)..... 200 Feb.
Women Radio Commandos (Porter). ..... 25 Sept.

PHONO

A New Crystal Pickup Cartridge (Bauer) ..... 44 Nov.

POWER SUPPLIES

Electronically-Regulated Power Supplies (Kay) ..... 38 Nov.

RAILROADS

End to End Communications for Trains (Dahl) ..... 29 Oct.
Microwaves for Postwar Railroads (Freedman) ..... 21 July
Transport Communications for Railways (Curtis) ..... 32 Sept.
Unique Radio Broadcast ((Butler).. 42 Jan.

RECEIVERS

Modernize Those Police Receivers (Lipson) ..... 44 Sept.

RECORDING

Recording Laboratory—Library of Congress (Read) ..... 42 Aug.
Sound on Cellophane (Kempner).. 56 Aug.
Soundscriber, The (Kempner)..... 43 Sept.

SERVICE

Clearing That Intermittent (Gabin). 50 Sept.
Design Tips for Rewinding Your Own Transformers (Dolan)..... 32 Oct.
G. I. Radio Servicing (Fernald).... 47 May
Let's Talk Shop (Marty) ..... 35 Nov.
..... 35 Dec.
Oscilloscope Applied to Radio Servicing, The (Howard and Eddy).. 28 Sept.
Postwar Opportunities for Servicemen and Technicians (Freedman) 28 June
Principles of Signal Tracing (Cook). 32 Nov.
Problems of a Radio Serviceman (Becker) ..... 47 Aug.
Repairing Defective Tropically-Designed Transformers (Anderson). 45 Dec.
Servicing Hints on Tube Substitutions (Kay) ..... 54 July
Servicing—Radio Oscillators (Crawley) ..... 26 May

Tube Substitutions for Radio Receivers (Kay) ..... 40 Aug.

SOUND (ACOUSTICS, ETC.)

Sound Reproducer for FM (Stocklin) 36 Dec.
Theater Acoustics (Moody) ..... 29 Aug.

TELEVISION

Postwar Television (Glanzer)..... 46 Mar.
Television's Postwar Possibilities (Glanzer) ..... 120 July

TESTING

Amplitude Modulation Measurements (Dexter) ..... 60 July
Government Acceptance Tests of Airborne Electronic Equipment (Coe) ..... 83 Aug.
Inductance Measurements (Dexter). 28 Jan.
Loud Speaker Response Measurements ..... 35 Apr.
..... 32 May
Square-Wave Testing of Amplifiers (Williams) ..... 24 Jan.

THEORY

Advanced Radio Theory for FCC Operator's Exams (Winter)..... 50 Oct.
Functional Analysis of Radio and Electronic Theory (Cook)..... 46 June
Inductive and Reactive Effects in Straight Leads (Jackson) ..... 42 Apr.
Oscillations Simplified (Post)..... 35 May
R.F. Impedance Matching (Post).. 51 Aug.
Radio Theory Review—For FCC Operator Exams (Winter)..... 48 Sept.
Theory of Wave Analyzers (Turner) 44 Oct.
Transients and Time Constants (Tatz) ..... 58 Sept.
You Will Never See an Atom (Goodell) ..... 53 Apr.

TRAINING

ESMWT Training Courses (Kay).. 45 Jan.
Gallups Island Goes to War (Canavan) ..... 28 Nov.
Military Training (Gillespie)..... 187 Feb.
Radio-Navigation Training in the C.A.P. (Weitzer) ..... 46 Dec.
Signal Corps Radio School..... 28 July
Training Army Photographers (Gaskill) ..... 128 Feb.
Visual Aids (Redding)..... 191 Feb.

TRANSMITTERS
(See Also—Amateurs)

Large Transmitter Construction... 34 Aug.
Low-Frequency Radio Telephone Transmitter (Silver) ..... 28 May
Low-Frequency Transmitters for Arctic Use (Miller)..... 31 Dec.
6-8 mc. Portable Transmitter (Maron) ..... 48 Aug.

TRANS.-RECVR.—TRANSCEIVERS

Canadian Walkie-Talkie ..... 48 Jan.
Mobile Transciever for 2½ Meters (Bowman) ..... 38 June
Postwar Two-Way Radio Systems (Freedman) ..... 24 Mar.
SCR-284, The (Noble)..... 38 Sept.
2½-Meter Transceiver for WERS (Bowman) ..... 38 Apr.

TUBES

The Saga of the Vacuum Tube (Tyne)
Part 9—Western Electric Type 101 ..... 38 Jan.
Part 10—Tube Development from 1914 to 1918..... 50 Mar.
Part 11—Unusual Earlier Tubes 54 Apr.
Part 12—De Forest's Developments ..... 52 June
Part 13—General Electric's Developments ..... 46 Sept.
Part 14—Further General Electric Developments ..... 56 Nov.

—30—

Spot News

(*Continued from page* 128)

intercity relay channel for transmission of programs simultaneously from a number of stations or directly to a specific theater or theaters in interconnecting cities will be necessary. This will require a frequency band of 1500 megacycles in 20-megacycle widths between 300 and 6300 megacycles. Mr. Larson pointed out that the present wire line facilities, including coaxial transmission lines, are not suitable for this service because of their channel width limitations. High-fidelity television, he says, requiring 20- to 60-megacycle widths needs radio facilities. And, of course, mobile links and relay systems are much more feasible with radio, he said.

Personals . . .

Phillips Carlin has resigned as vice president in charge of program operations of the Blue network. Mr. Carlin began his radio career as an announcer with WEAF in 1922. He is expected to go to the Mutual network to direct their news, special events, and program operations. **Edgar Kobak** who resigned from the Blue network some weeks ago has been appointed president of the Mutual network. . . . **W. E. McFarlane,** who was one of the founders of the Mutual network, died recently. . . . **Morris Pierce** has returned to this country to resume his post as engineer and supervisor for station WJR, WGAR, and KMPC. He was the chief engineer of the Psychological Warfare Division. . . . **Adolf L. Gross** has left the Terminal Radio Corp., where he was treasurer. For the past year Mr. Gross has been with the Electronic Research Supply Agency in New York. . . . **James H. Rasmussen** is now general sales manager of the manufacturing division of Crosley. . . . **Dr. W. L. Everitt** has been elected president of the Institute of Radio Engineers. He has also been appointed professor and head of the department of electrical engineering at the University of Illinois. At the present, Dr. Everitt is with the Signal Corps on special loan. . . . **Dr. Robert W. King,** first editor of the Bell System Technical Journal has been named assistant to the president of AT&T.

-30-

PHOTO CREDITS

Page	Credit
25, 26, 27, 28, 47	Frank Ross, Staff Photographer
29, 30, 31	Allen B. Du Mont Labs., Inc.
35 (top)	N.B.C.
38	C.B.S.
40 (bottom), 41, 42	General Electric
40 (top), 53	R.C.A.
43	Philco
49	Shure Bros.
50 (bottom)	Balaban & Katz
70	20th Ferrying Group
116	Baltimore & Ohio R.R.

Classified

Rate 20c per word, Minimum, 10 words

CORRESPONDENCE COURSES

PREPARE now for tremendous opportunities in new fields of Radio after the war. Training for Federal licenses. Write for particulars. American Radio Institute, 44 East 23rd St., New York 10, N. Y.

USED Correspondence Courses and Educational Books sold or rented. Inexpensive. Money-back guarantee. Write for Free Catalog listing 4000 bargains.—(Courses Bought.)—Lee Mountain, Pisgah, Ala.

CORRESPONDENCE Courses and self-instruction books, slightly used. Sold. Rented. Exchanged. All subjects. Satisfaction guaranteed. Cash paid for used courses. Complete information and 92-page illustrated bargain catalog FREE. Write Nelson Company, Dept. 2-59, Chicago 4.

RADIO ENGINEERING

RADIO Engineering, Broadcasting, Aviation and Police Radio, Servicing, Marine Operating and Electronics taught thoroughly. Expenses low. Write for catalog. Valparaiso Technical Institute, Dept. N, Valparaiso, Ind.

PATENT ATTORNEYS

INVENTORS—Before disclosing your invention to anyone, send for Form "Evidence of Conception"; "Schedule of Government and Attorneys' Fees" and instructions. Sent free. Lancaster, Allwine & Rommel, 414 Bowen Building, Washington 5, D. C.

PATENTS SECURED. Two valuable booklets sent free. Write immediately. Victor J. Evans & Co., 948-A Merling Bldg., Washington 6, D. C.

RADIO EQUIPMENT

RADIO Service men and experimenters send for our giant radio catalogue. Save dollars. United Radio Co., (1000M) Newark, N. J.

FOR SALE

SELENIUM Rectifiers—half wave, 4½ Amperes, 10 volts, $4.50, Full Wave, ⅓ Ampere, 10 volts, $1.85, 30 Volts, 1 Ampere, $3.49, Schematic 8F A.B. Eliminator using ⅓ Ampere Rectifier, 25c. Free with order, list free. Milton Bursma, 105 Avondale, Jackson, Mich.

BUZZER Code Practice set complete with key, battery and instructions. Sends real wireless signals. Only $1.65. Two sets $3.00. Guaranteed. Rathert Electric, Dept. N, Cresco, Iowa.

BUILD a radio, complete kit with tubes, $9.95, details. Radio, 9418 Avenue "A", Brooklyn, N. Y.

WANTED

SONG Poems wanted to be set to music. Send poem for immediate consideration. Five Star Music Masters, 420 Beacon Bldg., Boston 8, Mass.

MISCELLANEOUS

RADIO Book Catalog. Out soon; new complete catalog of radio books and manuals for beginners and experienced radio men. Write for your free copy of Catalog 4. Radionic Equipment Co., 170 Nassau St., New York 7, N. Y.

METERS, Instruments, Vacuum-tube Voltmeters repairs and Recalibrated. Immediate service and guaranteed workmanship. The Moring Co., 1414 Main St., Lynnefield Centre, Mass.

HELP WANTED

HELP Wanted: One auto radio service specialist, salary $200.00 a month. Munroe Radio Service, 111 Shelby St., Kingsport, Tenn.

PICTORIAL PORTFOLIO

THE series of full page illustrative advertisements published in RADIO NEWS the past year by the Universal Microphone Co., Inglewood, Cal., has been reprinted in portfolio form with more than a dozen pictures depicting various stages in the advancement of communications through the ages.

The pictures, by Los Angeles artist Keith Thomas, start with the early days of the Phoenician and Greek runners and end with a modern drawing from World War II.

The series has attracted wide and favorable attention and has been in demand by schools and colleges for classroom study. Several Army posts also have requested permission to use them for research work, and at least one encampment has reproduced the Thomas creations in mural form for study-hall decorations.

Interesting, instructional, and educational, the series was published in January. The pictures are of suitable size and arrangement to frame for office, den, or hobby room. Brief descriptions accompany each illustration to describe the successive steps in the advancement of communications methods.

The pictorial portfolio is being distributed without charge from the Inglewood plant of the company.

—30—

Introduction to Television

(*Continued from page* 52)

tube's electron gun. The beam from the picture tube's electron gun, in step with the motion of the pickup tube beam, scans a fluorescent screen. However, instead of releasing a charge the intensity of the beam itself is changed in accordance with the variations of the received signal. Consequently, the illumination of the screen is varied point-by-point and line-by-line, reproducing the original relative light distribution of the image, on the screen of the receiver tube.

Two other types of information transmitted on the television signal are synchronization and blanking. The synchronization signals are a series of rectangular pulses which keep the scanning beam of the television picture tube in step with the scanning beam of the pickup tube. Consequently, the receiving tube beam is always directed toward the same relative spot on the fluorescent screen as the pickup beam is scanning, at the same moment, on the mosaic. The sync pulses also set the time at which both scanning beams snap back from left to right and from bottom to top. Since a definite time interval is required for the beam to snapback or retrace, a retrace line would ordinarily be visible on the screen. Another pulse, called a blanking pulse, removes this possibility by shutting off the beam from the electron gun during the retrace intervals. Next month's installment discusses in detail the scanning process and construction of the standard television signal.

—30—

Statement of the ownership, management, circulation, etc., required by the Acts of Congress of August 24, 1912, and March 3, 1933, of Radio News, published monthly at Chicago, Ill., for Oct. 1, 1944. State of Illinois, County of Cook, ss. Before me, a notary public in and for the State and county aforesaid, personally appeared A. T. Pullen, who, having been duly sworn according to law, deposes and says that he is the business manager of Radio News and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to wit: 1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Wm. B. Ziff, 540 N. Michigan Ave., Chicago 11, Ill.; Editor, B. G. Davis, 540 N. Michigan Ave., Chicago 11, Ill.; Managing Editor, Oliver Read, 540 N. Michigan Ave., Chicago 11, Ill.; Business Manager, A. T. Pullen, 540 N. Michigan Ave., Chicago 11, Ill. 2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) Ziff-Davis Publishing Co., 540 N. Michigan Ave., Chicago 11, Ill.; A. Ziff, 540 N. Michigan Ave., Chicago 11, Ill.; W. B. Ziff Co., 540 N. Michigan Ave., Chicago 11, Ill.; S. Davis, 540 N. Michigan Ave., Chicago 11, Ill.; Wm. B. Ziff, 540 N. Michigan Ave., Chicago 11, Ill.; B. G. Davis, 540 N. Michigan Ave., Chicago 11, Ill. 3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None. 4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him. 5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the twelve months preceding the date shown above is ..... (This information is required from daily publications only.) Arthur T. Pullen, Business Manager. (Signature of business manager.) Sworn to and subscribed before me this 26th day of September, 1944. [Seal.] Wm. F. Hennessey, Notary Public. (My commission expires June 30, 1948.)

Transmitting or Receiving

RADIO STATION TECHNICIANS

MEN AND WOMEN

for Point-to-Point International Radio-communications Stations in the United States.

Applicants must possess at least Second Class commercial Radio-telegraph Operator's License.

Essential workers need release statement.

Apply weekdays except Saturdays between 10 am and 3 pm or write

PERSONNEL DEPARTMENT

R.C.A. COMMUNICATIONS, Inc.

64 Broad Street

NEW YORK 4, N. Y.

RADIO

Research & Development

Exceptional opportunity for young technically trained radio man to join the research staff of large, progressive company. This is a permanent position with splendid postwar future. Starting salary $200.00 per month with periodic increases. Assurance of substantial earnings. For a personal interview please give us (in complete confidence) your educational and technical background, age, religion and draft status. Our own organization knows of this advertisement.

Reply

c/o RADIO NEWS Box 380

SALES ENGINEER FOR TUBES

Eastern division of national electronic manufacturing company has position for sales engineer familiar with use of tubes in various types of electronic apparatus. Man should have merchandising and engineering background, knowledge of industry, and executive ability. He must be able to talk to technicians in factories, work with people and supervise a small staff of salesmen. Good salary and bonus. Write for full details to: Dept. 2R, Box 429, Grand Central Annex, New York 17, N. Y.

WANTED

ENGINEER

EXPERIENCED IN THE MANUFACTURING OF

TRANSFORMERS

GOOD FUTURE WITH GOOD SALARY

Our employees have been informed of this Ad

LOCATION CHICAGO

Box 379, c/o RADIO NEWS

★ INDUSTRIAL ★ MAN-POWER BUREAU

ENGINEERS....

Are You Concerned With YOUR POST WAR FUTURE?

The Federal Telephone & Radio Corporation, the manufacturing unit of the International Telephone & Telegraph Corporation with its multiple business activities extending to all parts of the civilized world, will accept applications from experienced men for immediate employment with almost limitless post war possibilities. These positions should interest those with an eye to the future and whose interest lies in forging ahead with this internationally known organization whose expansion plans for post war are of great magnitude covering all types of radio & telephone communications. Advancement as rapid as ability warrants. Majority of positions are located in the New York area! Essential workers need release statement.

We need the following personnel! Men with long experience or recent graduates considered.

- *ENGINEERS*
  - ELECTRONICS
  - ELECTRICAL
  - RADIO
  - MECHANICAL
  - CHEMICAL
  - TRANSFORMER DESIGN
- SALES AND APPLICATION ENGINEERS
- PHYSICISTS
- DESIGNERS
- DRAFTSMEN
- TOOL DESIGNERS
- TECHNICAL WRITERS

Look Ahead With Federal!

If inconvenient to apply in person, write letter in full, detailing about yourself, education, experience, age, etc., to Personnel Manager.

FEDERAL TELEPHONE & RADIO CORP.

39 Central Avenue

EAST NEWARK NEW JERSEY

HELP WANTED

TRANSFORMER & SMALL ELECTRIC MOTOR MEN

ENGINEERS
DESIGNERS
DRAFTSMEN
TECHNICIANS

For war time and post-war design and development of intricate, specialized, hermetically sealed transformers, and special purpose fractional h.p. motors.

Write, giving details about age, experience, past salaries to

SPERRY

GYROSCOPE COMPANY, INC.
RESEARCH LABORATORIES
STEWART AVE. AND CLINTON RD.
GARDEN CITY, NEW YORK

Vacuum Tube Engineers

One of our large Pennsylvania plants has openings for graduate physicists or electrical engineers with previous experience in the manufacture of vacuum tubes. The work will involve the development and control of processes and responsibility for maintaining low shrinkage ratios.

These positions place a high premium on men who can work cooperatively and understandingly with others.

We will arrange early interviews for qualified applicants who furnish full details concerning age, education, previous experience and salary expected.

SYLVANIA ELECTRIC PRODUCTS INC.

Industrial Relations Department

500 Fifth Ave. New York, New York

"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."

IS *Your* OPPORTUNITY HERE?

Think this over carefully. Where do you go from the spot you're in now? Are your surroundings friendly and full of promise for the future? Consider now the place you might fill in the electronic industry leadership assured to the fine staff of engineers, scientists, technicians at NATIONAL UNION RADIO CORPORATION. We're all young in years and ideas though most of us are old in electronic experience. We enjoy working together. We know we're going places! We're inviting you to join us if you have the qualifications. If you're looking for a success pattern for your future, it may be here with us at National Union. Find out! Come in and talk it over or write us!

NATIONAL UNION WANTS:

* **QUALITY CONTROL ENGINEER AND SENIOR TUBE ENGINEERS**—These men MUST have executive ability and extensive experience with radio tube manufacture. The pay and opportunities are commensurate with your ability.
* **COMMERCIAL ENGINEERS**—Men with pleasing personalities, initiative and a knowledge of vacuum tube applications.
* **TEST EQUIPMENT ENGINEERS**—Men with special interest in circuit design and applications.
* **QUALITY CONTROL MEN**—Statistical Training is chief requirement though a knowledge of vacuum tubes will help.
* **JUNIOR ENGINEERS**—MEN or WOMEN—If you have a college degree in Physics, Electrical Engineering, Mathematics or Chemistry and are the type of young person who is able to 'go places,' you'll be starting with your best foot forward if you are accepted at National Union Radio Corporation.
* **FOREMEN and ASSISTANT FOREMEN**—Men with foremanship experience in exhaust, stem or grid operations in radio tube manufacture.
* **TECHNICIANS, CIRCUIT MEN**—Maybe you've been repairing radios, maybe you've gained a knowledge of circuits by working on test equipment. It makes no difference either way if you have the 'know how' of circuits write us about the opportunities we have to offer!

WOMEN!

We have a number of fine young women engineers with us now. We need more. If you have a degree in Electrical Engineering, Physics, Chemistry or Mathematics and are seeking career opportunities, investigate.

Phone or Write

DR. L. GRANT HECTOR

Director of Engineering

NATIONAL UNION RADIO CORPORATION

RESEARCH LABORATORIES

Plane St. at Raymond Blvd.

Newark 2, New Jersey

WMC RULES OBSERVED

A WAR JOB FOR YOU

Men and Women Wanted

for

RADIO WORK

at

WESTINGHOUSE

Radio Amateurs, Radio Service Men, Ex-Service Men with Radio Training, Girl and Women Graduates of Radio Training Courses

are

needed to test

Radio and Electrical Equipment

All grades of positions open to fit individual electrical background.

Apply by letter or in person

to

Westinghouse Electric and Mfg. Co.
2519 Wilkens Ave.—Baltimore 3, Md.
or
Susquehanna and Front Streets
Sunbury, Pennsylvania

Those now employed at highest skill in essential industry need not apply

Wanted
ENGINEERS

Radio
* **Electrical**
Electronic
* **Mechanical**
Metallurgical
* **Factory Planning**
Materials Handling
Manufacturing Planning

Work in connection with the manufacture of a wide variety of new and advanced types of communications equipment and special electronic products.

Apply (or write), giving full qualifications, to:

R.L.D., EMPLOYMENT DEPT.

Western Electric Co.

100 CENTRAL AV., KEARNY, N. J.

***Also: C.A.L.**

Locust St., Haverhill, Mass.

Applicants must comply with WMC regulations

WANTED

RADIO LICENSED AMATEURS

thoroughly familiar with all types of parts, tubes, meters, test equipment, receivers, transmitters, etc., capable of dealing with our industrial accounts. Permanent position; excellent salary; splendid opportunity for some one residing in metropolitan New York area.

SUN RADIO & ELECTRONICS CO.
212 Fulton St. New York 7, N. Y.

Technical Writers Wanted!

Engineers and physicists who have had experience in (spare time) writing technical manuscripts on electronic design or applications including radio, television, facsimile, etc. Highest rates.

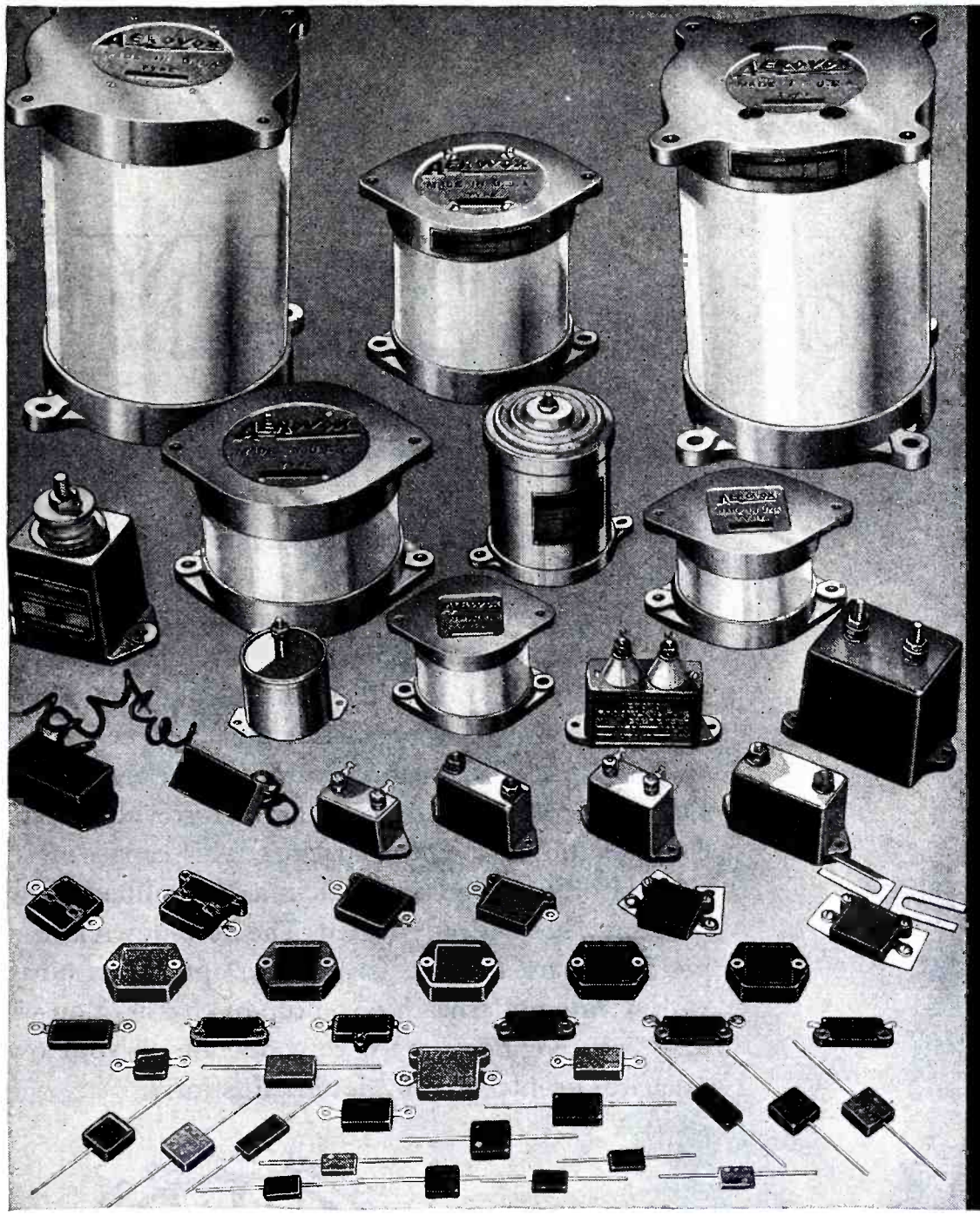
Reply Box 310, c/o RADIO NEWS
540 N. Michigan Ave., Chicago 11, Ill.

INDEX OF Advertisers

Jan. 1945

COMPANY	AGENCY	PAGE No.
Aerovox Corporation	Austin C. Lescarboura & Staff	147
Alliance Manufacturing Company	Campbell-Sanford Advertising Company	133
Allied Radio Corp	Henry H. Teplitz	60
American Condenser Co	Michael F. Mayger, Advertising	108
American Phenolic Corporation	Evans Associates, Inc	97
American Television & Radio Co	Frizzell Advertising Agency, Inc	117
Audak Company	Hart Lehman Advertising	8
Audel, Publishers	Grant & Wadsworth, Inc	132
Barker & Williamson	Harry P. Bridge Co., The	78
Bell Telephone Laboratories	N. W. Ayer & Son, Inc	115
Best Vibrator Co		138
Brach, L. S. Mfg. Corp	United Advertising Agency	135
Bruno Tools	West-Marquis, Inc	110
Burgess Battery Co	Howard H. Monk & Associates	94
Burlingame Associates		134
Burstein-Applebee Co	Frank C. Whalen Adv. Co	135
Candler System Co	Van De Mark Advertising, Inc	138
Capitol Radio Engineering Institute	Henry J. Kaufman Advertising	76
Centralab	Gustav Marx Advertising Agency	21
Cincinnati Electric Products Co	Perry-Brown, Inc	90, 91
Commercial Radio Institute		138
Concord Radio Corporation	Shappe-Wilkes, Inc	62
Connecticut Telephone & Elec. Div	Wilson & Haight, Inc., Adv	10
Cornell-Dubilier Electric Corporation	Reiss Advertising	103
Cornish Wire Company, Inc	Hart Lehman Advertising	128
Coyne Electrical School	McJunkin Advertising Company	135, 140, 145
Crowe Name Plate & Mfg. Co		93
DeForest's Training, Inc	MacDonald-Cook Co	15
Delco Radio Div., General Motors	Campbell-Ewald Company	100
Dresser Industries, Incorporated	Fuller & Smith & Ross, Inc	80, 81
Echophone Radio Co	Burton Browne Advertising	5
Editors and Engineers		136
Eicor, Inc	Henry H. Teplitz	84
Electro-Motive Mfg. Co., The	Cory-Snow, Inc	123
Electronic Laboratories, Inc	Burton Browne Advertising	99
Electro-Voice Corporation	Shappe-Wilkes, Inc	22
Fada Radio & Electric Co., Inc	Sternfield-Godley, Inc	6, 116
Federal Telephone & Radio Corp	Commerce Adv. Agency	142
Federal Telephone & Radio Corp	Marschalk & Pratt Co	17
Foster, A. P., Company	Gotham Advertising Co., Inc	113
Galvin Mfg. Corporation (Motorola)	Gourfain-Cobb Adv. Agency	107
General Cement Mfg. Co	Turner Advertising Agency	141
General Electric Company	Maxon Inc. Advertising	65
General Test Equipment Co	Suzanne Hayman, Advertising	138
Gothard Manufacturing Company	Merchandising Advertisers	116
Greenlee Tool Co	Howard H. Monk and Associates	126
Guardian Electric Mfg. Company	Kennedy & Company	2nd cover
Hallicrafters Company, The	Burton Browne Adv.	Back Cover
Hammarlund Mfg. Co., Inc., The	Roeding & Arnold, Inc	24
Harvey Radio Company	Shappe-Wilkes, Inc	20
Hatry & Young		138
Hazeltine Corporation	Equity Advertising Agency	144
Hollister Crystal Co	Merrett Owens Adv. Agency	141
Howard Manufacturing Corp	Bozell and Jacobs	133
Hytron Corporation	Henry A. Loudon Advertising	11
International Detrola Corporation	Zimmer-Keller, Inc	23
International Resistance Co	Lavenson Bureau	83
Illinois Condenser Company	Sander Rodkin Adv. Agency	128
Islip Radio Manufacturing Corp	Kotula Company	108
Jensen Radio Manufacturing Co	Burton Browne Advertising	7
Johnson, E. F., Co	David, Inc	16, 101, 114
Kato Engineering Co		130
Kenyon Transformer Co., Inc	Jasper, Lynch & Fishel, Inc	105
Knights, James Co., The	Turner Advertising Agency	67
Lake Radio Sales Co	Sander Rodkin Adv. Agency	120
Lectrolab Products		139
Lifetime Sound Equipment Co		132
Lincoln Engineering School	Buchanan Thomas Adv. Co	124

COMPANY	AGENCY	PAGE No.
Mallory, P. R. & Co., Inc	Aitkin-Kynett Co	85
Meck, John Industries	Western Advertising Agency	102
Meissner Manufacturing Company	Gardner Advertising Co	63
Merit Coil & Transformer Corp	Ross Llewellyn	66
Midwest Radio Corporation	Key Advertising Company, The	119
Miles Reproducer Co., Inc	Altomari Advertising Agency	138
Millen, James Mfg. Co., Inc	James Millen, Inc	12
Murdock, Wm. J., Co	John A. Smith & Staff	129
McBurney, A. D	West-Marquis, Inc	137
McElroy Manufacturing Corp	Shappe-Wilkes, Inc	124
McGraw-Hill Book Co		122
National Company	Graydon Smith	13
National Electronic Supply		88
National Radio Institute	Van Sant, Dugdale & Co., Inc	3
National Schools	Mayers Company, The	71
National Union Radio Corporation	Hutchins Advertising Co., Inc	69, 143
Nelson Co	A. N. Baker Advertising Agency	104
Newcomb Audio Products Co	Joe Perrett Company	134
New York YMCA Schools	Cecil & Presbrey, Inc	145
Ohmite Manufacturing Company	Henry H. Teplitz	59
Olson Radio Warehouse	Jessop Advertising Company	126
Onan, D. W. & Sons		122
Press Wireless, Inc		144
R.C.A. Communications, Inc	Albert Frank-Guenther Law, Inc	142
RCA Institutes, Inc		120
Radio City Products Co., Inc	Reiss Advertising	130
Radio Parts Company	Sidney S. Lovitt	106
Radio Supply & Engineering Co., Inc.	Karl G. Behr Adv. Agency	124
Radio & Technical Division of Murray Hill Books, Inc	Harry P. Bridge Co., The	89
Radio Tube Service Co., Inc	Daniel de Koven, Advertising	112
Radolek Co	Turner Advertising Agency	145
Raytheon Manufacturing Company	Burton Browne Advertising	75
Rider, John F., Publisher, Inc	Lansford F. King	86
Rowe Industries Electronics Division		138
Runzel Cord & Wire Co	Duane Wanamaker Advertising	111
Sauereisen Cements Company		138
Shure Brothers	Henry H. Teplitz	109
Sperry Gyroscope Company, Inc	Equity Advertising Agency	142
Sprague Products Co	Harry P. Bridge Co., The	73
Sprayberry Academy of Radio	Harry P. Bridge Co., The	19
Standard Transformer Corporation	Burnet-Kuhn Advertising Co	68
Stanwyck Winding Company	Franklin Advertising Service	136
Stark Distributing Co	C. Wendel Muench Agency	138
Stevens Walden, Inc	Howard-Wesson Co	98
Studio Service Co		120
Sun Radio & Electronics Co	Mitchell Advertising Agency	143
Superior Instruments Co	Loewy Advertising Agency	121
Supreme Instruments Corp	O'Callaghan Adv. Agency, Inc	72
Sylvan Wellington Company		138
Sylvania Electric Products Inc	Arthur Kudner, Inc	14, 142
Teleplex Co	Terrill Belknap Marsh Associates	145
Templetone Radio Mfg. Corp	Peck Advertising Agency, Inc	79
Thordarson Electric Mfg. Co	Duane Wanamaker Advertising	87
Tobe Deutschmann Corp	Franklin Bruck Adv. Corp	148
Tri-State College	Clem J. Steigmeyer	145
Turner Company, The	W. D. Lyon Co., The	127
United Transformer Co	Shappe-Wilkes, Inc	3rd Cover
Universal Microphone Company	Ralph L. Powers, Ph. D	77
Utah Radio Products Company	Abbott Kimball Co., Inc	18
Valparaiso Technical Institute	Smith, Benson & McClure, Inc	145
Vaughan Cabinet Co	Paul Grant, Advertising	122
Wallace, Wm. T., Mfg. Co	Michael F. Mayger, Adv	139
Ward Leonard Electric Company	E. M. Freystadt Associates, Inc	9
Ward Products Corporation, The	Burton Browne Advertising	95
Warner Electric Co	Mason Warner Co	140
Western Electric Co	Deutsch & Shea	143
Westinghouse Electric & Mfg. Co	Fuller & Smith & Ross, Inc	61, 143
Wholesale Radio Laboratories	Allen & Reynolds	137
York Radio Distributing Company		140



THERE'S A TYPE FITTED *PRECISELY* TO YOUR NEEDS...

AEROVOX MICA *Capacitors*

•

SPECIFY AEROVOX

Be sure you have the Aerovox Capacitor Manual in your working library, for general guidance. And for final insurance covering satisfactory results, just specify Aerovox Capacitors.

● Aerovox selection ranges from tiny "postage-stamp" molded-in-bakelite units to giant porcelain-cased stack-mounting units. These many varied types are standard with Aerovox—in daily production—available at quantity-production prices.

The following factors are suggested in guiding your selection:

Electrical: (a) Capacitance and tolerance; (b) D.C. voltage rating; (c) Current-carrying capacity and frequency characteristics; (d) Allowable temperature rise and maximum operating temperature; (e) Special characteristics such as temperature coefficient, retrace, etc.; (f) Special operating conditions such as high humidity, altitude, extreme temperatures, etc. *Mechanical:* (g) Basic type; (h) Terminals; (i) Case; (j) Mounting holes; (k) Nameplate data.

• • •

Yes, Aerovox expects you to *select* that type best fitting your particular requirements *in every way*. And Aerovox is ready to help you make the proper selection. Remember, *Aerovox Application Engineering*—that "know-how" second to none in the industry—can make all the difference between disastrous makeshifts and the most satisfactory results.

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.

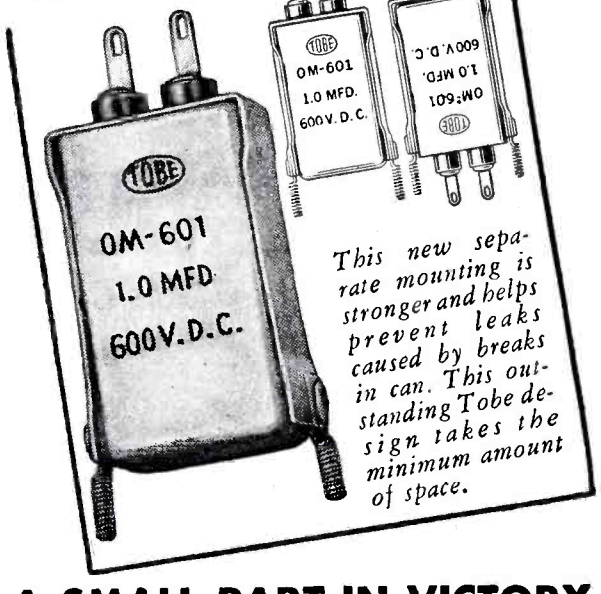
Sandy Hook Lighthouse, built in 1764.

ON THE BEAM-
for nearly two centuries

Tobe Capacitors, too, are "on the beam"—giving years of dependable service . . . for, at Tobe, *long life* is as integral a specification as the dimensions themselves. That is why, with millions of Tobe Capacitors operating under all conditions, "returns" are practically negligible. Continuation of this enviable record rests on long, specialized manufacturing experience—intensive inspections — and constant research. Illustrated below is the Tobe OM-Capacitor. This capacitor is a mineral oil impregnated unit in a streamlined drawn container, hermetically sealed. The hold-down bracket permits the use of either inverted or upright terminals, with wiring underneath or on top of chassis. You will find Tobe engineers ready to cooperate on your own capacitor problems. Why not inquire now?

TOBE DEUTSCHMANN CORP. TOBE CANTON · MASSACHUSETTS

LONG LIFE ASSURED



This new separate mounting is stronger and helps prevent leaks caused by breaks in can. This outstanding Tobe design takes the minimum amount of space.

SPECIFICATIONS

OM-CAPACITORS

TYPE	OM-*
RATINGS	.05 to 2.0 mfd. 600 V. D. C.
	.05 mfd. to 1.0 mfd. 1,000 V. D. C.
STANDARD CAPACITY TOLERANCE	20%**
TEST VOLTAGE	Twice D. C. rating
GROUND TEST	2,500 Volts D. C.
OPERATING TEMPERATURE	-55° F to 185° F
SHUNT RESISTANCE	
	.05 to 0.1 mfd. 20,000 megohms
	.25 to 0.5 mfd. 12,000 megohms
	1.0 to 2.0 mfd. 12,000 megohms
POWER FACTOR	
	At 1,000 cycles—.002 to .005
CONTAINER SIZE	
	Width 5/8", length 1 5/16", height 2 1/4"
MOUNTING HOLE CENTERS	1 1/2"

MIDGET OM-CAPACITORS

TYPE	OMM-*
RATINGS	.05, .1 and
	2 x .05 600 V. D. C.
	.05 x .1 1000 V. D. C.
STANDARD CAPACITY TOLERANCE	20%**
GROUND TEST	2,500 V. D. C.
OPERATING TEMPERATURES	-55° F to 185° F
SHUNT RESISTANCE	20,000 megohms
POWER FACTOR	At 1,000 cycles—.0075
CONTAINER SIZE	
	Width 5/8", length 1 5/16", height 1 11/64"
MOUNTING HOLE CENTERS	1 1/2"

*Data sheets showing complete code number for units having a specific capacitance value and voltage rating available on request. **Other tolerances available.

A SMALL PART IN VICTORY TODAY...A BIG PART IN INDUSTRY TOMORROW

PRINTED IN U.S.A.

Made in Japan*

* Japanese components illustrated obtained from the Pacific war theatre for the UTC Research Laboratory

A recent UTC analysis of Japanese components substantiates the conclusive superiority of products of American design and construction . . . for example, on transformer components . . .

JAPANESE unit weighs **8 oz.**
. . . failed on 15 minute submersion test
. . . very narrow frequency range.

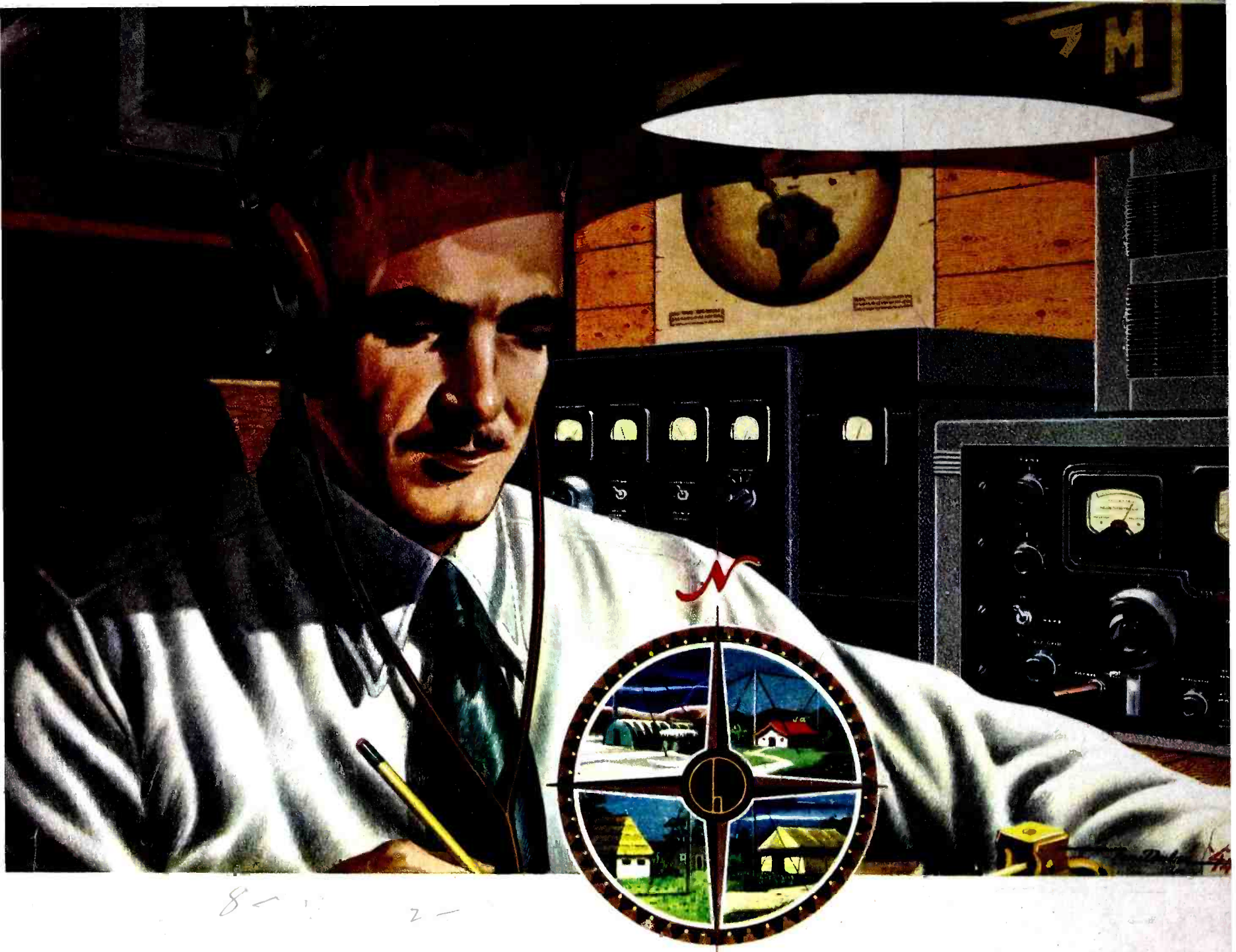
UTC hermetic ouncer weighs **1 oz.**
. . . takes full hermetic sealing tests
. . . has twice the frequency range.

MAY WE COOPERATE WITH YOU ON DESIGN SAVINGS FOR YOUR APPLICATION . . . WAR OR POSTWAR

United Transformer Co.

150 VARICK STREET NEW YORK 13, N. Y.

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



OUT OF THE ATTIC . . . AROUND THE WORLD!

This is only part of the story of the role played by amateur radio in extending the lines of victory around the world. It is a long, exciting and strictly American story. Before the war the amateur used to love to sit in his attic and talk to fellow enthusiasts on the other side of the globe. But long before war came he got out of the attic and began to use his special skills, his inventive genius to help establish wartime communications. The amateur radio expert found an especially valuable place in the ranks of the AACS—Army Airways Communications System. This group by the end of 1943 had established 600,000 circuit miles in 48 states and 52 foreign countries. It maintained vital communications over 100,000 miles of airways. Hundreds of millions of dollars worth of aircraft and tens of thousands of lives have been guarded by the far-flung safety and navigation facilities of the AACS.

It is officially acknowledged that the technical and operating leadership of this great group has come from amateur circles. Hundreds of their unsung heroes are licensed amateur radio operators. These are the anonymous workers on the radio front who should share some of the praise given to Edison, Bell, Marconi and the other giants of communications. Long before the war Hallicrafters served these exacting technicians with the best possible equipment. Hallicrafters sets were developed in the great testing grounds of amateur radio—and were built to perfection, by and for amateurs. Hallicrafters sets have served an "attic apprenticeship" and have come out of the attic to go around the world with victorious Allied armies.

Ads like this are appearing in numerous other national magazines, are currently telling the American public of the amateur's role in the war

For radio equipment that won't be satisfied with the limits of the pre-war world, for radio that will go places and do things hitherto undreamed of and uncharted—look to Hallicrafters, builders of the radio man's radio.

hallicrafters RADIO

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

COMMUNICATION

THE 20th ANNIVERSARY
OF WGY

NEW METHODS OF
PROGRAM SWITCHING

REVIEW OF IRE PAPERS
AT 1942 NEW YORK CITY
CONVENTION

JANUARY
1942