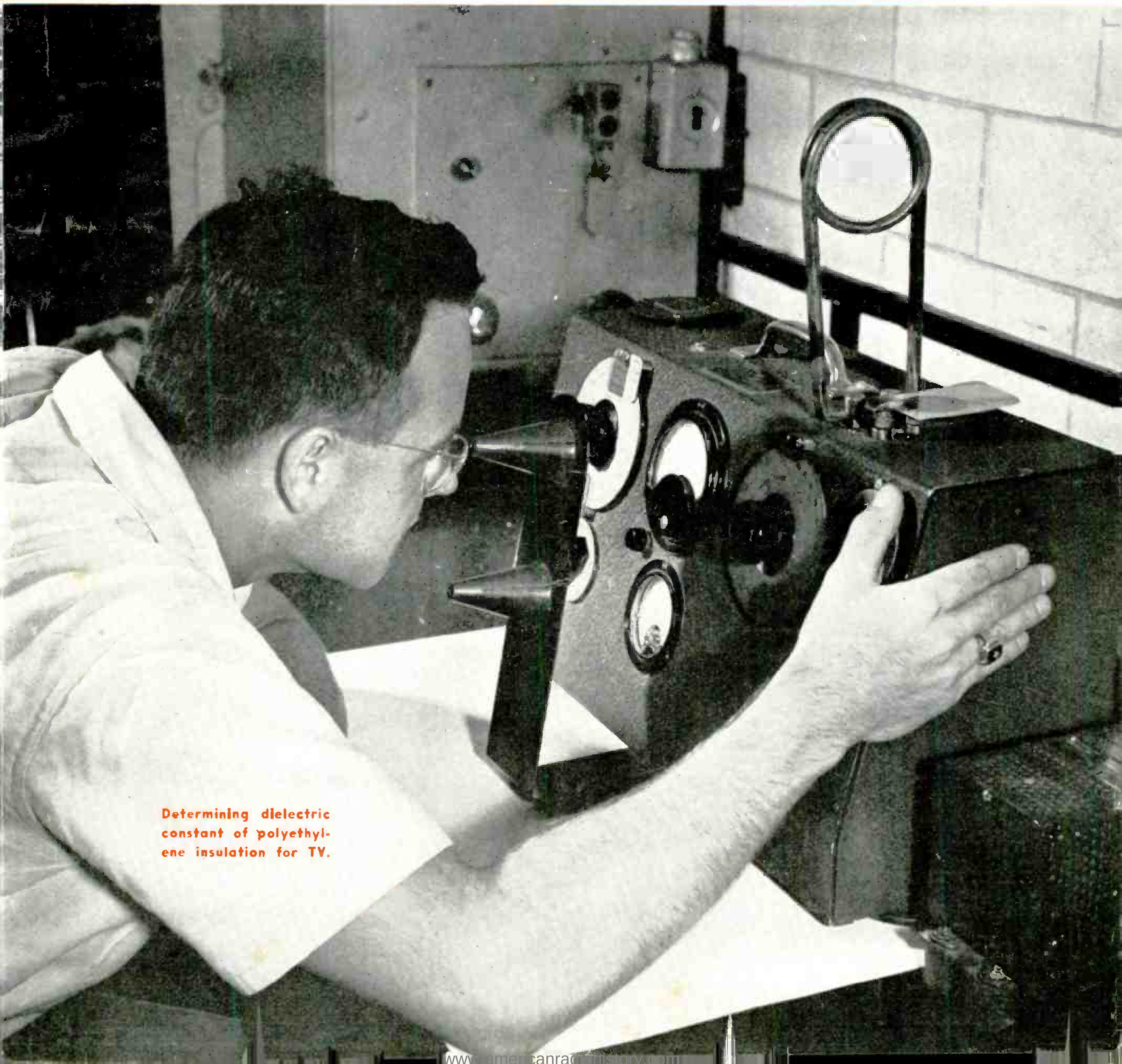
# TELEVISION ENGINEERING

OCTOBER, 1951

*The News-Engineering Journal of VHF-UHF TV, Radar and Allied Industries*



Determining dielectric constant of polyethylene insulation for TV.

# FIT

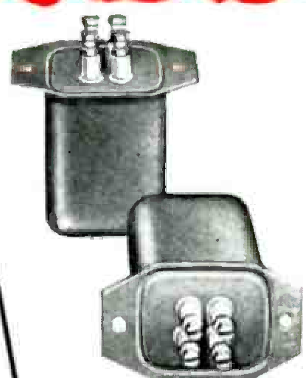
## FOR A KING
## *after*
## THE "ROYAL TASTER"

*Prudently, kings of old employed the "taste-it-first" method to test the presence of lethal power in bulk food and drink. Wary but wise, you'd say...*

## NOW GOVERNMENT CONTRACTORS BUY *Transformers* ON A "PROVE-IT-FIRST" BASIS!

We are prepared to submit a production sample GRACOIL TRANSFORMER (hermetically sealed to JAN-T-27 or MIL-T-27 Government specifications or one of open type construction), if your equipment is to be used for awarded prime or sub-contract work. Put your production sample to *any* test. Then order production quantities with absolute confidence of physical and electrical correctness, uniformity and substantial savings on profit-tight contracts.

James M. Blacklidge
PRESIDENT



VERTICAL BLOCKING OSCILLATING TRANSFORMER HERMETICALLY SEALED BUILT TO MIL-T-27

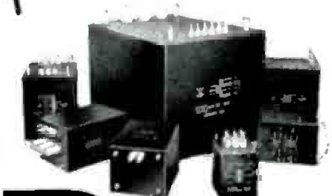


PLATE TRANSFORMER SHOWN (l to r) WITH POWER, FILAMENT, CHOKE, DRIVER, FILAMENT AND SMALLER PLATE TRANSFORMERS ALL BUILT TO MIL-T-27 SPECIFICATIONS. HERMETICALLY SEALED

*One good Turn—or a Million*

FILAMENT
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STEP-DOWN
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WINDINGS

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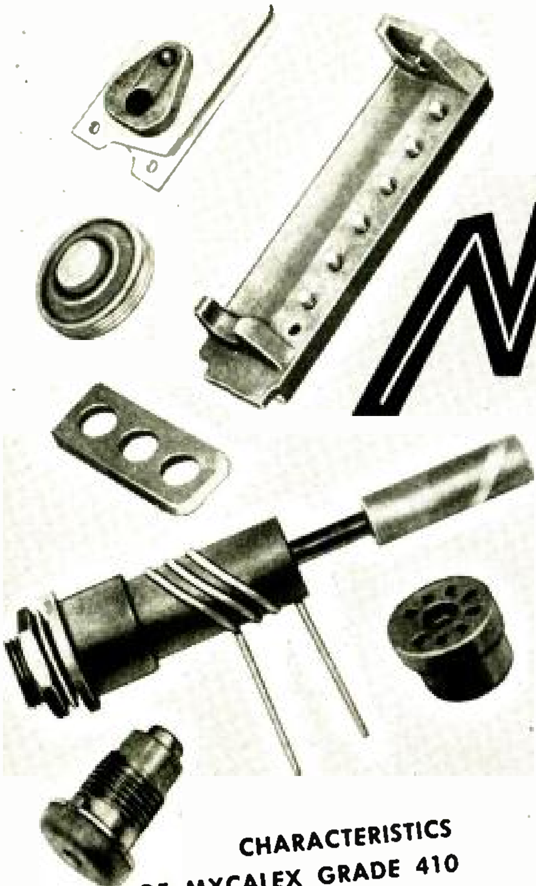
# The Ideal Dielectric

FOR NEW **UHF-TV** APPLICATIONS

# MYCALEX

## Glass-Bonded Mica INSULATION

**—for low loss at low cost!**



- LOW-LOSS FROM 60 CYCLES/SECOND TO 24,000 MEGACYCLES/SECOND
- MAXIMUM EFFICIENCY, UTMOST ADAPTABILITY, LOWEST COST
- AVAILABLE MOLDED TO PRACTICALLY ANY SHAPE OR SIZE WITH OR WITHOUT METAL ELECTRODES OR INSERTS

### CHARACTERISTICS OF MYCALEX GRADE 410

| | |
|---|---|
| Power factor, 1 megacycle | 0.0015 |
| Dielectric constant, 1 megacycle | 9.2 |
| Loss factor, 1 megacycle | 0.014 |
| Dielectric strength, volts/mil | 400 |
| Volume resistivity, ohm-cm | $1 \times 10^{15}$ |
| Arc resistance, seconds | 250 |
| Impact strength, Izod, ft.—lb/in. of notch | 0.7 |
| Maximum safe operating temperature, °C | 350 |
| Maximum safe operating temperature, °F | 650 |
| Water absorption % in 24 hours | nil |
| Coefficient of linear expansion, °C | $11 \times 10^{-6}$ |
| Tensile strength, psi | 6000 |

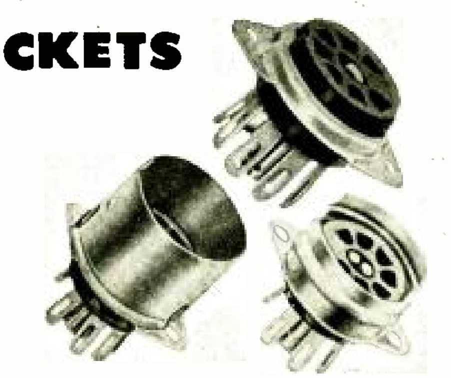
WRITE FOR 20-PAGE CATALOG
This comprehensive compilation of technical and manufacturing data includes complete dielectric information.

FCC Approval of UHF TV has introducea an era of engineering and manufacture to standards seldom before attained in mass production. Many materials, dielectrics in particular, fail to meet these more critical requirements. MYCALEX 410 is one exception. This dielectric can be molded to close tolerances with or without metal inserts—high efficiency to well over 24,000 megacycles. MYCALEX 410 can be molded in volume at low cost. It can be produced to closer tolerances than higher priced ceramics. Electrically and mechanically, MYCALEX 410 is the ideal dielectric for tube sockets, tuners, condensers, switches, coil structures and many other UHF components.

## TUBE SOCKETS

MYCALEX glass-bonded mica sockets are injection molded to extremely close tolerance. This exclusive process affords superior low-loss properties, exceptional uniformity and results in a socket of comparable quality but greater dimensional accuracy than ceramics—all at no greater cost than inferior phenolic types. These sockets are available in two grades, featuring high dielectric strength, low dielectric loss, high arc resistance and fully meet RTMA standards.

*Write for Tube Socket Data Sheets*



MYCALEX 410 is priced comparable to mica-filled phenolics. Loss factor is only .015 1 mc., insulation resistance 10,000 megohms. Fully approved as Grade L-4B under N.M.E.S. JAN-1-10 "Insulating Materials Ceramic, Radio, Class L."

MYCALEX 410X is low in cost but insulating properties greatly exceed those of general purpose phenolics. Loss factor is only one-fourth that of phenolics (.083 at 1 mc.) but cost is comparable. Insulation resistance 10,000 megohms.

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# TELE-VISION ENGINEERING

Including Radio Engineering, Communications and Broadcast Engineering. Registered U. S. Patent Office.

*Research . . . Design . . . Production . . . Instrumentation . . . Operation*

VOLUME 2 OCTOBER, 1951 NUMBER 10



## *MONTHLY FEATURES*



### *Cover Illustration*

Lab technician operating a Q meter to measure the loss factor and determine the dielectric constant of a sample of polyethylene plastic. Test, ASTM D-150-46T, represents one of several used in works control lab of Bakelite Company. *(See page 20, this issue, for detailed discussion on polyethylene.)*

*Editor: LEWIS WINNER*

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TELE-VISION ENGINEERING

LEWIS WINNER, Editor

## October, 1951

***Overseas TV***—Sightcasting centers, throughout the world, cited in these columns on several occasions as promising possibilities, have been found to be really a roaring factor. Reporting on this expanding market potential in a foreign television developmental survey, Washington has noted that there are about a dozen countries below and above the border, as well across the Atlantic, in which television has become a key media. Among the countries revealed as extremely TV conscious were Brazil, Cuba, Mexico, France, Germany, Italy, Netherlands, Argentine, Spain, Sweden, Switzerland and Great Britain. Brazil, Cuba, France and Mexico appear to be particularly active. Two stations are in operation and two more are planned for Brazil; whereas, in France there are three stations operating, and a network of eight transmitting cites is in the planning stage. Germany's two stations are soon to be supplemented by six more. The London and Midland stations in England, which have been favorites for quite a while, have been complemented by another transmitter, at Holme Moss, and it is understood that two more transmitters will be in operation soon. (A complete analysis of the Holme-Moss station will be published in the November issue of TELEVISION ENGINEERING).

The report also disclosed that there are quite a few receivers in use currently in these alien areas. In Cuba, where there are two stations in operation, there are 18,000 receivers; Mexico has over 3500; Brazil nearly 8000; France around 25,000; and there are over 800,000 in Great Britain. In Canada, where at the present time there are no stations, there are, nevertheless, nearly a million and a half receivers in operation. According to present plans, in March and July of '52, Toronto and Montreal expect to have transmitters on the air.

There are some countries in which extensive experiments have been underway for a long while, the results of which are expected to be responsible for the installation of a host of stations. In Denmark, for instance, it is proposed to install six stations very soon; and in the Netherlands, the two experimental units will be soon supplemented by one or two more systems. Even Japan, which now features one experimental station, may soon have at least two commercial-type transmitters on the air.

TV, originally believed to be purely a domestic project, has certainly spread its wings across the hemispheres. As in this country, TV has demonstrated its dynamic influence on viewers, and indicated that it has become a dominant link in modern communications.

***Science Receives a Challenge***—Speaking at a ceremony commemorating his 45th anniversary in the field of radio, RCA board chairman, Brigadier-General David Sarnoff, told research men at the celebration that five years from now he would like to see an electronic photo-amplifier which might permit projection of televised pictures in the home or theatre on a screen of any size, a device that it was felt could be called a *magnalux*. It was his opinion, too, that the boys in the lab could produce a TV picture recorder that would record video signals on an inexpensive tape for reproduction in the home, theater or elsewhere at anytime. Describing this as a *videograph*, the General declared that the technique could replace the present costly time-consuming and limited picture-recording system, and simplify problems of distribution and presentation.

A couple of robust problems to consider!

***Ultrahigh Age***—During the past year there has appeared significant evidence that upstairs TV is no longer a mere listless paper hypothesis, but quite a vibrating reality, with, it seems, limitless possibilities. Within the past months in tests at Bridgeport and Syracuse, and during symposia conclaves in Philadelphia and Camden, there has appeared further conclusive evidence that channels 14 to 83 represent quite a new lively world for broadcasters, with practically every type of gear that may be required available for reception, transmitting or trouble shooting.

The progress display is quite a victory for those who struggled with what everyone described were insurmountable problems. Not only has it been found possible to provide reliable service at low *uhf*, but at the very top where it was said performance would never be dependable. The difficulty of sufficient power has been overcome with craftily engineered amplifiers and antenna systems. Even the means needed for accurate field measurement have been provided, so that telecasters and setmakers now have at their disposal practical facilities which will insure effective transmission and production.

Of course, as in every new facet of science, there are still a host of questions to be answered, but there is little doubt that appropriate replies will be forthcoming soon. In the meantime, the basis for a sound, practical approach to a new orbit of viewing and listening is at hand, an approach that merits the echoing applause of everyone in and allied with the television industry.—L. W.

# TVE-grams . . .

***Materials, Allocations and Production:*** Two of industry's most essential materials, copper and nickel, once again appear to be steeped in trouble. As in the World War II defense era, government has knifed the allocations schedule, and industry faces an acute shortage that could mean serious cutbacks in production and employment—cutbacks which might not only affect civilian output, but military as well. . . . RTMA prexy Glen McDaniel, in a note to NPA electronics division director, Ed Morris, warned that . . . "Unless relief from present nickel allocation policies is granted immediately to the tube-receiving industry . . . by December 1 it will be operating as low as 50 per cent of its present rate of production. Under present conditions between 15 and 18,000 people may be affected. Delays in meeting delivery schedules of military tubes will eventually develop." . . . *On the copper front*, the problem is just as acute. Washington reports that this year we have been using copper at the rate of 110 per cent of what was being mined. A bit of sunshine may appear on the horizon in the latter part of the year, in view of the world accord recently reached on copper, and zinc too, among twelve countries. . . . *Mica supply* which has also loomed as another problem child may be bolstered soon by the stockpiling of grades of block mica, designated as "good, stained and inferior," a type that will actually be sub-standard, but suitable for certain applications.

***Conservation and Substitution:*** Over 70,000 tons of aluminum, cadmium, colbalt, copper, lead, nickel, iron, steel, tin and zinc will have been saved through conservation steps, through the end of '51, according to a report prepared by the materials bureau of RTMA. Specifically, the estimated savings were noted as: aluminum, 1,324 tons or 21 per cent; cadmium, 66 tons or 23 per cent; cobalt, 229 tons or 36 per cent; copper, 9,687 tons or 21 per cent; lead, 239 tons or 21 per cent; nickel, 367 tons or 28 per cent; iron and steel, 51,058 tons or 24 per cent; tin, 266 tons or 25 per cent; and zinc, 1,117 tons or 26 per cent.

***More Material for TV Broadcasters:*** The TV broadcasting industry is now being considered for reclassification by NPA for allocation of critical materials, according to a report from Peter Black, special assistant to the NPA administrator. The reclassification might provide broadcasters with 25 tons of steel, 2,000 pounds of copper and a 1,000 pounds of aluminum per quarter on the basis of self-authorization, replacing the present small allotment of two tons and only 200 pounds of copper and paralleling the authorization granted to newspapers and other publishing enterprises.

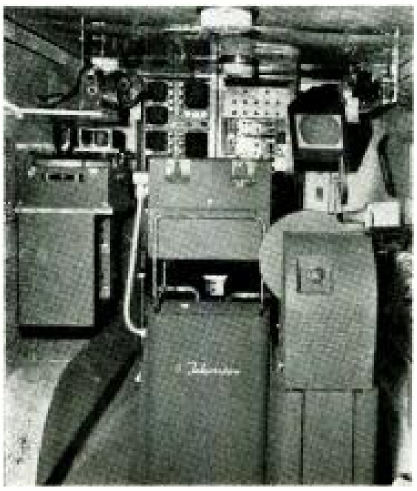
***Another Color System:*** The red, green and blue vista now has another tenant, born on the Pacific coast and featuring a camera disc revolving at 1800 rpm, a whirling receiver disc using a 900-rpm speed, and a frame rate of 30 instead of 48 as used by CBS. According to the sponsors of the technique, who incidentally demonstrated the system over KPHO-TV in Phoenix, Arizona, a few weeks ago, effective reproduction can be achieved on projection equipment. The method, developed by Color-TV Associates, appeared to some observers at the experimental show to provide satisfactory results, although flicker was apparent.

***Colored Solder:*** Colored resin core available in red, blue, green or yellow, developed to speed production and reduce inspection time, is now being used in a few plants in Australia. According to the manufacturer, the addition of the coloring matter does not impair the function of the flux at any soldering temperature, nor does it affect the electrical behavior of the residue or the insulation resistance of the parts to which it has been applied.

***On the Calendar:*** During the summer of '52, Chicago will be the scene of a centennial of engineering, during which will be featured symposiums on every facet of science including a round of sessions on radar and TV. Pageants on the trends of science will be presented in the 1000-seat theater at the Museum of Science and Industry. An attendance of 50,000 is expected during this outstanding celebration.

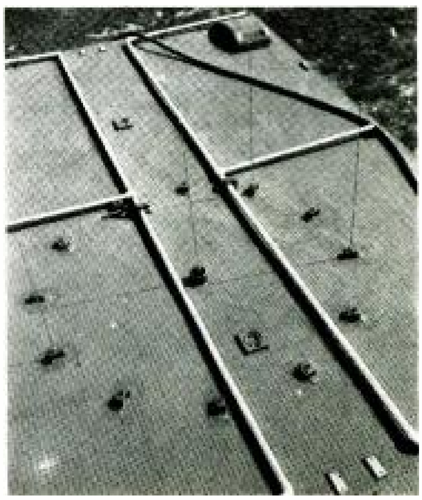
**Housing which could be molded of styrene in combination with any other plastics compound or metal, that has as its basic module a simple rectangular case, with smoothly contoured edges for ease of molding. Modular design can be used either horizontally or vertically, and a possible six or eight different-looking housings could be designed around the one basic form, a factor which would cut down retooling expenses.** *(Courtesy General Electric).*

**Interior view of a Signal Corps TV mobile caravan receiving unit. In addition to housing FM and microwave receiving equipment, the truck contains ten 16-inch picture monitors, a 16-mm TV projector and film camera, slide projector, large screen TV projector, and a video switching panel. Visible is the film camera, diplexer, and film projector in center and to right, while to the left are disc and tape recorder amplifiers and disc recorder.** *(Courtesy RCA.)*



**Reinforced roof of the caravan's transmitting vehicle showing FM audio transmitting antenna system. Directional radiation is achieved by proper location of parasitic director whips with respect to the radiator (center).**

*(Courtesy RCA.)*



# TVE-grams . . . — Personals

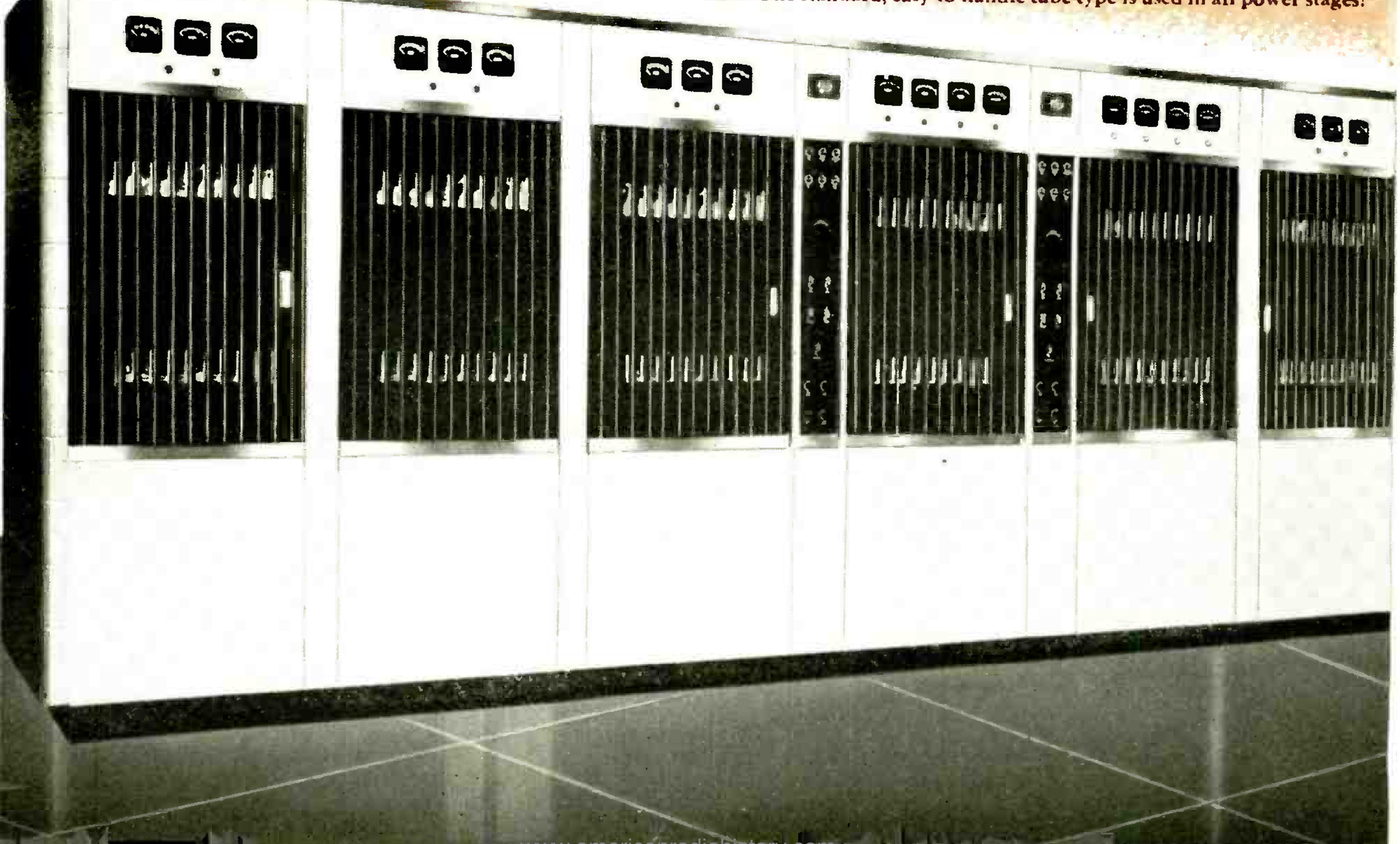
**New Posts:** *Louis M. Robb* has been appointed district tube rep for the G. E. tube department, headquartering in San Francisco. . . . *Julius Fine* has been appointed commercial sales manager, and *Kenneth S. Brock* has been named advertising and sales promotion manager, for both The Ward Products and Workshop Associates divisions of The Gabriel Co. . . . *Charles F. Adams, Jr.*, has been reelected president of the Raytheon Manufacturing Co. Others reelected were: *David T. Schultz*, vice president and treasurer; *Wallace L. Gifford, Ray C. Ellis, Percy L. Spencer, Norman B. Krim, David R. Hull* and *Ivan A. Getting*, vice presidents; *Ernest F. Leathem*, assistant to the president; *Paul F. Hannah*, secretary and general counsel; *J. E. Smith* and *G. E. M. Brown*, assistant vice presidents; *Allen E. Reed*, comptroller; and *Elmer J. Gorn* and *Ruth E. Babb*, assistant secretaries. . . . *M. A. Chapman*, president of the Mica Insulator Co., has been elected president of the Mica Fabricators Association. Julius Canter, president, Mica Fabricating Co., and *Sidney A. Montague*, president, Spruce Pine Mica Co., have been elected vice presidents. . . . *Dr. Charles B. Jolliffe* has been elected vice president and technical director of RCA, and *Dr. E. W. Engstrom* has been elected vice president in charge of the laboratories division. . . . *Howard Rowland* has been appointed chief research engineer of the Workshop Associates. . . . *John A. Van Auken* has been named vice president-sales of Utility Electronics Corp. . . . *James B. Ferguson* has been appointed chief engineer of Link Radio Corp. . . . *Robert T. Borth* has been appointed manager of employee relations of the G. E. tube department. . . . *Jack Thomas*, formerly with the Antenna Laboratories, has joined the engineering staff of Technical Appliance Corp. . . . *William M. Nave*, formerly superintenden of metal tube production at Owensboro, Ky., has been appointed works manager for the G. E. electronic plant under construction near Anniston, Ala. . . . Bendix radio division of Bendix Aviation Corp. has announced the following appointments: *Walter G. Jager*, assistant manager of government sales and *James S. Wells*, chief industrial engineer.

**Awards:** *Dr. Newbern Smith*, Chief of the Central Radio Propagation Lab of the Bureau of Standards, will receive the 1952 Harry Diamond Memorial Award from the IRE for his outstanding contributions to the field of radio and electronics. . . . Forty-five fellow awards have been announced by IRE for '52. Among those to receive the award are: *John L. Barnes*, University of California; *S. J. Begun*, vice president and chief engineer, Brush Development Co.; *Ralph D. Bennett*, technical director, U. S. Naval Ordnance Lab; *Leo L. Beranek*, technical director of acoustics lab and associate professor, MIT; *H. W. Bode*, research mathematician, Bell Telephone Labs; *Leon N. Brillouin*, director of electronic education, IBM; *Marvin Camras*, senior physicist, Armour Research Foundation; *C. W. Carnahan*, manager electronics department, Sandia Corp.; *P. S. Christaldi*, engineering manager, instrument division, DuMont; *L. J. Chu*, associate professor, MIT; *Howard Post Corwith*, vice president, Western Union; *Arthur B. Crawford*, radio research engineer, Bell Telephone Labs; *L. A. De Rosa*, department head, Federal Tel Labs; *L. T. DeVore*, manager electronics lab, G. E.; *D. W. Epstein*, research engineer, RCA Labs; *Lester M. Field*, professor of electrical engineering, Stanford; *L. B. Hallman, Jr.*, chief of operations, communication and navigation lab, USAF; *R. N. Harmon*, engineering manager, Westinghouse Radio; *Henry E. Hartig*, professor and head of department of EE, University of Minnesota; *John K. Hilliard*, chief engineer, Altec Lansing; *R. S. Holmes*, manager contract projects, RCA Labs; *Charles N. Kimball*, president, Midwest Research Institute; *W. E. Kock*, research engineer in charge of acoustics, Bell Telephone Labs; *Harold B. Law*, research engineer, RCA Labs; *Louis Malter*, RCA Labs; *William S. Marks, Jr.*, chief engineer, Coles Signal Lab; *William W. Mumford*, technical staff, Bell Telephone Labs; *L. S. Nergaard*, research engineer, RCA Labs; *Harry Nyquist*, Bell Telephone Labs; *J. A. Ouimet*, chief engineer and coordinator of TV, Canadian Broadcasting Corp.; *Henry W. Parker*, technical advisor, Sylvania; and *D. W. Pugsley*, designing engineer, G. E.


Twenty-eighth '51-'52 RTMA board of directors.

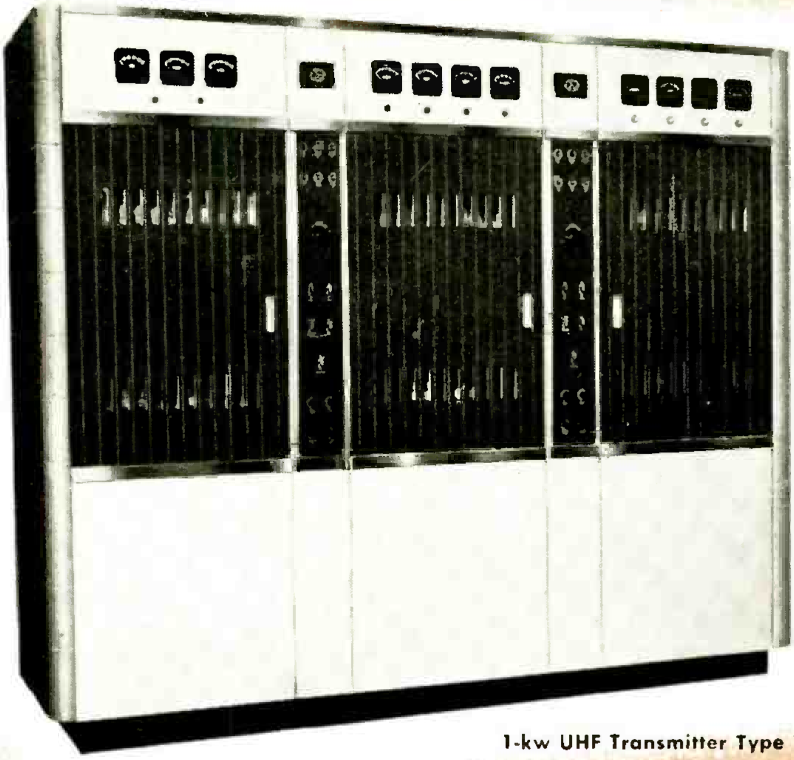
# For UHF ...go RCA

## Any power to 200 kw*....



**10-kw UHF Transmitter Type TTU-10A**

RCA's answer to high power on channels 14 to 83. With an RCA high-gain UHF antenna, this transmitter can produce up to 200 kw, ERP. One standard, easy-to-handle tube type is used in all power stages!



**1-kw UHF Transmitter Type TTU-1B**

This transmitter, and a high-gain RCA UHF antenna, can produce up to 20 kw, ERP on channels 14 to 83! Type TTU-1B is all air-cooled.

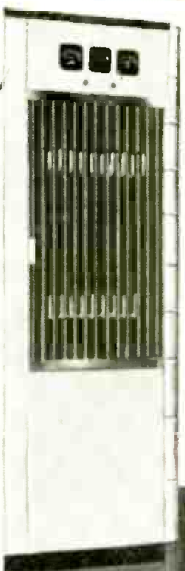
RCA's new 1-kw and 10-kw UHF transmitters (and RCA's high-gain UHF antennas) will give you power combinations up to 200 kw . . . on any TV channel!

If you are planning high power UHF, RCA's new 10-kw transmitter is the answer. If you are planning to start with low power UHF, then RCA's new 1-kw transmitter will meet your needs (increase power later simply by adding matching amplifier units).

Be sure your station planning is correct from the start . . . before you invest a single dollar. Your RCA Broadcast Sales Specialist will show you exactly what equipment you'll need to get on the air at lowest cost.

**Available only from your RCA Broadcast Sales Specialist**

A 64-page book on RCA's new line of TV broadcast equipment for all channels, 2 to 83! An indispensable reference for station planning.



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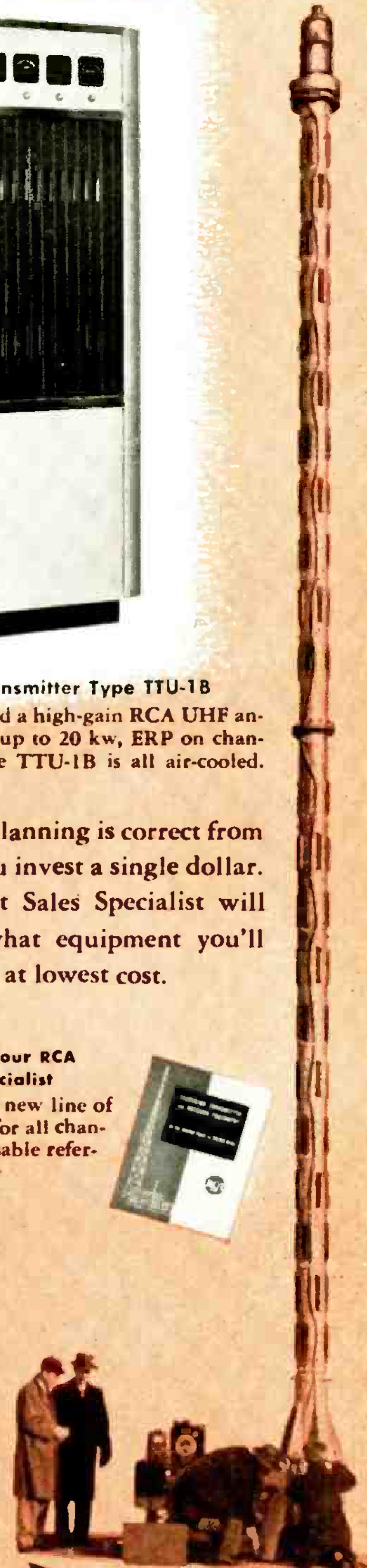


**New High-Gain Antenna for UHF**

The most economical way known to produce high effective radiated power for UHF—and more kilowatts per dollar. Excellent "close-in" coverage in all directions. Power gain, 24 to 28, depending on channel.

*Effective Radiated Power

**RADIO CORPORATION of AMERICA**
**ENGINEERING PRODUCTS DEPARTMENT** CAMDEN, N.J.

# Report on the First

## *Highlights of Papers Presented by George H. Brown, R. A. Soderman and F. D. Lewis, Lloyd Krause and W. B. Whalley Covering . . . Results on 850-Mc, UHF Impedance and Frequency Instrumentation, Helix Transmitting Antenna and UHF Receiver Design Considerations.*

UHF TV, whose stellar performances at Bridgeport, not only on the lower portion but even at the top rung of the spectrum, have excited everyone, has become, as a result, a sizzling priority project along the entire front in industry. Producers of instruments, transmitters and receivers, and antennas, have all exhibited an enthusiasm in the new art which has not been seen since the days of the carbon-mike studios. In the labs, and in the field, too, there have appeared new types of gear for higher-band application, resplendent with striking features. Unfortunately, since these developments have come at such a furious pace, it has not been possible to inform everyone and disclose not only how the new equipment operates, but what it contains and what additional features we may expect to see in the future.

Believing that such information might be forthcoming at an industry conference, it was decided to probe the possibilities of such a meeting under the sponsorship of the IRE *Professional Group* on *Broadcast Transmission Systems*, whose members would be particularly interested in the ultrahighs. The response indicated unanimous approval of the plan, resulting in the first *uhf* symposium‡, held at the Franklin Institute in Philadelphia. The theme was so intriguing that nearly 200 members and guests from twenty states attended.

Offered were papers on 850-mc transmission, 700-mc installations, impedance and frequency measurements at the ultrahighs, side-fire helix *uhf* transmitting antennas, receiver design, transmission-line problems and field-strength analyzers. In addition, there were displayed, for the first time, operational exhibits of the equipment covered in the talks.

Reporting on 850-mc transmission, Doc Brown of RCA Labs, revealed that in the spring of this year it was decided to conduct experiments on antenna beam tilting, which it was felt might provide some increase in signal. Rather than attempt an involved procedure of beam tilting with the existing antenna, a new directional beam antenna was constructed, mounted on the side of the tower 145 feet above ground level and arranged to swing through an angle of tilt of six degrees or more. It was pointed out that the base of the tower is approximately 180′ above sea level, while the average elevation through the metropolitan area of Bridgeport is approximately 50′.

### *Test Results*

The beam antenna was found to have a vertical pattern, essentially the same as the omnidirectional antenna. With the beam tilted down approximately 3°, the signal increase was found to be at least 10 db.

From the initial test data thus far collected, it has been learned that tilting of the beam downward results in an average increase of signal of 10 db throughout Bridgeport to distances of five miles from the transmitter. At distances greater than five miles, the signal is decreased by a downward tilt of the beam. With an effective radiated power of 40 kw, it was said, a median field intensity of at least 10,000 microvolts per meter can be obtained to a distance of five miles from the transmitter. The tests also revealed that tropospheric field at a distance of 100 miles is reduced approximately twelve db when the beam is tilted downward 1.3°.

### *Side-Fire Helix UHF Transmitting Antenna*

Reviewing the characteristics of a 4-section antenna having a power gain of 20, achieved by using a radiation-attenuated, traveling-wave helical current, Lloyd O. Krause of G.E. pointed out that with this type of design the helix sidefires, producing a beam of narrow angle in the vertical plane, horizontally polarized, and of uniform azimuth pattern.

The antenna, it was said, uses a traveling-wave principle to excite a large portion of the aperture from a single feed; the traveling-wave is made to suffer rather high attenuation due

*Above*
Ye editor, who served as chairman of the symposium, and Robert A. Soderman of General Radio, probing the sidefire helix transmitting antenna, on display at the meeting. At right appears an uhf admittance meter, as well as a uhf oscillator. The admittance meter can be used in a setup for measuring the impedance of a stub antenna, a constant-impedance adjustable line also being employed to eliminate line-length correction. (*Courtesy, The Philadelphia Inquirer.*)

‡ *All the papers offered at the symposium are scheduled to appear soon in a special professional group report volume which will be available for approximately $2.00. Complete publishing details will be announced shortly.*

Transmitting tower of *RCA-NBC's* experimental ultrahigh station KC2XAK, near Bridgeport, Conn., showing, on the left side, antenna, which when tilted slightly more than 3° up or down has been found to provide a substantial boost in power output. In testing the antenna, Jess Epstein and D. W. Peterson, of the research staff of *RCA Labs*, who designed the antenna and supervised field surveys, employed a motor-driven arrangement and rocked the antenna back and forth in an arc of approximately 12° to permit recording of the resulting variations in signal strength.

# IRE UHF Symposium

to radiation loss. The far end of the conductor may be left open or shorted, rather than terminated, Krause noted, with negligible effects from the reflections occurring at the unterminated ends because of the small amount of energy remaining in the wave at this point. Thus, each portion of the wire serves as a radiator, and as a feed for successive portions, simultaneously.

The operation of the helix can be analyzed, it was said, by studying the radiation from one turn, and then applying array factors to sum up the effect of all the turns. Preliminary studies were made of the radiation occurring from one turn, in general terms. The integral mode case was then studied further; the integral mode case means that the helix turn is an integral number of wavelengths, the mode number corresponding to the number of wavelengths. In studying calculated results for the vertical pattern up to modes including the fifth, it was noted that the one-wavelength mode radiated rather uniformly in most directions, but better along the axis than in its plane. This was cited as the mode commonly used in the presently well-known end-fire helices of circular polarization.

It was pointed out that the one-wavelength mode does not lend itself to practical mast support, since the strong loop field passes directly through the

by BERT M. ELY

Frank Lewis, of General Radio, with a frequency meter designed for uhf work. At left appears an amplifier and null detector.

center of the loop, and a large metallic member causes serious disruption of normal operation. By using a higher order mode, where the field at the center is zero, and where the diameter per turn is large enough to permit a sufficiently strong support without seriously disturbing operation, the desired radiation characteristics can be obtained.

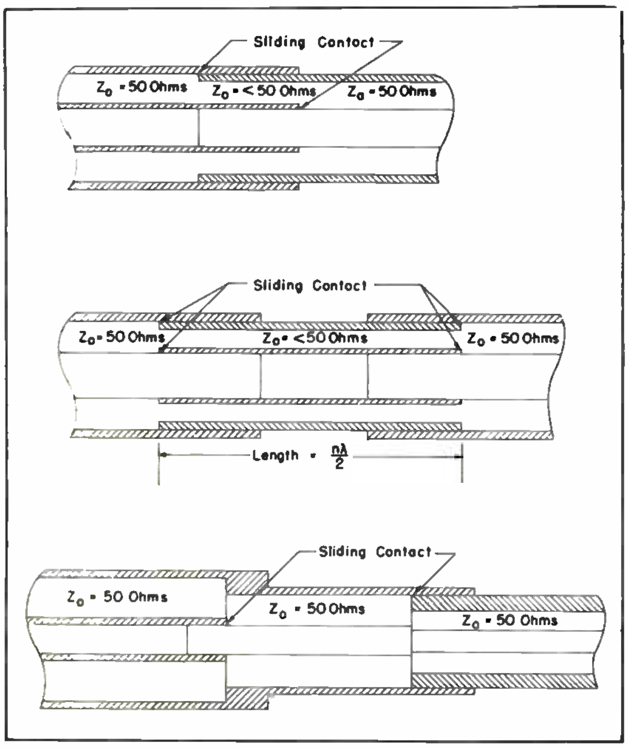
A mathematical analysis of one turn for an unattenuated case disclosed that the azimuth pattern was independent of azimuth angle or helix pitch in the plane at right angles to the helix axis, or the horizon. However, the pattern gradually was found to become scalloped as the vertical, or parallelism with the helix axis, was approached; the depth of scalloping is a function of the helix pitch angle. No scalloping was said to occur with zero pitch angle. The scalloping was noted as being insignificant in the region of the horizontal beam produced by a practical helix.

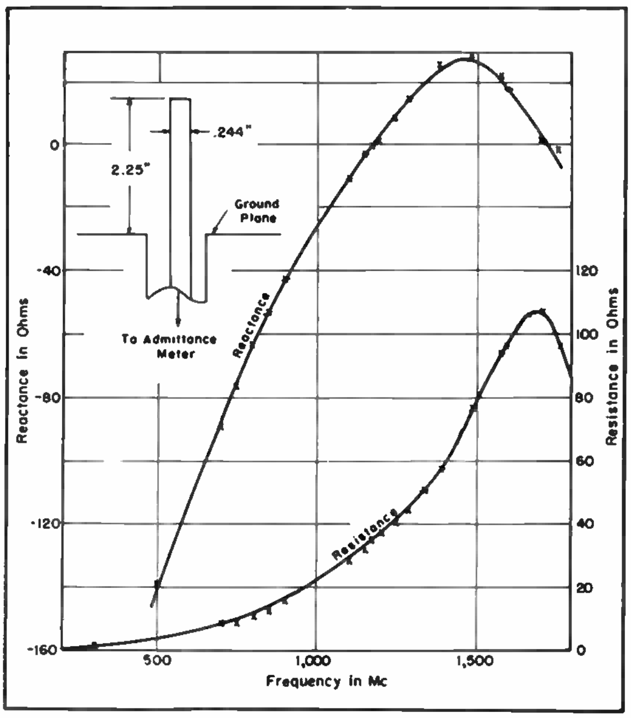
Analyzing the 4-bay antenna, Krause stated that the length of one section is five wavelengths, a length that also corresponds to the distance between feed points of the four sections. Noting that a series feed is used, the G.E. expert said that the distance between feeds must be an integral number of wavelengths to yield in-phase feeding of the four sections. The five-wavelength spacing results in a near optimum array factor for the particular pattern produced by one section.

It was noted that a right and a left hand helix were used in each section, each helix having five turns, and the two helices being placed end to end, and fed at their junction, which is in the center of the section.

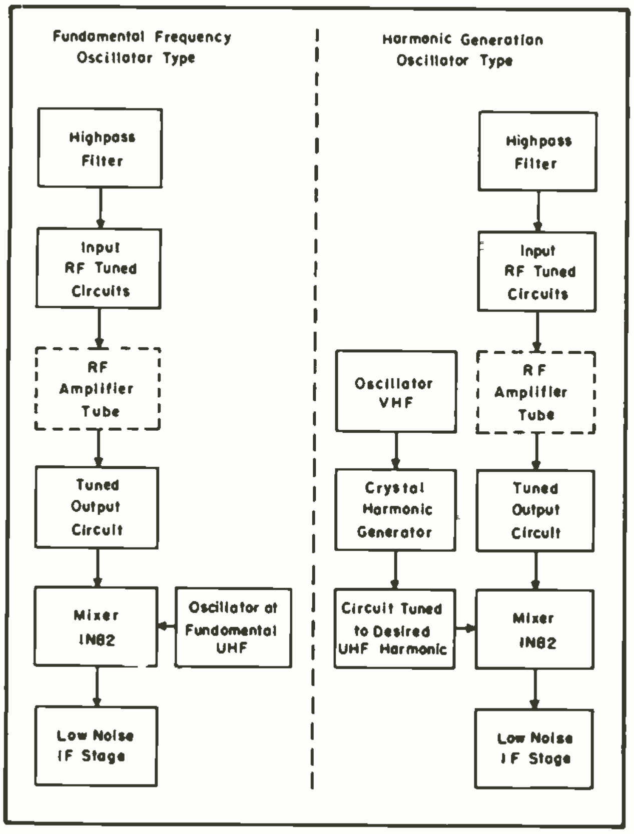
The use of center feed on each section was said to prevent beam tilt from

Cross sections of various types of adjustable-length coax lines, described by Soderman and Lewis: See p. 13 for details.




Plot of results of measurements made on the stub antenna, reviewed in Soderman-Lewis paper.




**W. B. Whalley of Sylvania and the display of tubes and diodes which it was said would be used for ultrahigh tuners and converters. Included in the exhibit were a 5768 planar grid uhf amp-triode. 1N82 silicon uhf mixer-diode. 5R1165E uhf triode oscillator. 1N34 and 1N34A germanium diodes for harmonic generation. 12AU7 vhf oscillator-mixer double triode for use with 1N34-1N34A as uhf harmonic source. 6BQ7 double-triode for first if stage. 6BK7 alternate double triode for first if stage. 1N60 video detector and 6BF5 direct-coupled video-amp beam tetrode.**

**(Left)**

**Simplified block diagram of ultrahigh tuner described by Whalley.**

occurring in the beam of the basic sections. The upper and lower portions advance and retard in phase together, keeping the maximum field on the horizon. However, Krause pointed out, the beamwidth will increase, resulting in a net reduction of gain. The beaming bandwidth was defined as the total frequency separation between the two points where the half-power beamwidth has increased 1 db. For television purposes, it was decided to make this bandwidth a minimum of 20 mc, to insure that over the channel the gain variation would be negligible. The beaming curve was described as having a rather flat bottom; the channel under consideration may be placed on this flat portion.

The use of the right and left hand helices were found to reduce the vertical polarization to a tolerable amount. Feeding the two helices in parallel was said to have the advantage of reducing the feed resistance to a more convenient value.

By estimating the attenuation and surge impedance, it was found that the net distributed radiation resistance per turn is about 200 ohms. At *uhf* frequencies, it was noted, even such a high value of distributed resistance results in insignificant phase angle in the surge impedance of the helix.

*Kel-F* insulators were adopted to support the helices, the material having excellent mechanical and weathering properties, combined with a very low dielectric constant.

Declaring that the intrabay feed system is coaxial, with the mast itself serving as the outer conductor, Krause added that the inner conductor is shorted to the mast a quarter-wave above the top section feed for mechanical support and *rf* isolation of the rest of the mast. The main-line input at the bottom of the antenna was said to have been designed for 3⅛" line, the input entering the mast from the side through a special matched *T*. The inner conductor is again shorted to the mast a quarter-wave below this input.

The individual bays are probe coupled to the inner, not making direct connection. The individual probes are adjusted so that each bay receives one-quarter of the input power. Impedance match is maintained throughout the mast coax to insure maximum impedance bandwidth.

Noting that beam tilting can be produced by this type of antenna, Krause declared that by mechanically rotating one portion of the antenna relative to the other, beam tilt can be achieved, since the relative phase between bays has been effectively changed.

### *UHF Receiver Design Considerations*

In an analysis on receiver design for practical reception of *uhf* signals, W. B. Whalley, of Sylvania, cited that four sections of the chassis require particular engineering consideration: input tuner, *if* amplifiers, *agc*, and sync. Sections of a *uhf* receiver which do not require design change from conventional *vhf* receiver arrangements, he said, include video detector, video amplifier, horizontal *afc*, deflection, sound system and supply voltage circuits.

Commenting on those sections of the set which do not require modification for *uhf* reception, Whalley stated that 1N60 germanium diodes provide advantages for video detection because of their high forward conductance, low intrinsic capacitance and high back resistance characteristics which permit good wideband operation.

The intercarrier sound system, Whalley continued, facilitates tuning and can give less audio noise between channels. This can be a factor in *uhf* reception where the great number of channels, and the wide spaces between those which are active in a given location, will make tuning difficult.

It will be necessary to use the best possible *agc* system, it was said, since fading could be more severe on *uhf* than on present *vhf* channels, a condition caused by the sharper shadow regions, less diffusion of the wave front around obstacles and because airplane flutter produces larger ratios of signal-strength change.

To reduce the effects of rapidly fluctuating signals and such interference as may occur due to cross-modulation, Whalley recommended that the sync circuits should also be of the best possible design. Cross-modulation may occur more readily at *uhf*, he explained, due to the poorer discrimination against nearby channels, because of the limited number of tuned circuits.

Summarizing considerations of the *if*

frequency selected. Whalley said that it should be chosen for the best image rejection; minimum power in best frequencies between harmonics of the *if* and the incoming signal; minimum local oscillator radiation; low-noise factor; good gain for a given number of stages, and non-regeneration with low channels in the *vhf* band.

Because of the large number of channels possible at *uhf*, or seventy, in contrast to twelve in the present band, Whalley said that several schools of thought have developed with regard to the mechanical operation of the *uhf* tuner. He classified possible mechanical designs in three groups including the continuously tunable as used by DuMont and Mallory; the semi-continuous or *bandspread* type in which a switch selects *uhf* zones and a dial is used to tune in the channels in each zone; and selector switching where a choice of up to eleven *uhf* channels may be preset and are then tunable with seven or fewer *vhf* channels by the same type of selector switching now being used for *vhf* TV reception.

Commenting on *uhf* tuners, from the viewpoint of ease of tuning, the Sylvania physicist said that it has appeared that many television owners prefer channel switching. This becomes even more important, when *uhf* is considered, since one part in 42,000 accuracy is required in tuning for good sound for a double *if* receiver. This tuning sensitivity may be compared, he pointed out, with an AM broadcast receiver where tuning within 1 kc is quite acceptable and where the total spectrum is only 1100 kc.

Summarizing the basic electronic sections of *uhf* tuners, Whalley said that they can be divided into two groups: the fundamental oscillator of the continuously tunable type and harmonic generation of the local oscillator frequencies associated with selector switch tuning.

George H. Brown and ye editor reviewing the electronic field-strength analyzer for use in field surveys described by Fred Smith of NBC at the symposium.
*(Courtesy, The Philadelphia Inquirer.)*

### *RF Amplifier Requirements*

Requirements for *rf* amplifiers at *uhf* were said to include reduction of local oscillator coupling to antenna; improvement of noise factor to increase useful range of the transmitter, and provision for increased image rejection and reduced cross-modulation at the mixer.

While types of tubes now available at a reasonable price for *rf* amplifiers at *uhf* are, it was pointed out, conspicuous by their absence, there are some around with possibilities: planar grid triodes such as 5768 and the small travelling-wave tube suggested by Adler of Zenith. Also mentioned was the new silicon diode mixer, 1N82, because of its low noise factor which was said to be better than that of germanium diodes.

Describing the procedure for impedance matching of the *front-end* Whalley said that procedure was the reverse of that usually employed in the case of *vhf* receivers, or from output to input.

### *Ultrahigh Impedance and Frequency Measurements*

In a revealing dissertation on impedance measurements on the higher bands, Robert Soderman of G-R detailed the key problems which must be overcome at *vhf* and the ultrahighs.

In the *vhf* band, he said, the engineer is plagued by stray capacitances and inductances which effectively appear as reactances in series or parallel with all circuit elements, while in the *uhf* band, the situation is still more complicated since, in most cases, the distributed nature of the stray reactances is of importance. It was noted that the calculation or measurement of the distribution of the stray reactances is usually difficult for most lumped-circuit elements, and the use of sections of transmission lines for circuit elements is attractive as the distribution of the parameters can be easily calculated and the performance determined.

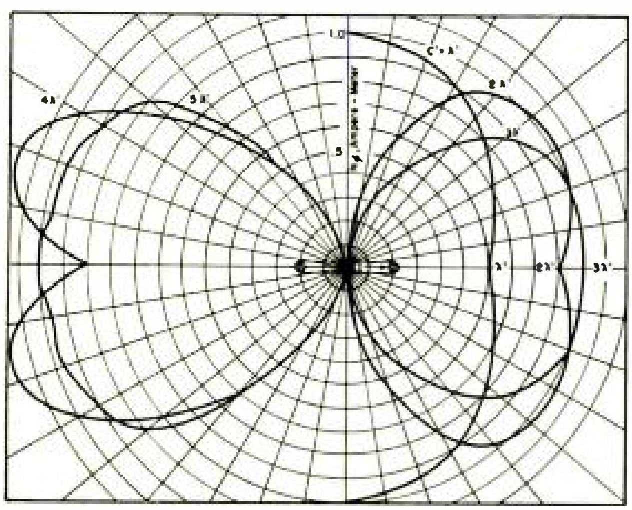
In the *uhf* band, the distributed nature and the magnitude of the stray reactances difficulties were said to be usually overcome by using impedance-measuring devices based entirely on distributed-parameter circuit theory or semi-lumped-parameter devices, in which the most objectionable stray reactances have been made a part of distributed-parameter circuit elements.

The most commonly used impedance-measuring device was noted as being the old standby, the slotted line, which measures impedance by indicating the magnitude and position of the standing-wave set up on a uniform transmission line terminated in the unknown impedance.

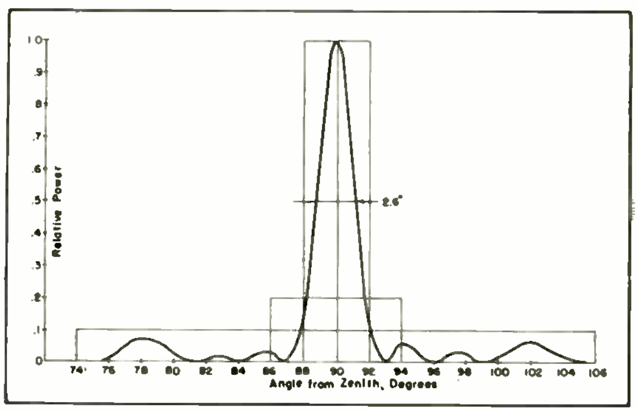
Describing two newer instruments which measure impedance or admit-

*(Continued on page 28)*

Vertical patterns obtained from one turn of integral mode-helix, described by Lloyd Krause, the pitch and attenuation being equal to zero.

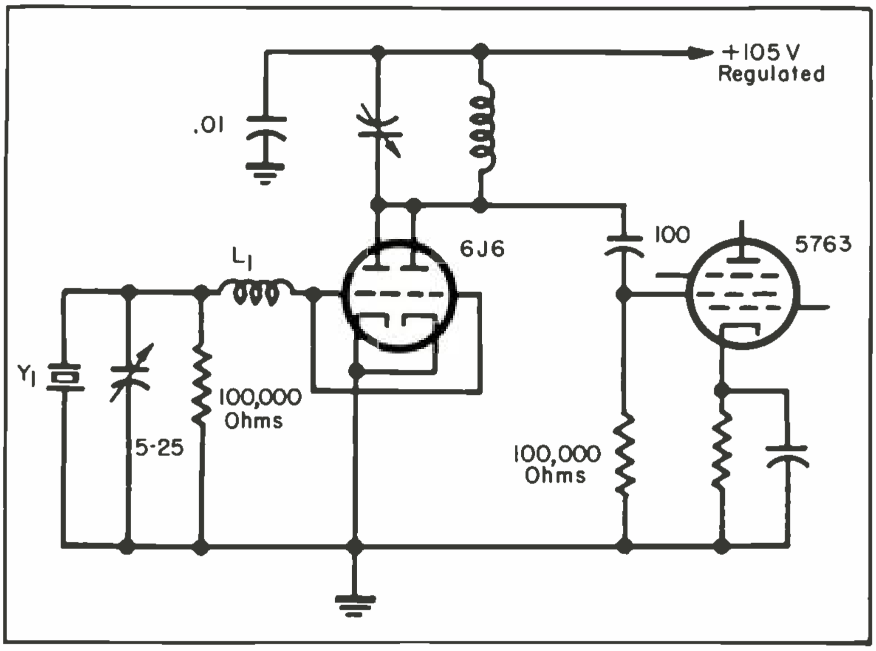


Measured vertical pattern of a 4-bay 1,000-mc helix antenna. The antenna uses a helical conductor supported by a coax metallic mast. The vertical aperture is about 20 wavelengths, each turn of the helix being two wavelengths in circumference.



# *Ultrahigh*

Figure 1
Schematic of overtone crystal oscillator used in 1-kw uhf transmitter.




THE ULTRAHIGH WORLD, originally described as a globe of mystery, beyond the reach of the scientists of this era, a belief which has now been soundly routed, is today quite a bristling land of activity, thanks to persistent efforts of those in the lab and field. Destined to become the expansive home of most telecasters, *uhf* has been stripped of many puzzles permitting the use of practical systems for sending and viewing. Available now are not only trouble-proof transmitters, but antennas and measuring gear, which can be applied anywhere within the entire *uhf* spectrum of 470 to 890 mc or channels 14 to 83.

In one line there is a transmitter[1] which provides 1 kw of peak picture power and 500 watts of aural power out of a side-band filter and diplexer. In conjunction with a slotted TV antenna,[2] the transmitter will provide peak picture powers in the order of 20 kw.

Also available is a 10-kw linear amplifier which can be added later to provide peak powers of up to 200 kw.

### *RF Circuits*

To maintain crystal control in this transmitter and eventually achieve operating frequencies in the *uhf* spectrum, it was decided to use overtone crystals with an output frequency of 26 to 37 mc. This arrangement was found to yield a multiplying factor of 18 and 24 (for operation between 470 and 630 mc; multiplying factor 18), and result in a transmitter with 8 *rf* stages. Heretofore, the crystal oscillator output frequency was approximately 6 mc and this necessitated a multiplying factor of 144 before a final operating frequency in the order of 850 mc was reached. The use of overtone crystals was also found to provide increased frequency stability.

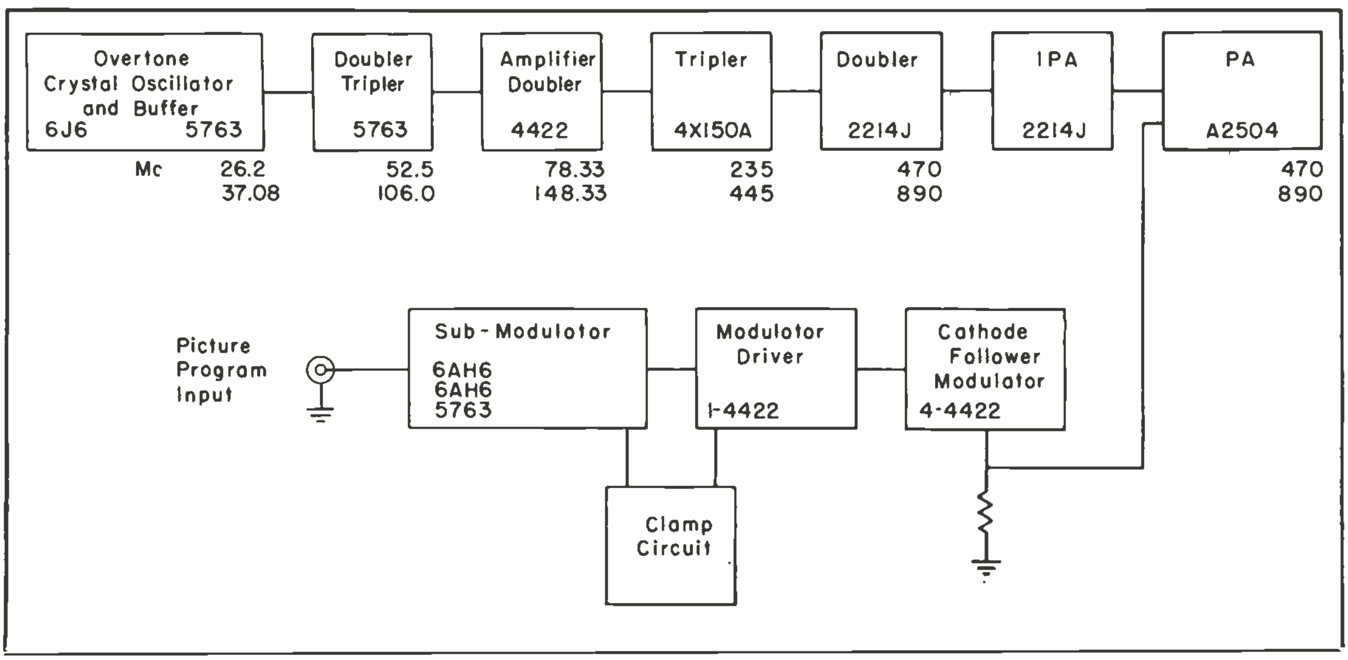
The overtone-crystal application was also noted as being quite helpful when intercarrier-type TV receivers are used. The intercarrier system operates because of the beat between the picture and sound carriers produced in the video detector. This beat is nominally 4.5 mc and the receiver *if* stage or stages and discriminator are tuned to

*Based on copyrighted data appearing in the RCA TV Technical Training Manual and information presented during the recent week-long TV clinic sponsored by the RCA Engineering Products Department for broadcasters. The manual, a 444-page book, priced at $8.00, is available to TV broadcasters from Broadcast Equipment Sales, Engineering Products Department, RCA, Camden, N. J.

[1] RCA TTU-1B.

[2] TFU-24.

Figure 2
Simplified block diagram of 1-kw uhf picture transmitter.



# Transmitter and Antenna Design and Application*

by RALPH G. PETERS

*Characteristics of 1 and 10-Kw Equipment: RF Circuitry . . . the Video Modulator. Features of Antennas and Allied Equipment: Electrical and Mechanical Aspects . . . Deflection of Antenna and Tower . . . Coverage and Site Location Problems . . . Installation and Operation.*

this frequency. If the sound carrier and picture carrier frequencies drift, particularly in the opposite direction, it is possible that the beat between the two carriers will no longer be 4.5 mc. This will result in adverse receiver operation. It has been decided by an RTMA committee that the maximum difference between the carriers must not exceed 5000 cycles. At *vhf* frequencies this maximum difference can be achieved by using crystals with a tolerance of .0005 per cent for the visual carrier, and .001 per cent for the aural carrier. If the same tolerance is used for *uhf* operation, the maximum carrier difference will be approximately 12,150 cycles at 890 mc, which is beyond acceptable limits. A tolerance of .0001 per cent for the visual carrier and .0004 per cent for the aural carrier will maintain the difference between the two carriers to an acceptable value. The difference could be maintained by using the beat between the carriers to control an *afc* system in the transmitter. However, this would require common circuitry between picture and sound transmitter. The use of overtone crystals, with their greater stability, thus permits the two transmitters to operate independently of one another and avoid trouble at the higher frequencies.

Off-set carrier operation has been used successfully at *vhf*, but its success has been found to be dependent to some extent upon maintaining a stable difference frequency between interfering carriers. The use of overtone crystals was found to allow the use of off-set carrier operation at *uhf*, if ever needed.

The overtone crystals[3] are contained in a case similar to standard broadcast crystals, which features a heater unit operating from 115 volts and requiring approximately 14 watts.

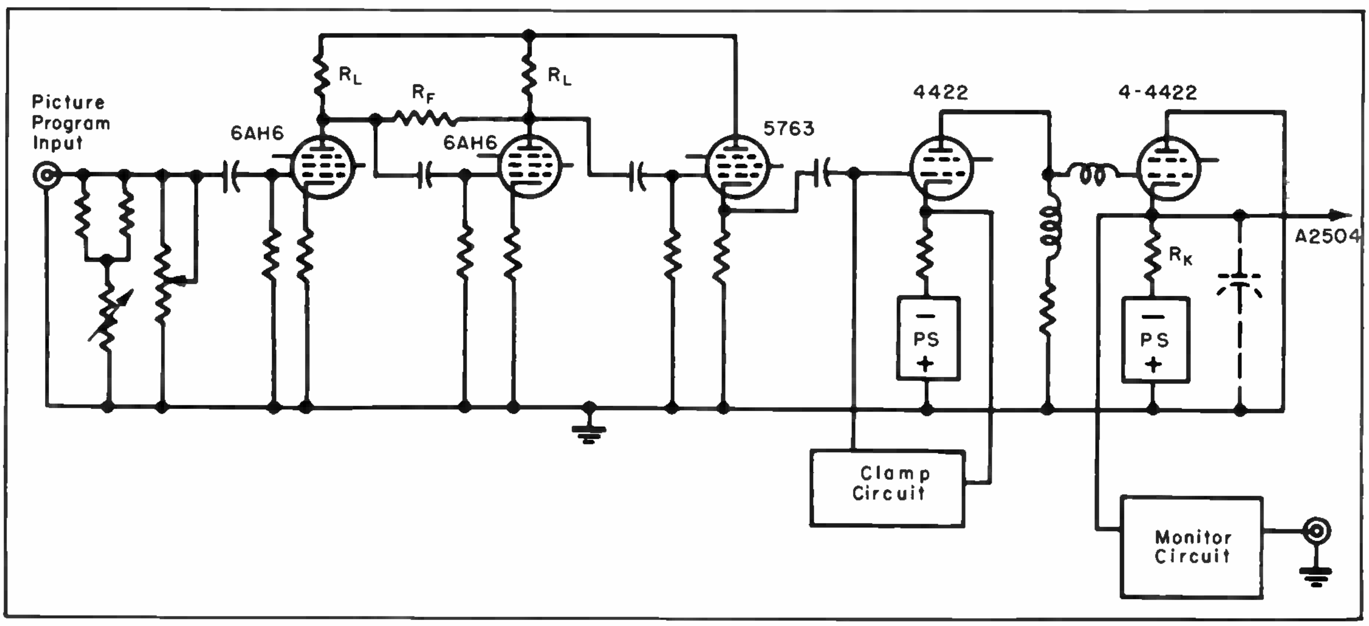
A 6J6, used as the crystal oscillator tube, operates with a plate voltage of 105. This stage is followed by a buffer using a 5763, a miniature with a 9-pin base.

Both sections of the 6J6 are paralleled to permit the use of a large trimmer capacitor to allow for adjustment to the exact operating frequency. The use of a 6J6 for the crystal oscillator has been found to be most suitable because the crystal current can be kept low. This is desirable because excessive crystal current will not only damage the crystal, but will affect the crystal's aging characteristics.

A schematic of the oscillator circuit is shown in Figure 1. It will be noted that the circuit is simple and similar

[3] RCA TMV-129P.

Figure 3
Circuitry of visual modulator employed in uhf transmitter.



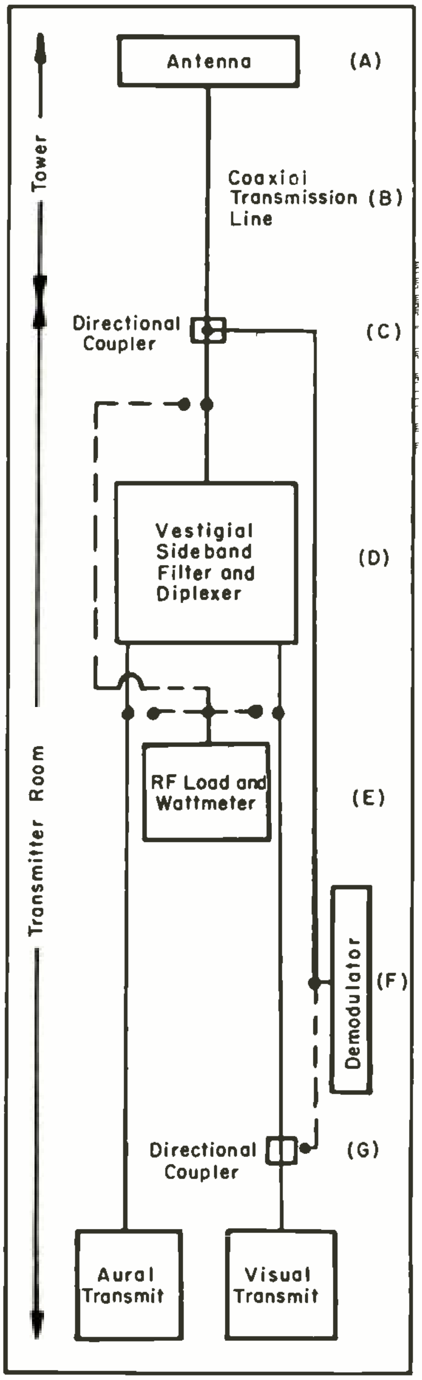



**Figure 4**

**Antenna equipment setup for uhf: A represents the tower or building top; B, coax line, connected between antenna and diplexer and transmitters, which uses a 3⅛" od or larger low-loss pressurized line; C, reflectionless connection between transmission line and demodulator; D, diplexer portion, which connects visual and aural transmitters to single antenna input without interaction (vestigial) sideband filter and diplexer serves to absorb unused portion of lower visual sideband to prevent radiation outside of assigned channel, while maintaining a constant resistance load on transmitter); E, test gear used to measure power ouput and for adjusting transmitter, which can be connected to visual or aural transmitter output or sideband filter/diplexer output; G, coax line between visual transmitter and vsb filter/diplexer, which is optional.**

**Figure 5: Right**

**RCA prexy Frank Folsom (right) and FCC headman Wayne Coy, with bow-tie type receiving antenna developed for uhf, displayed during RCA uhf seminar session at Bridgeport.**

to a conventional crystal oscillator with the exception of $L_1$, which in conjunction with the crystal-holder and tube input capacitance provides a high impedance in the grid circuit necessary to permit the crystal unit to operate on its third overtone. The overtone to be used is determined by the plate circuit tuning and the crystal will vibrate at only one overtone at a time. It should be pointed out that the overtone frequency of a crystal is not an exact multiple of the fundamental crystal frequency. Therefore, markings on the crystal unit represent the proper overtone frequency.

A second 5763 operating as a doubler for transmitter output frequencies between 630 and 890 mc, or as a tripler for frequencies between 470 and 630 mc, follows the crystal oscillator and buffer stage. This stage is conventional and the plate tank circuit uses lumped constants.

Following this there is a 4422, which acts as an amplifier for the lower group of channels or as a doubler for the upper group of channels. The 4422, similar to a 2E26, which has been found to be just a bit more rugged, is used in the picture modulator reducing the number of different tube types necessary.

The 4422 amplifier-doubler drives a 4X150A which operates as a frequency tripler and provides an output of 50 watts in the region of 235-445 mc. This range is just above the *vhf* TV band and is the first stage with any appreciable power output. The 4422 stage, whose frequency falls in the present *vhf* band, produces an output of approximately 10 watts, a power that is not likely to cause any interference in the *vhf* spectrum. The 4X150A stage is contained in an interlocked enclosure and provided with approximately 6 cubic feet per minute of air for cooling purposes.

The remainder of the *rf* unit includes two 2214J cavities and a A2504 final output stage. Here the transmitter departs from familiar practice in that coax cavities are used. The first 2214J operates as a frequency doubler and produces an output in the order of 80 watts. The second 2214J is a straight through amp and develops conservatively a power of 180 watts. The 4X150A and the two 2214J cavities are supplied with a plate voltage of approximately 1100.

The output of the second 2214J cavity is coupled by means of flexible coax cable to the grid circuit of the A2504 final power amp. The *rf* output connection consists of 1⅝" coax line fed through a reflectometer, which when properly calibrated allows continuous monitoring of the output power of the transmitter.

### *RF Circuitry Problems at UHF*

In designing *rf* circuitry for *uhf*, four factors must be considered: (*1*)—Circuit losses are increased at *uhf* because of skin effect; (*2*)—radiation loss increases at *uhf* because tube and circuit dimensions assume larger proportions in terms of wavelength; (*3*)—transit time effects are more noticeable; (*4*)—practically the entire tuned circuit is contained within the tube and it becomes difficult to extract power from the circuit. Secondary effects which make themselves evident because of the preceding are: increased *rf* driving power necessary, reduced *rf* bandwidth, reduction in apparent tube efficiency, and filament back heating.

An increase in *rf* driving power is required to offset the losses in the grid portion of the cavity. This loss can be kept low by paying particular attention to cavity plating, shorting contacts and tube contactors. It is desirable but not always possible to use quarter-wave grid circuits. Multiple quarter-wave sections, whether in the grid or plate circuit, add to the losses already present.

Reduced *rf* bandwidth is particularly detrimental when it occurs in the plate circuit of the final power amp, because the carrier and both sideband components are present at this point. This assumes what is defined as high-level modulation for TV, where the grid of the final *pa* is modulated. If the *pa* operates as a linear amp, then the tank circuit of the modulated stage plus both the grid and plate circuits of the linear *pa* must be broadbanded. Actually, in practice as the operating frequence is increased, feedback considerations require that both grid and plate circuits of a high level modulated *pa* be broadbanded. Broadbanding at *uhf* and reduction of losses in the cavity

are probably the two most difficult requirements to satisfy.

The grid circuits of the 2214J cavities are of coax construction. The tuning slug, wrapped with teflon tape to form a capacitor, acts to tune out the reactive component of impedance that the grid of the tube presents. This matches a 50-ohm input line to the grid of the tube and acts as an input tuning control. A knurled grid tuning adjustment moves a teflon screw, which in turn moves a teflon concentric capacitor. Input is applied by means of a type N fitting.

### *Video Modulator*

Five video stages are used in the modulator of the transmitter. Three of the stages use miniatures. The output stage is a cathode follower type modulator which drives the grid of the A2504 final power amp directly. Only one set of peaking coils is required in the video chain and that is in the plate circuit of the 4422 driver.

Inverse feedback is used between the first 6AH6 and the second 6AH6. Inverse feedback of the type used here offers many advantages, among which are the reduction of distortion, reduction of noise, and an increase in stability. Peaking coils are eliminated which greatly simplifies initial adjustments. Feedback is achieved by the use of a resistor between the plate of the first and second tubes.

To make feedback of this type practical, it is necessary to select a tube which has a high ratio of mutual conductance to input and output capacity; a factor called the figure of merit. The 6AH6 has a figure of merit of 750, while the 5763 has a figure of merit of 500, the latter being considered as

*(Continued on page 29)*

| | Small City (below 100,000) VHF* (10 kw) | Small City (below 100,000) UHF* (20 kw) | Medium City (100,000-750,000) VHF* (50 kw) | Medium City (100,000-750,000) UHF* (200 kw)** | Large City (750,000 and higher) VHF* (100/200 kw)*** | Large City (750,000 and higher) UHF* (200 kw)** |
|---|---|---|---|---|---|---|
| Simplest station film and network only — no live cameras | $135,000 | $145,000 | $170,000 | $230,500 | $260,000 | $230,500 |
| Tower for above (if not available locally) | 31,000 | 31,000 | 44,000 | 31,000 | 64,000 | 31,000 |
| Total | $168,500 | $176,000 | $214,000 | $261,500 | $324,000 | $261,500 |
| If it is desired to have local studio equipment, add (For two cameras and lighting in one studio). | 70,000 | 70,000 | 70,000 | 70,000 | 70,000 | 70,000 |
| Total | $238,500 | $246,000 | $284,000 | $331,000 | $394,000 | $331,000 |
| For remote pickup truck add (Does not include additional live cameras). | 24,700 | 24,700 | 24,700 | 24,700 | 24,700 | 24,700 |
| Total | $263,000 | $270,700 | $308,700 | $335,700 | $418,700 | $355,700 |

*Radiated power.

**UHF stations in cities under one-million population may start at 20-kw radiated power (at costs given for small city) and then add amplifier later to increase power to 200-kw radiated.

***100 kw on channels 2 to 6 and 200 kw on channels 7 to 13 vhf; large cities may start at 50 kw (costs for medium city) and then add amplifier later.

**Approximate costs of very simplified TV stations**

**Figure 6**

**Workings of developmental RCA color television camera being explained to broadcast engineers during TV training program. Featured during the session were talks on "What's Ahead in TV," by T. A. Smith; "Television Theory," J. H. Roe and A. H. Lind; "TV Camera Equipment," J. H. Roe; "Flying Spot Equipment," W. E. Tucker; "Synchronizing Generator," R. J. Smith; "TV Switching," L. E. Anderson; "Film Projectors," A. E. Jackson; "Video Amplifiers," R. L. Hucaby; "Video Monitors," N. P. Kellaway; "Genlock and Special Effects," E. M. Gore; "Microwave Relay Equipment," C. A. Rosencrans; "TV Mobile and Supplementary Equipment," L. E. Anderson; "TV Systems," J. H. Roe; "Test Equipment," J. A. Bauer; "TV Studio Lighting," H. M. Gurin (NBC); "TV Pickup Tubes," R. Johnson; "Audio Systems for TV," W. E. Stewart; "Custom Audio for TV," H. J. Lavery; "Microphone and Microphone Technique," Graham (NBC); "Principles of TV Transmitter Design," T. Gluyas; "2-Kw TV Transmitter," W. T. Douglas; "10-Kw TV Transmitter," R. Meisenheimer; "25 and 20-Kw TV Amplifiers," F. Talmage; "1-Kw and 10-Kw UHF Transmitters," T. P. Tisset; "Monitoring and Test Equipment", W. T. Douglas; "General Principal and Theory of TV Antennas," W. Darling; "TV Antenna Components," L. Wolf; "TV Super Turnstile Antenna," H. Wescott; "VHF Custom Antenna," L. Wolf; "UHF Antenna System Equipment," O. Fiet; "TV Towers," D. Halmer; "Installations and Tune-Up of TV Transmitting Equipment," T. Griffin.**

**Figure 7**

**Some of the broadcasters who attended RCA's eighth TV clinic (l to r): D. Winn, KARK, Little Rock; J. Deaderick, WMPS, Memphis; P. Baldwin, WHDH, Boston; E. T. Griffith, RCA; John Adams, KFDX, Wichita Falls, Tex.; H. Strum, WHTN, Huntington; J. H. Roe, RCA; W. H. Torrey, KGNC, Amarillo, Tex.; E. P. Talbott, KROD, El Paso; W. E. Dixon, WCHS, Charleston, W. Va.; H. Garba, WASK, Lafayette, Ind.; G. Zaharis, WTIP, Charleston, W. Va.; D. Norborg, RCA; R. J. Anderson, WDSU, New Orleans; W. D. Wenger, RCA; and E. Hull, WHLD, Niagara Falls. Others at the meeting included Capt. J. L. Abbels, U. S. Signal Corps; George Bartlett, KDNC, Durham, N. C.; Father Beemster, WBAY, Green Bay, Wisc.; N. Brauer, WTMJ, Milwaukee, Wisc.; W. D. Buford, KSWO, Lawton, Okla.; V. Byers, Ryerson Inst., Toronto, Ontario; John Cherpack, WBBW, Youngstown, Ohio; S. Clark, CKLW, Windsor, Ontario; K. Cooke, WGBI, Scranton, Penna.; Neff Cox, Tel-A-Ray, Anderson, Ky.; W. Coyne, U. S. Air Force; M. M. Crain, WLBC, Muncie, Ind.; Robert Cross, KROC, Rochester, Minn.; Capt. J. R. Dessez, U. S. Signal Corps; R. Dettman, KDAL, Duluth, Minn.; W. Dickson, WABI, Bangor, Maine; J. Forbom, CKSO, Sudbury, Ontario; R. Fornier, Canadian Broadcasting Co.; R. A. Fox, WGAR, Cleveland; P. N. Goode, KSWO, Lawton, Okla.; Z. V. Grobowski, WNBH, New Bedford, Mass.; R. I. Hancock, KDTH, Dubuque, Iowa; E. Haralson, WPDQ, Jacksonville, Fla.; A. O. Harvey, KRIS, Corpus Christi, Texas; Julius Hetland, WDAY, Fargo, N. D.; V. Hinshaw, KFH, Wichita, Kan.; R. W. Hodgkins, WGAN, Portland, Maine; H. Holmes, WTOL, Toledo, Ohio; J. R. Horton, WBIR, Knoxville, Tenn.; H. Hulick, WPTF, Raleigh, N. C.; J. Kennedy, Canadian Broadcasting Co.; J. W. Koch, KFEQ, St. Joseph, Mo.; R. Luukinen, WIRL, Peoria, Ill.; W. Lovely, WEEK, Peoria, Ill.; C. Ludwick, WTSP, St. Petersburg, Fla.; E. A. Malone, KIEM, Eureka, Calif.; D. C. McCallister, WGAR, Cleveland, Ohio; T. McFerrin, WCBI, Columbus, Miss.; J. McGoldrick, WQAN, Scranton, Penna.; K. Mealey, KRFE, Fresno, Calif.; R. Minton, WIBC, Indianapolis, Ind.; H. Newby, KAKE, Wichita, Kan.; R. E. Paske, WEMP, Milwaukee, Wisc.; C. Perkins, WSLI, Jackson, Miss.; C. B. Persons, WEBC, Duluth, Minn.; W. J. Provis, KXLF, Butte, Mont.; R. Reust, WJR, Detroit, Mich.; R. Robinson, WACE, Chicopee, Mass.; G. Robitaille, CFPL, London, Ontario; R. Schroeder, KMTV, Omaha, Neb.; H. Singleton, KGW, Portland, Ore.; F. Slingland, U. S. Air Force; D. H. Smith, WCSH, Portland, Maine; Julian Smith, WFBR, Baltimore, Md.; W. B. Smullin, KIEM, Eureka, Calif.; M. L. Snedeker, WERE, Cleveland, Ohio; L. S. Stafford, KOAM, Pittsburg, Kan.; Wallace Stangel, WBAY, Green Bay, Wisc.; C. Strang, KVOR, Colorado Springs, Colo.; Lynn Towsley, Michigan State College, East Lansing, Mich.; A. P. Tripp, WPTF, Raleigh, N. C.; D. White, KGBX, Springfield, Mo.; C. W. Whitley, WSOC, Charlotte, N. C.; Lt. Col. M. E. Williamson, U. S. Air Force; A. F. Wooster, KRMG, Tulsa, Okla.; and T. Wright, A. Earl Cullum, Consultants, Dallas, Texas.**

# Fringe-Area Performance Predictions

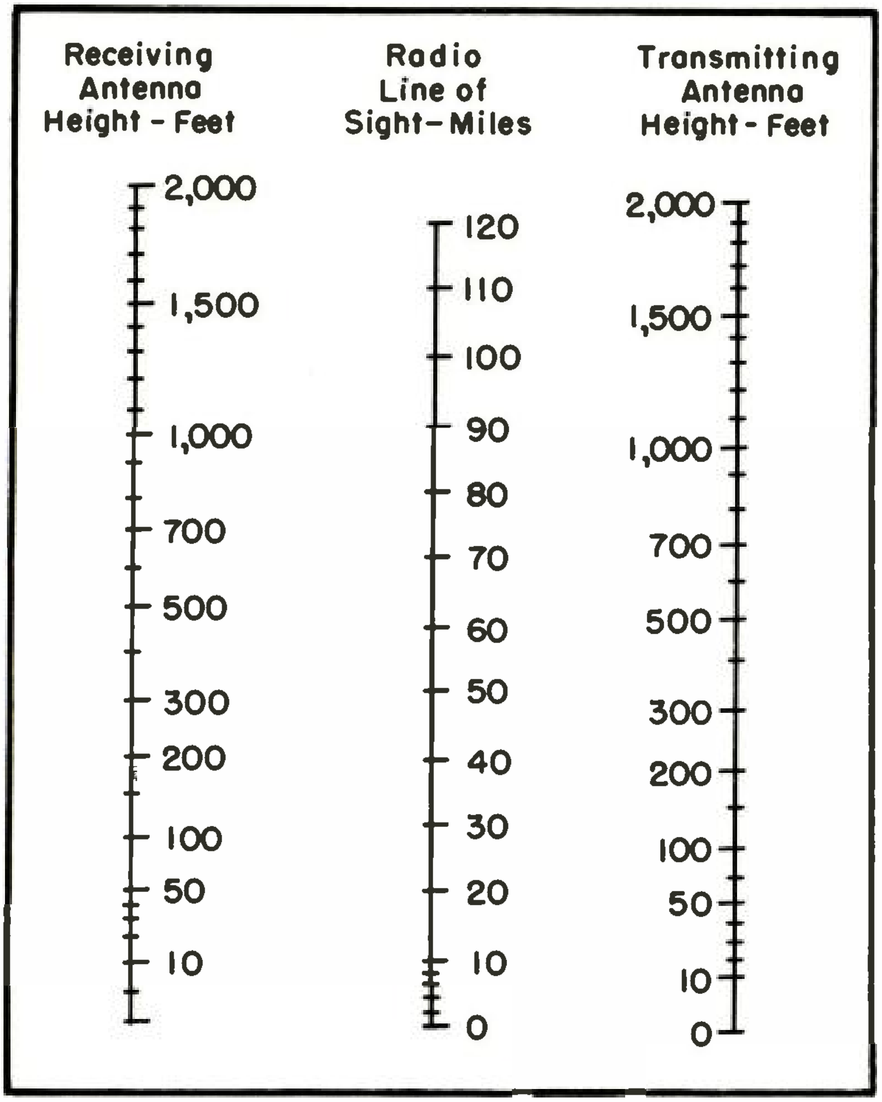



Figure 1
Nomogram which can be used to determine radio line-of-sight distances.

by E. A. SLUSSER

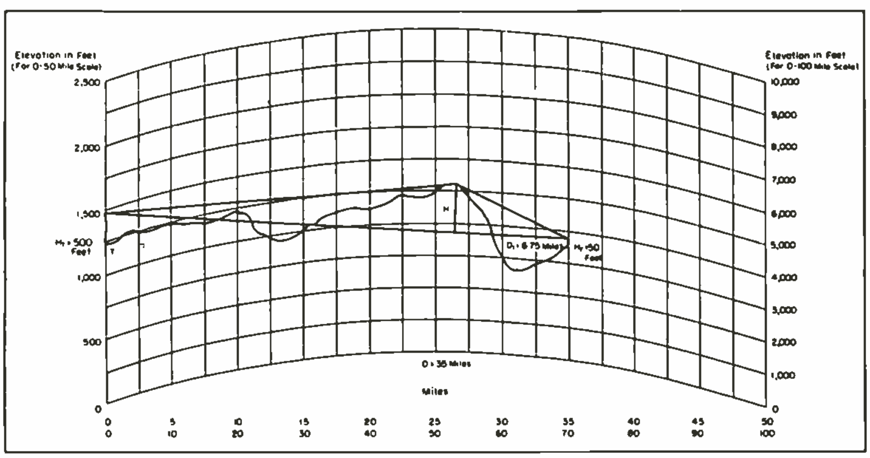
*Study Probing Propagation Losses, Effective Transmitted Power, Antenna Gain, Antenna Elevation and Receiver Sensitivity Provides Data for Nomograms and Allied Curves Which Can Be Used to Determine Receiver Performance and Pickup Capabilities.*

IN DETERMINING the performance of a TV set, four major factors must be considered: the effective transmitted power, propagation losses, receiving antenna and the gain of the TV receiver. By investigating each of these factors it has been found possible to make a reasonable prediction of expected fringe performance.

### *Propagation Losses*

To predict the propagation losses that may exist on a given path, the existence of a radio line of sight or shadow transmission must be determined. If the intervening terrain is relatively smooth and there are no known projections in the transmission path, the radio line-of-sight distance can be determined by referring to Figure 1. Drawing a line on the nomogram intersecting the heights of the receiving and transmitting antennas will give a corresponding maximum radio line-of-sight distance. If the actual distance is less than the value taken from the map, free space transmission can be assumed. If the actual distance exceeds the value, calculations must be made on the basis of shadow losses.

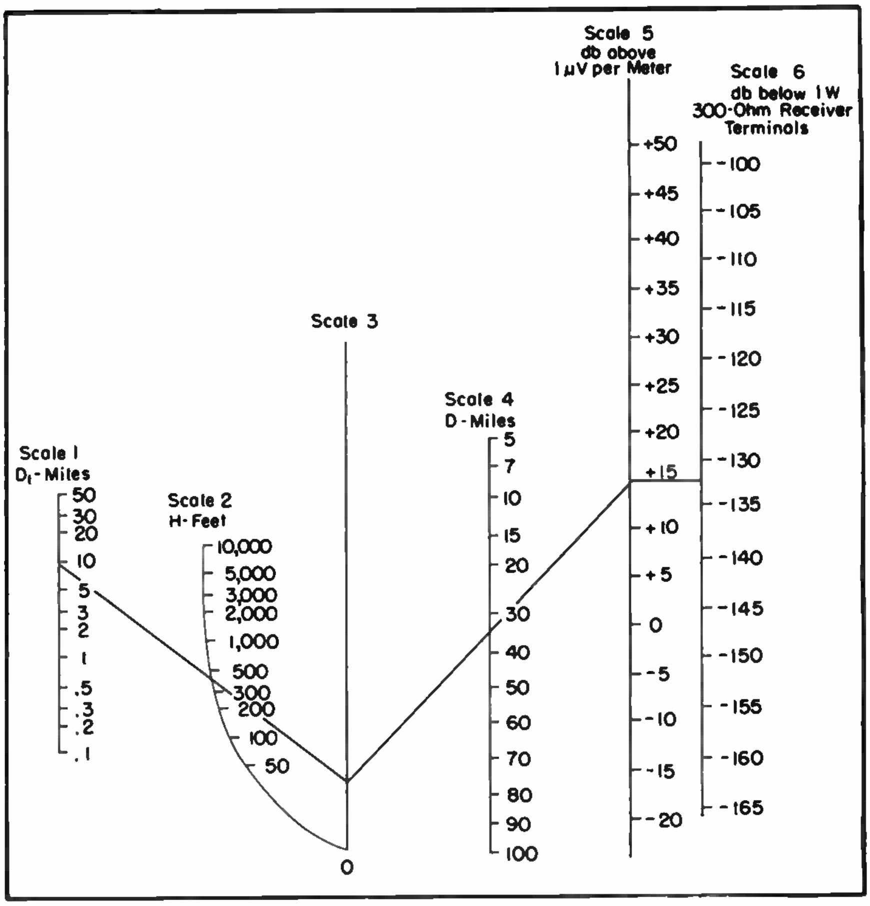
If shadow transmission is determined




*Left*

Figure 2
Plot of surface-level profile between antennas.

Figure 3
Propagation nomogram for channels 2 to 6.




from the nomogram or if the terrain intervening the antennas is not relatively smooth, it will be necessary to plot a profile of the surface level between the antennas from a contour map, as illustrated in Figure 2. This must be plotted on special graph paper which has been prepared so as to take into account the earth's curvature and the average refraction of radio waves. If a straight line can be drawn between the elevations of the two antennas on the profile map without intersecting the surface, then it can be assumed that radio line-or-sight conditions wil exist. If this line intersects the surface, calculations must be made on the basis of shadow conditions.

### *Propagation Nomograms*

Actual propagation calculation for shadow conditions can be made with the aid of the nomograms shown in Figures 3 and 4; Figure 3 serving for channels 2 through 6 and Figure 4 for channels 7 through 13.

Both line-of-sight and shadow transmission calculations can be made from these maps. If line-of-sight conditions exist, only scales *3*, *4*, *5*, and *6* should be used and *H* taken as zero on scale *3*. If shadow transmission exists, the values of $D_t$ and *H* must be used. These data can be taken from the actual profile plot, where a base line has been constructed intersecting the receiving and the transmitting antennas. It will then be necessary to construct two more lines to an intersection point, each tangent to the first obstruction. Then a line perpendicular to the base line will have to be constructed; its length will correspond to the value of *H*.

Knowing the values of $D_t$, *H* and the total distance *D*, the field intensity at the receiver can be obtained.

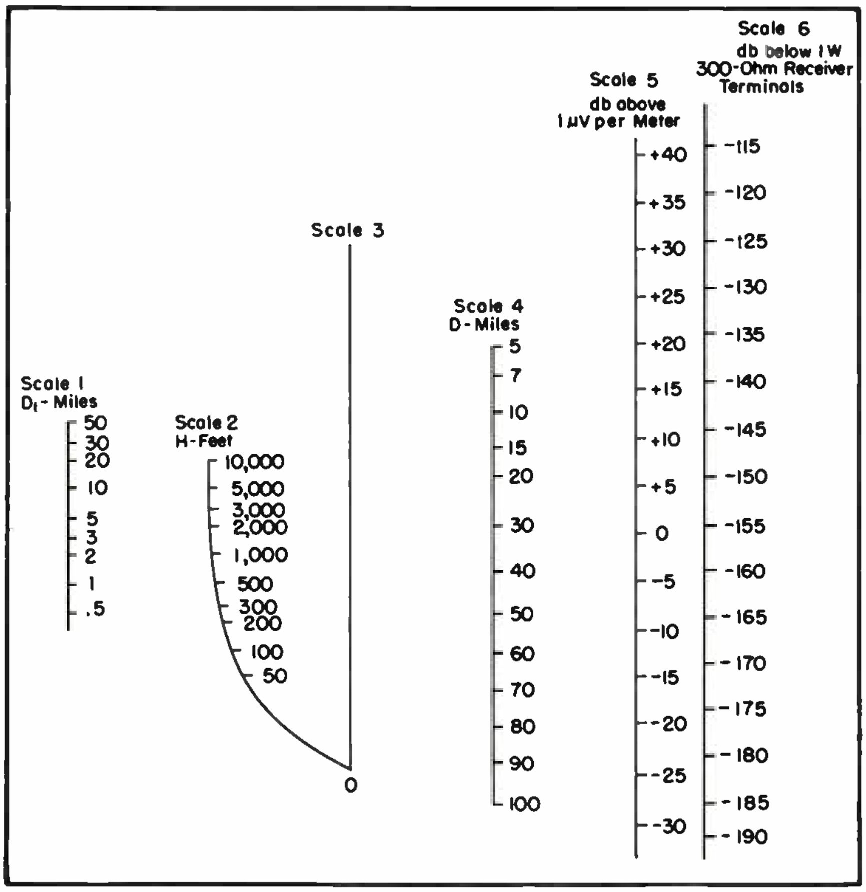
The values taken from the foregoing nomograms have been based on *erp* of 1 kw and effective antenna elevation of 40′ for both transmitting and receiving antennas. Corrections for the effective radiated power of a given transmitter and effective antenna elevation must be applied.

### *Antenna Gain*

The field intensity at the receiver is effectively improved by the gain of the antenna. The average gain of antennas has been found to be about 5 *db*. The gain in *db* of the antenna actually used should be added to the predicted propagation figure, whether it be expressed

*(Continued on page 30)*

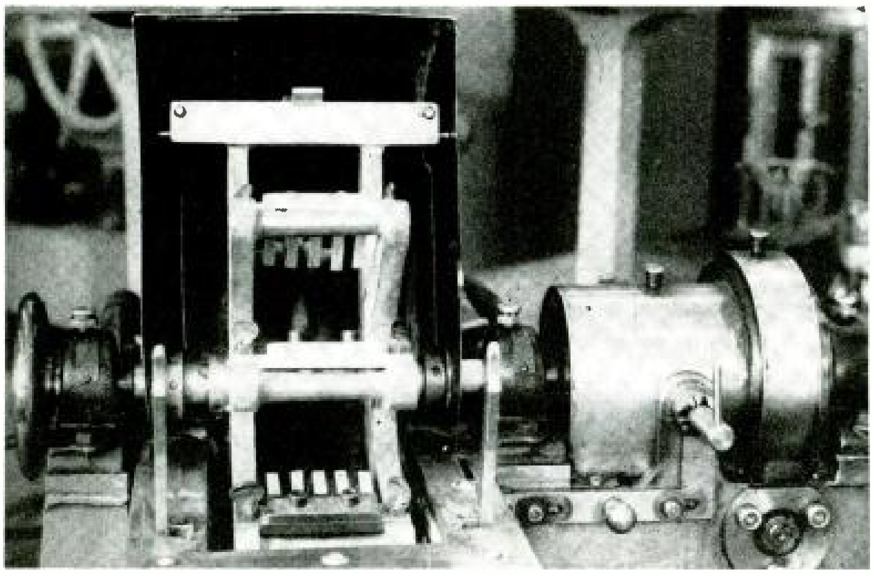
Figure 4 (below)
Propagation nomogram for channels 7 to 13.



# POLYETHYLENE in TV

by ARTHUR J. FALCONER, Jr.

Bakelite Company, Division of Union Carbide and Carbon Corporation



Equipment (ASTM D-746-44T) developed jointly by Bakelite and the Bell Telephone Labs to determine the low temperature impact properties of polyethylene materials.

Determining tensile strength and ultimate elongation of polyethylene with special tester equipment (ASTM D-412-41) in the works control labs of the Bakelite Company.

In TV, operating at the higher frequencies and with higher voltages, insulation is particularly important. In the leadin, coax or twinlead, it is necessary to use a material that has superior dielectric strength, extremely low power factor and dielectric constant, both being stable with temperature and frequency, and flexible. And in *hv* circuits, be they in the anode picture tube* or camera coax cable, the foregoing factors are extremely important, too. In polyethylene, industry has been found these unique properties. Straight or modified polyethylene anode lead covering has provided the only types of wire to receive *UL* approval.

Polyethylene,[1] first developed in Great Britain during the recent war, answered the need for a solid low-loss dielectric material featuring flexibility and excellent electrical properties.

When polyethylene was first used in England it was necessary to include in the process a softening agent due to extrusion equipment limitations. This softening agent was necessary because only short barrelled extrusion machines were available in that country. It was found possible to eliminate the need for a softening agent in this country, through the use of long barrelled extruders, which are capable of producing a pure polyethylene product. This, of course, offers users the best physical and electrical properties available, without modification.

Currently, twinlead is the largest consumer of polyethylene. When questioned as to the supply of polyethylene for leadin six months from now, a Bakelite spokesman declared that although all polyethylene is subject to government allocation, the allocation normally

[1]A generic term, it is used to designate the products which result from the polymerization of ethylene. The many trademarks applied to various products made from polyethylene may confuse end users. However, there are only two polyethylene resin manufacturers in this country, E. I. DuPont (*Alathon polyethylene*) and Bakelite (*Bakelite polyethylene*). Other trademarks used by wire manufacturers are merely individual company designations employed to classify and merchandise their polyethylene-insulated wires and cables.

*Anode lead covering for picture tubes can either be straight or modified polyethylene or polyethylene with a vinyl jacket. As stated, Underwriters' have approved only these coverings for such service. The primary requisite in obtaining *UL* approval is that the material have excellent dielectric strength during long time voltage stress.

| *Exposure South Florida: Months* | *Polyethylene DYNH** Natural* | | *DE-6490** Brown* | |
|---|---|---|---|---|
| | *50-mc Power Factor* | *Appearance* | *50-mc Power Factor* | *Appearance* |
| 0 | 25 x $10^{-5}$ | Translucent white | 47 x $10^{-5}$ | Brown |
| 3 | 142 x $10^{-5}$ | Translucent white | 55 x $10^{-5}$ | No change |
| 6 | 264 x $10^{-5}$ | Slight crazing | 68 x $10^{-5}$ | No change |
| 9 | 438 x $10^{-5}$ | Severe crazing | 69 x $10^{-5}$ | No change |
| 12 | (Exposure discontinued) | | 70 x $10^{-5}$ | No change |
| 16 | | | 90 x $10^{-5}$ | Very slight crazing |
| 32.5 | | | 170 x $10^{-5}$ | Very slight crazing |
| 36 | | | ....... | Very shallow crazing |
| 39 | | | 189 x $10^{-5}$ | Very shallow crazing |
| 42.5 | | | 195 x $10^{-5}$ | Very shallow crazing |
| 46 | | | 207 x $10^{-5}$ | Very shallow crazing |
| | | | (Exposure still in progress) | |

** Bakelite Co. designation.

Table 1

Weathering of polyethylene compounds.

***Report on Properties and Application Possibilities of Low-Loss Flexible Thermoplastic Material Found to Be the Ideal Type of Insulation for Twinlead, Coax, Anode Leads, Interconnecting Cables, Power Supply Leads and Shielded Wiring in Audio and RF.***

includes a specified quantity of material with no directed end use. The quantity is dependent on military requirements and the amount allocated for essential civilian use. Polyethylene for TV use is now being shipped from the non-directed end use quantities available and indications are that this will still be the case in another six months.

Proper insulation offers many features. It provides not only a better product because of its good electrical properties and a certain standard of physical properties, but a means of saving many dollars on warranties and guarantees for component replacements through an elimination of difficulties that start elsewhere than in the component, difficulties caused by faulty insulation.

It is suggested that buyers of polyethylene insulation cable deal with recognized manufacturers who supply specific polyethylene compounds designed for the wire or cable applications, because these materials are subjected to rigid dielectric and physical inspections. These tests serve to insure an excellent standard product that will fulfill service requirements. When *scrap* material is used in the production of insulating cable, it is no longer a property-controlled material and might vary from *scrap* with electrical properties that have been greatly deteriorated, to *scrap* that might still maintain an electrical similarity to the original material. Attenuation measurements and voltage breakdown tests can be used to check the quality of the wire insulation.

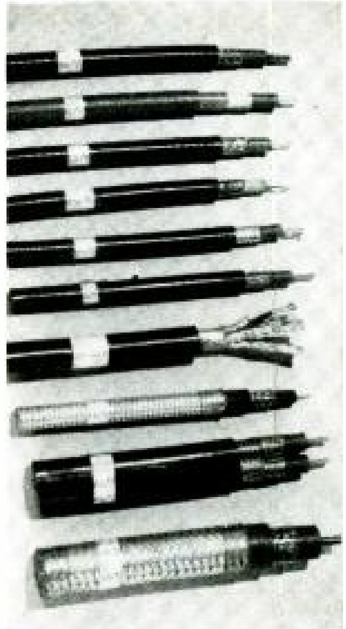
A second property problem involves pigmentation and its effects on the life service of this material. Natural or unpigmented polyethylene may be more attractive. It is not, however, the most practical for outdoor use. Unpigmented polyethylene has been found to have a relatively short service life when exposed to sunlight and cracks on exposure after a short period. Because of these damaging rays, dark brown and black have become the recommended colors. As can be seen in the weathering charts, natural polyethylene has about one-fourth of the presently recorded life span of either black or brown, while brown, although excellent for this work, is still inferior to black pigmented polyethylene. Thus, for quality and long life, black pigmentation is by far the best.

With the expansion of *uhf*, it will be important to consider the losses that might be encountered with flat 300-ohm leadin wire. It may be necessary, eventually, to resort to 72-ohm coax lines, which will operate more satisfactorily at the higher frequencies.

The tendency for TV hookup wire insulation is toward higher operating temperatures. Initially there was produced a *Vinylite*† wire insulating com-

(*Continued on page* 30)

†A registered trade mark of the Bakelite Co.



Assorted cables with polyethylene covers: RG 65/U used for spiral delay lines to provide a longer path for signal at high impedance; K-71 used in servo mechanisms; RG 9/U, a K456 silver-plated conductor and silver-plated braid used for uhf up to 3,000 mc in leadin, test gear, probes, etc.; RG 11/U, a K-49 general purpose of shielded line; RG 63 A/U, a K-91 low capacitance rf cable used for test probes and applications requiring low capacity; RG 22/U, used as a balanced line for smaller df equipments such as those on planes and smaller naval vessels (also used successfully as FM and television lead wire); RG 8/U, a K-45 general purpose rf cable and transmission line, also used for special applications as power cable and high-voltage test probes; EX 610 cable, 5 pair for pa systems; RG 12/U, K-49A general purpose rf cable armored for rough duty; RG 23/U, K602 power cable and highly balanced rf line for direction finder equipment (used in SCR-291 equipment during the war); RG 18/U, K12A heavy duty power rf cable used in df equipment and for shielded power lines, currently used in broadcast medium power antenna leadins and special train radio applications.

(*1*) Briltin antenna: 300-ohm insulated lead.

(*2*) Terminal to tuner: Short length of 300-ohm wire similar to twinlead.

(*3*) Tuner to *if*: Coax cable with polyethylene primary and *vinylite* jacket or polyethylene insulated 300-ohm currently being used.

(*4*) Tuner to chassis: 80° hookup wire with QG-5909 insulation.

(*5*) Anode leads: Insulated with flameproof polyethylene or regular polyethylene with *vinylite* jacket.

(*6*) Interconnecting cables: *Type 1* . . . from chassis to deflection coil, cable consisting of a bundle of 80° insulated singles; *type 2* . . . interconnecting cables from back of tube to socket's cable consisting of QG-5909 insulated singles; *type 3* . . . speaker cable, consisting of QG-5909 insulated singles.

(*7*) Power supply: Type *POT* with VG-9530 insulation.

(*8*) Shielded leads for use in specific locations in audio circuit: Can be either polyethylene or *vinylite* plastic under the shield.

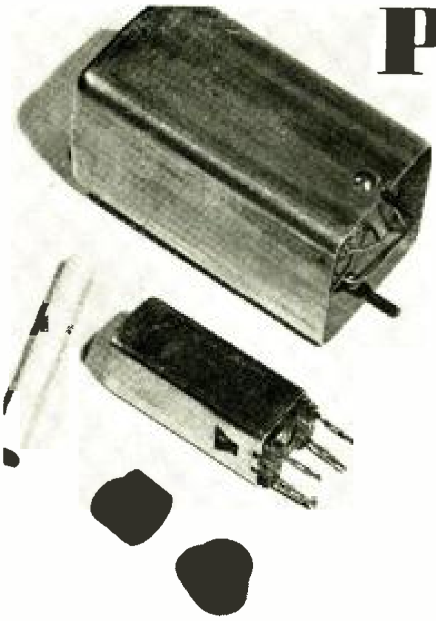
Applications of polyethylene.

| ***Designation*** | ***DE-3401** Natural*** | ***DE-6490** Brown 09*** |
|---|---|---|
| Power factor at 50 mc at 25° C. max (Test method WC64-C)*** | .0005 | |
| Power factor at 1000 cps at 25° C. max (Test method WC64-A) | | .0015 |
| Dielectric constant at 50 mc at 25° C. min (Test method WC64-C) | 2.35 | |
| Dielectric constant at 1000 cps at 25° C. min (Test method WC64-A) | | 2.50 |
| Brittleness degrees C, max (ASTM D-746-43T) | −45 | -45 |
| Tensile strength, psi, min (ASTM D-412-41: Die C-speed 20"/min.) | 1400 | 1400 |
| Elongation at break per cent minimum (ASTM D-412-41: Die C-speed 20"/min.) | 100 | 400 |
| Specific gravity at 25/25° C. ±0.01 (ASTM D-74-27) | 0.92 | 0.94 |

***Manufacturer's test designation.

Table 2

Specification properties: Summary for Bakelite polyethylene resin and compounds



# POWDER METAL IF CORES

by JOHN P. TUCKER

Assistant Chief Engineer, Automatic Manufacturing Corp.

(Left)
Large old-type and cigarette-size type of if with powdered-iron tuning core.

***Finely Divided Iron Powder With Phenolic Resin as Binder and Insulator, Featured in Extremely Small IFs, Fabricated in Granulators and on Rotary Powder Metal Presses, and Checked on Assortment of Special Test Gear.***

POWDER METALLURGY, which has been found not only to accelerate and simplify production, but permit the fabrication of improved components, has become a key material in many plants, particularly where smaller items, such as *if* transformers, are made.

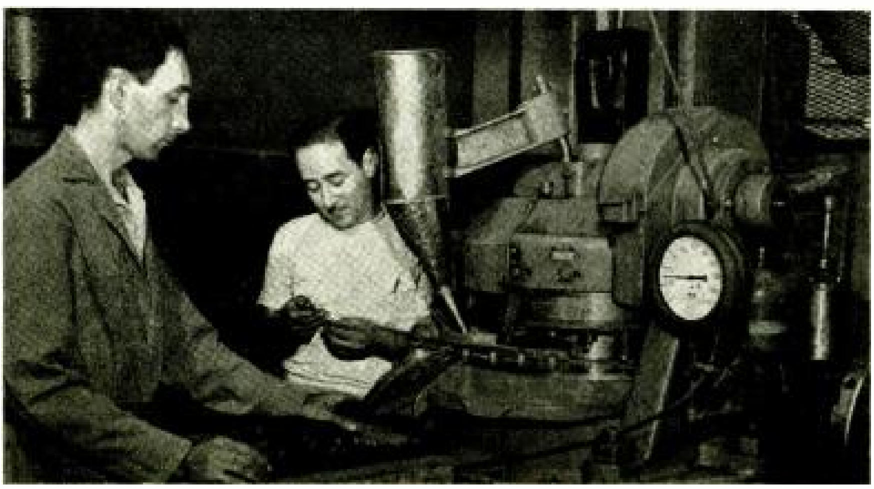
Intermediate-frequency transformers were formerly large and bulky, some of them as much as 2" square and 5" or 6" long. In '45, there was introduced a unit* ¾" square and 2½" long, featuring pressed iron tuning cores, which obsoleted the older large items. At that time, they were produced, in the main, for standard broadcast chassis. Subsequently, types with the same small dimensions, were evolved for FM and TV.

It was found possible to secure the required wide range of frequencies by using a set of *building blocks*, the variations for efficient operation involving only changes in the basic windings and in the composition of the powdered magnetic material from which the cores are pressed. It was found that changes in the particle size, density and in the analysis of the metal itself, could be introduced without any change in the physical dimensions of the powdered iron cores and consequently the physical make-up of the transformer.

As a result of this adaptability, it has been possible to design and manufacture transformers for many special purposes where production quantities may be limited to a few thousand, without the usual price penalties for such small quantities, as compared to the millions used in television work. All assembly methods are identical, regardless of the application, since all of the building blocks are identical and an assembly operator can change at a moment's notice from one type of core or winding to another without interrupting the rhythm of her work.

### *Core Characteristics*

The transformers feature a pair of pressed iron tuning cores. These cores, which are small cup-like cylinders about 9/16" in diameter and 7/16" long, could not economically be machined from cylindrical stock; the cost of machining a shallow slot for a screwdriver and a deep depression around the cen-



Rotary-powder press used for production of iron cores.

(Below)

Closeup of processed cores.

Final electrical test of if transformers.

Optical comparator for control of winding machine setups.

ter pin on the opposite side would be prohibitive. In addition, screw threads must be ground on all of the cylindrical periphery of the core to permit frequency adjustment.

### *Processing the Powdered Iron*

Powder metallurgy was found to be the ideal solution, permitting fabrication of cores from loose iron powder. In the processing of the iron powder it is mixed with a phenolic resin, which acts as a binder and inter-particle insulation. This resin is mixed mechanically with the iron powder, and the mixture is ground to suitable size by a hammermill and a granulator[1] and screened so that it flows like sugar.

The powder is then poured in the hopper of a powder metal press[2] similar to the tabletting machines used in production of aspirin tablets and candy mints. This loose powder flows into cavities in a rotating die table and is compressed into cores under tremendous pressure; punches compress the powder simultaneously from above and below to assure uniform density.

Production of transformer tuning cores at our plant runs around 10,000 hourly per press.

### *Check Techniques*

As the cores roll off the die tables of the powder metal presses, they are continually checked for mechanical dimensions and electrical characteristics. Micrometer calipers are used to check dimensions, and $Q$ and permeability are measured with a $Q$-meter and specially designed permeability meters.

A centerless thread-grinding machine[4] puts threads on the cores after they have been cured. This machine merits considerable credit for making small transformers practicable, for until it was developed no practical method of threading cores existed. After the threads have been ground, the cores are degreased to remove the grinding coolant and taken to the assembly room.

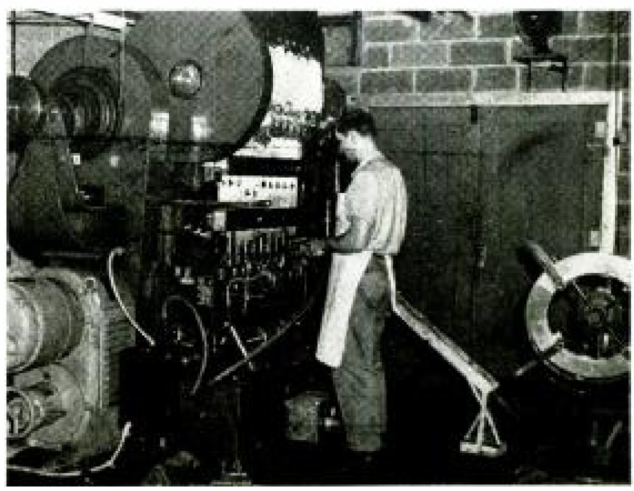
### *Final Steps*

Then, the wax-impregnated windings of the transformers are slipped over the opposing center pins of the two iron cores that comprise each unit, and the plastic base and side frames are assembled over them. Connections are soldered, the unit is inserted in its aluminum shield can, and the completed transformer is plugged into a 'scope for adjustment and final test.

[1]K-Tran.

[2]Stokes; F. J. Stokes Machine Co., Philadelphia, Pa. [3]Stokes.

[4]Landis.



(Right)

Deep-drawing press used for fabricating aluminum transformer shields.

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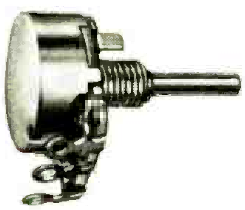
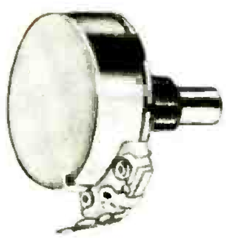
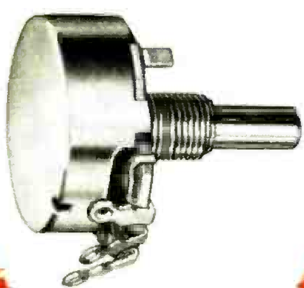


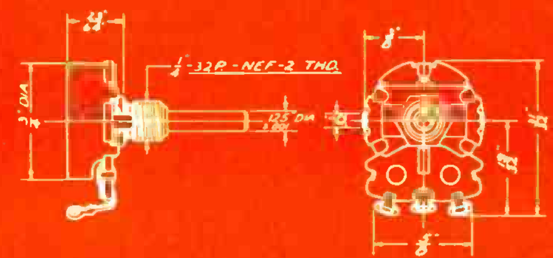
Type 65

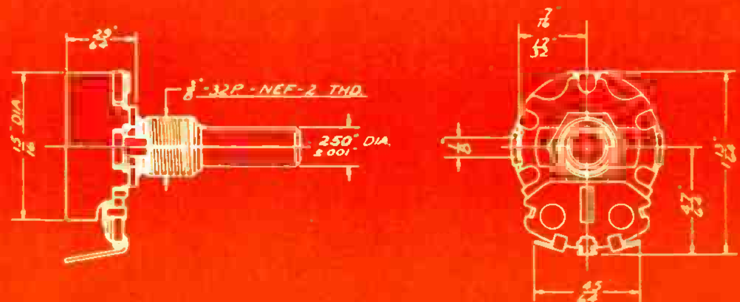


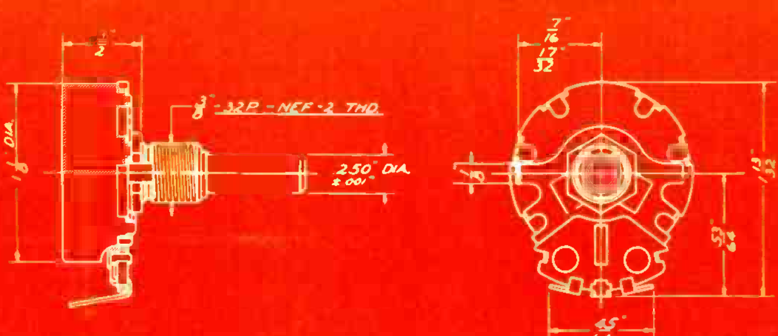
Type 90



Type 95







+150°C to −55°C

| DIAMETER | TYPE 95 1⅛" | TYPE 90 15/16" | TYPE 65 (miniaturized) ¾" |
|---|---|---|---|
| Wattage and Voltage Rating | 2 watts @ 70°C with 500 V max. across end terminals | 1 watt @ 70°C with 500 V max. across end terminals | ½ watt @ 70°C with 350 V max. across end terminals |

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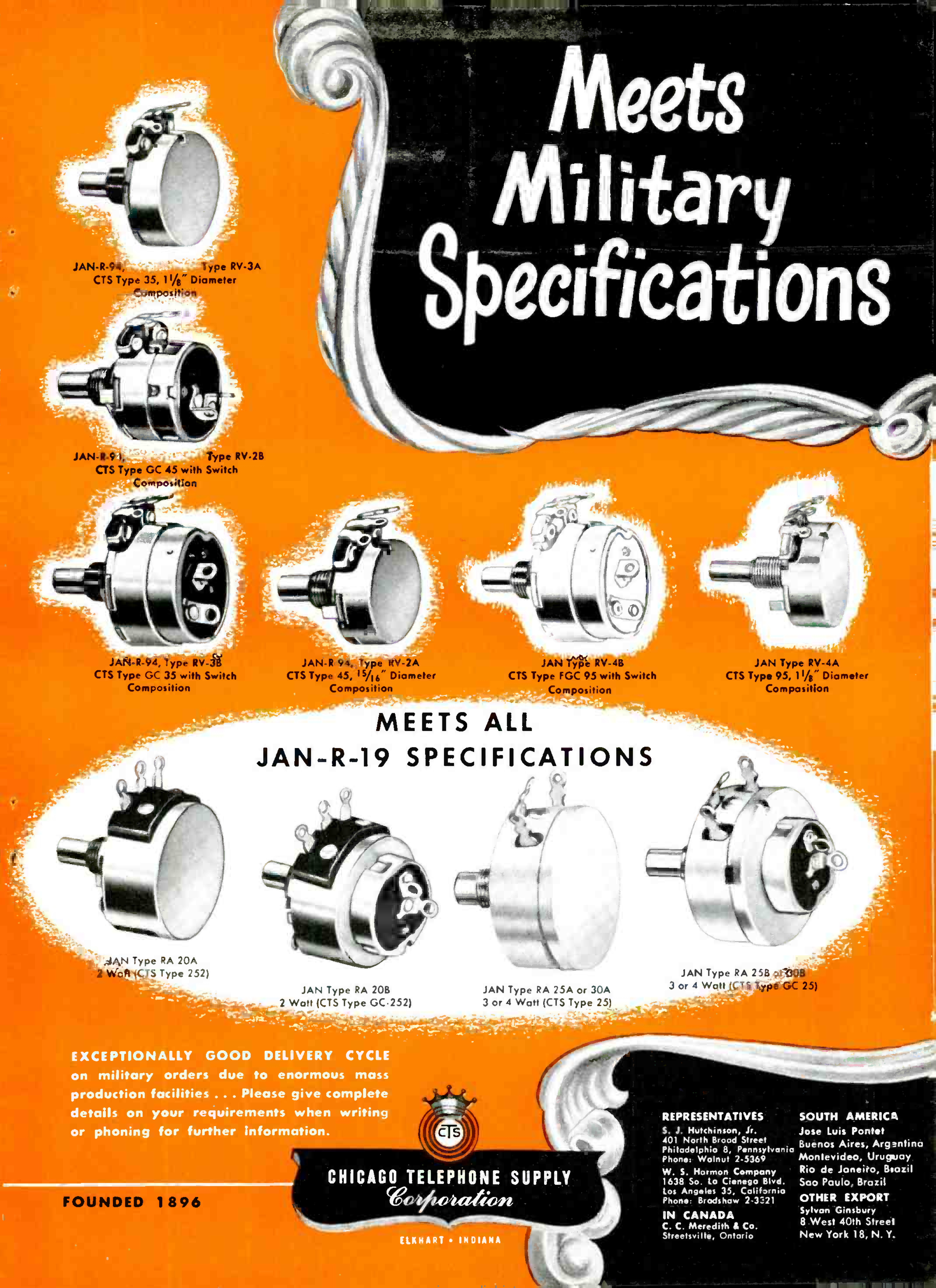
Meets Military Specifications
JAN-R-94, Type RV-3A
CTS Type 35, 1 1/8" Diameter
Composition
JAN-R-94, Type RV-2B
CTS Type GC 45 with Switch
Composition
JAN-R-94, Type RV-3B
CTS Type GC 35 with Switch
Composition
JAN-R 94, Type RV-2A
CTS Type 45, 15/16" Diameter
Composition
JAN Type RV-4B
CTS Type FGC 95 with Switch
Composition
JAN Type RV-4A
CTS Type 95, 1 1/8" Diameter
Composition
MEETS ALL
JAN-R-19 SPECIFICATIONS
JAN Type RA 20A
2 Watt (CTS Type 252)
JAN Type RA 20B
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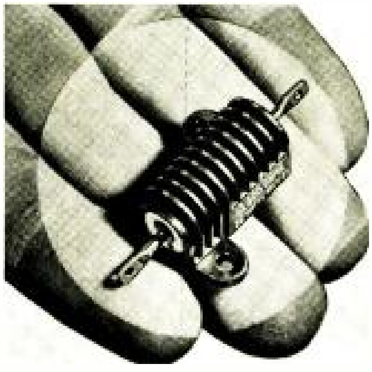
# TV Parts

### *Miniature Power Resistors*

Miniature power resistors in two, five, ten, 25 and 50-watt sizes have been produced. Silicone material seals the resistance element.

Resistors are said to have a completely-welded construction from terminal to terminal. Standard tolerance is claimed to be one per cent; temperature coefficient is substantialy flat, and the resistance shift is less than 0.00002 per cent per degree C.—*Dalohm; Dale Products Co., Inc., Columbia, Nebraska.*



Dalohm

### *Subminiature Selenium Rectifiers*

Subminiature selenium rectifiers that are said to have ratings up to 20 ma *dc* output and 25,000 *vac* input per single stack have been produced. Provide for hermetic sealing and fungus proofing. Constructed of matched ¼" diameter round selenium rectifier cells encased in bakelite, glass or metal housings.—*Minisel; Precision Rectifier division, Electronic Devices, Inc., 429 12th St., Brooklyn 15, N. Y.*

Precision Rectifier Minisels

### *High Torque Controls*

Production of high torque controls, designed specifically for maintenance of circuit balance under conditions of vibration, has been announced.

Has a torque range from two to four ounce-inches. It is available in plain type with screwdriver slot on either end or with conventional knob adjustment.

Unit also can be supplied with a dust cover or electrostatic shield. Identical in size and resistance ranges to regular model I Radiohm controls.—*Further details appear in bulletin 42-158; Centralab, 900 E. Keefe Ave., Milwaukee 1, Wisconsin.*



# Production

### *Vane Axial-Type Blower*

A vane axial-type blower, available in 400-cycle 3-phase and single phase, 60-cycle single phase and 27½ volt *dc*, has been produced. Speeds range from 10,000 to 3300 rpm. Unit is constructed of aluminum. Motor is located within the air stream. Blower is available in 2-, 4- and 6-inch sizes in diameter, and also in intermediate sizes.—*Stanat Tool and Machine Co., 47-28 37th St., Long Island City 1, N. Y.*

### *Color Concentrates*

Color concentrates, for producing 3-color television filter screens and 3-color rotating discs, have been developed.

Used on cellulose acetate filters and discs, the colors can be applied to sheeting by means of an air-spray brush. Masks can be used to air-spray one color at a time while protecting the rest of the color wheel.

Concentrate for filters is available in TV blue, amber and green, and for use on discs, the colors are available in red, blue and green.—*Schwartz Chemical Co., Inc., 326-328 West 70th St., New York 23, N. Y.*

### *Resistance-Type Soldering Tool*

A resistance-type soldering tool that features a plastic electrode holder and interchangeable 5/16-inch electrodes, has been introduced. Electrodes are copper-coated, and 5-foot flexible cables are included.—*Sunrise Products Co., Electrical Division, P. O. Box 173, Hawthorne 1, N. J.*

# Instruments

### Rada-Pulser

A PULSED CARRIER GENERATOR developed to provide rapid and accurate transient response information in labs, on production lines and in the field, is now available. Specifications are: Carrier frequencies . . . 30 and 60 mc; pulse widths . . . 0.1 and 0.25 microsecond; pulse repetition rate . . . continuously variable from 500 to 2000 pps; maximum *rf* output . . . approximately 1 volt at 70 ohms; attenuators . . . 20 db, 20 db, 10 db switched 10 db continuously variable.

Pulse output is 50 volts at 70 ohms. A jack is provided to permit use of envelope pulses. Input terminals are also provided to permit modulation by other pulse widths from external source. Positive and negative furnished ahead of pulsed carrier to trigger 'scope sweep circuit. Regulated power supply is built in.—*Rada-Pulser; Kay Electric Company, Pine Brook, N. J.*

Kay Rada-Pulser

### Single-Unit Frequency Counter

AN ELECTRONIC MEASURING DEVICE which it is said is capable of instantly measuring and displaying low, medium and higher frequencies up to 10,000,000 cycles per second, has been announced.

The exact frequency of each *unknown* measured is said to be presented instantly and directly on the instrument's front panel. No interpolation or mental arithmetic is required.

Two types of measurement are offered: For determination of frequencies above 300 cycles per second, the equipment counts and displays the unknown directly on the front panel. To obtain these readings it is only necessary to connect the unknown to the instrument. For low frequency work the instrument measures the period or duration of a cycle in microseconds. A 10 cycle sample is taken, and the duration of a cycle is then presented directly in microseconds.

Instrument operates on pulse counting techniques. The unknown is applied through a wide-band squaring amplifier to a fast gate controlled by a time base generator. When the gate is open, the unknown is applied to the counting circuits. When the gate is automatically closed, the counting circuits remember and display medium or higher frequencies in cycles per second, or the duration of low frequencies samples in microseconds. The time base circuits are controlled by a crystal oscillator with instantaneous stability of 1 part per million, and an accuracy of 2 parts per million per week.—*Model 524A; Hewlett-Packard Co., 395 Page Mill Road, Palo Alto, Calif.*



# Industry Literature

*The Rectifier Division of Sarkes Tarzian, Inc.*, 415 N. College Ave., Bloomington, Indiana, have announced publication of a 16-page booklet with complete circuit and application details on high-power selenium rectifiers used in TV, radar, etc.

*Geo. Stevens Manufacturing Co., Inc.*, Pulaski Road at Peterson, Chicago 30, have issued a 32-page catalog with detailed descriptions of coil winding machines for armatures, bobbins, chokes, heavy duty fields, paper sections, lattice wound progressive universals, solenoids, space wound coils, transformer and variable pitch coils, etc.

*Helipot Corp.*, South Pasadena, Calif., have released a 36-page catalog describing their products, and featuring material on the design and application of wire-wound precision potentiometers.

*Milo Radio and Electronics Corp.*, 200 Greenwich St., New York 7, N. Y., have released a 28-page booklet with data on industrial electronic and special purpose tubes.

*Stackpole Carbon Co.*, St. Marys, Pa., have issued a 12-page bulletin describing the use of *Ceramag* cores for segmented deflection yoke cores, image width controls and flyback transformers. A series of characteristic curves is also featured.

## UHF Report

(*Continued from page* 13)

tance using null methods, an *admittance meter** and a *vhf bridge.*** Soderman said that the admittance meter can be used to well above 1000 mc, while the nominal upper frequency limit of the *vhf* bridge is 500 mc, although it can be used with some deterioration in performance up to 1000 mc.

The *uhf* admittance meter was said to be balanced like a bridge, although it is not a true bridge, but is related to a hybrid junction. In this instrument, the currents were noted as flowing in three coax lines fed from a common source at a common junction point and sampled by three adjustable loops which couple to the magnetic field in each line. Declaring that the coupling of each of the loops can be varied by rotation of the loop, Soderman added that one of the coax lines is terminated in a conductance standard, which is a pure resistance equal to the characteristic impedance of the line, one in a susceptance standard which is a short-circuited length of coaxial line, and one in the unknown circuit. The output of the three loops are combined by connecting all three loops in parallel and when properly oriented, the combined output is zero.

Reviewing connection problems at *uhf*, the G-R instrument specialist said that one of the most troublesome problems is that of connecting the unknown to the point at which the impedance is actually measured. In measurements on transmission-line circuits, the solution was noted as being simple since the connection can be made using a length of transmission line; this length of line, however, affects the measured impedance, and, if the actual impedance and not only the *vswr* is desired, corrections must be made for the length of line. In measurements on components such as resistors, capacitors, and inductors, it was said, the leads used for connecting the unknown to the measuring instrument usually have sufficient inductance and stray capacitance to affect the measurements greatly. To illustrate this point, Soderman declared that at 900 mc, a connecting lead of No. 20 wire, ¼" long, has an inductive resistance of approximately 35 ohms, and a stray shunt capacitance of 1 mmfd has a reactance of 177 ohms. He noted that these effects can be corrected for, but the process may be tedious.

Reviewing frequency measurements, Frank D. Lewis, also of G-R, said that measurement techniques in the *uhf* band are essentially extensions of methods which are in use at lower frequencies. For rapid approximate measurements, an absorption type wavemeter is useful whenever an accuracy of ± 2% is satisfactory. For more precise measurements, oscillating heterodyne frequency meters are used. One such oscillator was described as a heterodyne frequency meter*** covering a fundamental frequency range of 100-200 mc with useable harmonics to well above the *uhf* range. Although this frequency meter is accurate to ± 0.1% as it stands, it was said that its accuracy can be improved considerably by the use of a suitable precision calibrator.

* G-R. ** Hewlett-Packard.

*** G-R 720-A.

[*Highlights of the symposium papers on field strength analyzers for* uhf *and* vhf, *and transmission-line problems, will appear in the November issue.*]

## Ultrahigh Design

(Continued from page 17)

the lower limit to the figure of merit for feedback applications of this type.

The initial stages of the 10-kw transmitter[4] are identical with the 1-kw transmitter. A total of 9 *rf* stages are needed to produce the 10 kw of peak picture power. The final *rf* power amp is an A2250 which acts as a linear amp. The *rf* circuit is of coax construction and the plate circuit similar to that used for the 1-kw unit. The output coax line contains a reflectometer to provide an indication of the transmitter output power and standing-wave ratio.

### *UHF Antenna System Equipment*

For *uhf* it has been found possible to use a simple slotted cylinder antenna. which consists of an array of slots in one steel tube. The number of layers of slots depends on the required gain, but is usually 14 to 18 layers for power gains of approximately 24 to 30, the gain being approximately 1.66 times the number of layers. Each layer consists of three slots approximately 1.3 wavelengths long equally spaced around the circumference. The layers are spaced 1.5 wavelengths for minimum vertical side lobes. Each layer of slots is staggered 60° to obtain a horizontal pattern which is circular within 1% in field.

### *Deflection of Antenna and Tower*

Because of the narrow vertical pattern attained in high-gain *uhf* antennas, it is necessary to consider deflection of the supporting structure during high winds. The gain is limited to a value which permits the use of economical and practical supporting structures.

During high winds, which occur only a few times a year, the antenna and supporting structure will oscillate at the natural mechanical resonant frequency of the antenna and supporting structure. This mechanical swaying will cause the received signal to vary in intensity at the natural mechanical frequency of the antenna and support system, usually .5 to 1 cycle per second. If receivers without *agc* were used on *uhf*, the effect on the received picture would be similar to airplane flutter. It will be necessary to use *agc* on *uhf* receivers for many reasons; hence, all *uhf* receivers will be tolerant of this signal fluctuation due to antenna sway without adverse effects on the observed picture.

---

[4] RCA TTU-10A.

## Polyethylene in TV

(*Continued from page 21*)

pound with a 60° C. maximum operating temperature; this was changed to a compound having an 80° C. maximum operating temperature, and currently there is being processed a compound having a 105° C. maximum operating temperature wire insulation, which has UL approval for continuous operation at this temperature. Today, *Vinylite* plastic wire coverings in solid color are being supplanted by spiral-striped colored leads, because the additional circuits being brought into use do not have enough solid color categories and need the variations allowable for circuit identification.

Included in instructions to the ultimate television set buyer, concerning painting of television leadin wire might be a note stating that painting of leadin wires may affect the television cable and give higher attenuation. Secondly, paint may not dry properly when applied to leadin wire. Thus, during house painting care should be taken so as not to paint the television wiring.

## Fringe Area

(*Continued from page 19*)

in field intensity or power at the receiver terminals.

### *Receiver Sensitivity*

The maximum gain for an ideal receiver is limited by the noise power input. For a 300-ohm termination and a 4-mc bandwidth, this is approximately 13 *db* below 1 watt at the receiver terminals. On this basis it can be assumed that satisfactory video signals in an ideal receiver would appear at a signal power input of approximately 110 *db* below 1 watt, and below this level video signals would probably be poor to unsatisfactory as the level approaches noise. This figure is based on a suburban location and assumes man-made noise to be a minimum. For urban locations where man-made noise is higher, this is optimistic and –90 *db* below one watt can be arbitrarily established as the level at which satisfactory video signals will begin to appear.

Different receivers vary in sensitivity and it might be assumed that the foregoing figures based on man-made noise to be practical limits of receiver sensitivity. In the case of a receiver and booster combination, the total receiver sensitivity would be the sum of the receiver and booster gains.

[*To be Concluded in November*]

# VWOA News

Member George P. Shandy has announced the opening of a new RMCA office in Cleveland. Shandy is regional sales manager and is in charge of company activities in that area. . . . *Earle E. Hill* is with Tropical Radio as plant engineer in Fort Lauderdale, site of their new WAX station. . . . From way out across the Pacific a note has been received from W. W. Hofmann saying that he is busy operating station KHK, the RCAC station in Kahkuku on the Island of Oahu. WWH began has career back in '29, when he started pounding brass on the SS Socony 94, which was a Standard Oil barge in tow of a tanker, on the run between New York and Beaumont, Tex. His last ship job was on the SS Mauna Kea of the Matson Navigation Co. . . . *G. P. Houston*, who has been chief engineer of WCBM, Baltimore, Md., for many years, is quite a *wireless* oldtimer, too, having received his first class telegraph and phone license in '19, when he was assigned to the SS Connersville. He has worked with the C. and P. Telephone Co., and has been chief engineer of WCAO and WFBR. He also served for four years with the Signal Corps. He is also a member of the NARTB engineering committee. . . . E. W. Mayer, with the CAA in San Juan, Puerto Rico, as electronics technician, has reported that there are rough operating difficulties on the island. . . . *G. B. Angle*, another Tropical Radio man located at WAX, has suggested that VWOA publish a list of amateurs. . . . *N. E. Blackie* of Redondo Beach, Calif., has written in saying that he is still on the firing line and still holds two *firsts*, 38 years since the first issue. He's active in the *ham* world, using the call W6WNZ. . . . *Major Leroy Thompson* is chief of the radio engineering branch of the Signal Section, Gen. HQ, Far East Command. . . . *E. P. Nelson*, in addition to running his personal business as a consulting engineer in electrical power, control and instrumentation, has taken over the job of vice president of Designers for Industry, located in Cleveland. His specialty is magnetic amplifiers. . . . *L. R. Dawson* has reported that he is still with the FCC at Seattle and Portland, Oregon. . . . *R. H. Hersey*, who is with M. Stunert and Sons, Boston, has completed his twenty-sixth year with them. He handles the installation and repairs of Hammond organs and radio and TV gear which they sell. . . . *Arthur Rehbein* has moved to Long Island. . . .

## Briefly Speaking..

ROAD-SHOW closed-circuit TV, featured overseas and found to be an ideal way to demonstrate the potentialities of sight and sound, has now become a domestic headliner with exhibits scheduled all over the land. In one instance, a tour of the midwest has been announced by DuMont, with John Klindworth of the TV transmitter division, scheduled to appear at the National Dairy Cattle Congress in Waterloo, Iowa, in cooperation with station KXEL; the All-Iowa Fair in Cedar Rapids, Iowa; Peoria, Ill.; and Fargo, North Dakota. In use will be an image orthicon camera chain and a Du-mitter, to feed images to a 30-inch chassis. . . . Expansion plans of the Hebrew Institute of Technology, Haifa, are now underway, according to Rav-Aloof Y. Dori, president, and professor S. Goldstein, vice president, who have announced openings for lecturers, instructors, associate professors and professors in nineteen departments involving power engineering, telecommunications, electrical engineering, production engineering, mathematics and physics. . . . The Navy department is now recruiting electronic and technical personnel to staff their research, development and production facilities, according to George R. Hickman, placement officer, employment operations section, departmental civilian personnel division. . . . Airborne Instruments Lab, Mineola, N. Y., celebrated its sixth anniversary with a ground-breaking ceremony for a new engineering and production division building, which will be located on Stewart Ave., east of Garden City. . . . JFD Manufacturing Co., Inc., Brooklyn, N. Y., is now producing 7-section, collapsible, long antennas; flexible rule antennas; molded Kel-F connectors for these antennas; coax antenna connectors; alignment tools, etc., for the military. . . . A TV picture-tube replacement selector which indicates correct replacement picture-tube types is now available from Allen B. DuMont Labs. . . . A 212-page buying guide, *No. 127*, has been announced by Allied Radio Corp., Chicago, Ill. . . . Standards for laminated thermosetting products, publication No. *LPI-1951*, have been published by the National Electrical Manufacturers Association, 155 East 44th St., New York 17, N. Y. Priced at $1.00, the publication has information concerning the manufacture, test and performance of laminated thermosetting sheets, rods and tubes. . . . Westinghouse Electric Corp. has announced that it will undertake a $296,000,000 expansion program extending beyond '53.



## ADVERTISERS IN THIS ISSUE

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OCTOBER, 1951

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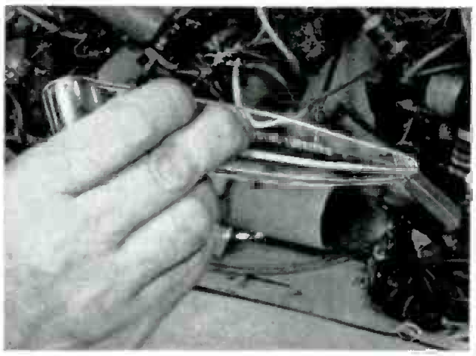

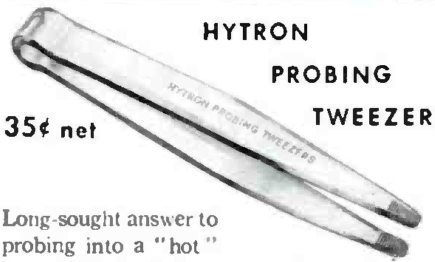


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