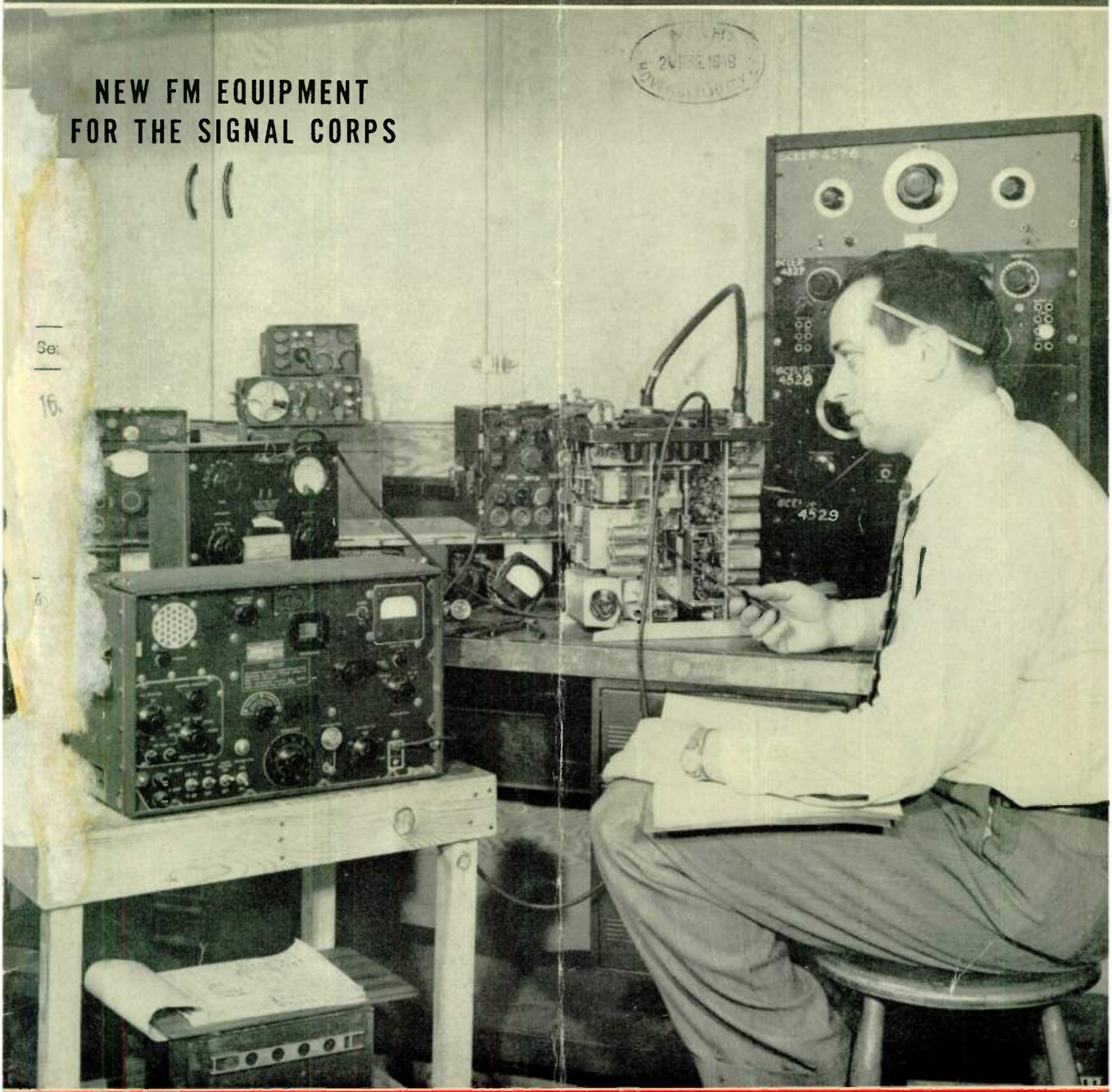
Price 25 Cents

Feb. '49

FM-TV

★ Edited by ★
Milton B. Sleeper

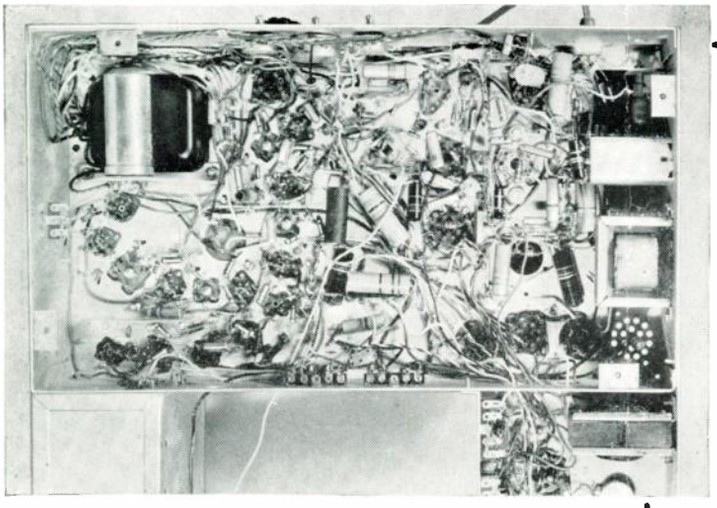
NEW FM EQUIPMENT FOR THE SIGNAL CORPS



9th Year of Service to Management and Engineering

IT PAYS * TO SPECIFY Hi-Q COMPONENTS

for Hi-Quality T. V. Performance



RCA Victor television receiver Table Model 8T241 uses many **Hi-Q** *capacitors for Uniform, Dependable reception.*

● Not only RCA Victor, but practically every manufacturer of television sets looks to **Hi-Q** Electrical Reactance Corporation for components of *Dependable* quality ...*Precision* tested and *Uniform* capacity.

Today's tremendous demand for high quality **Hi-Q** components is being met at three (3) modern plants equipped with the most modern machines helping supply the needs of the fast growing electronics industry.

Our competent engineering staff is available for consultation with your engineers in the design of newly developed circuits.

Booth No. 54 at I. R. E.

A FEW OF THE COMPANIES USING Hi-Q ELECTRONIC COMPONENTS

STROMBERG-CARLSON
ZENITH RADIO
RCA VICTOR
Westinghouse
Sparton
CROSLEY
Bendix Radio
Motorola
Tele-tone
Packard-Bell
Admiral
DUMONT
GENERAL ELECTRIC

Hi-Q components are specified by over 200 leading manufacturers. Space does not permit listing all of our valued customers.

*

Hi-Q COMPONENTS BETTER 4 WAYS

PRECISION Tested step by step from raw material to finished product. Accuracy guaranteed to your specified tolerance.

UNIFORMITY Constancy of quality is maintained over entire production through continuous manufacturing controls.

DEPENDABILITY Interpret this factor in terms of your customers' satisfaction . . . Year after year of trouble-free performance. Our Hi-Q makes your product better.

MINIATURIZATION The smallest BIG VALUE components in the business make possible space saving factors which reduce your production costs . . . increase your profits.

Hi-Q *Electrical Reactance Corp.*

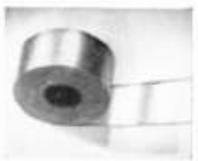
FRANKLINVILLE, N. Y.

Plants: FRANKLINVILLE, N. Y.—JESSUP, PA.—MYRTLE BEACH, S. C.
Sales Offices: NEW YORK, PHILADELPHIA, DETROIT, CHICAGO, LOS ANGELES

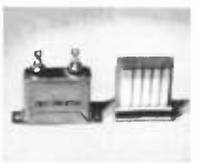
Announcing... METALLIZED PAPER

A REVOLUTIONARY NEW SPACE-SAVING CONDENSER PAPER WITH AMAZING SELF-HEALING QUALITIES.

SMITH'S New-type Metallized Condenser Paper not only reduces space factor by eliminating the use of electrodes, but gives longer life, higher dielectric strength, and ends forever the disastrous effects of breakdowns.



Metallized Paper



1 MFD—400 WVDC

4 MFD—150 WVDC

Capacitor samples courtesy Solar Manufacturing Corp., North Bergen, N. J.

NEW!!! NEW!!! Never before has anything like Smith Metallized Condenser Paper been offered the Electric and Electronic Industries.

It's here! Today . . . now . . . Smith Paper, Inc. makes available its new Metallized Condenser Paper that bids fair to revolutionize the entire electric and electronic field. Smith Metallized Condenser Paper makes possible the first one-layer condenser with an .0003" dielectric material. It also makes possible a 75% saving in space factor over most conventional capacitors. And because of its self-healing characteristics it almost completely eliminates the factor of conducting particles and the usual serious effect of a breakdown.

Answers a long-unfilled need. Design engineers since earliest days of the capacitor industry have sought capacitors that would provide higher capacities, smaller space factors, higher dielectric strength, longer life characteristics, and the elimination of breakdown causes. Since such improvements in design have been limited by the dielectric materials available, the introduction of Smith's Metallized Paper will prove a great boon towards the attainment of these special characteristics. This industry-sought paper not only permits 75% savings in space factor, but also provides other extraordinary advantages.

Increased insulation resistance. It has been found in the manufacture of metallized paper that by covering the base Kraft Condenser sheet with an extremely thin, continuous and uniform film of lacquer, a marked increase in insulation resistance is obtained. This lacquering causes an increase in the thickness of .00030 condenser paper of .03 - .05 mils; while the succeeding zinc coating operation causes an increase in thickness of 3 - 5 millionths of an inch.

Self-healing on breakdowns. Another of the outstanding properties of metallized paper is its capacity to self-heal on a breakdown. In other words, a capacitor wound with metallized paper may be brought to a breakdown voltage, but the effects of the breakdown are sufficient to cause a re-insulation around the breakdown area so that the capacitor is satisfactory for continued use. Numerous breakdowns do not appear to impair this self-healing characteristic. Smith Paper, by taking advantage of this property, is able to furnish a metallized paper devoid of particles which are conducting at the usual test voltages.

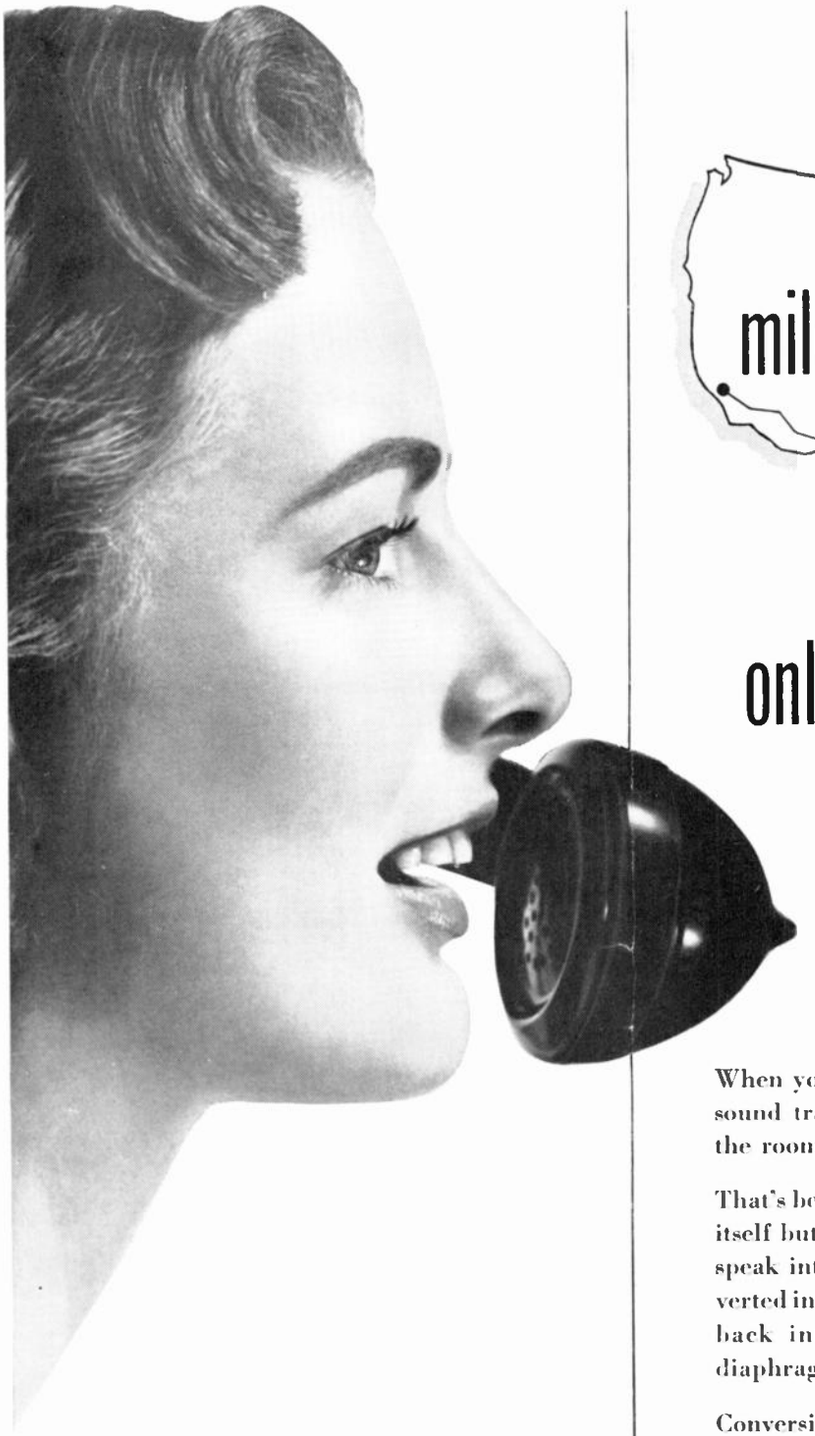
Automatically Controlled. Today equipment has been perfected for automatically controlling and continuously recording (where necessary) such properties as lacquer thickness and consistency, thickness of the metal layer, color and resistance of the metal layer, width of margin, etc. — all important characteristics of the product, the close control of which is essential for the best design and manufacture of metallized paper capacitors.

Complete facts available. All facts on Smith Metallized Condenser Paper as it applies to your industry may be had on request. Simply address Smith Paper, Inc., Lee, Massachusetts. There is no obligation.

SMITH PAPER, INC.

LEE, SMITH MASS.

SEE US IN BOOTH M AT THE IRE RADIO ENGINEERING SHOW



only inches of sound!

When you talk by telephone, far or near, the actual sound travels much less than when you talk across the room!

That's because the telephone system carries not sound itself but an electrical facsimile of sound. When you speak into a telephone transmitter your voice is converted into electrical vibrations which are not changed back into sound until they reach the receiver diaphragm.

Conversion of sound into its electrical equivalent, through the invention of the telephone, opened the way to the measurement of sound by accurate electrical methods. In developing means to make the telephone talk farther and sound clearer, the scientists of Bell Telephone Laboratories had to develop the tools for sound-wave analysis and measurement.

The condenser microphone, the wave filter, the amplifier — each the product of telephone research — have helped to reveal the structure of sound as never before. Each has helped to build the world's finest telephone system.

BELL TELEPHONE LABORATORIES

PIONEERS IN THE RESEARCH OF FM RADIO AND TELEVISION, AND ACTIVE IN DEVELOPING IMPROVEMENTS IN BOTH FIELDS TODAY.

FM-TV

Formerly, *FM* MAGAZINE and *FM* RADIO-ELECTRONICS

VOL. 9 February, 1949 NO. 2

CONTENTS

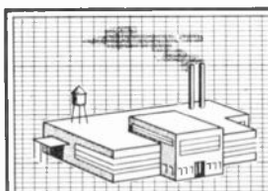
MILTON B. SLEEPER, *Editor and Publisher*

CHARLES FOWLER, *Business Mgr.* RICHARD H. LEE, *Advertising Mgr.*
STELLA DUGGAN, *Production Mgr.* LILLIAN BENDROSS, *Circulation Mgr.*
Published by: FM COMPANY

Publication Office: 264 Main St., Gt. Barrington, Mass. Tel. Gt. Barrington 500
FM Magazine is issued on the 20th of each month.
Single copies 25c — Yearly subscription in the U. S. A. $3.00; foreign $4.00.
Contributions will be neither acknowledged nor returned unless accompanied by adequate postage, packing, and directions, nor will FM Magazine be responsible for their safe handling in its office or in transit.

Entered as second-class matter August 22, 1945, at the Post Office, Great Barrington, Mass., under the Act of March 3, 1879. Application for additional entry at the Post Office, Boston, Mass., pending. Printed in the U. S. A.

MEMBER, AUDIT BUREAU OF CIRCULATIONS



Set Production

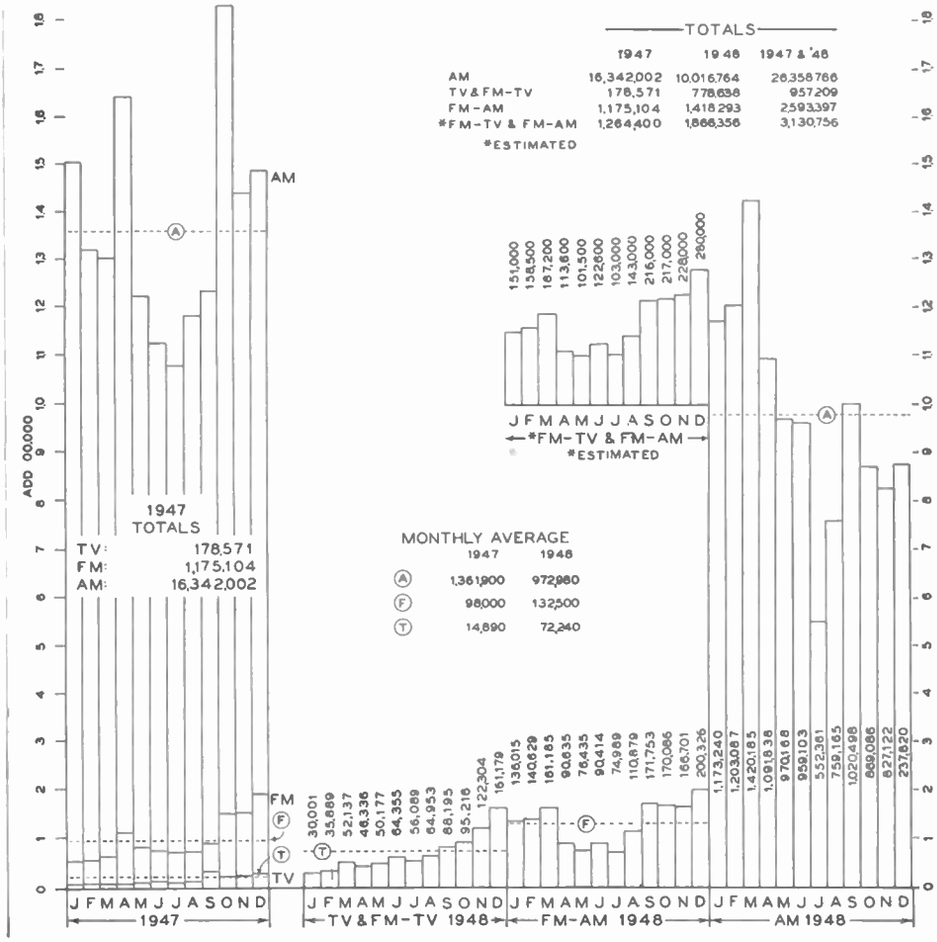
DECEMBER figures on set production by RMA members round out the most radical changes that have occurred in any year of radio history. Both FM and TV hit all-time highs in December, while AM sets dragged along almost half a million under the 1947 monthly average, and 608,300 below the December 1947 figure.

The trend away from AM is illustrated graphically by comparing the monthly blocks on the Production Barometer with the dotted lines indicating average monthly FM, AM, and TV production for '47 and '48. First, average monthly production in '48 shows a substantial gain over '47 for FM and TV sets, and a heavy loss for AM sets. Second, the production trend at the end of '48 was climbing steadily above the average monthly level for FM and TV, and falling off for AM.

The AM situation is more unfavorable than the Barometer indicates. Of the 11,675,747 AM sets made last year, 3,409,013 or 25% were auto models, while 2,114,133 or 17% were portables. And of the 6,152,601 AM sets for home use, a considerable part were for export.

Most of the loss in AM sets was taken by a relatively large number of small companies that are not building FM or TV models. A few big concerns produced the majority of the AM sets that were made last year, and they were also the principal manufacturers of FM and TV receivers.

There's trouble ahead for the me-too element in TV manufacturing. Those are the quickies headed by individuals who jumped into television not because they knew anything about the business, but because it looked like a good thing. So they took loft space, knocked together a few benches, and put some youngster in charge who knows all about television. Similar outfits lasted long enough in 1920 to sell out to the public, but television is giving them the quick-freeze.



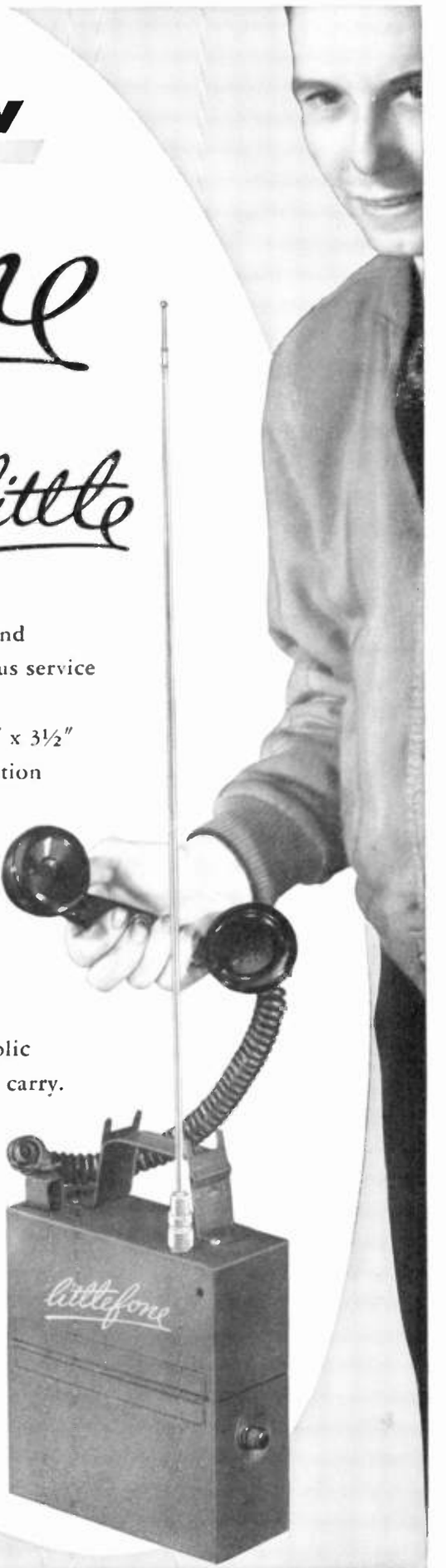
Amazing...New

littlefone

the Portable FM Radiotelephone by Doolittle

Compact, crystal-controlled 8-tube FM transmitter and 11-tube ultra-sensitive receiver. Gives 8 hours continuous service between charges which can be made from car battery or 115 volts AC. The *littlefone* is complete in one 8″ x 8″ x 3½″ case. Weighs only 9 lbs. Ready for immediate 2-way operation on the 25-50*mc. band. Gives 2 to 5 mile coverage between units or much greater coverage when used with a fixed station or mobile equipment.

Opens vast new opportunities for the effective use of 2-way radio communication. Enables constant contact between and with men in the field. Provides new efficiency and flexibility in field operations of emergency radio, public services, transportation, and industry. Easy to carry. Simple to operate. Dependable. Variety of accessories available.



***Also available now for 152-162 mc.**
Both models can be supplied with dry batteries if desired.

Doolittle
RADIO, INC.

Builders of Precision Radio Communication Equipment
7421 S. LOOMIS BLVD • CHICAGO 36, ILLINOIS

RECORD OF PROGRESS

FM-TV for September:	10,000 copies
FM-TV for January:	11,000 copies
FM-TV for March:	12,000 copies

31.1% increase in paid circulation during the past 12 months.

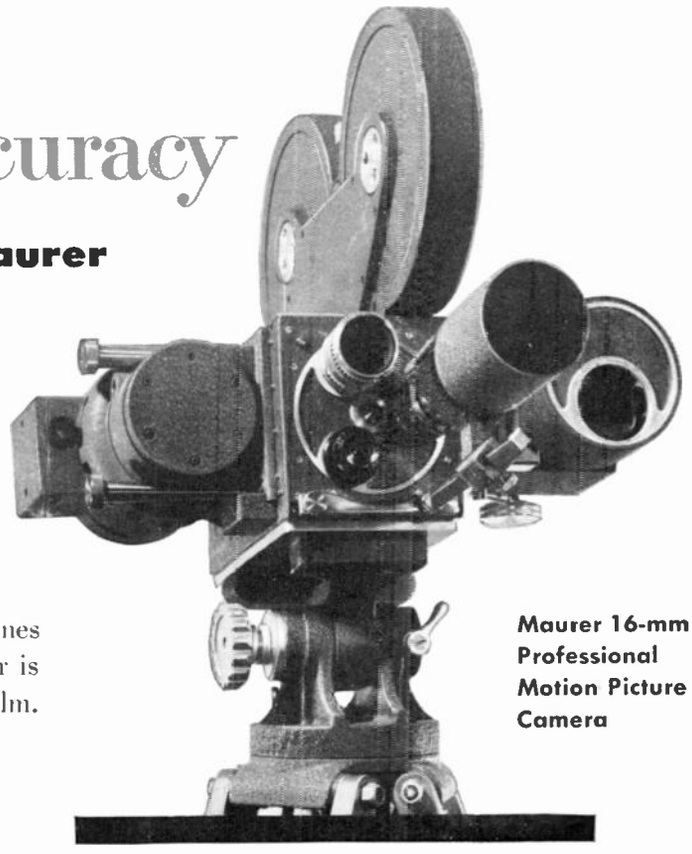
33.1% increase in rate of renewals during the past 12 months.

When you see the March N.A.B. number, you'll understand why *FM-TV* circulation is climbing faster now than ever before.

You secure

Maximum Accuracy

only in the 16-mm Maurer



Maurer 16-mm Professional Motion Picture Camera

The accuracy of his camera equipment determines how completely the professional photographer is able to transfer his skill and experience to film.

The Maurer is the most accurate professional 16-mm camera made because of its distinctive features of design and construction, including —

1 The new Maurer critical focusing system that is many times more accurate than any other available.

2 The new Maurer intermittent movement which is appreciably more accurate than the best previous type of movement — so that picture images are really rock-steady.

3 The new Maurer finder which provides automatic, accurate parallax correction and the largest and clearest image of all erect image view finders.

Any compromise from these exacting standards of design that assure maximum accuracy makes the finest results more difficult, and sometimes impossible, to obtain.

A new catalogue of Maurer post-war equipment will be furnished on request.

16mm maurer

J. A. MAURER, INC.

37-07 31st Street, Long Island City 1, N. Y.

Professional Motion Picture Cameras and Recording Equipment for the Production of Industrial, Educational and Training Films

THIS MONTH'S COVER

As a result of wartime experience, the Signal Corps is using FM for much of its new short-haul and relay equipment. This month's cover shows one of the latest FM transmitters, AN/GRC-3, on the test bench at the Signal Corps Engineering Laboratories, Fort Monmouth, N. J. A view of the complete equipment, installed in a 1½-ton truck, appears on page 13. This is a part of a new series of military radio designs featuring standardization of maintenance and operating procedure among all branches of the Army.

WHAT'S NEW THIS MONTH

1. Only Important to Listeners 2. Protection for TV Antennas
3. Paul De Mars Undertakes an Engineering Project in Iran

1. Maybe you know the answer to this one. We don't. It doesn't make sense to us, although it isn't any more screwy than some of the other things about broadcasting, at least as they are seen from the receiving end. Here it is:

Just recently, since WTAG-FM has gone to full power on 96.1 mc., we've been getting more dependable reception of CBS programs from it than from another FM station nearer home. WTAG-FM has only 10 kw. effective radiation, and it's in Worcester, Mass., 74 miles away by air-line. Although the meter on our REL receiver shows that the signals dip a little at times, there is always plenty of signal, day or night, to give full limiting.

Listening to WTAG-FM and noting the steady signal level, we've been hoping that many other FM listeners would discover this improvement, and share our enjoyment of the new *Worcester Telegram-Gazette* station.

Then, just this morning, we picked up one of the radio trade papers and saw, on the back cover, a full-page advertisement headed: "Central New England, sharing the nation's strongest concentration of radio sets, listens long and intently to WTAG." Then there was the report of a survey explaining that "in 54 surrounding cities and towns" WTAG has the largest audience (presumably of the 4 local stations) 81% of the total time.

Now, where does WTAG-FM come in? Was that mentioned in the advertisement of WTAG coverage? Not a word! Not a single reference to its getting out 4 or 5 times as far as the AM transmitter. Oh, yes, there was a rectangle as big as our little fingernail, down in the bottom left hand corner, that said just "WTAG-FM."

Yet a modest estimate of 50 miles radius (only two-thirds the distance to Great Barrington) gives WTAG-FM a solid night-and-day, good-or-bad weather coverage area 25 times that of the AM transmitter! That radius not only affords perfect reception of CBS programs to those whose evening AM reception is rent with static, noise, and fading, but it enables people to enjoy CBS programs on FM who have never been able to pick up WTAG at all!

But, from the *Worcester Telegram-Gazette* advertising, you can't find out anything about that extra service to listeners and that great extra audience. Not one word. The way the little rectangle with "WTAG-FM" is partly covered up by "WTAG" in big bold letters, you'd think that the FM station is just some little signal-squirter.

Please don't think we're picking on WTAG. We think the general manager and the chief engineer are pretty swell. We should, because they are regular readers of FM-TV, and have been for many years. And now we're regular listeners to their FM station.

We wouldn't have identified the station except that it would be silly and unconvincing to discuss this situation if we didn't give that information.

This discussion may sound silly to broadcasters, anyway. But it's a strange state of affairs when a broadcaster forgets (or doesn't want) to tell time buyers about the extended coverage his FM station provides. The fact remains that there is a whacking lot of people getting reception of delightful quality from WTAG-FM who cannot get WTAG at all, or who get it so poorly that the programs do little credit to the sponsors.

(Continued on page 10)

NEW CATALOGS & DESIGN DATA

THE products listed here are described in new catalogs and bulletins now available. Unless otherwise noted, they will be sent on request, without charge.

Measuring Instruments: First units in a new series of inexpensive instruments are: 3-watt amplifier, 45 db gain, covering 20 cycles to 200 kc.; oscillator with plug-in coils for 400 cycles to 80 mc.; and an AC power supply for either amplifier or oscillator. *General Radio Co., Cambridge 39, Mass.*

Specifications on Tenite: A 42-page book giving exhaustive information on the electrical properties of clear and colored Tenite. *Tennessee Eastman Corp., Kingsport, Tenn.*

Cracked-Carbon Resistors: Similar in appearance to composition carbon resistors, these units are available in values of .1 to 50 megohms at 1% tolerance, and in a wider range at 5% tolerance, with ratings of ¼, ½, 1, and 2 watts. *Welwyn Electronic Components, Inc., 234 E. 46th St., New York 17.*

Dry Electrolytic Condensers: Data on type FP condensers as to design, capacity, containers, chassis layouts, mountings, sockets, surge voltage, and performance at various temperatures. *P. R. Mallory & Co., Indianapolis 6, Ind.*

TV Receiver Chassis: Chassis for custom installations, includes speaker and all tubes except picture tube. Designed for 10-or 12-in. direct-view picture tube. Separate power supply is connected by cable and plug. Model T-64. *Hallicrafters Co., 4401 W. 5th Ave., Chicago.*

TV Antenna-Preamplifier: Cabinet containing preamplifier carries adjustable antenna rods. Designed to provide extra gain for indoor TV antenna installation. *Jerrold Electronics Corp., 121 N. Broad St., Phila.*

Cement Drill: For making holes in cement or brick. Adapter tool converts any electric drill into a power hammer to drive Rawlplug or Anchor drill bits. *Roto-Power Corp., 283 Greene Ave., Brooklyn 5.*

Plastic Testing Machines: Complete line of machines for testing the mechanical properties of plastic materials, with details of their use, presented in a 36-page booklet. *Tinius Olsen Testing Machine Co., Willow Grove, Pa.*

2-Bay FM Antenna: Lightweight antenna has gain of 1.6 and capacity of 10 kw. Elements are fed in phase by single transmission line through a full-wave phasing length, and are matched by a quarter-wave matching section. No field adjustments necessary. With ½-in. of ice, antenna withstands winds in excess of 100 MPH. *Andrew Corp. Chicago 19.*

Custom-Bilt TV Sets: TV kits and integrated cabinets in a variety of woods and finishes. Planned to afford a wide choice of designs with minimum floor stock. *Transvision, Inc., New Rochelle, N. Y.*

Miniature Plug-in Relays: SPDT polarized relay sealed in can 1⅝ by 1⅝ by 2⅞ ins. seated height. Originally designed as Signal Corps telegraph relays for 50 to 150 words per minute. Type 7-JOZ. *Sigma Instruments, Inc., 70 Ceylon St., Boston, Mass.*

Permanent Magnets: Stock magnets of cast and sintered Alnico are listed in a 28-page illustrated booklet which also presents pull curves and dimension drawings. Bulletin CDM-2A. *General Electric Co., Pittsfield, Mass.*

Indoor TV Antenna: Dipole rods of adjustable length are carried on a bronze base for mounting on the TV cabinet or on a window sill. *Insuline Corp. of Amer., Long Island City, N. Y.*

Microwave Power Meter: Automatically indicates power developed in standard barreter. Direct-reading meter is calibrated in dbm and milliwatts. Five ranges cover .02 to 10 milliwatts. Full-scale accuracy is 15%. Operates from 115 volts, 60 cycles. Type 430A. *Hewlett-Packard Co., Palo Alto, Calif.*

High Impedance Transformers: Filament transformers, designed for use with specific types of transmitter tubes, limit inrush and operating currents to values recommended by tube manufacturers. Single or polyphase operation. *Amer. Transformer Co., Newark, N. J.*

Electrical Contact Rivets: Bulletin illustrates standard sizes of flat, crowned, and pointed contacts in various alloy materials. *Gibson Electric Co., 8350 Frankstown Ave., Pittsburgh 21.*

300-Ohm TV Lead-in: Two-conductor shielded cable with solid dielectric, designed to improve signal-to-noise ratio by reducing lead pickup of automobile ignition and other types of interference, and re-radiated signals. Type K-111. *Federal Telephone & Radio Corp., 100 Kingsland Rd., Clifton, N. J.*

FM Communications Magnetron: Tunable from 1990 to 2110 mc. for various point-to-point and relay operations. For frequency modulation up to 15 mc. Output 100 watts, 35% efficiency. Type QK-174A. *Raytheon Mfg. Co., Waltham 54, Mass.*

Transformers for TV Sets: Bulletin on power, blocking oscillator, and vertical and horizontal scanning output transformers are illustrated with photographs and dimension drawings. Fifteen different types are listed. *Chicago Transformer Div., Essex Wire Co., Chicago 18.*

Nuts for Chassis Assembly: Thin metal sheets can be fastened together by expansion nuts inserted from the front. Purpose is to eliminate staking, welding, clinching, and riveting. Nuts expand and are self-retaining when tapping screw is inserted. *Timmerman Products, Inc., Cleveland 13, Ohio.*

WHAT'S NEW THIS MONTH

(Continued from page 8)

Maybe broadcasters don't care about the people who have become fed up with the annoyance of AM static, fading, and interference; or the ex-listeners who only turn on their AM sets to get time signals. Why should they worry as long as the sponsors are indifferent to the steady shrinkage of AM audiences? Certainly the sales representatives won't bring up this situation.

So maybe FM is not important to anyone—that is, not important to anyone except the listeners.

2. The National Board of Fire Underwriters has issued a bulletin, No. 275, on the fire and life hazards of television sets and antennas.

Concerning receivers, the bulletin states: "It is generally considered that a television receiver has a greater inherent fire hazard than a conventional radio receiver, because of its greater current consumption, greater number of heat-producing components, and the higher voltage used. Particular care should be taken that the natural ventilation built into the set is not obstructed or reduced by location or blanketing. Television sets should not be left turned on while unattended.

"Television sets of several manufacturers have been listed by Underwriters' Laboratories, Inc., as having been acceptably designed and constructed with respect to the fire and life hazard. Prospective purchasers should assure themselves that the set they contemplate purchasing is listed by the Laboratories."

As for antennas: "The high elevation at which the antenna is usually mounted increases somewhat the possibility of damage by lightning. As the antenna is usually mounted on a pole or tower on the roof, there is a possibility that, unless properly installed and supported, the system may fall in high winds, dropping across power lines or injuring persons or property.

"Arresters for ordinary radio aerials are not suitable for television, but proper arresters are available. These arresters should be placed on each conductor of a ribbon-type lead-in. If a coaxial cable is used for lead-in, suitable protection will be provided by grounding of the exterior metal sheath.

"Where the antenna is mounted on a metal pole or tower, the pole or tower should be properly grounded. Opinions vary as to the size of the grounding conductor, but it should preferably be at least No. 6 or 8 A.W.G., connected to a suitable ground such as an underground water pipe. If the building is equipped with a lightning rod system, the metal

(Continued on page 11)

WHAT'S NEW THIS MONTH

(Continued from page 10)

pole should be properly bonded to this system.

"The type of lead-in commonly used is the polyethylene ribbon type. Although this material burns much like rubber, and falls in flaming drops, its use for this purpose is not considered particularly hazardous. Recent improvements of the polyethylene lead-in, although still flammable, have eliminated the flaming drops. The coaxial cable lead-in is generally considered the best from the fire hazard viewpoint.

"Considerable care should be given to the mechanical stability of the antenna and its support. Where located on the roofs of buildings, the antenna and supporting guys should not be so located as to interfere with operations of the fire department or where they are liable to cross electric power lines. Some fears have been expressed as to the possibility of shock hazard on contact with an antenna or lead-in, because of the high voltage used in the receiver, but these fears are groundless if the receiver is properly designed."

Those responsible for installing antennas should see that their work conforms with these simple, commonsense recommendations.

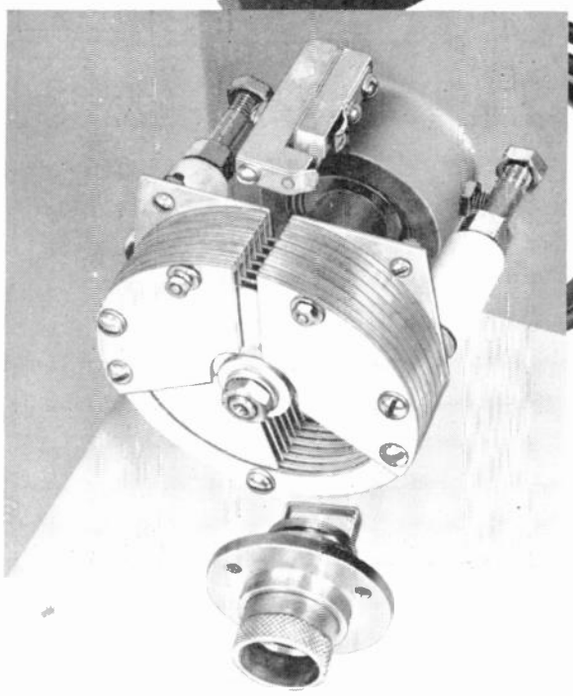
3. Paul deMars took off by plane on February 18 for what promises to be the most interesting assignment ever handed to a radio engineer. This goes back to President Truman's announcement of plans to implement the development of backward countries. Under the aegis of the State Department, the government of Iran has set up a 7-year plan to spend $700 million on the development of education, communications, transportation, public health, and oil resources. The initial step was a contract with Overseas Consultants, a U. S. pool of engineering firms, to make a survey of conditions and to present a plan for national improvements under the 7-year plan.

Members of Overseas Consultants include such firms as Stone & Webster, Jackson & Moreland, J. G. White, and Ford, Bacon & Davis. Paul deMars, as a representative of Jackson & Moreland, will head the section on communications. This assignment includes the establishment of broadcasting, telephone, and telegraph services and a postal system. He will be assisted by Carl P. Rapp of IT & T, and an expert from the U. S. Post Office Department.

We hope he will keep out of the hot sun, and return on schedule next July. Meanwhile, he can be reached by air mail at the office of Overseas Consultants, Teheran, Iran.

100 to 500 Mc OSCILLATOR

THIS oscillator, designed for use as a power source for general laboratory measurements and testing, covers the frequency range of 100 Mc to 500 Mc. With its associated power supply it is small, lightweight and compact. The entire range is covered with a single-dial frequency control with a slow-motion drive equipped with an auxiliary scale.



The tuned circuit of the Type 857-A Oscillator is our well-known Butterfly type. The difficulty of sliding contacts in any part of the oscillator circuit is avoided in this unique construction. The photograph above shows the output coupling loop and output jack. Coupling can be changed from maximum to almost zero by rotating the output jack.

FEATURES

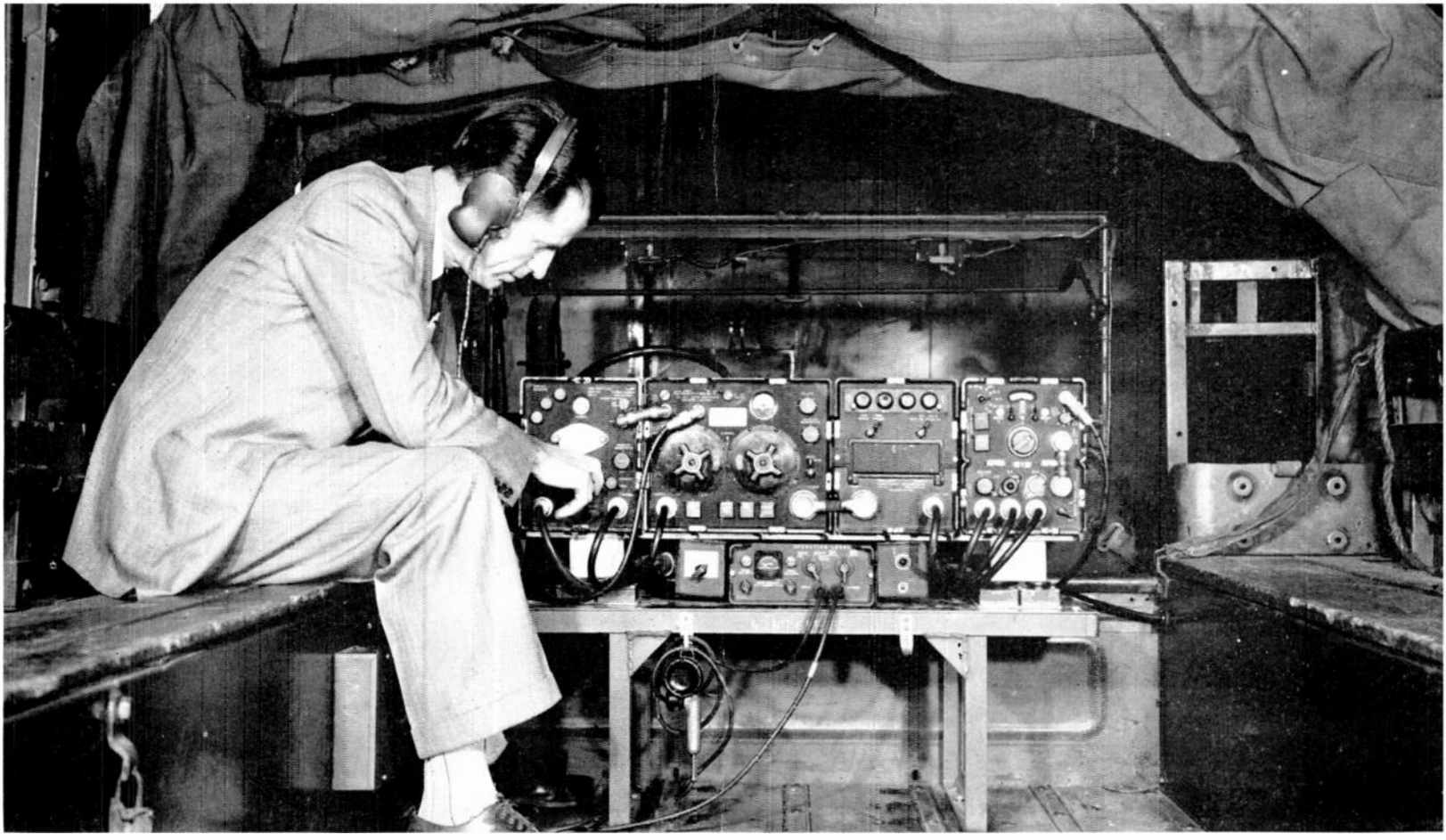
- Dial calibrated directly in megacycles to an accuracy of ± 1%
- Vernier dial with 100 divisions, covering the oscillator range in ten turns
- Output through a coaxial jack with provision for varying coupling
- Output of ½-watt at 500 Mc
- Electron-ray tube in power supply to indicate grid current and furnish indication of oscillation
- Filament and plate power furnished by the Type 857-P1 Power Supply which is furnished with the oscillator

TYPE 857-A U-H-F OSCILLATOR (with power supply) . . **$285**

WRITE FOR COMPLETE DATA

GENERAL RADIO COMPANY Cambridge 39, Massachusetts

90 West St., New York 6 920 S. Michigan Ave., Chicago 5 1000 N. Seward St., Los Angeles 38



Operating and maintenance experience of World War 2 are represented in this new FM transmitter and receiver AN/GRC-3

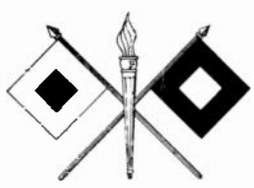
WHAT THE SCEL IS DOING

SIGNAL CORPS RESEARCH EMPLOYS A STAFF OF 2,500, AND DRAWS ON MANY OF THE UNIVERSITY AND INDUSTRIAL LABORATORIES— *By* DR. HAROLD A. ZAHL*

IN 1942, under the stress of war, long-term research was dropped from all project activities of the various Signal Corps Laboratories. All effort was turned to the problems of expedited engineering, development, production, maintenance and training, for those directly involved life and death for troops overseas in combat. Research during that period implied use of manpower against a postwar period or assumed a war of indefinite duration. Advance studies carried out during the war for the Signal Corps were, therefore, made only as indirect by-products of development contracts with industry, and through the efforts of the Office of Scientific Research and Development.

The wisdom of the military decision in thus restricting research, while questioned by some, is supported nevertheless in that victory came sooner than generally expected, and each day less of conflict meant more living Americans.

Through experience in two major wars, it now appears as probable that should a period of conflict arise again, the baton of research will, as before, be passed to others less directly concerned with the immediate problems of battle. All plant



and personnel resources built up during peace by the Signal Corps will again be thrown directly into military problems, particularly those such as quick developments required to meet the unexpected situations arising in a fast-moving scientific war, assistance in the procurement and maintenance of fantastically large quantities of complex scientific military equipments, and assistance in troop-training problems in camps and under conditions of combat.

During periods of peace, Signal Corps research policy, supported by the Chief Signal Officer, Major General Spencer B. Akin, and the Research and Development Division of the General Staff, Department of the Army, is: 1) to encourage advanced studies within Army laboratories; and 2) in accordance with budget allocations, to maintain research projects related to military interests in educational institutions and in industry.

More than three and one-half years have now passed since the cessation of hostilities, and the peacetime program of the Signal Corps has taken rather definite shape. Development work is still the primary and major task of the laboratories, but it has been possible to divert a considerable portion of available personnel and facilities towards basic and applied research projects related to the military effort.

Physically, the Signal Corps Engineering Laboratories are divided into three parts, all in Monmouth County, New Jersey: Squier Signal Laboratory, Fort Monmouth; Evans Signal Laboratory, Belmar; and Coles Signal Laboratory, Red Bank. A total personnel of approximately 2,500 individuals is divided among the three laboratories for all activities.

SCEL Research Policy:

Before considering the program, a few words on Signal Corps research policy may be of interest:

1. National defense is the primary consideration, as the Armed Services must be provided with the best possible equipment of the type for which the Signal Corps is assigned responsibility.

*Director of Research, Signal Corps Engineering Laboratories, Fort Monmouth, N. J.

2. Research on specific problems is not undertaken or financially supported if the same work is already being done with acceptable expenditure of effort by educational institutions, or industry, or some other governmental agency.

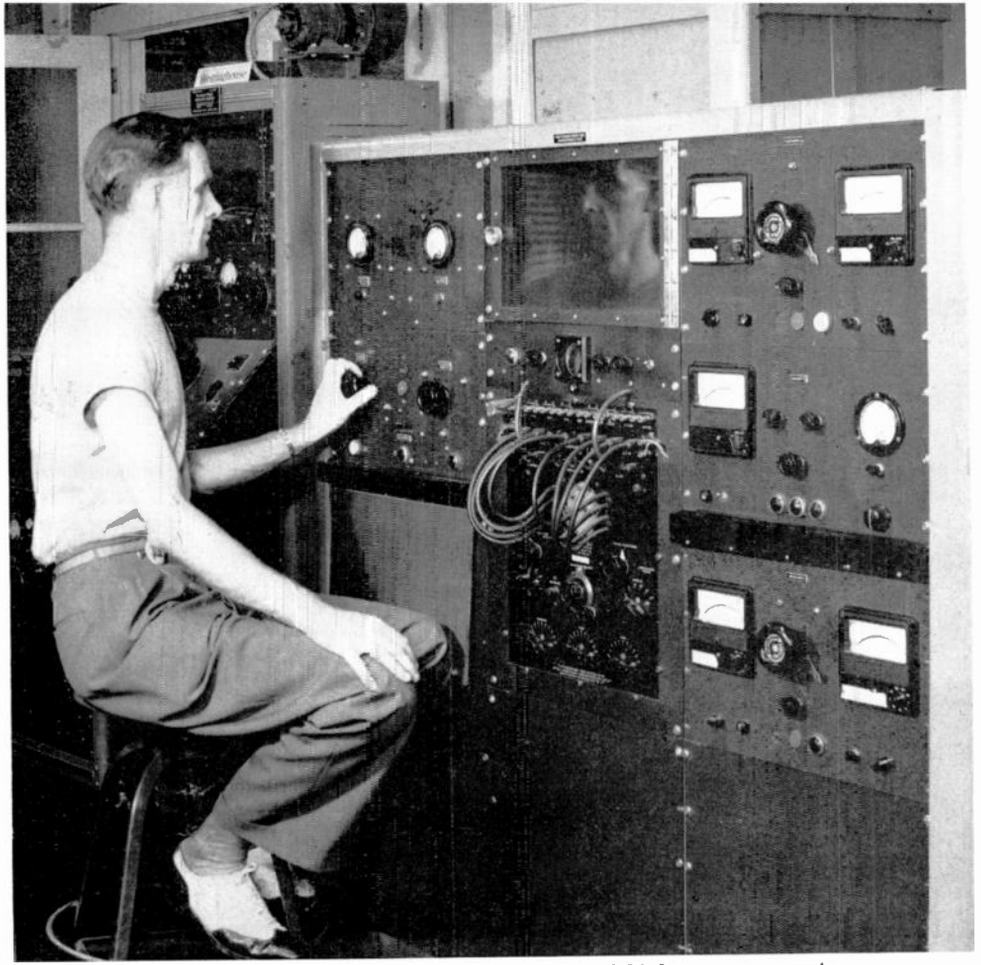
3. Internal research in most cases is kept closely allied to the current development program.

Many readers will undoubtedly raise the question as to whether research would not flourish better when not too closely allied with development. Surely, the answer for basic research must be in the affirmative, but a military laboratory can hardly operate without regard to practical problems because:

1. The time interval between discovery and application must be kept to a minimum.

2. The sheer magnitude of many projects requires facilities and personnel far beyond the scope of any self-centered research group. For instance, research dealing with the upper atmosphere may require simultaneous employment of rockets, radar, communications, visual tracking, sound ranging, and aircraft.

3. The scope of Signal Corps interest and responsibilities is so broad that, within limited budget and personnel ceilings, it is usually necessary for the same personnel to participate actively both in the research and development aspects of new projects.



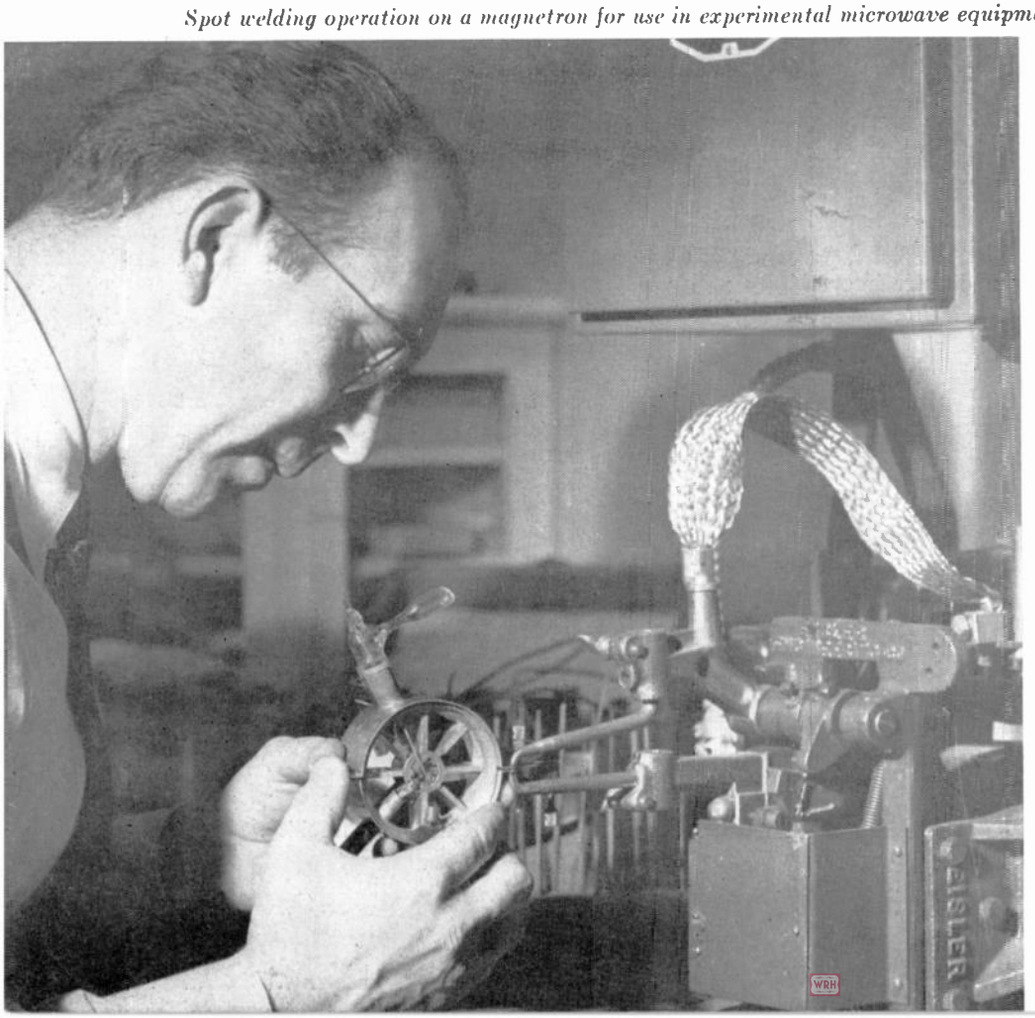
Measuring the performance of tubes for newly-developed high-power transmitters

Research Program:

Readers acquainted with the difficulty of classifying research in Science Abstracts, Governmental fiscal procedures, etc., will understand the reasons for subdividing the research program according to the organizational structure of the laboratories based upon applications, rather than on physical definitions. However, within this structure, research is under way in the field of magnetism and electricity, electron ballistics, circuitry, elementary particles and their interactions, particle accelerators, solid state, properties of matter, deterioration prevention, electro-chemistry, thermo-chemistry, polymers, mechanics, applied mathematics, computing devices, atmospheric physics, propagation, radiation and heat, acoustics, power systems, biophysics, and others.

Communications in a broad sense is the Signal Corps' major activity. Experience of the last war pointed out the need for more and more integration of communications systems. The fast moving action of large military groups involves coordination in the air and on the ground, together with the frequent addition of supporting naval units, thus requiring a flexible system which will permit the inter-connection of wire, radio, and optical circuits to the maximum extent possible, and with the provision of a large number of voice, facsimile, telegraph and even television circuits for high-speed communications and the transmission of data. Accordingly, in planning the Signal Corps' research program, major emphasis has been directed into fields leading toward information which will help in solving the many complex problems vital to successful communications in wartime.

Spot welding operation on a magnetron for use in experimental microwave equipment



Microware research is of great importance at the SCEL. This setup is for 30,000 mc

In planning such a research program, it was known from the beginning that a basic program for communications alone could hardly exist, since the requirements of radar, sound and light ranging, meteorology, and other fields must be related. For example, knowledge of electromagnetic propagation, which is vital in communications and radar, serves the meteorologist in the sense that limiting factors provide the methods for making measurements on atmospheric phenomena most essential in explaining, predicting, and perhaps, in the future, even controlling the weather.

With these introductory remarks, a few high spots in some of the major fields will be touched upon in the sections following. Specific references, therefore, are to be considered as representative of, but not portraying, the full scope of activity.

Vacuum Tube Research:

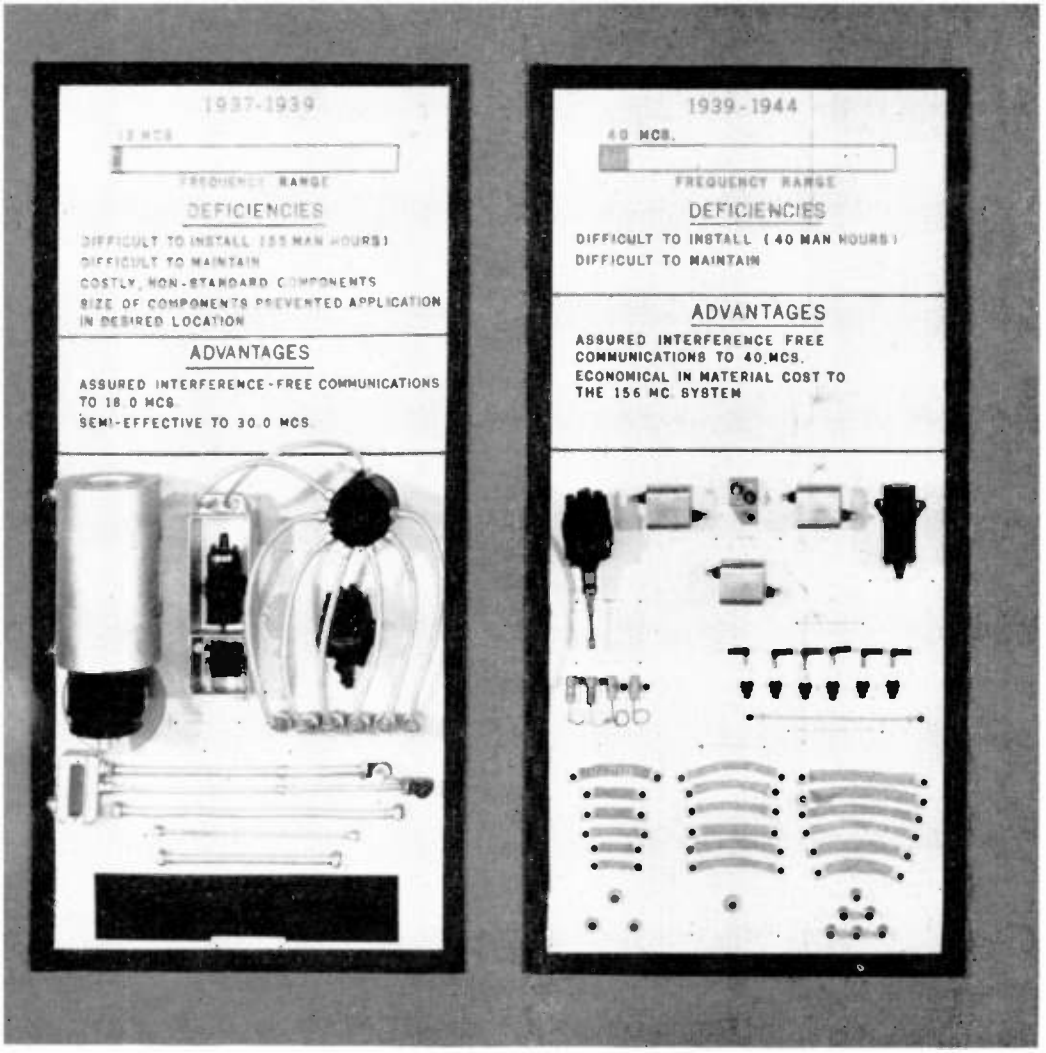
Perhaps no single field of research in the physical sciences has more fundamental importance to Signal Corps problems than studies of electronic phenomena, since the application of such knowledge may open the way for solution of military problems thus far unsolvable. In fact, the recent history of communications and radar is in essence that of the electron tube. Accordingly, considerable research in this field is conducted within the Signal Corps Engineering Laboratories, greatly augmented through support given to industrial concerns and academic institutions for basic studies.

For example, at Columbia's Radiation Laboratory, Rabi and his co-workers are doing work on microwaves started under the NDRC during the war, stressing research leading towards a better solution of generation and detection of millimeter waves. It is of interest to note that this work recently led to an important by-product in pure physics in which, following the brilliant experiments of Lamb and Retherford, a small but most significant discrepancy between the Dirac theory of the hydrogen atom and experimental observation was revealed through use of microwave techniques.

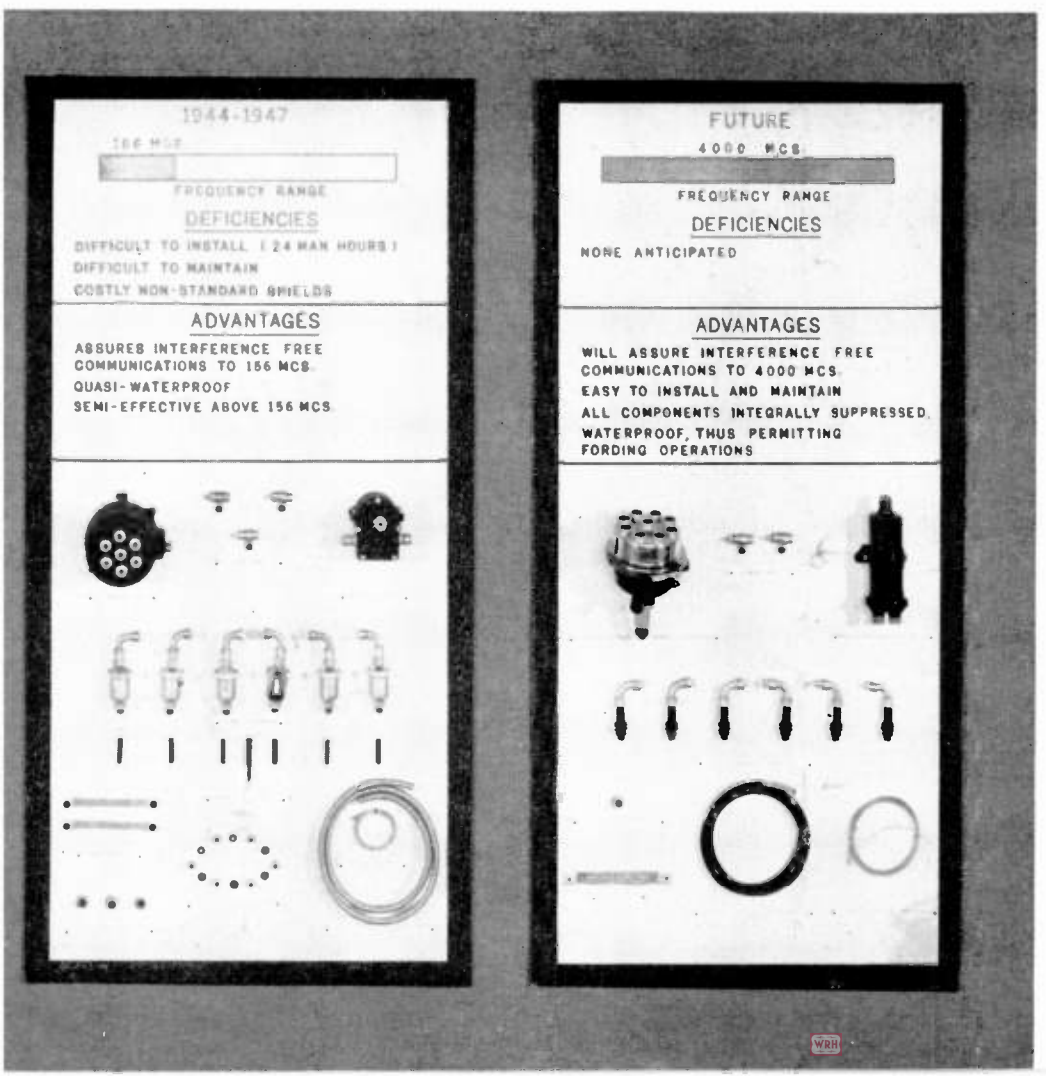
Related to the Columbia activities is the electron tube program at the General Electric Company, also started by the NDRC, which has been continued under Hull, Wilbur and Nelson. In this program, major emphasis is being directed toward a better understanding of the theory and fundamental electronic problems of continuous wave magnetrons.

At Purdue, Lark-Horovitz and his staff are pressing forward in the field of semiconductors such as germanium. In this work it has also been possible to predict theoretically the transition from behavior explained by classical mechanics to behavior requiring quantum mechanics for their explanation, and then to check the predictions of the theory quantitatively by comparison with experiments. From a practical point of view, the experiments are leading the way toward greatly improved crystal rectifiers for use in radio and radar circuits and, of course, advance and improve the understanding of transmitter-like devices which appear destined to play an important role in many phases of electronics.

Experts at SCEL are equipped to make special tubes required for development work



Example of progress through research. These panels show simplification of ignition interference suppressors used since 1937, and the extension of their effectiveness



Among the internal basic research projects under way are studies of gas spectra under pulsed conditions and the initiation of oscillations in magnetrons. Of interest also is the production of intense hollow electron beams using suitably modified cylindrical-anode magnetrons. Because secondary phenomena are basic in many cathode ray and storage tubes, fundamental work is under way on investigation of the secondary emission curves of many hitherto unmeasured semi-conducting materials, including the phosphors.

In addition, important work in electron physics is underway at Massachusetts Institute of Technology, Harvard, Michigan, and Stanford. Moreover, almost every major electronic industrial facility is contractually involved in the extension of knowledge in this field through development activity.

Research on Materials:

The improvement of the presently available materials used in the construction of electronic and other equipments is a requirement for meeting the demands of higher frequency and power, operating under extreme climatic conditions. Since it must be assumed that future military operations may be conducted in any climate between tropic and arctic, it is necessary that the materials of construction be able to withstand such conditions. Accordingly, materials research is based upon:

1. Improvement of materials considered quite suitable for civilian usages but not meeting military requirements. Fields of research include plastics, ceramics, insulators, metallurgy, high-temperature films, and oils.

2. Research on synthesizing processes for production of critical materials such as mica and quartz, which are obtained largely by import and may not be available during a future conflict.

3. Development of entirely new materials specifically for military requirements.

Among the contractual programs in this field is that at Princeton where Taylor, Tobolsky, Alyea, Willis, Rahm, and Vasileff are carrying on a program intended to provide the basis for producing improved plastics, synthetic resins, flexible insulators and insulating oils; at MIT where von Hippel and his staff are continuing basic work on dielectrics started by NDRC during the war; at Rutgers where Koenig is carrying on investigations toward improved ceramic materials for a wide range of temperature and humidity conditions; at Batelle and at Armour where Gonser and Mahin, respectively, are looking into properties of alloys for improving the Army's field wire.

Substitutes for Quartz:

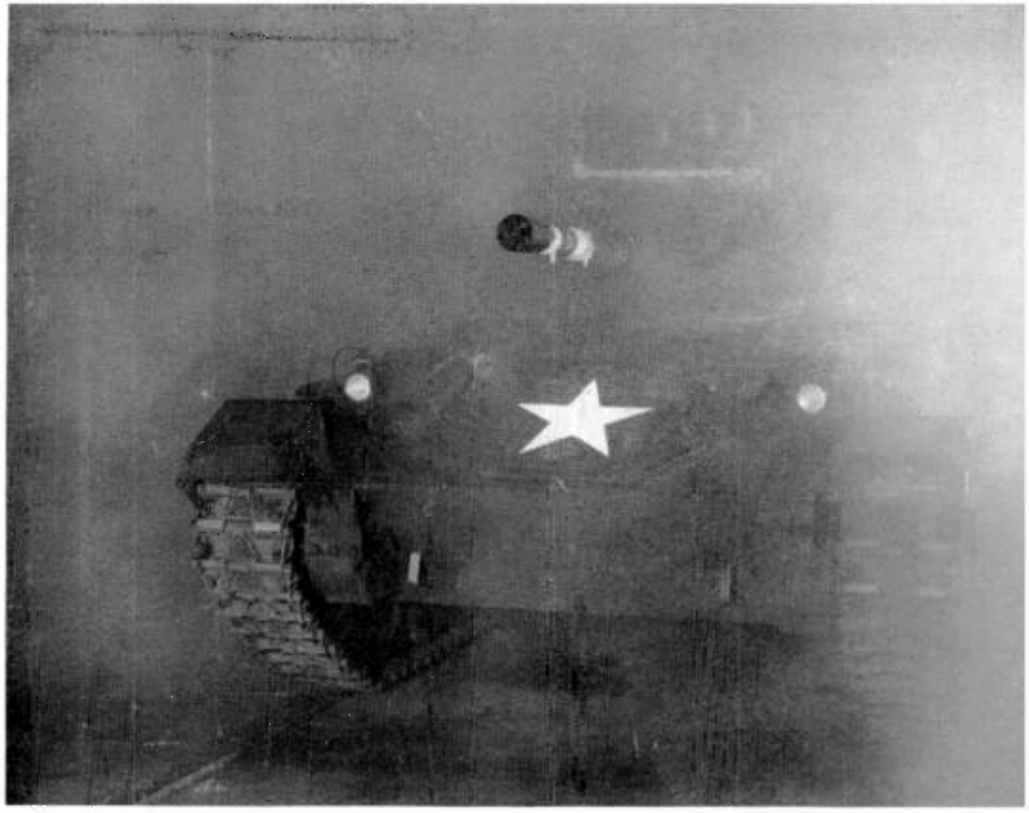
During the war 70,000,000 quartz crystal units were produced for frequency stabilization purposes. So critical was the use of quartz in combat communications that crystal-grinding teams were sent directly to the theaters of operations. The supply of good, natural quartz is very limited and of equal significance, it is imported. Accordingly, a major effort is being directed toward finding a suitable substitute for quartz or learning how to grow quartz within the laboratory.

The work of Frondel of Harvard on synthetic tourmaline structure types and that of Jaffe and Hale at Brush in synthetic growth of quartz is now showing particular promise. Among other institutions engaged in research in the field of frequency control elements may be listed Antioch College, University of Minnesota, Edward Washken, Baird Associates, Tufts College, Wesleyan University, Colorado A & M, Auburn Research Foundation, Philips Laboratories, Georgia Tech Research Institute, University of Illinois, Rutgers University, Armour Research Foundation, and others. On matters of frequency stabilization, the work of Cook and Fletcher at Harvard, using an absorption line of ammonia to control a conventional micro-wave oscillating circuit, is of great interest for future application of micro-waves.

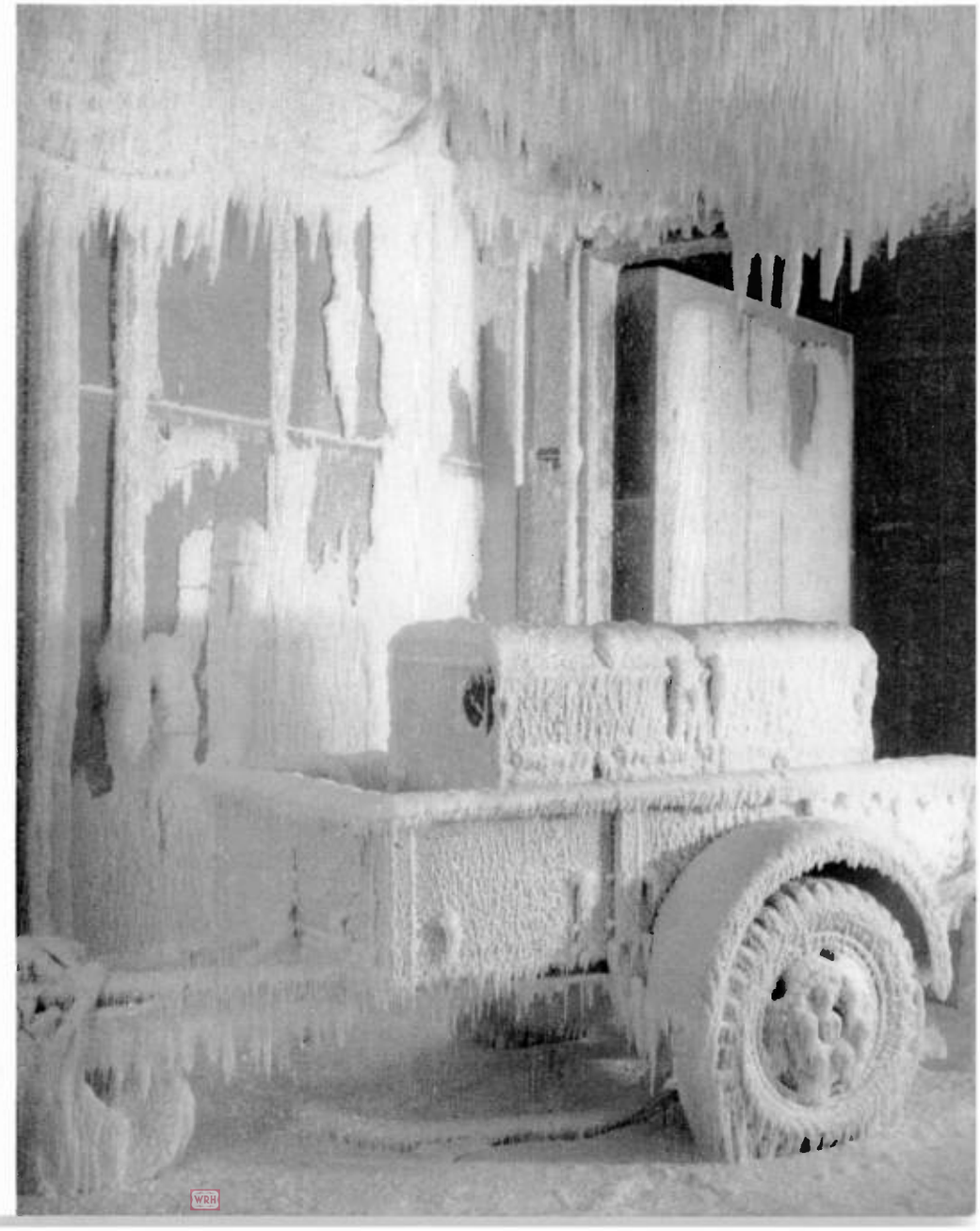
Power Sources:

The problems of satisfactory power sources, including motor and hand-driven generators, primary and secondary batteries, are most vital in all military applications of electronic equipment. Perhaps no other group of components is further from meeting the full requirements of military use. For example: during the recent war, the tell-tale noise of motor generators led countless enemy night patrols to communications and radar centers. In light-weight communications or radar sets, much of their weight is represented by power supplies, either motor-driven or battery. In the future, effective use of radio or television relay systems in many cases implies unattended stations in remote and very inaccessible parts of the world where reliable power sources for continuous duty constitute the major problem. For this reason, it is quite natural that a significant fraction of the basic research effort is directed toward investigations involving the fundamental principles of power generation or conversion.

In the field of conventional motor-driven generators, a decided step forward has already been taken in pioneering the use of permanent magnetic fields and higher frequencies for power purposes. In batteries, progress is being sought through exhaustive investigations



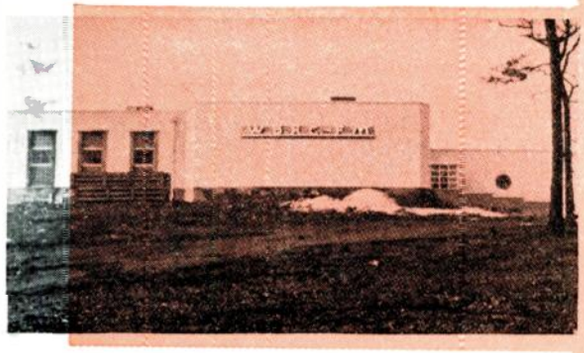
Huge temperature-controlled rooms reproduce conditions of the tropics, above, and the arctic, below, under which Signal Corps equipment must operate in global war



World's first super-power

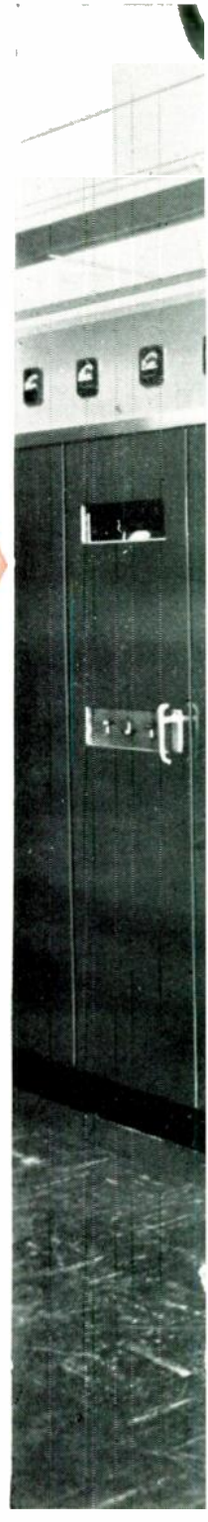
all three... use RCA 50-kw's

SUPER-POWER FM STATION WTMJ-FM, MILWAUKEE. Operates an RCA BTF-50A FM transmitter in conjunction with a high-gain antenna. Total effective radiated power, 349 kw—on 93.3 Mc!



SUPER-POWER FM STATION WBRC-FM, BIRMINGHAM. Operates a type BTF-50A FM transmitter in conjunction with an RCA 8-section Pylon—880 feet above average terrain. Total effective radiated power, 546 kw—on 102.5 Mc!

SUPER-POWER FM STATION WMCF, MEMPHIS. Operates an RCA BTF-50A FM transmitter in conjunction with an RCA 4-section Pylon antenna mounted on a 750 foot tower. Total effective radiated power, 260 kw—on 99.7 Mc!



THESE PIONEER STATIONS are making FM service over wide areas a PRACTICAL REALITY *—with the world's first commercial 50-kw FM transmitter, the RCA BTF-50A!*

This is the transmitter that makes it possible to link 50 kilowatts of FM power to a high-gain Pylon antenna *and deliver up to 600 kilowatts of effective radiated power*—enough radiated power to serve primary areas out to 200 miles radius from mountain elevations.

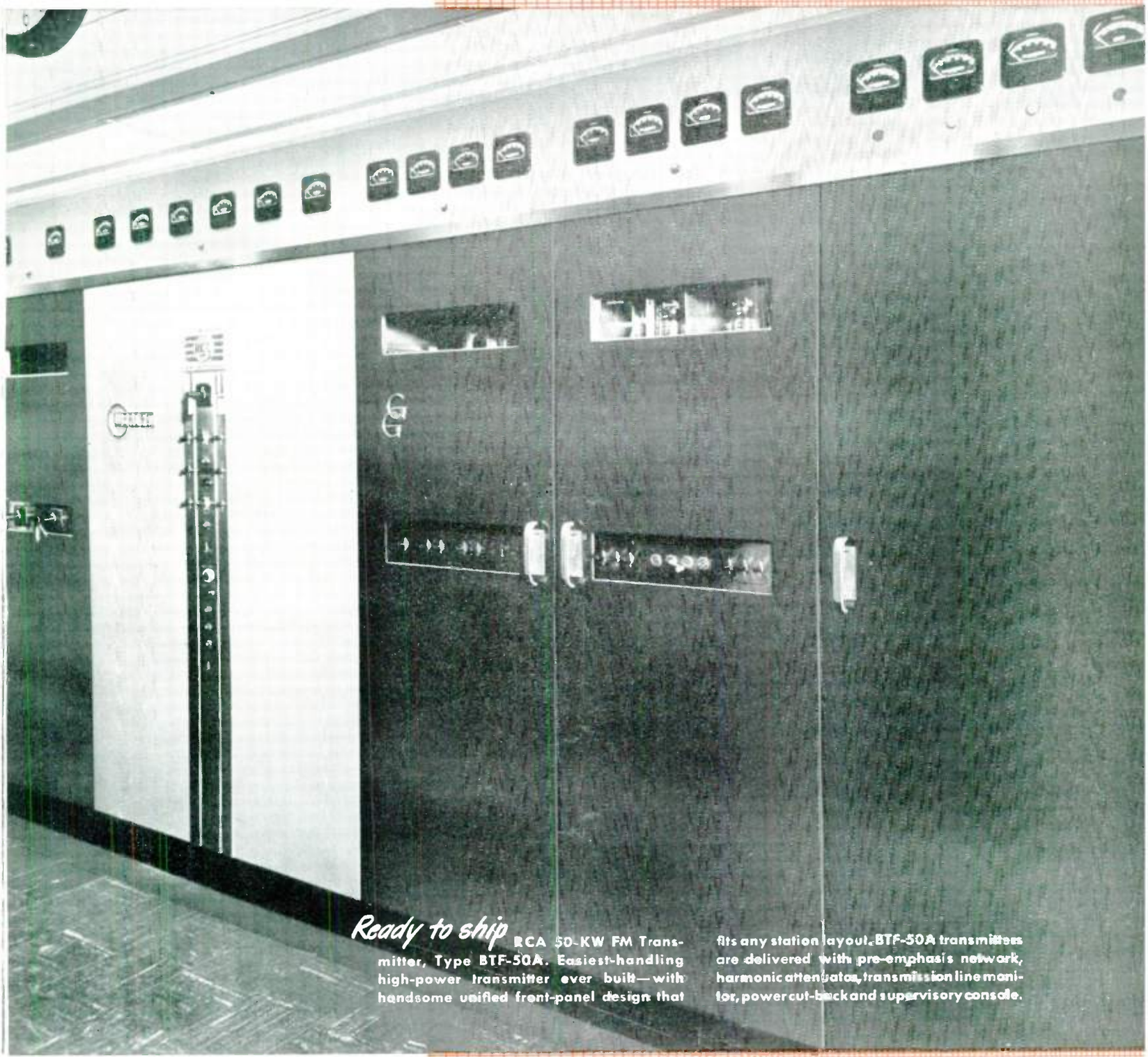
Here are some of the transmitter features:

50,000 watts output on any specified frequency in the 88-108 Mc band. Grounded-Grid amplifiers and simplified single-end r-f circuits (all class C) for extreme stability and easy tuning. Direct FM to give high-fidelity FM simply and directly (less than 1% output distortion over the range of 30-15,000 c.p.s.). Only 43 tubes in the entire transmitter—and emergency operation may be maintained with only 24 tubes. *Only 16 different tube types all told.* One high-voltage supply for all high-power needs. Hi-lo power switching for emergency 8-kw operation. Complete air-cooling . . . using two independently-operated blowers.

• • •

Type BTF-50A . . . *immediately available from stock* . . . can be used with an RCA FM Pylon to improve your station coverage *materially.* For the facts, see your RCA Broadcast Sales Engineer. Or write Dept. 38B, RCA Engineering Products, Camden, N. J.

FM's . . .



Ready to ship RCA 50-KW FM Transmitter, Type BTF-50A. Easiest-handling high-power transmitter ever built—with handsome unified front-panel design that fits any station layout. BTF-50A transmitters are delivered with pre-emphasis network, harmonic attenuator, transmission line monitor, power cut-back and supervisory console.

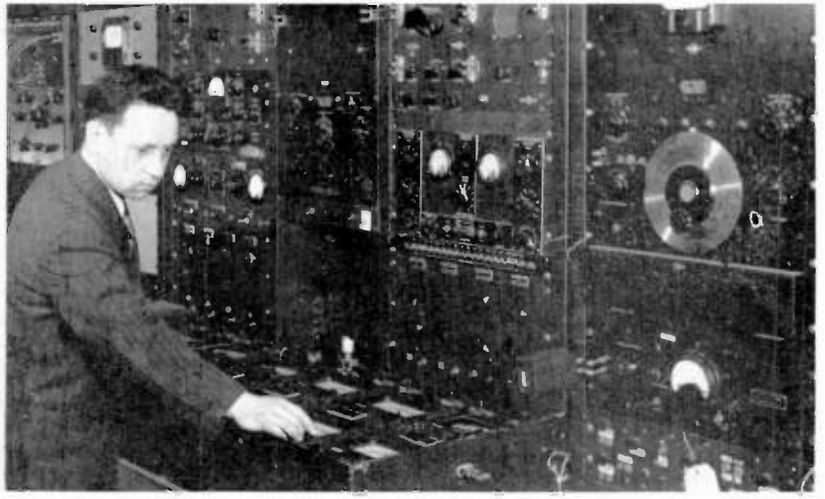
Transmitter photo by courtesy
WBRC-FM, Birmingham, Alabama.

BROADCAST EQUIPMENT

RADIO CORPORATION of AMERICA

ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N.J.

In Canada: RCA VICTOR Company Limited, Montreal



Part of the tube museum at Evans Signal Laboratory. Equipment for measuring static characteristics, used in tube research

in electrochemical combinations and factors which presently impose limiting conditions on commercial products.

Work in this latter field is being done by Illinois, Georgia Tech Research Institute, University of Ohio, Northwestern University, Dow Chemical, Eagle Picher, and others. Even the ancient thermo-electric method of generating power is in the picture, and a search is under way at Franklin Institute, under Swann and Coleman, for increasing thermo-electric efficiencies through use of new materials which appear promising in attaining the theoretically required high values of thermo-electric power, low heat, conductivity, and low specific resistance.

Need for Propagation Data:

The limitations of present knowledge on propagation make this a particularly fertile field for further research. Perhaps the best known Signal Corps experiment in this field was that conducted by DeWitt and co-workers when, in January 1946, electromagnetic waves were transmitted through the earth's atmosphere and again detected, following reflection from the moon. Activity in this particular field is now being directed toward construction of planetary equipment for selected frequency operation as the gear follows the moon in its orbit.

The current propagation program was established to investigate the propagation of radio, sonic, and infra-red waves through the atmosphere and earth media intended particularly in the first-named field to supplement the program of the Central Radio Propagation Laboratory of the National Bureau of Standards.

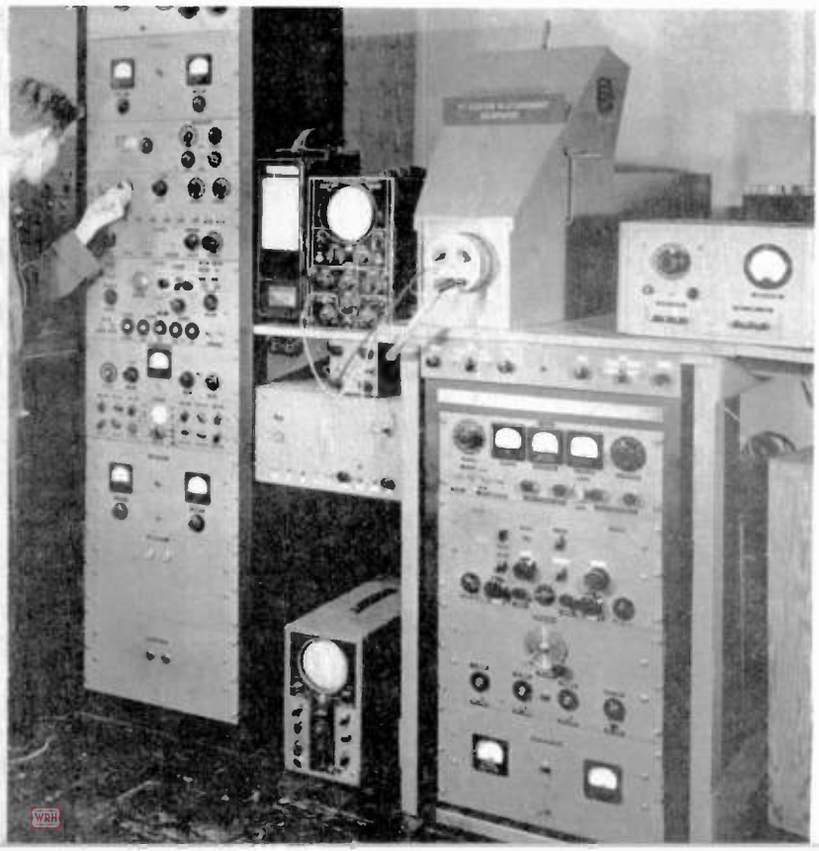
Insofar as specific application to Signal Corps equipment is concerned, the opening up of the microwave spectrum has focused attention on the effects of meteorological phenomena on guidance, attenuation, reflection, and refraction of radio waves.

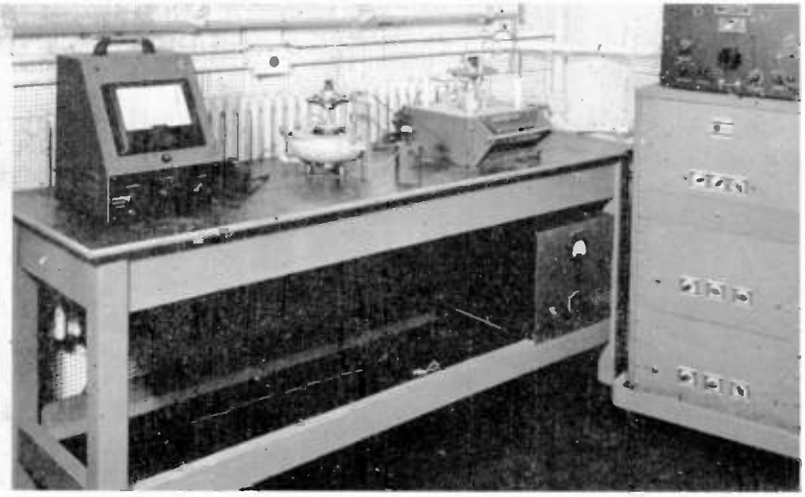
During the war, several instances of equipment development without concomitant research on propagation led to bitter endings. For example, a K-band radar device was put in production and, to the distress of all concerned, the operating frequency selected was found to coincide with a strong water-vapor absorption band. It is increasingly evident that basic data relative to all types of propagation must be compiled to provide that fundamental knowledge which is essential to the design of future equipments. Because of geographic difficulties inherent to work in the field of propagation, most of this work is conducted in various Service laboratories of the Navy, Air Force and Army and at the National Bureau of Standards. Mention must, however, be made of the outstanding work in electro-magnetic propagation under way at Harvard under Mimno and Pierce, and of Schilling at Pennsylvania State in the field of supersonics.

Circuit Development:

For reasons of security, only casual mention will be made of activities in this field. Bell Telephone Laboratories, together with Farnsworth, Radio Corporation of America, Westinghouse Electric and Manufacturing Company, Federal Telephone and Telegraph, General Electric, and other industrial concerns are all pushing forward in these fields, under either research or development contracts.

Preparation of methyl mathacrylate, in chemical laboratory. Setup for research on properties of cathode-ray tube screens





FM radio relay equipment AN/TRC-4 dates back to World War 2. Setup for mechanical resonance studies of vacuum tubes

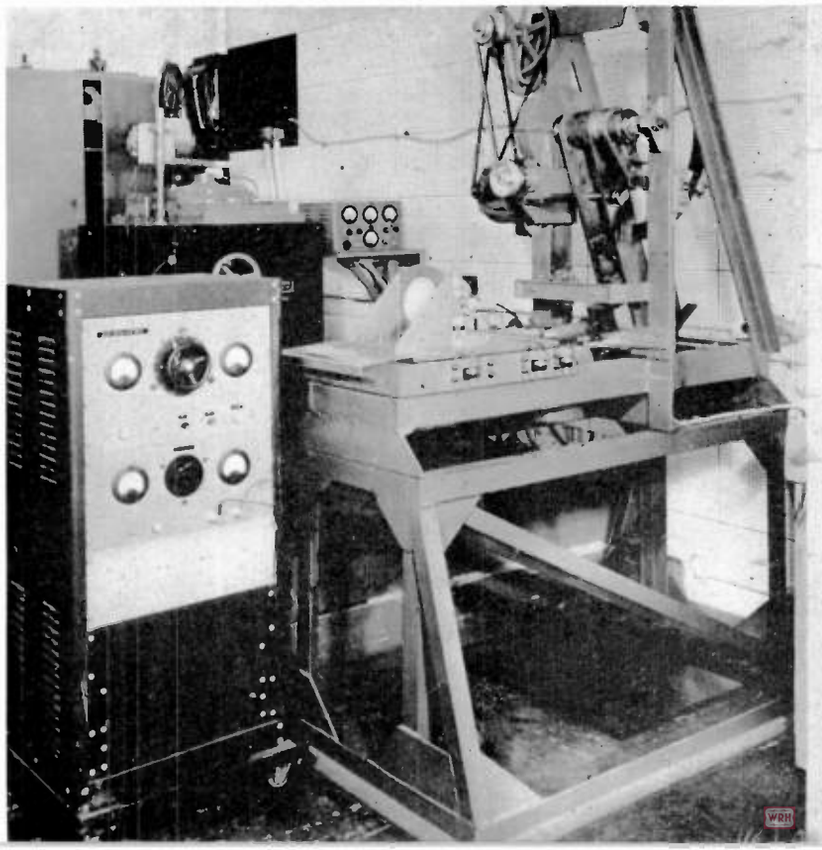
In academic circles, particular mention must be made of the work of Stratton and his staff at the MIT Research Laboratory of Electronics where, following the closing of the wartime Radiation Laboratory, considerable basic electronic research work was initiated under the joint sponsorship of the three Services. Projects under way at MIT include microwave and physical electronics; microwave physics; modern electronic techniques applied to physics and engineering; communications and related projects. Similarly, since the wartime Radio Research Laboratory at Cruft Laboratory, Harvard, was closed, Chaffee and members of his staff are carrying on basic work in antennas, microwave optics, microwave circuits and physical electronics, and wave propagation.

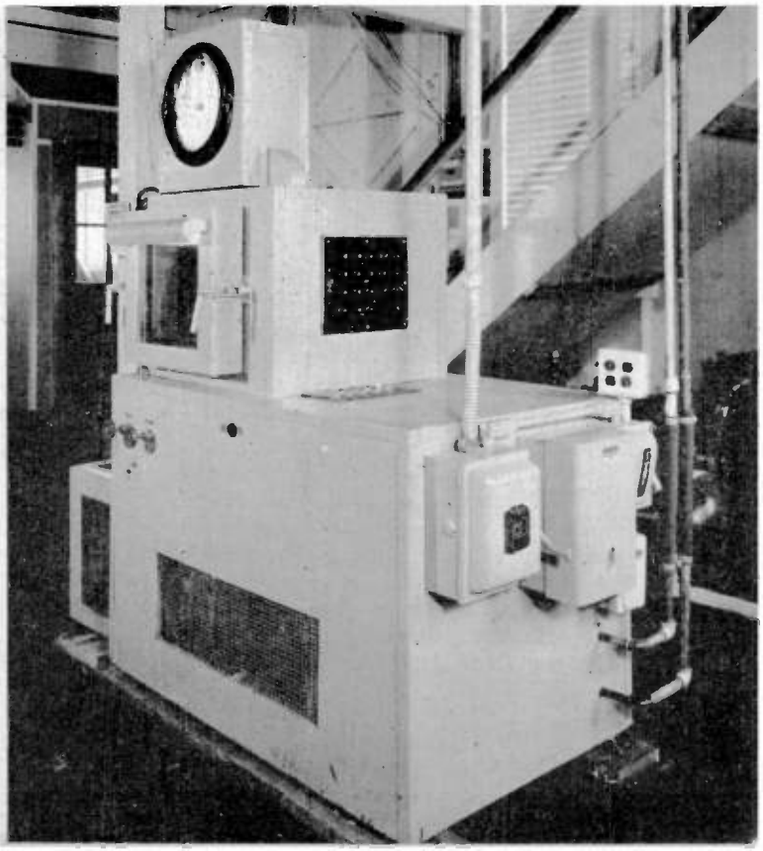
Upper Atmosphere Research:

Prior to World War II, the instrumentation and techniques used in experimental meteorology were to a dangerous extent obsolete. The new techniques, especially electronic, developed by physicists and engineers during the past twenty years had not been fully exploited by the meteorologists. Lack of equipments by which to acquire definite data on the physical state of the atmosphere and on the nature of the continual and subtle changes taking place therein resulted in serious shortcomings in forecasting techniques. Wind velocities were required when the sky was overcast, but pilot balloon techniques were inoperative under those conditions. The trajectory of hurricanes and typhoons were needed but no equipment was available by which they could be determined. Data on the upper atmosphere at least to 75 kilometers and preferably more were needed, but no appartus existed for this requirement. To accomplish these purposes and others, the meteorologist turned increasingly towards electronics. It is now considered that forecasting for future military operations will require instantaneous and long-range three-dimensional presentation of data concerning winds, temperature, pressure, humidity, and turbulence, all of which draw heavily on electronics and communications techniques.

Special balloons, capable of carrying electronic equipment to 150,000 ft. have been developed. As another part of the Signal Corps upper atmosphere program, the Wac Corporal was developed by the Ordnance Department as a vehicle for carrying measuring instruments into the stratosphere. Later, through the availability of German V-2's, these rockets were and are being used in many aspects of the meteorological program, including measurement of atmospheric parameters to 150 kilometers and beyond by means of specially developed temperature and pressure instruments, sound ranging techniques, smoke trails, and air sampling flasks lowered by parachute after seal-off at known altitudes. Navy-developed Aerobee rockets are used with lighter loads. Research of this type is only possible through the cooperative efforts of various elements of the Department of the Navy, Department of the Air Force, the Army Ordnance and the Chemical Warfare Department. The Upper Atmosphere Research Panel serves to implement this cooperation, by including at the working level representatives of

Method of shock-testing tubes of various types. Reactions of tubes to high-altitude conditions are checked in this chamber





these various departments, as well as of participating civilian agencies. Among the latter, special mention must be made of Nichols and his co-workers at Michigan who are engaged in designing instruments and methods for use in rockets to determine pressure, temperature, wind velocity and consistency of the upper atmosphere.

Radar and Meteorology

In the field of weather control, the past eighteen months has been a period of great achievement. The techniques of Langmuir and Schaefer of the General Electric Company in seeding supercooled clouds with solid carbon dioxide and silver iodide nuclei, producing condensation and precipitation, have placed this phase of the research program among the items of primary interest to the Department of National Defense as well as to other governmental agencies. No one can predict at this time where research in this field will eventually lead and to what extent application of research results will affect military warfare or civilian life.

To exploit radar possibilities in meteorology, Bemis at MIT is making radar observations simulutaneously on weather disturbances and on ariplanes flying in and about such disturbances, correlating the effect of frequency, pulse length, pulse repetition, frequency, and peak power on radar echoes from cloud formations, rain or snow, or other weather phenomena. Synchronous measurements are made from aircraft of water content, particle size and distribution, and turbulence of the atmosphere. These items are then correlated with weather radar.

In the field of sferics, which means radio direction-finding on electrical disturbances in the atmosphere, work is under way at the University of Florida, the New Mexico School of Mines and Belmont Radio. The principal problem in this field is to complete the understanding of basic physical phenomena of atmospheric disturbances and to apply this understanding to the development of methods for localizing individual disturbances over large distances.

Problems in Photography:

In overall importance to the Signal Corps, this field is second only to communications. In the past, however, because of strong commercial interests coinciding to a considerable degree with military requirements, it has not been found expedient to support a large-scale research program, since development of military photographic equipments in most cases followed commercial advances through adaptation. It may be said, however, that research in this field will be greatly increased in the future, for many problems have arisen which appear to be now more of military interest than civilian. Some of the fields for future work include evaporography, electrostatic electrography, secondary photochemical photography, ion-exchange purification of wash water, non-aqueous developing solutions, light-sentitive materials, and ultra-long range ground photography.

Joint Service Contracts:

It is a matter of policy with the Department of National Defense that research results of interest to elements of the three major Departments be circulated for informational purposes and to prevent duplication. In large contractual research investigations of mutual interest, it has been found expedient for the interested Services to merge efforts and establish single contracts with joint support. Such contracts are always administered in their non-technical aspects by a Contracting Officer from only one Service, while technical control is vested in an Advisory or Steering Committee made up of members of the participating Services, meeting regularly with the contractor's staff. As an example, the MIT Research Laboratory of Electronics and portions of the Cruft Laboratory at Harvard are conducting research in which all three Departments of the National Defense have great interests. An advisory Committee for the Services is made up of representatives of the Office of Naval Research, the Air Material Command and the Signal Corps. In quarterly meetings of the Advisory Committee, projects are discussed, initiated or terminated. Broad distribution of quarterly reports and special technical reports assures quick exchange of research information and expedites application. Joint contracts include:

MIT Research Lab. of Electronics: Microwave, electronics, physics, communications, & associated problems (SigC, AMC, ONR)

Harvard, Cruft Lab.: Electromagnetic radiation & wave propagation, microwave circuits, physical electronics (ONR, SigC, AMC)

Princeton, Plastics Lab.: Plastics, synthetic resins, flexible insulations, & insulating oils (SigC, ONR, BuShips also has representation)

G. E. Co.: Cloud studies, techniques for artificial nucleation of clouds, instrumentation (SigC, ONR, aircraft & associated personnel furnished by USAF)

Columbia, Radiation Lab.: Generation of supermicrowaves, microwave techniques & apparatus, microwave physics, tube fabrication (SigC, ONR)

Stanford: Tunable circuits & non-scanning spectrum analysis, wideband oscillators, traveling wave tube principles, propagation effects of ionization due to meteors (ONR, SigC)

Bureau of Standards, CRLP: Propagation studies (SigC, ONR, AMC)

MIT, Lab. for Insulation Research: Dielectric materials, microwave research spectroscopy, X-ray & electron difraction, high-voltage breakdown (ONR, SigC, AMC)

Armour Research Foundation: Magnetostriction frequency control (AMC, SigC)

Columbia: Coordination of all Government-sponsored electron tube research & development (SigC, BuShips, Secretariat for Panel on Electron Tubes RDB)

Bureau of Mines, Electro-Technical Lab.: Studies on production of synthetic mica (ONR, SigC)

University of Alaska: Arctic tropospheric propagation (AMC, SigC)

W. E. Co.: Studies pertaining to the application of transitors (SigC, AMC, BuShips)

Coordinating Other Services:

The program discussed in this paper represents only one phase of related programs also being carried on by various elements of other Services. Coordination on a national scale is accomplished through the Research and Development Board under K. T. Compton. Except for meteorology, all the projects discussed in this paper fall within the province of the Committee on Electronics, of which Donald Quarles is Chairman. The various Panels of the Electronics Committee having cognizance of the work described are Basic Research, Communications, Components, Countermeasures, Electron Tubes, Infra-red, Radar, and Radiating Systems. At Panel meetings, Service programs are compared and coordinated, and recommendations are made for initiating, terminating, or increasing activity on projects.

Aids to Education:

No research is sponsored by the Signal Corps directly as an aid to advanced education, although it is happily recognized that such will be a welcome by-product. With approximately an equal balance between funds expended through industrial and academic contracts, it is recognized that through the latter category many graduate students find the support which makes their advanced study possible and indirect benefits of inestimable value accrue to the National Defense effort through increase in the Country's scientific manpower resources. Within the Signal Corps Engineering Laboratories, in a number of carefully selected cases, research studies are under way, the results of which will be submitted in partial requirements toward doctorate degrees through special arrangements with certain universities located within the New York-Philadelphia area.

It would be well to restate that specific references to every project within the Signal Corps' own Laboratories and among industry and educational institutions has not been possible, either because of their close association with problems involving national security or because of space limitations on this paper.

OPPORTUNITIES FOR ENGINEERS

THE SIGNAL CORPS' PEACETIME PROGRAM OF RESEARCH AND DEVELOPMENT OPENS OPPORTUNITIES FOR SPECIALIZED WORK — *By* HAROLD B. CHURCHILL*

NEARLY every engineer, at some time in his professional career, reaches a point where he pauses to take stock of the progress he has made, and his probable future attainments. The proportions vary, but the basic ingredients of success are the engineer's particular abilities and qualifications, and the conditions of employment under which he works. If the algebraic sum of these two factors is a high value, preceded by a plus sign, the individual has reason to congratulate himself.

But engineers sometimes find that they have been side-tracked from the line of work they want to follow, or that they are limited in the attainment of full professional stature by lack of facilities. Then, a definite change is indicated.

Opportunities at SCEL:

At the Signal Corps Engineering Laboratories, Fort Monmouth, N. J., we sometimes use a simple chart to summarize the advantages and opportunities open to those who join our staff, and to help them make comparisons with other positions. The chart asks nine questions:

1. Will you have outstanding facilities for scientific research?

2. A choice of more than 20 scientific fields within one organization?

3. Freedom to develop new ideas in the advancement of science, regardless of foreseeable commercial value?

4. Wide opportunity to transfer from one field to another as specialization develops, without change of employers?

5. Can you keep in close and continual touch with scientific progress at leading academic and commercial laboratories?

6. Can you continue your education and acquire higher academic degrees from a university of recognized standing, while progressing on your job?

7. Is the salary good, with open opportunity for promotion?

8. Is there security and reasonable assurance of uninterrupted employment, independent of economic cycles?

9. Will you have ideal country living with ready access to a large metropolitan area? Suitable housing, schools, and a wide choice of recreation?

The Signal Corps Engineering Laboratories offer all these basic advantages to qualified engineers and research workers.

*Chief of Technical Information, Signal Corps Engineering Laboratories, Fort Monmouth, N. J.

SCEL Development Projects:

Staffed by civilian scientists working in concert with technical officers of the Signal Corps, SCEL has developed or sponsored during the last ten years a very large proportion of the electronic equipment which supports our Army.

The total number of major fields probably offers the widest opportunities for technical employment of any scientific organization today:

1. Radiological detection research.
2. Photographic and camera development.
3. Sound, heat, and light detection and projection.
4. Thermionics and vacuum tube development.
5. Micro-optics.
6. Enemy missile and gunfire detection.
7. Electron acoustics.
8. Facsimile development.
9. Telephone, telegraph, and wire systems.
10. Electronic power supply research.
11. Internal combustion power units.
12. Meteorological research.
13. Radio transmitter and receiver development.
14. Primary and secondary battery and battery substitute development.
15. Generator and dynamotor research.
16. Production engineering and maintenance.
17. Radio interference suppression.
18. Antennas and propagation research.
19. Component part and circuit element research and development.
20. Crystal and frequency control research.
21. Specifications and standards.

Furthering this initial choice is the traditional SCEL policy of acquainting professional men with activities in all branches, to keep them abreast of projects in fields related to their own. Thus during the first year or two of employment for example, transfer to different specializations is readily possible, permitting each man to become channeled into the field where he finds himself best adapted.

Organization of Facilities:

Research and development in the Signal Corps Engineering Laboratories proceed in three separate but closely integrated laboratories, each equipped with advanced technical apparatus for work in the fields under continuous study by SCEL.

These laboratories are Evans Signal Laboratory, Belmar, N. J.; Coles Signal Laboratory, near Red Bank, N. J.; and Squier Signal Laboratory, at Fort Monmouth, N. J.

Research and development in each field centers in a specific laboratory, with overall technical and administrative control exercised at Headquarters, SCEL, Squier Signal Laboratory.

Each equipped with the most modern machine shop facilities, the three Laboratories range over an area of more than 300 acres, providing test sites for any activity from mobile television to radiosonde flight.

In many cases the engineer follows the development of an embryo idea, often his own, through to the completion of the finished product.

While the engineer begins his experiments, precision parts and components are produced in SCEL shops. New special-purpose vacuum tubes may be needed. These are fabricated, and a model constructed. Experiments may proceed on the ground, aloft by balloon, rocket, or aircraft, or in the controlled atmosphere of chambers providing any required combination of pressure, temperature, and humidity.

Tests completed, the engineer may publish a report contributing his findings to basic knowledge in the field. Or, if the device meets a military need, SCEL production and maintenance specialists are assigned to work closely with him to effect transition of his prototype model into production for national defense.

Outside Contacts:

The engineer joining SCEL has a singular opportunity to keep abreast of nation-wide progress in the field he selects since, in its direct research and development responsibility for the U. S. Army, SCEL acts as the technical catalyst between industry and national defense.

In guiding and assisting in this nation-wide program, SCEL engineers have an unparallelled opportunity for contact and information exchange with leading authorities in their fields, and for the increase of professional prestige.

There is also the opportunity to publish the findings of their work in both official media and the nation's technical press. They have complete freedom in this respect, except where the subject or discovery is so important to national defense that it must be held under security for our country's benefit.

(Concluded on page 35)

SPOT NEWS NOTES

NOTES AND COMMENTS ABOUT SIGNIFICANT ACTIVITIES OF PEOPLE & COMPANIES

"Wish they'd make FM portables"

New York IRE Convention:

To be held at the Grand Central Palace, March 7 to 10. Some 200 manufacturers will display their equipment, and 172 papers will be delivered. The luncheon honoring incoming president Stuart Bailey will be on March 8, and the Annual Banquet on March 9. Meetings and displays will be open to the public.

Engineering Theory vs. Economics:

No formal announcement has been made at this time of writing, but if the Joint Technical Advisory Committee finally recommends that upper- and lower-band TV assignments should not be made in the same service area it will be because they remembered that, however idealistic a plan may be, it's no good if the public won't buy it. And a 2-band setup would be more impractical for TV than for FM, particularly in view of the receiving antenna problems involved.

Donald S. Morgan:

Elected president of Langevin Manufacturing Corporation. Carl C. Langevin, former president, has been elected board chairman. Jules Martinez will continue as vice president.

Refinancing:

Agreement in principle has been reached under which IT & T will acquire 1,680,568 outstanding shares of Farnsworth in exchange for 140,047 IT & T shares. Pending consummation IT & T will make a $1,000,000 secured advance to Farnsworth. Fort Wayne plant and present jobber-dealer organization will be continued.

William C. Speed:

President of Audio Devices, discussing program quality: "The sponsor invests perhaps hundreds of thousands of dollars in talent and program material. But somewhere along the line the quality of the entire program is sacrificed in the name of economy. . . . Economy-minded studio executives may say, 'After all, what difference does it make? The vast majority of radio sets are miniatures, and you can't tell the difference anyway.' The fallacy of such thinking is obvious to the engineer. Distortion added to distortion spells listener discontent, even if he doesn't know just why. . . . These all-important listeners cannot be held with poor programs, whether poor in material or ruined with poor fidelity."

Broadcast Authorizations:

FCC figures show the following changes in broadcast authorization during the year of 1948:

	Jan. 1	Dec. 31	Incr.
AM	1,962	2,127	165
FM	1,010	966	-44
Ed. FM	40	50	10
TV	73	124	51
Exp. TV	91	182	91
Remote Pickup	590	574	-16

Non-Standard C-R Tubes:

The lack of interchangeability of TV picture tubes is creating a serious problem for manufacturers and retailers. One company, for example, is using four different makes of 12-in. tubes, each requiring chassis modifications, although the sets carry the same model number. If a tube burns out, it must be replaced by another of the same make. Something must be done about standardizing tube dimensions and characteristics.

Two Egg Baskets Needed:

More and more opinions from top management level recommend that plans for 1949 set production and sales should not be limited to TV sets, but should include FM receivers as an anchor to windward.

This thinking is inspired by apprehension over delay in defrosting the TV freeze and the possibility that the FCC may come up with an allocation plan that will be a successful operation from their point of view, but may nevertheless kill TV business this year.

Effect of FM on Paid Audiences:

Bill Ware of KFMX Council Bluffs, has organized a weekly talent-scout program staged at a local Fox theatre, and broadcast only on FM. Result: standing room only at the theatre, and a big increase in local FM set sales. Zenith models are featured on the program.

Third Power Increase for WCFC:

Ed Hodel's FM station at Beckley, W. Va., has a new 4-bay FM antenna, upping the effective radiation to 31-kw.

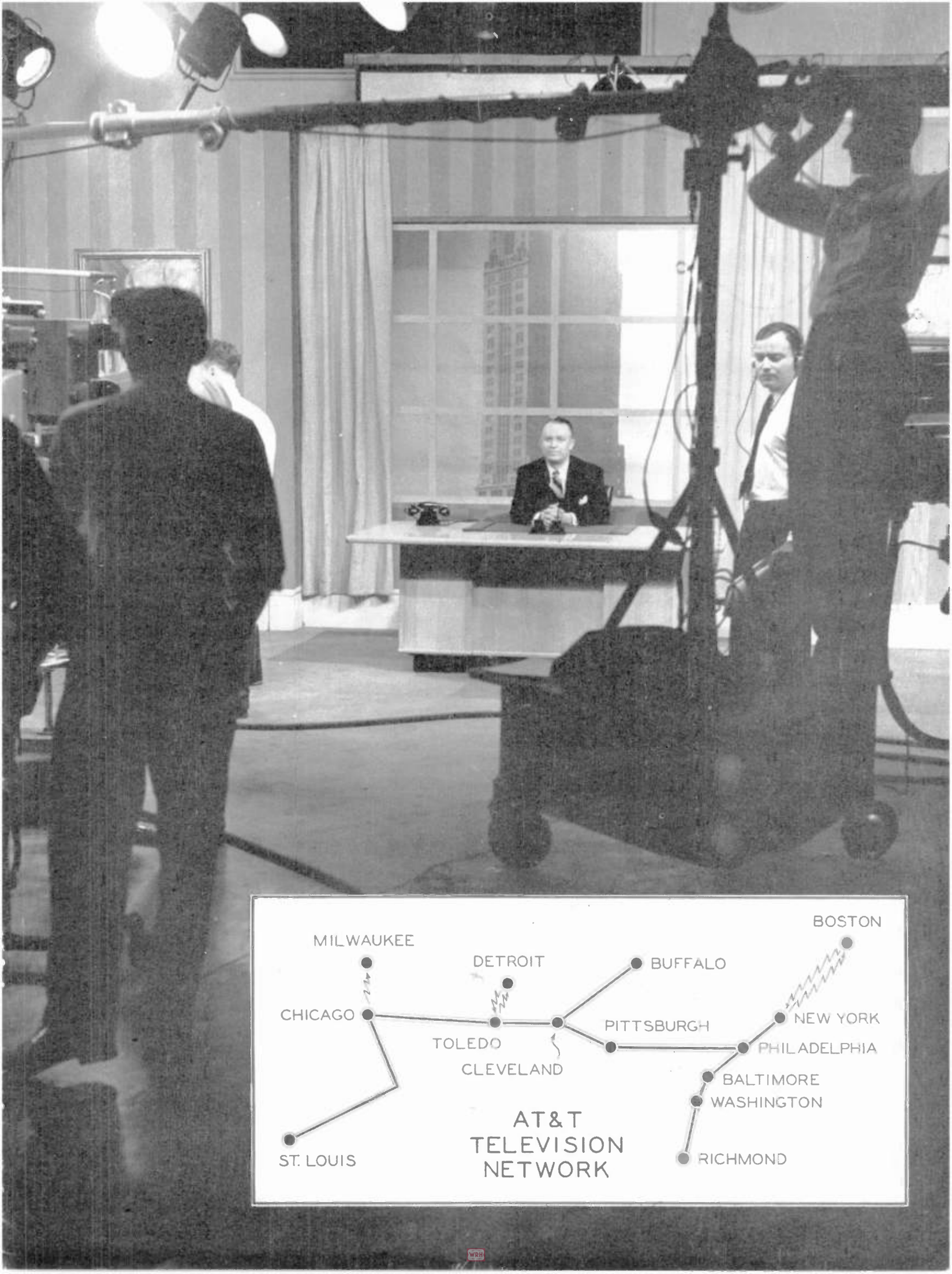
Louis de Rochemont:

Film producer and co-founder of the March of Time, addressing the Screen Directors Guild at New York on January 15: "The old-line Hollywood philosophy of 'entertainment only' rests upon a fundamental fallacy. . . If those who possess the know-how to make the kind of films needed for television do not take advantage of today's opportunities, they have only themselves to blame. . . . In California, the advice today is: Go east, young man. Opportunity lies in New York."

Leroy Wilson:

The dramatic picture opposite was taken after all photographers had been chased out of NBC studio 8G at Radio City, in preparation for the first TV broadcast over the midwest-to-east-coast network of coaxial cables. AT & T president Leroy Wilson, seated before a skyscraper backdrop, was seen and heard by audiences in all the areas marked on the diagram.

Left, actual photo of WNBW-WNBT co-channel interference. Right, interference pattern eliminated by Kell synchronizing control, developed at RCA Laboratories


BOSTON
MILWAUKEE
DETROIT
BUFFALO
CHICAGO
NEW YORK
PITTSBURGH
TOLEDO
PHILADELPHIA
CLEVELAND
BALTIMORE
WASHINGTON
AT&T
TELEVISION
NETWORK
ST. LOUIS
RICHMOND

PLOTTING TELEVISION'S FUTURE

THE COMING IMPACT OF TELEVISION DEVELOPMENT AND EXPANSION AS SEEN AT THE FEDERAL COMMUNICATIONS COMMISSION—*By* THE HON. WAYNE COY*

WE are today in the midst of a revolution—a revolution in our living habits, in our home life, in our recreation, in our mass communications because of the developments of television. Being the infant that it is among present day industries of the United States does not prevent us from believing that it is destined, within a very few years, to be one of our larger industrial groups. It is to understate the obvious when we say that television is to have a profound effect on the movies, the legitimate theater, aural broadcasting, newspapers, magazines, books, politics, education, and sports.

Television can very well mean an era of undreamed-of abundance in information, culture, education, and entertainment for the people of this country.

Accelerated Development:

I have heard it said that our present progress in the field of television is due to the phenomenal development of electronics in the war period. One does not like to think that any war has contributed to the public welfare. But we would be blind not to recognize that the last war, perhaps more than any other, stimulated great projects in the electronics field-developments now being used in the service of the people of this country. However much help we are now receiving on the scientific front from these wartime developments, we should not forget that television was getting its start before the war began, with stations on the air in New York, Schnectady, Chicago, and Los Angeles. At the war's end, six stations were on the air and 7,000 receivers were in the hands of the public. Today more than 50 stations are on the air in 31 cities; 1,000,000 receivers are in the hands of the public; and networking facilities (coaxial cable or radio relay) are available to stations with a potential audience of one-quarter of the nation's population.

By 1951, I expect to see 400 television stations in operation and 1,000 stations within the next six or seven years. If the production of tubes needed for receivers can be stepped up in accordance with present plans, then perhaps as many as 2,000,000 receivers will be produced in 1949. Receiver production can, and probably will, reach a rate of 5,000,000 a year by 1951.

I make the foregoing predictions in spite of the "freeze" on the granting of applications ordered by the FCC—perhaps even because of it. Certainly my predictions reflect my optimism about the future of television. The technical problems which resulted in the "freeze" will be solved in large measure (perhaps in part by new technical developments) and will not retard the future growth of television as they well might have done.

Channels for Nationwide TV:

It seems necessary for me to review some recent television history at this point. Thirteen channels in the VHF bands were allocated to television service as a result of the 1945 allocations proceedings of the FCC. One of these channels, No. 1, has since been deleted by action of the Commission, leaving only 12 channels available today. In making the 1945 allocations to this service the Commission pointed out that the 13 channels available were inadequate for a nationwide competitive system. It was pointed out at that time and many times since, that the 475- to 890-mc. band also allocated to television in the 1945 proceedings would have to be utilized to provide such a nationwide competitive system. The need for immediate experimentation with these frequencies was urged upon the industry.

Coverage and Interference:

Since 1945 we, the industry and the Commission, have acted as if we believed we might provide a nationwide service with the low-band channels. It was known in 1945 that co-channel operation 200 miles apart would provide a safety factor against tropospheric interference, although we then did not have sufficient data on these phenomena to include in the Commission's Standards of Good Engineering Practice rules covering the measurement of tropospheric propagation. Instead of maintaining such a separation as provided in the initial assignment plan proposed by the Commission, we disregarded any safety factor and adopted a standard of 150 miles separation between co-channel stations. In some instances less than 100 miles separates co-channel stations in the "frozen" assignment plan. Television was in danger of becoming a metropolitan service at its best. In some cases, adequate service could not be rendered to all of the metropolitan area under the plan.

People do live in the areas between cities. They have the same right to be informed and entertained through the medium of government-licensed broadcast facilities as those living in cities.

The Commission was, and is, concerned about getting television service to all the people of the country. Broadcasters and prospective broadcasters wanted larger service areas. The problem is to get sufficiently large service areas for stations to achieve the goal of television service to all our people and at the same time provide a sufficient number of assignments for local outlets, for local expression in the many communities of the country. Obviously, a solution of our problem will be a compromise. The possibilities of synchronization, now in the laboratory phase, may cushion that compromise.

I think it is likewise obvious that any widening of the separation between co-channel stations will mean fewer station assignments with a greater disparity between the requirements for a nationwide competitive system and the actual assignments possible, and will demonstrate the great need for additional television channels.

Preparing for UHF Operation:

The "freeze" has not yet reached the "thawing" stage. All the engineering data bearing on the problems has been made available at an engineering conference held by the Commission in late November and early December. Industry engineers are now reviewing this data with Commission engineers, and a report is expected from this group within a few weeks. It is my belief that there is substantial agreement on the correctness of the data. If I am correct in that assumption, then it can be expected that the Commission may within a few weeks be able to submit proposed revisions of Standards of Good Engineering practice for television.

At the time the "freeze" was ordered, the Commission estimated it would be 6 to 9 months before it could be lifted. That estimate still stands. March 30 will mark the end of 6 months. I am sure the "freeze" cannot be lifted before then, but it is still a good target date.

Just a few comments about the need for additional channels in order that we may have a nationwide competitive system: I hold the need to be self-evident, and thus will dispose of that part of the problem. How many channels it takes to

*Chairman, Federal Communications Commission, Washington, D. C. An address delivered at a joint luncheon meeting of the Radio Executives Club and the Advertising Club, Boston, Mass., January 25, 1949.

satisfy that need I do not know. My present thinking is that 50 to 70 channels may be required.

The Commission started a proceeding on September 20 last seeking information bearing upon the utilization of the UHF band of frequencies allocated to television. This hearing raised several questions. Among others, those questions are:

1. Do we have sufficient propagation data now to write standards of good engineering practice for television service at these frequencies?

2. Should we now change our television system and provide for higher definition black and white television or for high definition color or low definition color?

3. Should we keep our present system and standards and allocate a sufficient number of channels in the UHF band to provide for a nationwide competitive system?

We do not yet have the answer to the first question. The Commission's staff is studying the problem, and there is some indication that a further hearing may be necessary, although this is by no means certain.

Standards for TV on UHF:

Industry witnesses seem to be in accord on utilizing the high band, or a substantial portion of it, for the present television system. It seemed to be the concensus that high-definition black-and-white or color would have to await future research and development. It is almost unnecessary to observe that such a position is compatible with their present interests.

The Commission must, however, look at the problem from the point of view of the public interest. If either high-definition black-and-white or color television is now practical and feasible, the Commission can hardly stand in the way of such a development and thus retard progress.

The point is frequently made to me that both the British and French have a higher technical standard than does this country. In both those countries television is government operated. There is no competitive system. Spectrum space is therefore a small problem for them. Whether a single channel is 6 mc. or 18 mc. wide is of little significance. I am quite sure we could have a wide-channel, higher-definition service in this country if we had a monopoly, either privately-owned or government owned. Personally, I will take competition rather than improved definition if it means monopoly of either variety. But I will also take improved definition or color when it is technically practicable and when it no longer serves to restrict competition.

I think it is extremely unfortunate that the demand for more channels is upon us before we are prepared to cope with it. The research and experimental work in the UHF band lagged as we moved into the production of VHF equipment. I hope and expect, however, that the need for additional channels will be met before the current year is finished.

Even a much larger number of television channels for nationwide competitive service will not enable us to make television available to all the smaller communities and to all the rural areas. New techniques will have to be devised or a considerable segment of the population of the country may be without television service.

CHAIRMAN COY'S knowledge of broadcasting, both as to operations and technical aspects, is admirably illustrated in this extremely interesting discussion of plans for nationwide television service.

The text deserves the most careful reading because, in recent years, actions by the Commission have almost invariably followed the line of thinking expressed publicly before official decisions are made known.

This, of course, is an effective and not uncommon way of testing industry or public reactions before new plans are put into effect.

Stratovision may be one of the new techniques to assist us in solving this part of the problem. Under the stratovision system 20 big transport planes carrying transmitters would circle 5 miles up and, properly spaced, could broadcast television signals to the entire nation. These experiments have been going on for about two years. Sometime in the near future the Federal Communications Commission will determine if this novel method is technically feasible, and whether assigning exclusive channels for nationwide coverage in this way would be in the public interest. Investing one company with so much power over publicly-owned channels of communication raises serious questions of free speech and monopoly, and must be carefully weighed.

Another possibility of serving the rural areas is to use unattended, low-cost satellite stations that would merely relay the programs of the large stations or the networks.

I think we may safely assume that the broadcasting of television beyond the horizon will eventually be a reality. Our scientists seem to have a way of performing impossible feats. I see no reason to abandon faith in them in connection with this problem.

The Television Audience:

As television grows, we find our living habits, our home life, our recreational habits steadily changing. For the past several years, Americans have been spending more time listening to the radio than to any other pursuit during their leisure time. Ninety-five per cent of America's families now own one or more radio sets. Many people have the habit of listening to the radio while they talk, read, or play gin-rummy. But there is one thing we have all found out, that is, you cannot listen to your radio and see television at the same time. You are all familiar with the results of the many surveys showing what people do who have both television receivers and audio receivers in their homes. The most conservative of the surveys show that television receivers, in homes having both television and audio sets, are used more than twice as much as audio receivers.

These figures have naturally made the audio broadcasters do some hard thinking about the future of their business. Many of them have television stations or construction permits for such stations. Many others will get into the television business as soon as more channels are available.

As I see it, broadcasters who also own television stations, will gradually dispose of their audio stations and concentrate on television. I say this because I do not think it is possible for television stations and audio stations to compete for the same audience under the same management. Advertisers just do not like to spend their money with an organization operating another medium designed to compete for an audience which they believe they are paying to reach.

Those broadcasters who are not in television will have to readjust their program services to offer new services catering to special interests in an effort to compete with visual broadcasting.

This is a big country and a lot of people live in it. Some 20 millions of those people have never had adequate radio service. Service to those people, plus those who do not buy television sets, plus those who will prefer the specialized programming by aural radio stations constitutes the future task of radio broadcasters. It seems inevitable to me that those who remain in the aural broadcasting business must give considerable thought to the planning of that program service, and to the facilities which they will use.

I think it is inevitable that the present networks will soon begin the task of revising their program structures, and may end up with two network services: one to areas with television service avail-

able, and one to areas where television is not available.

More Films for Television:

The motion picture exhibitors are doing a lot of thinking about the competition they will have from the "theaters" in the homes of America equipped with television. They are pondering deeply the implications of this problem. Some of them do not forget what happened to the legitimate theater and vaudeville when the motion picture theater was established. They are wondering if they have seen "the best years of their lives" and if they are now doomed to become the victims of technological unemployment.

Some of them are thinking in terms of adapting the technique of television for their theaters. They see vast crowds of people cueing up in front of their box offices to see the inauguration, the Saturday afternoon football games, championship prize fights, the Davis Cup matches, and perhaps even telecasts of musical hits from Broadway or our outstanding symphony orchestras.

If we are to assume that the present motion picture producers will produce all of the film needed for television stations and theatres, then we can likewise assume a major battle in the bidding for the products of the producers. It may develop that the costs of quality pictures will be more than can be paid by television broadcasters. In such event either the motion picture producers will have to produce pictures, perhaps tailor-made for television and at lower costs, or television network operators or individual television broadcasters will have to get into producing their own films.

This we know for a certainty—that the operation of television stations in this country will use up much more film per year than has ever been produced in America. There is certain expansion coming in the field of film production. New competitive forces in that industry cannot help but benefit America.

Audience Impact of TV:

The outstanding sports events in America are naturals for television. I am sure that all of you are familiar with the arguments as to whether or not television cuts down on the gate. This survey says it does, the next survey says it doesn't, and so on and so forth. But the hard facts of the matter are, from the television operator's point of view, that sports promotors want more and more money for television rights to their promotions. They look upon each television receiver as an additional five seats in their grandstands, and speculate upon the price they can charge for these new ringside seats. Some of them are already refusing to sell television rights. Others are threatening to refuse, and only a few of them are enthusiastic about television's developing a new public for them, a public which they believe will eventually come in through their turnstiles rather than stay at home and see the events electronically.

Book manufacturers point to television as a devastating competitor. They see people viewing television rather than reading books, and are now trying to find ways to use television to stimulate the reading of their books.

Newspaper publishers foresee a loss in some advertising appropriations to television. For the first time an electronic medium can compete with newspapers in visual advertising. Whether television in the long run will get its revenues from other media such as newspapers, magazines, billboards, or whether it will result in further increases in advertising benefits of our corporate business enterprises remains to be seen.

The real impact of television upon these competitors, if you want to call them that, will be determined by the manner in which television broadcasters use this new electronic marvel. Misguided and misconceived notions of what constitutes the public interest can cripple the development of television and perhaps retard it forever. Television broadcasters must not forget that the public interest must be served.

I was reminded of this very forcefully on January 12 of this year when I received a letter, one of several, commenting indignantly upon the television show presented on January 11, when the East and Midwestern television networks were linked together. The writer referred to the closing paragraph of my speech on this occasion when I said this linking together of the two networks brings television "closer to its high mission of unifying our nation and making more perfect our democracy." But the writer went on to say that "as a reluctant television owner and user, I get encouraged every two weeks or so when some worthwhile and reasonably adult program is put on. But the lady wrestler, the Charlie Chaplin and the ten-year old Grade C cowboy movies seem to have enchanted the network owners so that, except for commercials, they usurp most of our time."

And then she referred pointedly to the television programs of the night of January 11, put on by the four networks and said that "these are the programs which will (and she used my words) 'deepen our understanding of democracy'." More than that, she said, "You (the Commission) are to blame for it."

What Does Television Say?

I do not necessarily think that mail represents cross-section thinking. Neither do I believe a postal card survey gets a cross-section of America, and, since the last election, I don't believe that the so-called scientific polls necessarily represent a cross-section of America. But I am impressed by what this writer had to say because I had the feeling on the night of January 11, and it still persists, that television broadcasters did not put their best foot forward on that night. They missed a great opportunity to showcase the best of their program services such as, for example, "The Man Who Came To Dinner" on CBS Sunday night, January 16, or "Papa is All" which was on NBC the same night.

In this connection, and in closing, I am reminded of a story which I recently heard about the inauguration of an electrical marvel of another age. England had just built a cable connecting London, the seat of the British Empire, with India. Ruskin, the great British critic of his day, was asked to comment on this achievement. He said that it was indeed a wonderful thing, but he issued a challenge which I think you can paraphrase as well as I. In fact, I am sorry in retrospect that I did not use Ruskin's comment in inaugurating the linking of the Eastern and Midwestern television networks. Ruskin said, in commenting on the cable to India, and he directed his remarks to the people of England who were so proud of the achievement, and I quote him—"What do you have to say to India?"

Were the television programs inaugurating the linking of these two networks a reflection of all that we have to say to each other? The answer, of course, is a resounding "No."

The broadcast of last Thursday, when thousands here in Boston and ten million people in all from the Atlantic to the Mississippi "attended" the colorful inauguration of their President, seeing and hearing more than those on Pennsylvania Avenue, was a striking demonstration of television's unique powers.

There is a great hunger all over this land for that kind of equality of opportunity—equal opportunity to enjoy the finest in dramatic, musical, educational, cultural and informational programs that the broadcasters can devise. Every section of our nation has much to contribute to every other section. Through television we can have that nationwide exchange.

In between such spot news events, television broadcasters can and must produce programs that are worthy of the scientific genius that created this electronic miracle.

Faithful to that concept of public service, American television can stand forth to all the world as a pattern of what this most powerful of all the instruments of mass communications can accomplish to promote equality of opportunity and the general welfare in a democracy.

CRACKED-CARBON RESISTORS

DATA ON THE CHARACTERISTICS OF ENGLISH RESISTORS MADE BY THE PYROLYTIC PROCESS OF DEPOSITING CARBON ON PORCELAIN—*By* ROBERT W. WILTON*

IN recent months, resistor units manufactured by the pyrolytic, or cracked-carbon process have become generally available in the U. S. A. While the nature of this process has been known for some time, it has not been until quite recently that the special properties available in resistors produced by this technique, have been fully realized.

Produced in tolerances to plus or minus 1% or even closer, resistors of this new high-stability design are characterized by low noise, voltage, and temperature coefficients, and high long-term stability. In all of these characteristics a very considerable improvement over composition type resistors is obtained and, in many cases, results approaching those of wire-wound components are realized.

These improvements are available at some increase in cost over composition types of equivalent resistance and wattage ratings. Thus, they cannot be substituted for composition resistors in all applications.

Cracked-carbon resistors were produced quite successfully in Europe for a number of years prior to 1939. With the imminence of war, it became apparent that some other source of supply should be made available. Several firms in England began work on the project and, as a result, completely independent techniques of production were evolved. At least three English firms were eventually involved in supplying high-stability resistors to the British wartime industry.

A major share of this supply was carried out by Welwyn Electrical Laboratories. It should be emphasized that the remarks in this paper apply more specifically to cracked-carbon resistors produced by the Welwyn process, this being the technique with which the author is most familiar.

Basically, the essential part of the process consists of decomposing a carbon-containing gas in the presence of a porcelain rod or tube at a temperature in the vicinity of 1,000°C. This produces a crystalline film of carbon of extreme purity and of very stable electrical properties. Carbon so produced is extremely hard and resistant to abrasion. Because of the high degree of purity of the deposited carbon, practically no non-linearity of resistance exists, while the particle size, being very much smaller compared to ordinary graphite, leads to higher resistance values. A further advantage is the homogeneity of the conductor, resulting in a uniform distribution of the electrical potential and temperature over the conducting path.

The thickness of the carbon deposit, and hence the resistance of the rod, can be controlled by the cracking temperature, the hydro-carbon content of the gas mixture, and time exposure of the rod in the cracking zone. In practice, one or more of these factors is used to control the final value of the resistors.

Techniques now employed produce resistors which are more directly comparable to wire-wound than to the composition types, and show certain advantages over the wire-wound types. Cost-wise, the cracked-carbon resistors are invariably far more economical than wire-wound units for ratings up to 2 to 4 watts, at least. Unless final accuracies of considerably better than plus or minus 1% are required, they will duplicate very closely all other desirable characteristics of wire-wound resistors.

For very high values, where the cost of wire-wound resistors is completely prohibitive, the new types are even more attractive. Inductive effects associated with even the best wire-wound units are eliminated entirely, or reduced to a very low order by the cracked-carbon construction.

It should be apparent that control of the cracking process is not so fine as to allow exact values of resistance to be produced, nor is it possible to produce tracks having a reliable resistance of much more than 10,000 ohms per square centimeter. For this reason, higher values of resistance are generally arrived at by the use of the helical grooves around the rods. This has certain drawbacks in that the inductance is increased and robustness of the unit as a whole is decreased. However, better temperature coefficients and very much higher resistance values are made available.

Resistors so produced range from a lower limit of 10 ohms to an upper limit of 100 megohms or better, rated at .25 to 2 watts. It is characteristic of the process that the stability of the resistor decreases with increased resistance. For that reason, very high values cannot be held to the same tolerance which can be expected from lower values. Since physical size limits the amount of resistance that can be produced, extremely high values are available only in the higher wattage ratings.

Roughly, the fields of application can be determined by two major considerations:

1. The possible substitution of cracked-carbon resistors in applications where wire-wound units are normally used, and where the absolute value of resistance is a major design factor.

2. In circuits where permanence of value (stability) and noise, temperature and voltage coefficients are of prime importance, but where the absolute resistance value is a secondary consideration.

This includes potential-dividing, sweep oscillator, and time-base circuits for television, and VTVM bridge circuits.

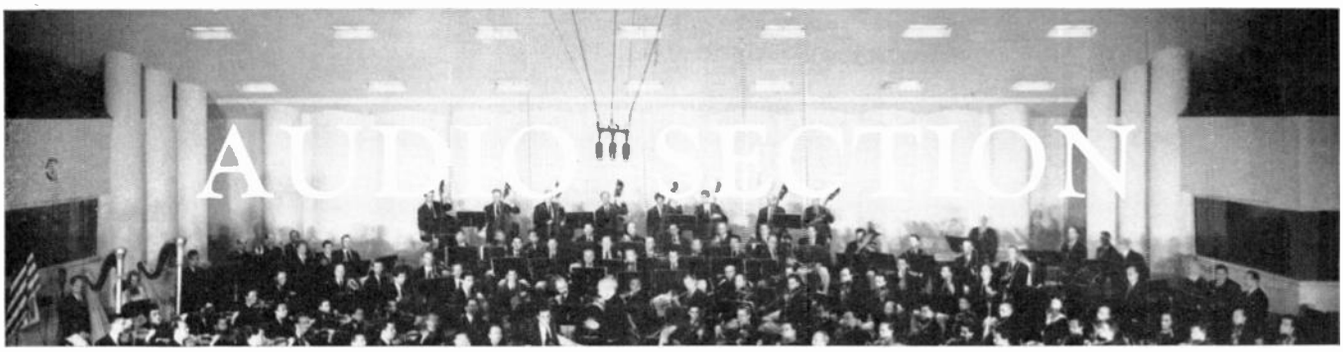
When close tolerances are demanded, the value at the end of the expected life of a resistor is important. This calls for a much closer initial tolerance so that a reasonable factor of safety for aging, moisture, and temperature effects. Voltage and temperature coefficients must be considered, also.

It is interesting to note that cracked-carbon resistors have a voltage coefficient so low that it is extremely difficult to measure it. In this respect, the effects of temperature coefficient cannot be eliminated entirely.

The temperature coefficient of the carbon track itself is about 0.025%/°. Under certain conditions, and especially in the higher resistance values, this may run somewhat higher. However, even under the worst conditions, errors resulting are very much lower than for composition types. Proof of this is seen in that the change of resistance likely to result from soldering the leads of a cracked-carbon resistor seldom if ever exceeds 0.1%. British specifications call for a change of resistance not to exceed 0.2% when the resistor termination is inserted to within ½ in. of the resistor proper in molten solder at 250 C for 30 seconds!

High-gain amplifiers built around composition resistors have a characteristic high-level hiss, with a lower-frequency transient very often superimposed. The use of cracked-carbon resistors, especially as plate loads, reduces such hiss and other commonly-accepted high-level noise to a very marked and, in many cases, startling extent. For example, when a series of 1-megohm resistors, selected at random, were placed under load, the noise output was never in excess of 30 micro-volts for the cracked-carbon type, while that for the composition type was never less than 120 microvolts and, in a large percentage of the cases, several times higher!

*Chief Engineer, Bach-Simpson, Ltd., 71 Carling St., London, Ontario, Canada.



AUDIO DEVELOPMENTS

DEVOTED TO THE INTERESTS OF THOSE WHO WORK WITH AUDIO FACILITIES — *Edited by* LAWRENCE OLDS

FROM all the pros and cons about 45-RPM records, certain features stand out that are worth consideration:

1. For the first time, record and changer designs have been engineered to work together. Direct result is a mechanism that is much simpler, and should be virtually fool-proof.

2. The 7-in., 45-RPM vinylite records are superior in tone quality to ordinary 78-RPM pressings, and are equivalent in playing time.

3. Juke-boxes cannot use 33 1/3-RPM long-playing records because they don't use up nickels fast enough.

4. However, the improved tone and longer wear of the 45-RPM discs, plus the reduction in service expense and out-of-order time expected from simplified changer designs, makes them admirably suited to juke-box use.

5. There's no discounting the sales-promoting power of the juke-box in the sale of phonograph records.

So, because juke-boxes can't use 33 1/3-RPM records but can and soon will use the 45-RPM discs, they may be a deciding factor in the ultimate determination of a single standard.

How long it will take for this influence to be felt is anybody's guess. Not over night, certainly, for the record business is suffering from a couple of lefts and rights in the solar plexus. A lot of things must happen before it can draw a deep breath again, and start recovering lost ground.

HAVE you ever felt the immobility of the sound source while you watched the action on a television screen move around in all directions, or the perspective shift from a far shot to a close-up? It isn't apparent in the first flash of enthusiasm, but it's this observer's experience that, as television becomes a familiar adjunct to the home, the lack of sound perspective seems to be the most disturbing technical defect.

While standards are being worked out for upper-band TV, provision could be made readily for stereophonic sound transmission. Think about this feature carefully, and you may come up with the conclusion that it can add more to the enjoyment and the realism of television than anything else you'd like to have added or changed in the present system.

Whether the top brass now working on upper-band TV will think of this is something else again. They may, or they may not choose to give it consideration.

It would add only a little to studio and transmitter equipment cost. Some TV receivers have two speakers now. A simple, added circuit would make the sound move with the action on the screen. If stereophonic transmission is provided, listeners would not be compelled to pay a higher price for such reception, since single speakers could be used. However, with the added enjoyment that sound perspective would provide, few people would be satisfied to hear stationary voices from moving people.

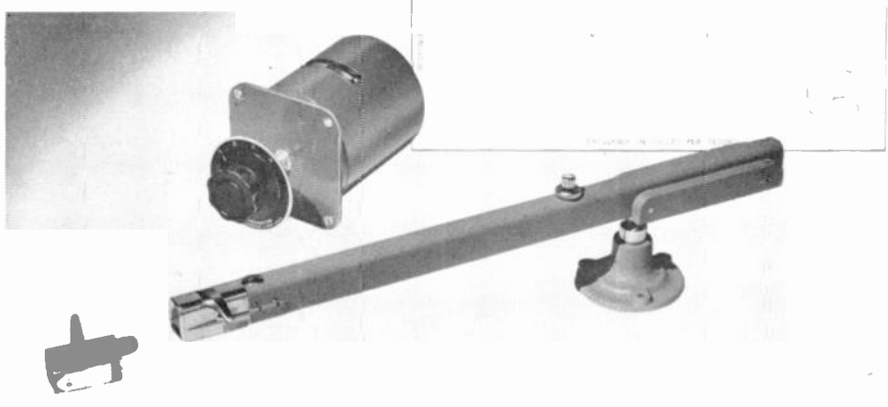
LATEST addition to sound-reproducing equipment is the tone arm, pick-up, and compensator just released by Presto Recording Company, Paramus, N. J. Either microgroove or standard records and transcriptions can be played by clipping in the corresponding head. Pickering cartridges are supplied with a 1-mil or a 2.5 mil diamond-point stylus. The corresponding head is weighted to exert 7 or 17 grams pressure, so that the change from playing one type of record to the other can be made quickly, without the need of any adjustment.

The accompanying curves show the characteristics of the 4-position compensator. The networks are designed for the reproduction of flat-response recordings, 78-RPM records, NAB recordings and those requiring a substantial roll-off at the high-frequency end. Frequency response of the compensator is practically unaffected by terminating loads ranging from 100 ohms to high impedance. Mumetal shields on the two network inductances are designed to prevent hum pick-up from adjacent AC circuits.

ANOTHER interesting and very useful item of audio equipment is a new input transformer from United Transformer Corporation, New York 13. The unique feature is a small, die-cast case with a standard plug extending from one end, and a jack set into the other. These provide input and output connections to a matching transformer sealed inside the case.

Thus, low-impedance microphones, pick-ups, or other devices of 50 to 500 ohms can be quickly matched to high-impedance audio circuits. The matching transformer is rated approximately flat from 50 to 10,000 cycles.

Dual pickup and compensator



COST VS. QUALITY IN AF CIRCUITS

CAREFULLY-CHOSEN COMPONENTS AND WELL-DESIGNED CIRCUITS CAN GIVE A BIG IMPROVEMENT AT VERY SMALL EXTRA COST—*By* JOHN M. VAN BEUREN*

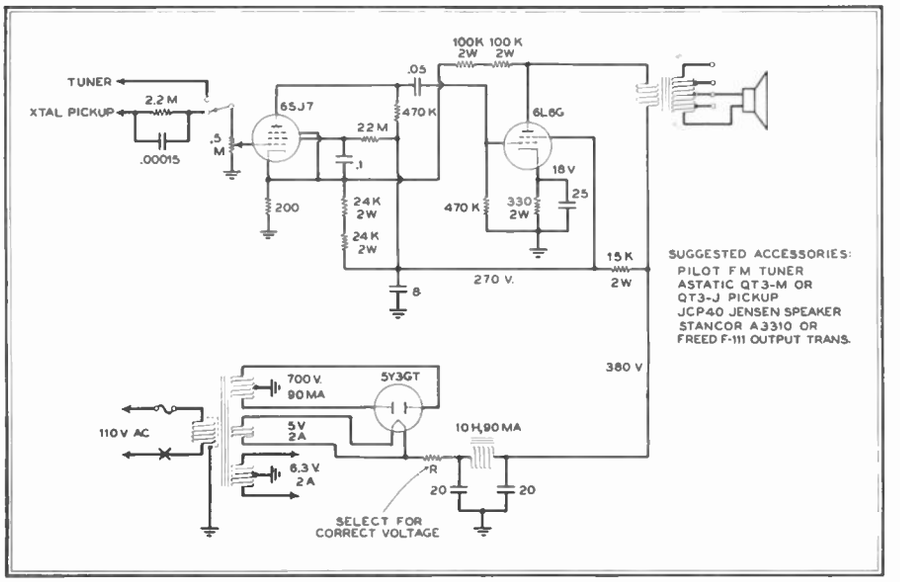


Fig. 1. A low-cost system giving better audio quality than many factory-built sets

"WHAT is the cost of a custom-built high, fidelity, radio-phonograph?" That question can most easily be answered by asking how much the person is willing to spend for such equipment.

This paper has been written in an attempt to demonstrate how much audio quality costs, and how a given budget can be most wisely spent. The first statement that may be made is that reasonably good fidelity is not by any means expensive. The main cost of the average high-priced radio-phonograph is in the cabinet rather than in the essential parts of the system. It is easy to demonstrate that good fidelity can be obtained at a moderate cost, and that excellent performance can be obtained at a somewhat higher, but still far from exorbitant cost. No claim is made that the amplifiers and systems to be described are the ultimate in quality. However, they will give the average listener a most satisfactory setup at substantially less than the cost of equivalent performance from conventional cabinet-type instruments.

Phonograph Pickups:

The crystal cartridge has been standard in home phonographs for many years. Only recently has the magnetic cartridge enjoyed a return to popularity. It is capable of somewhat better performance than the crystal cartridge, though unless used with a very good system, the better type crystal is still quite satisfactory for general home use. The newer types of crystal cartridges with the bent stylus, costing around $5, are excellent for use with the average commercial shellac pressings. Their main advantages are that they are not subject to hum pickup from magnetic fields around phonograph motors, and their relatively high voltage output makes pre-amplification unnecessary. Likewise, they are easily compensated to suit modern recording characteristics. The maximum response, however, in the lower-price types is around 7,000 cycles which, while adequate for commercial shellac pressings, will not give the utmost fidelity.

The magnetic cartridge has recently had a resurgence of popularity due to the fact that, with proper design of the stylus and armature, it is possible to extend the frequency response to above the limit of audibility and to decrease harmonic and intermodulation distortion. Prices of these units range from around $5 to $15.

Choosing a Loudspeaker:

Before going on to describe amplifiers, let us consider for a moment loudspeakers and their associated enclosures. There are two general price classes for loudspeakers suitable for use in the home, around $20 and around $80. The $20 class includes both single-cone radiators and duplex speakers consisting of a simple woofer and tweeter combination.

There are several speakers in the $80 class. One in particular is favored by the writer. It consists of a 15-in. cone as the low-frequency unit and a coaxial exponential horn for the high-frequency or tweeter unit. It has excellent high-frequency coverage through an angle of approximately 120°, and its power-handling capability is more than adequate for the home. It should be used with an amplifier having some bass boost as it is apparently somewhat lacking in bass response due to the fact that the low-frequency resonance of the cone is

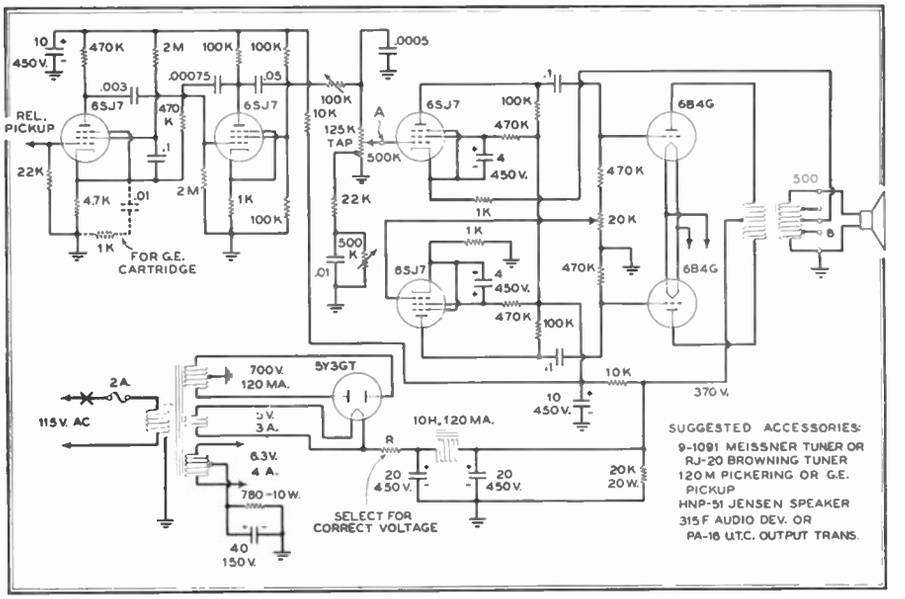


Fig. 2. Few standard radio sets can equal the performance of this audio amplifier

*Research Engineer, Measurements Corp., Boonton, N. J. A paper delivered before the Radio Club of America, Columbia University, Apr. 30, 1948. Published by permission of the Paper Committee.

very broad and smooth, and the efficiency in the middle and high range is much greater than most speakers. There are several speakers priced considerably above the $80 class which offer even improved performance.

A Low-Price Amplifier:

Let us now discuss the most important and undoubtedly the most controversial part of any audio system, namely, the amplifier.

From the standpoint of minimum possible expenditure, the amplifier shown in Fig. 1 should be of interest. It utilizes only 3 tubes, is of single-ended rather than push-pull design, and will deliver 3 to 4 watts output with less than 1% harmonic distortion. It is designed to work from a modern, bent-stylus crystal pickup into a 12-in. coaxial speaker. The design is simple and straightforward, and the average custom set-builder should have no difficulty with it.

While a power output of 3 to 4 watts may seem small, it is ample for the average home living room, unless extreme volume is desired. Approximately 14 db of negative feedback is used to lower the plate impedance of the beam tetrode output tube, and to improve and flatten the frequency response of the amplifier.

To keep costs low, no boost or attenuation circuits have been provided. However, record scratch can be attenuated by using the high frequency control on the speaker recommended.

A Medium-Price Amplifier:

The amplifier shown in Fig. 2 uses push-pull triodes in the output stage. Under the conditions shown, it will deliver 8 to 10 watts of audio at less than 1% harmonic distortion and with low intermodulation distortion. Feedback in this case is taken directly from one of the voice coil windings and applied to the cathode of the driver tube. The design of this amplifier is straightforward and successful results have been obtained from a considerable number now in use.

The pre-amplifier and input circuits deserve some mention. Designed to work from a magnetic phonograph cartridge, they contain the proper compensation circuits to raise the bass response to the correct level. This is accomplished by the use of negative feedback which decreases as the frequency decreases below the turnover point of approximately 500 cycles.

Pentodes are used for the pre-amplifier tubes to provide the relatively high gain required, as it takes somewhat more than 5 volts to drive the final amplifier. At the output of the pre-amplifier are placed the high-attenuation and bass-boost circuits. High attenuation is accomplished in a somewhat unconventional manner by an RC network in which the variable resistance is in series and the capacity in shunt. This gives a roll-off characteristic rather than the shelf type of characteristic obtained from the usual tone control. Bass boost is accomplished by using a tapped gain control. The tap at 125,000 ohms is loaded rather heavily, by a 22,000-ohm resistor in series with a .01 condenser. Control is obtained by a 500,000-ohm variable resistance shunting the .01 condenser. As this resistance is increased, the reactance of the .01 condenser increases at the lower frequencies, decreasing the shunting on the 125,000-ohm tap.

If it is desired to use this amplifier with one of the tuners recommended, the pre-amplifier circuit may be ignored and the output of the tuner connected to the amplifier at point A. Since treble attenuation and bass boost circuits are contained in the tuner, these may be eliminated. However, if a magnetic cartridge is used with the tuner, a single-stage pre-amplifier such as the first stage shown in Fig. 3 can be used. It may be necessary to remove the compensation from the phonograph position in the tuner, as this compensation is designed for a crystal pickup and should not be used with the magnetic type.

A More Expensive Amplifier:

The third amplifier, Fig. 3, to be described is somewhat more complex and is capable of considerably greater power output. Approximately 25 to 30 watts are obtainable with under 1% harmonic distortion. This amplifier uses beam tetrodes in push-pull parallel in the output stage. Again, considerable feedback is used to reduce the plate impedance of the output tubes and to flatten the response.

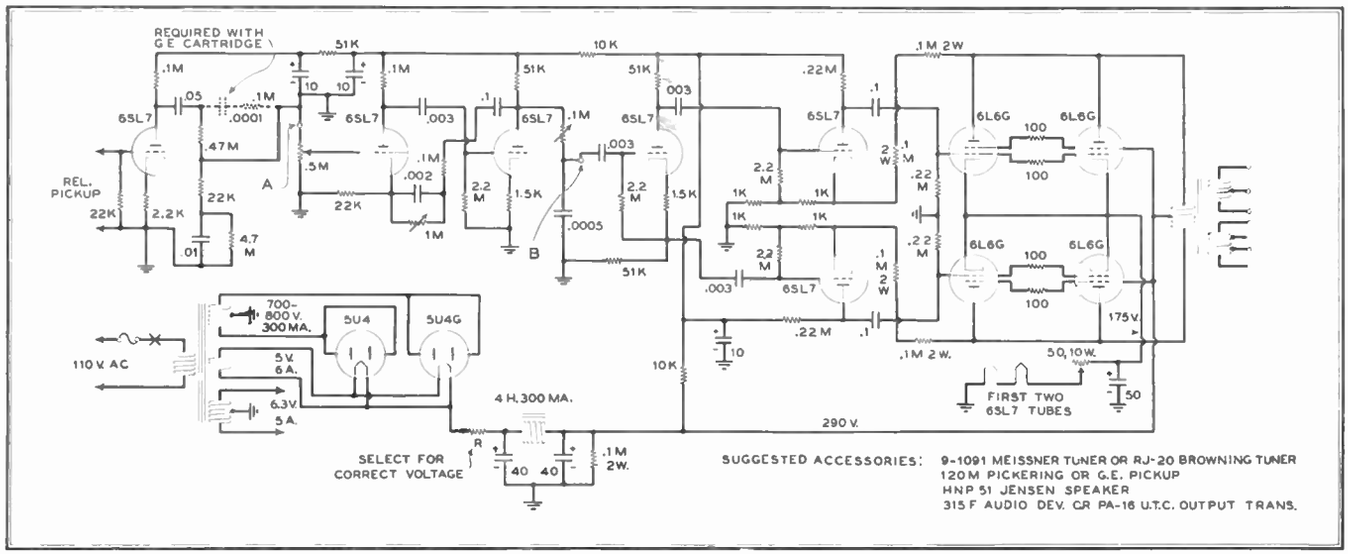


Fig. 3. You may pay upward of $1,000 for a set in a period cabinet, but the amplifier will probably not equal this $70 unit

Over-all feedback from the voice coil is not recommended with these particular types of tubes, due to the fact that it is rather difficult to prevent oscillations and poor transient response unless the primary is rather heavily damped by an RC network, which begins to load the primary rather heavily above 10,000 cycles.

The pre-amplifier consists of a single triode with proper compensation in the output. Bass boost is obtained by use of frequency-selective negative feedback in the second and third stages. Hum is reduced to the vanishing point by making the heaters of the first two double triodes part of the cathode resistor of the output stage. The output stage draws approximately 300 milliamperes, which is the correct current for the heaters of the 6SL7 tubes, and the additional bias required for the output tubes is obtained by a resistor. In the case of each of the amplifiers described, the power supply input resistor R, which may vary from zero to 1,000 ohms, should be determined

(Concluded on page 34)

The finest requires the BEST! And in amplifiers the best is the H. H. Scott model 210-A, with the Dynamic Noise Suppressor. The installation shown here was made by Voice and Vision, Chicago. It is typical of thousands of custom radio-phonographs now in use throughout the U. S. A. in homes, clubs, hotels, studios, and advertising agency offices—wherever superlative reproduction is required.

Improves All Music Reproduction

THIS H. H. SCOTT unit combines a superlative 20-watt amplifier with treble and bass boost controls, PLUS the Dynamic Noise Suppressor.

You may be under the impression that the Dynamic Noise Suppressor is just another device to quiet needle scratch and hiss by cutting treble response. Nothing could be further from the truth, as the loudspeaker will tell you.

Actually the Dynamic Noise Suppressor is a gate-circuit. It performs the seemingly impossible function of enabling you to enjoy more high musical overtones, by limiting the background noise from records, AM, FM, and TV!

This unique function is performed by no other record reproducing system. It operates on vinylite and shellac records, and studio transcriptions at 33 1/3, 45, and 78 RPM. Your request for Bulletin F29 will bring complete information.

Hermon Hosmer Scott, Inc.
383 Putnam Ave., Cambridge, Mass.
Representatives in all principal cities

AF CIRCUITS

(continued from page 32)

by experiment to give the proper operating voltage.

Total installation cost:

Now let us consider the cost of the various amplifiers described and their associated accessories. At current over-the-counter prices the amplifier described in Fig. 1 can be built for approximately $15 including tubes, chassis and miscellaneous hardware. The output transformer and loudspeaker add approximately $23, and a simple bass reflex enclosure costing less than $5 for materials can be built in a few hours. An excellent phonograph motor and an arm containing the recommended crystal cartridge can be obtained for an additional $20 or, if desired, a record changer can be substituted for these items. For approximately $30 additional, FM reception can be added. Unfortunately, at this time of writing, there does not seem to be available on the market an AM tuner comparable in price and performance to the recommended FM tuner. However, for the expenditure of approximately $90, the user can have an FM radio-phonograph that is superior to commercial models selling for $400 or more.

The second amplifier described can be built at current prices for less than $40, including the recommended output transformer. The phonograph motor, pickup, and speaker add approximately $100 more to the cost, giving for less than $150 a phonograph capable of reproducing the best records available today. For approximately $150 additional, the FM-AM tuner can be obtained. Thus, for less than $300, a complete outfit can be assembled that is superior to commercial radio-phonographs selling for upwards of $1,000.

The amplifier shown in Fig. 3 can be built at a cost of $60 to $70. The accessories recommended are the same as shown in Fig. 2.

No mention has been made in this paper of cabinet space. Almost every home has enough bookcases or shelf space to contain the amplifier and tuner, which can be concealed by a simple plywood panel. The speaker can be built into a window seat or bookcase.

In this paper, it has been the author's intention to show that excellent audio performance can be obtained at a very reasonable cost. It is always somewhat of a shock to look behind the imposing cabinet of a $400 radio and find an inadequate chassis, an output transformer weighing a pound or less, and a 6- or 8-in. loudspeaker.

The performance of such receivers compares miserably with even the cheapest outfit described in this paper.

OPPORTUNITIES AT SCEL

(Continued from page 33)

Salaries at SCEL:

A graduate with a Bachelor's degree in engineering or physics, for example, can start at SCEL on a salary of approximately $3,000.

Or, if he has a Master's degree in the appropriate field, $3,727.20; and with a Doctor's degree, the entrance salary becomes $4,479.60.

For each year of successful service, SCEL engineers become qualified for promotion to a higher level. Thus the graduate with a Bachelor's degree may receive $3,727.20 after the first year, $4,479.60 after the second, and $5,232 after the third. Comparable increases range up to $12,500 for graduates with Master's or Doctor's degrees.

Separate from these full-grade promotions are in-grade or step promotions if the professional employee does not receive any other promotion during the year. This system provides pay increases of approximately $120 a year in the first three professional grades, and $250 every eighteen months in the higher professional grades if the employee's services are satisfactory. Such seniority salary increase is fully automatic if a full-grade promotion is not received within the 12- or 18-month period.

Approximately 10% of the professional men at SCEL are in the $7,400 to $12,500 salary bracket; another 15% in the $6,200 to $7,400 group, and 23% are earning between $5,200 and $6,200. Nearly all enjoy permanent employment status, insuring the high degree of continuing security so essential to a satisfactory career in research.

Further Academic Studies:

An unusual feature of advancement opportunities at SCEL is that the engineer's academic education is not cut short by his employment.

Academic facilities are provided at SCEL for advanced education under the direction of a leading university, with classes held within the laboratories. This graduate program presently offers credits leading to a Master's degree, while others are planned leading to a Doctorate. Half of the class attendance time is allowed during working hours at full pay; the other half is on the engineer's own time. He pays only half the nominal tuition fee of $5 a semester-hour, plus book costs.

Applications for Employment:

Employment application forms can be obtained by those interested in joining the SCEL staff from the Chief Civilian Branch, Personnel Division, Fort Monmouth, N. J., and any detailed information will be supplied.

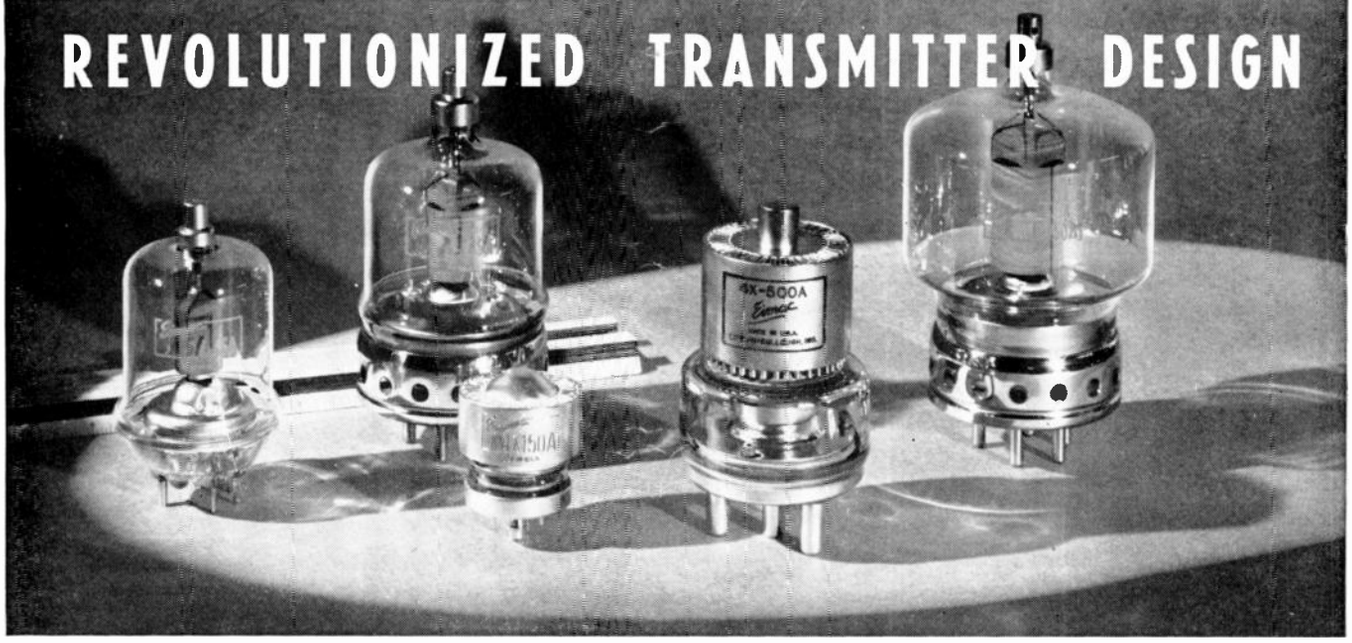
Follow the Leaders to

Eimac TUBES

The Power for R-F

THESE TUBES . . .

REVOLUTIONIZED TRANSMITTER DESIGN



THE 4-65A . . . is the smallest of the radiation cooled Eimac tetrodes. Its ability to produce relatively high-power at all frequencies up to 200-Mc. and over a wide voltage range offers considerable advantage to the end user. For instance the same tubes may be used in the final stage of an operator's mobile and fixed station. Two tubes, in the mobile unit operating on 600 plate volts will handle 150 watts input, while two other 4-65A's in the fixed station will provide a half kilowatt output on 3000 volts .

THE 4-125A . . . is the mainstay of present day communication. These highly dependable tetrodes have been proven in years of service and thousands of applications. Two tubes are capable of handling 1000 watts input (in class-C telegraphy or FM telephony) with less than 5 watts of grid driving power. In AM service two tubes high-level modulated will provide 600 watts output. For AM broadcast they carry an FCC rating of 125 watts per tube.

THE 4X150A . . . is highly versatile and extremely small (2½ inches high). It is an external anode tetrode capable of operating above 950-Mc. As much as 140 watts of useful output can be obtained at 500-Mc. Below 165-Mc. the output can be increased to 195 watts. It is ideally suited as a wide-band amplifier for television and for harmonic or conventional RF amplification.

THE 4X500A . . . is a top tube for high power at high frequencies and is especially suited to TV and FM. It is a small external anode tetrode, rated at 500 watts of plate dissipation. The low driving power requirement presents obvious advantages to the equipment designer Two tubes in a push-pull or parallel circuit provide over 1½ kw of useful output power with less than 25 watts of driving power at 108-Mc.

THE 4-250A . . . is a power tetrode with a plate dissipation rating of 250 watts and stability characteristics familiar to the 4-125A. Rugged compact construction together with low plate-grid capacitance, allows simplification of the associated circuits and the driver stage. As audio amplifiers, 2 tubes will provide 500 watts power output with zero drive.

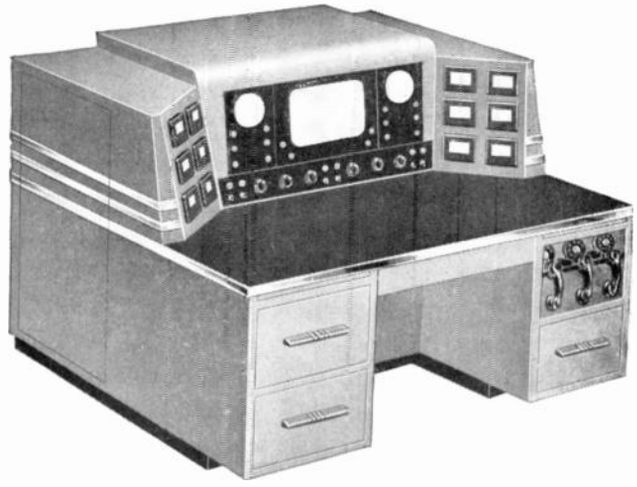
FOR COMPLETE DATA ON ANY EIMAC TUBE TYPE WRITE TO:

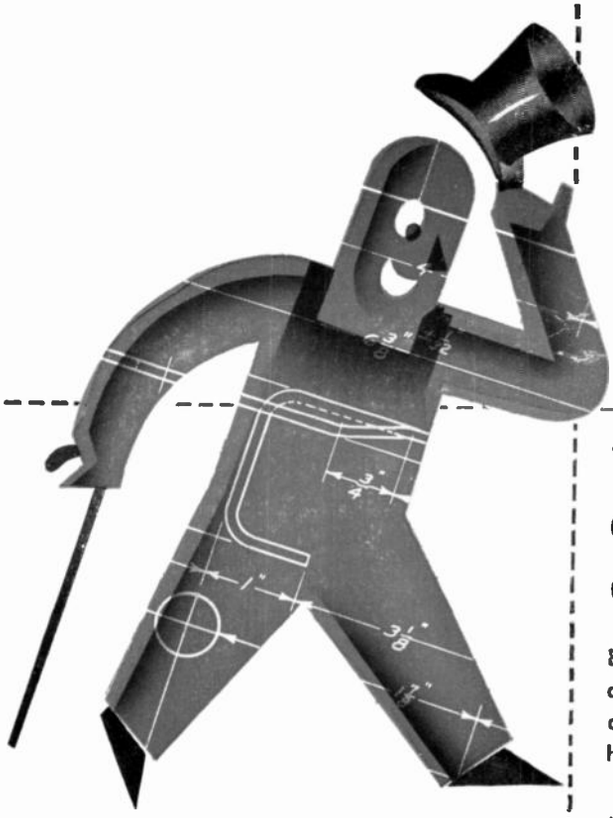
EITEL-McCULLOUGH, INC.

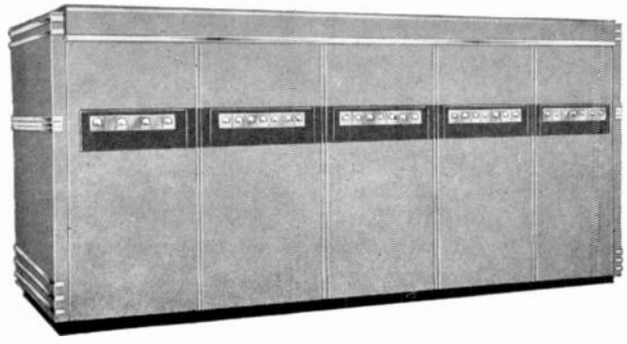
210 San Mateo Ave., San Bruno, California

Export Agents: Frazar & Hansen, 301 Clay St., San Francisco, California

Our Hat Is Off to Television Engineers







Who Demand Superior Craftsmanship in Cabinets and Housings

Building housings for television apparatus requires an ever-increasing degree of skilled workmanship and precision. Demands of design engineers are highly exacting.

Karp keeps pace with these higher standards by turning out racks, cabinets, consoles, chassis and other enclosures for telecasting equipment that bears the names of leading manufacturers in the field.

This month we are moving into our new plant of 70,000 square feet—the last word in modern manufacturing quarters, equipped with newest and most efficient facilities, including up-to-date painting and finishing department, scientifically air-conditioned. In this new home we can serve exacting needs better than ever.

For superior sheet metal cabinets, chassis and housings for television, radio or electronic apparatus of any kind, whether simple or elaborate, you will like our quality and service. Get our quotations.

WRITE FOR NEW CATALOG

KARP METAL PRODUCTS CO., INC.

217-63rd STREET, BROOKLYN 20, NEW YORK

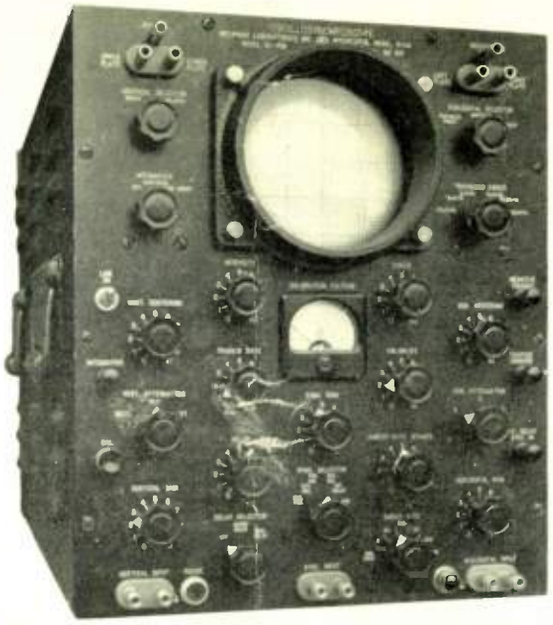
Custom Craftsmen in Sheet Metal

Browning

OSCILLOSYNCHROSCOPE

MODEL OL-15B

COMBINING
THE FUNCTIONS OF
OSCILLOSCOPE
AND
SYNCHROSCOPE . . .
AN
OUTSTANDINGLY
VERSATILE
INSTRUMENT



APPLICABLE TO . . .
TELEVISION
FACSIMILE
PULSE
MODULATION
RADAR
NUCLEAR PHYSICS
COMMUNICATIONS

GENERAL FEATURES

Five-inch cathode ray tube operating at 4,000 volts accelerating potential. Ordinarily supplied with P1 phosphor, others available on special order.

Vertical amplifier flat within 3 db. from 5 cycles to 6 megacycles. One inch deflection with .05-volt RMS input.

Horizontal amplifier flat within 1 db. from 5 cycles to 1 megacycle.

Built-in calibrating system for determining wave amplitude. No external meter needed.

Deflection plates and intensity grid available directly at front panel terminals.

No waiting for trace to reappear after adjusting gain or applying DC component to input.

Low capacitance, high impedance probe supplied for minimizing test circuit disturbance.

Reasonably symmetrical waves permit full screen vertical deflection.

Contained in single cabinet, weighs less than 100 pounds.

AS AN OSCILLOSCOPE

Linear sawtooth sweeps continuously variable from 5 to 500,000 per second in conjunction with the excellent vertical amplifier outlined. Permits observation of RF waves and envelopes to above 6 megacycles. Because of the extended ranges of the amplifiers and sweep generator, oscilloscopic capabilities are correspondingly increased over standard oscilloscopes.

AS A SYNCHROSCOPE

An internal trigger generator continuously variable from 200 to 5,000 cycles can be used to excite external equipment as well as the sweeps. The trigger can be made by panel control to lead or lag the start of the sweep by amounts up to 1,000 microseconds, making it possible to phase any part of a pulse or transient onto the screen for measurement. Sweep speeds of ¼, ½, 1, 5, 20, and 200 microseconds per inch provide convenient image time expansion for detailed observation. As the sweep generator will sweep once for each incoming pulse, single transients or pulses occurring at irregular intervals can be observed or photographed.

FOR MORE DETAILED INFORMATION WRITE FOR DESCRIPTIVE BULLETIN FM15

companion instruments

SWEEP CALIBRATOR
MODEL GL-22

For accurately calibrating sweeps. Markers are provided at 1/10, 1/2, 1, 10, and 100 microsecond intervals which may be applied as deflection or as intensity modulation. May be triggered directly from OL-15B. Write for bulletin FM22.

FAIRCHILD OSCILLO-RECORD CAMERA

For permanent records of waveforms on 35mm. film. Single frames or variable continuous motion permit recording of all phenomena. Various lenses, magazines, etc. available. Easily set up with OL-15B. Write for information.

BROWNING LABORATORIES, INC.

WINCHESTER, MASSACHUSETTS

CANADIAN REPRESENTATIVE: MEASUREMENTS ENGINEERING ARNPRIOR, ONTARIO