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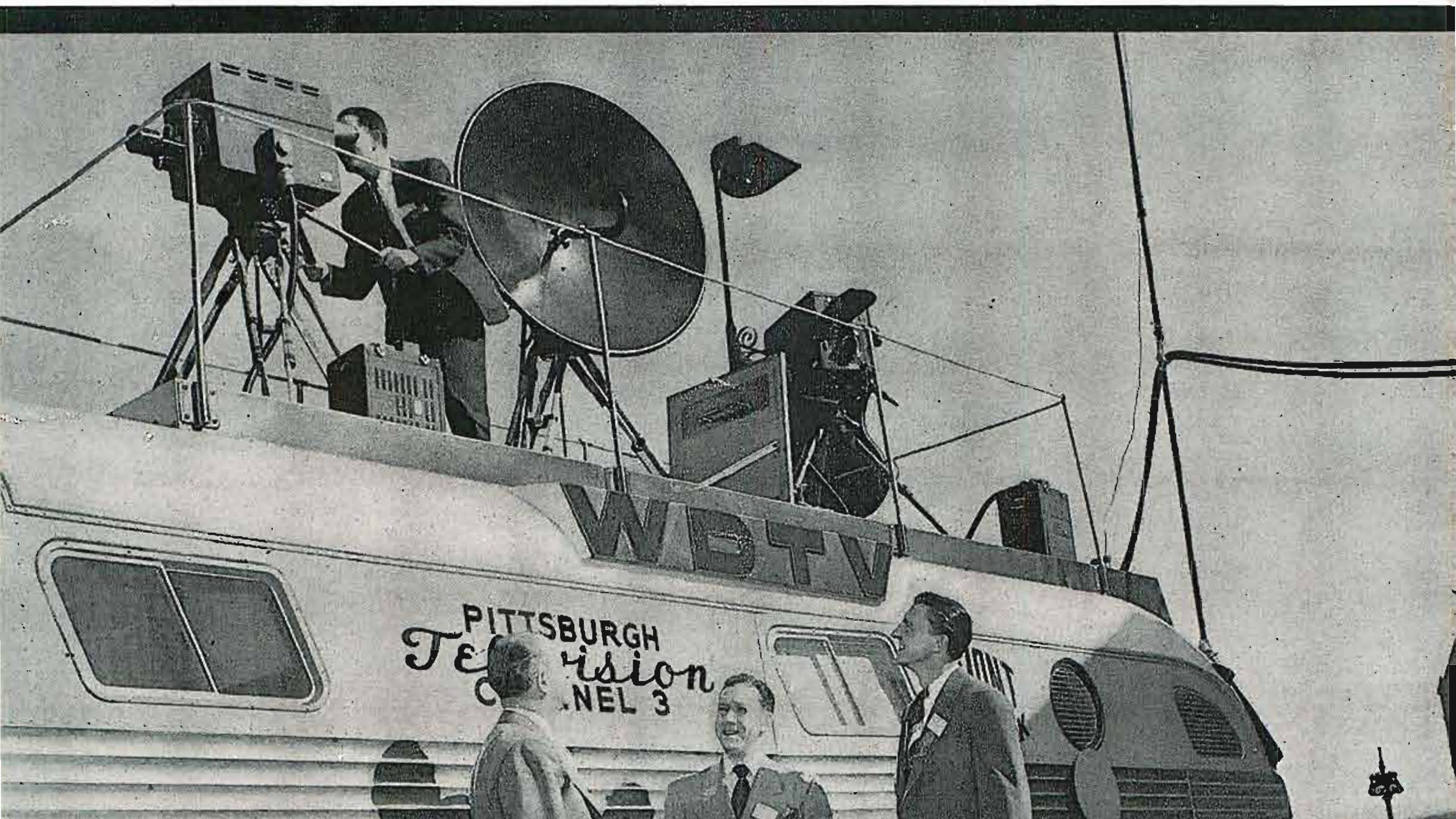

OCTOBER

★ TRANSMITTING TUBE-CHECKER DESIGN

★ TV-FM SITE TESTING WITH BALLOON-SUPPORTED ANTENNAS

★ 3-KW MF TRANSMITTER USING IRON-CORE INTERSTAGE AND OUTPUT CIRCUIT

1949

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LEWIS WINNER
Editor

F. WALEN
Assistant Editor

Bryan S. Davis, President
Paul S. Weil, Vice Pres.-Gen. Mgr.
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East-Central Representative:
James C. Munn
2253 Delaware Dr., Cleveland 6, Ohio
Telephone: Erieview 1726

Pacific Coast Representative:
Brand & Brand
1052 W. Sixth St., Los Angeles 14, Calif.
Telephone: Michigan 1732
Suite 1204, Russ Building, San Francisco 4, Calif.
Telephone: SUtter 1-2251

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COVER ILLUSTRATION

Testing WDTV mobile van during a recent field tour, with T. T. Goldsmith, Jr., director of research of Allen B. DuMont Labs, at the camera controls. Looking on, left to right: Royal V. Howard, former NAB director of engineering and at present a Washington consulting engineer; ye editor and Lincoln A. Thelmeyer, executive assistant to the director at the Brookhaven National Laboratory.

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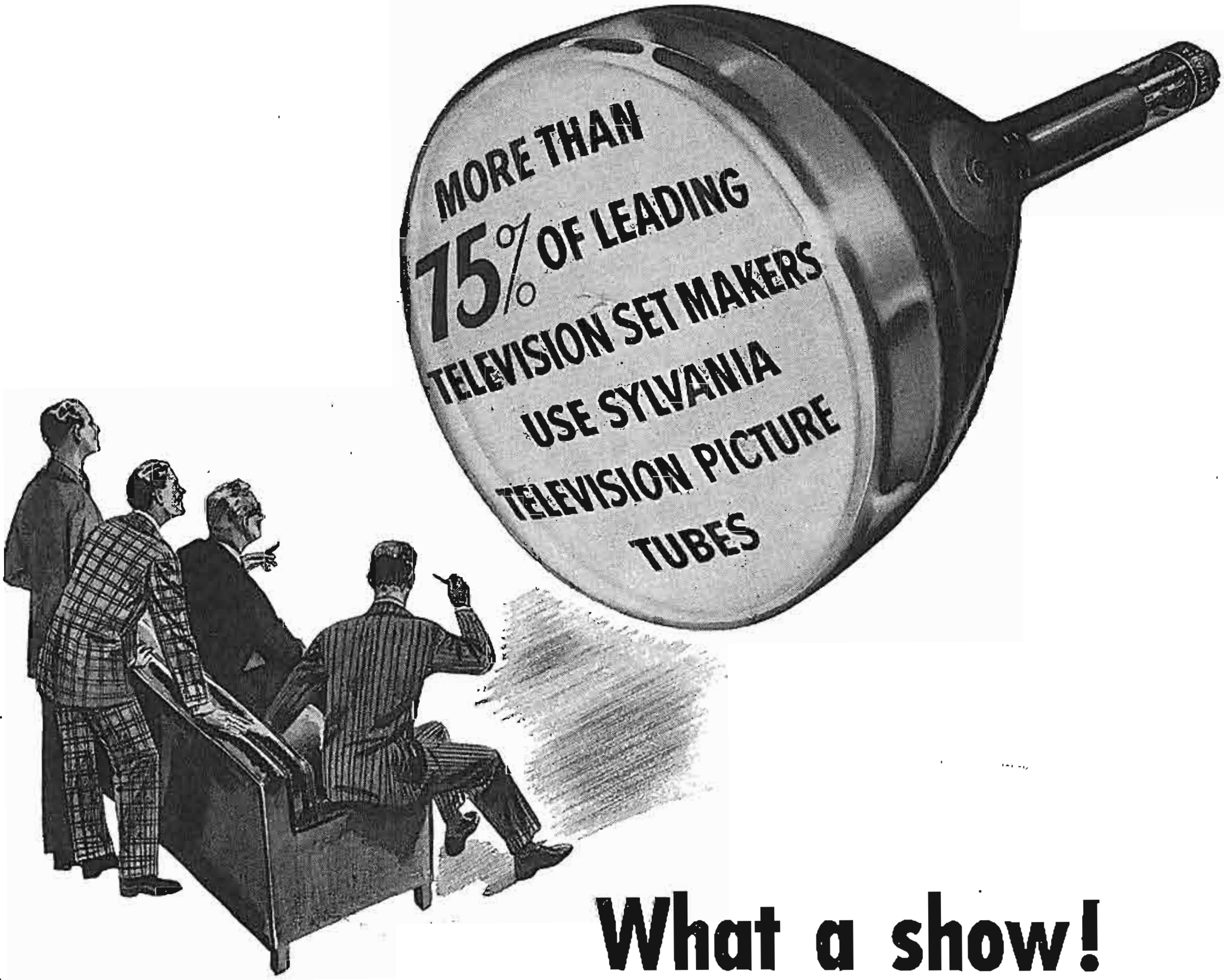

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COMMUNICATIONS

LEWIS WINNER, Editor

OCTOBER, 1949

The TV Freeze and Color

COLOR, which appears to have hypnotized our legislators in Washington, found itself with an emblazoned priority over a host of vital problems, including the freeze question at the crucial Washington allocation hearings. Recalling the serious interest the FCC displayed in the urgent need for action on the stymied channel puzzle and their attempt to affect a settlement with the announcement of their proposal some months ago, the decision to ponder over color first prompted many to frown. With all industry, including representative bodies such as TBA, JTAC and RMA, stressing the acuteness of the freeze situation, the Commission still insisted that the reds, blues and greens warranted immediate consideration. Industry complied, and several bookcases of testimony resulted, the most revealing of which was the RMA and JTAC report.

Disclosing for the first time the number of color systems that have been suggested for possible application, the JTAC report provided a comprehensive review of what the laboratories have produced thus far. Eight systems have been designed, two for twelve mc and the remainder for six mc. The twelve-mc developments include the simultaneous 30-color picture, 60-field approach and the field sequential 24-color picture, 144-field arrangement, both of which were demonstrated during the '46-'47 hearings. The newer types, featuring the use of the 6-mc bands, include two field-sequential systems with 24 pictures and 144 fields and 20 color pictures and 240 fields, respectively, the latter system using dot and line interlace. Three line-sequential systems are also available, two of which use 30 color pictures and 60 fields, one with simple interlace and the other with non-interlace. The third system in this group uses 10 color pictures and 60 fields, with a simple interlace plus color-line commutation. The eighth system recently announced is the dot-sequential approach with 15 color pictures and 60 fields, with a dot and line interlace. In the original simultaneous color system, green was allowed a bandwidth of 4 mc, red a bandwidth of 1.8 and blue a bandwidth of 1.4. In the 6-mc feld-sequential approach using dot and line interlace, we have interlacing in both directions, vertically in the usual fashion and horizontally by pulsing the video signal with an 8-mc dot carrier. In the dot and line interlace dot-sequential system, the video signal is pulsed with an 8-mc dot carrier and the colors are changed at both line and dotting frequencies; a picture dot is a half cycle of the top frequency of the nominal video band and in present practice with a nominal video band of 4 mc a picture dot lasts ⅛ microsecond, while a scanning line lasts 63.4 microseconds, providing a total of 507 picture dots per line.

The report went on to point out that analyses have indicated that the frame flicker of the 6-mc sequential color system, using dot and line interlace, was superior to all other systems available thus far, although the simple interlace and dot and line interlace (dot-sequential) approaches were equal for monochrome and color. We also learn from this report that color breakup is apparent in the field sequential color systems, but not in the others.

The term, compatibility, was stressed quite strongly during the hearings, since a compatible system would permit reception of black and white pictures from color transmissions without any modifications or adjustments in the receivers now being made. According to the JTAC report, the only systems that were compatible were the line sequential and dot sequential. Analyzing these points, the report stated that the field-sequential systems necessarily required changes in the scanning rates to maintain a sufficient color repetition rate to preserve the element of continuity. Since, the report stated, these systems employ a mechanical means of color control less geometric detail will be transmitted because the pattern rate must be higher to accommodate the several colors. Describing line-sequential systems the report said that these are substantial compatible with present standards if suitable numerical values are chosen. To maintain the illusion of continuity either the geometric picture detail or pattern rate must be sufficient and a compromise affected to maintain compatibility. The dot-sequential system was described as being generally similar to line-sequential systems.

One canont deny that the color stress has provoked agreement on a key point, the use of 6 mc, which should simplify allocation charting. There is hope, therefore, that this unanimity may prompt the Commission to reconsider earlier action on unfreezing and a prompt probe of the ultrahigh problem.

The industry concensus is that once the ultrahigh program has been set, the color question will not be too difficult to solve. According to the engineering divisions of such groups as the TBA, the ultrahigh plan should provide at least as many stations to each metropolitan district and community as contained in the proposal, and include at least four stations in the first 140 metropolitan areas. And wherever a mixture of veryhigh and ultrahigh systems are required, at least two ultrahigh stations should be included. Stressed in these plans is a new point which has become of concern to many. This is the image and oscillator interference protection problem, a factor which the FCC did not provide for in their allocations schedule. The suggestion has been made that such interference can be minimized if a 41.25-mc receiver sound if frequency is considered, with station separation of one-hundred miles.

Announcements have indicated that the color hearings will run until probably early in December. It was believed that perhaps this arrangement could be altered, but the plans seem to have gone too far for such a change. However, once these sessions are over and channel allocations become a topic of the day, the move to open up the television bands should be on, with a concerted effort to reaccent the critical import of the freeze lift.—L. W.

TV-FM SITE TESTING

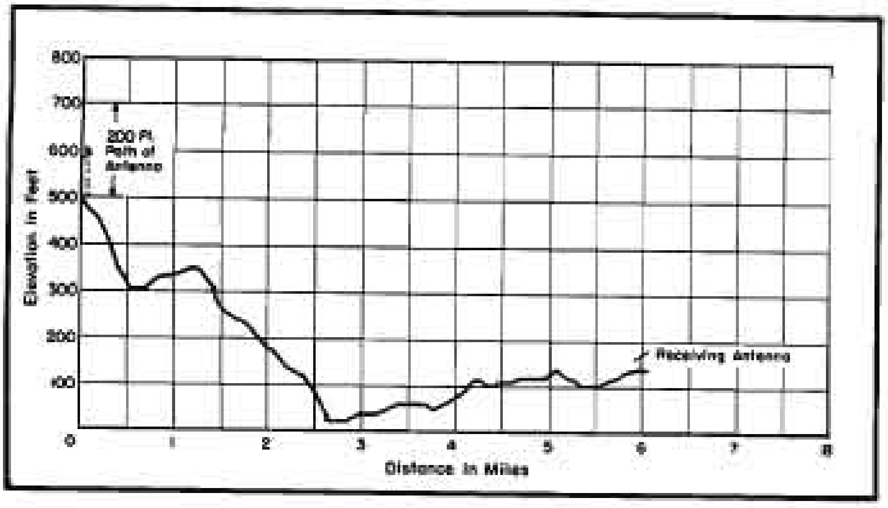


Figure 1
Profile of terrain probed by Hodgkins during his site test.

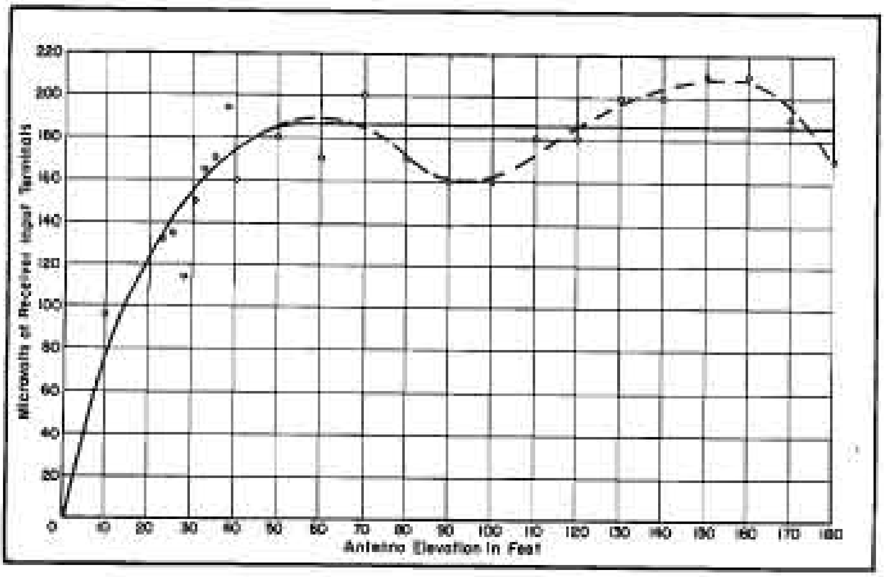
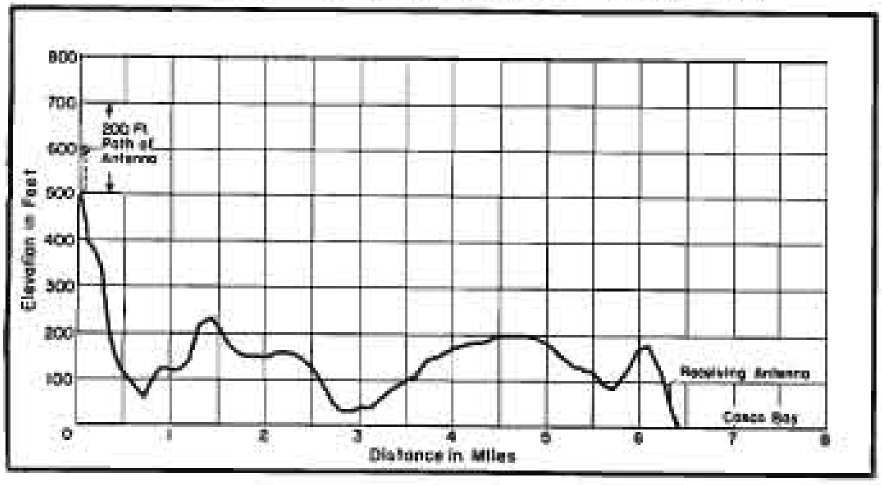


Figure 2
Plot of received signal versus antenna height above ground.

Figure 3
Profile indicating receiving conditions in an extremely adverse location.



The selection of a suitable high-frequency transmitting location is a problem of increasing importance to all broadcasters. Not only is it necessary to select the site which will give the best service to the area under consideration, but it is increasingly important to prove that this proposed site will measure up to predicted operation and possess no hidden faults. With the major financial investments which are going into TV transmitting plants the road back from a poor site is extremely expensive and would in all probability be avoided and a compromise made by getting along with what was already constructed regardless of its shortcomings.

To avoid such a dilemma, and to predict as accurately as possible the operation of a proposed station, it was decided to investigate the possibilities of a test with a balloon-supported antenna operating from a low power test transmitter.

Two factors had to be considered in planning such tests. The first was that the height of the antenna above the average terrain determines to a far greater extent the coverage than does the power which is to be radiated. In other words, if the service range is to be extended it is usually better to raise the antenna an appropriate amount to accomplish this, than to increase the power. The second consideration had little to do with the maximum reliable range of the station but it was an item which we felt was important concerning the site. This was the question of what would happen in terms of signal strength in the nearby business and residential areas when the completed installation was placed in operation. Such areas must have an adequate signal or the whole purpose of the station would be lost.

The causes of low signal intensities, or wide variations in signal from place to place, are numerous. Many factors are not yet fully understood. Among these items which may affect the signal are reflections from surrounding terrain or objects, amount of drop off from the antenna site in the direction of the receiver, and the character of the ground over which the signal travels. To fully evaluate the effects which will be encountered at the chosen point of reception the field intensity should be investigated for various antenna heights starting near the ground and progressing at definite in-

With Balloon-Supported Antennas

Use of Meteorological Balloon, 250' of 72-ohm Line Connected to Dipole, 25-Watt Tuned-Plate Tuned-Grid Oscillator and Field Intensity Meter, Found to Provide Conclusive Site-Selection Information.

by ROGER W. HODGKINS

Chief Engineer
Guy Gannett Broadcasting Services

tervals up to and exceeding the proposed height.

To carry on such tests a number of approaches to the problem are possible. In our case we used a low power oscillator operating on the frequency in question, a meteorological balloon, a tank of hydrogen, a simple dipole antenna, lines for staying off the antenna, and a field intensity meter.

The oscillator consisted of a tuned-plate tuned-grid type in which the grid was stabilized by using long lines of the shorted stub variety. This unit had a power output of about 25 watts maximum using an 815 tube. It was found to be very stable and suitable for this purpose.

The meteorological balloon was exactly the same as those used by the U. S. Weather Bureau to carry aloft its radio equipment during daily weather observations. These balloons have a lifting power of around 35 pounds when fully inflated.

The hydrogen tank was obtained from a local source of industrial gas. Certain cities have ordinances prohibiting the sale of hydrogen because of the hazard of filling toy balloons. This must be taken into account when arranging for this substance. In addition, a regulator was used to reduce the gas pressure and give more control in filling the balloon. The type used for nitrogen supplies to coaxial lines will fit the hydrogen tank and operate just as well as it does for nitrogen.

The antenna may be any light sort of a dipole arrangement which may be easily supported by the balloon. Light cord of some variety should be at hand to fashion stays for the antenna ends and also for a third stay against the wind direction.

The manner of field intensity measurement depends on the requirements of the tests. If actual values of signal intensity are desired to convert to actual signals which will be obtained from the finished installation, then a calibrated field intensity set of some standard manufacturer should be employed. If a comparative set of readings in terms of microvolts delivered to a receiver is desired a calibrated signal generator may be used to advantage. In our tests the latter method was used.

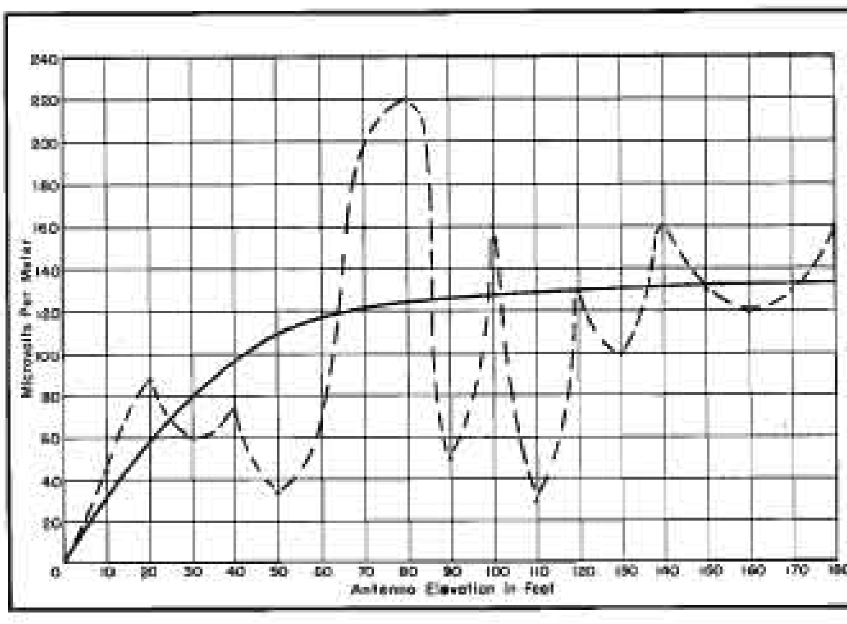
Methods Employed in Tests at WGAN-FM

In our tests at Portland, Maine, the oscillator was first set up and checked for proper operation. Then the dipole antenna was rigged on a suitable support and 250' of 72-ohm transmission line used to connect the antenna to the oscillator. This length of transmission line was kept constant in order to radiate the same amount of power regardless of antenna height. Care must be taken to properly arrange the surplus line with respect to metal objects and wires. To check the possibility of error from this source the line was draped in various positions while the antenna was near the ground but no appreciable difference could be observed at the receiving site.

Once the oscillator and antenna were in readiness the balloon was prepared for inflation. Care was exercised with respect to smoking as hydrogen when

(Continued on page 26)

Figure 4
Plot illustrating the result of test conducted in the Figure 3 location.



Determination of

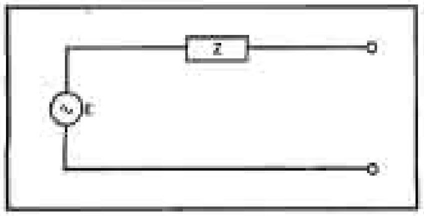


Figure 1
Representation of the source of voltage based on Thevenin's theorem.

System Requires Only Measurement of Output Voltage Magnitudes.

by R. W. BUCHHEIM
Instructor in Electrical Engineering
Yale University

When considering problems such as impedance matching, etc., it is convenient to represent a source of voltage by the form shown in Figure 1, as based on *Thevenin's theorem.*

This theorem states that: When a load impedance is connected to the output terminals of a two-terminal network composed of linear elements and voltage sources, the network can be replaced by a single generator of voltage, E, and internal impedance Z, where E is the terminal voltage when the terminals are open circuited and Z is given by the ratio of E to the current, I_{sc}, which flows in a short circuit at the output terminals.

In the practical case, the principles of this theorem, as stated, are of little use in actually determining Z. To remove E by shorting it out, if possible at all, will certainly be most likely to alter Z in an electronic generator; therefore, direct measurement of Z is not often feasible. To find Z from E/I_{sc} is not at all practical, because a knowledge of the phase relation between E and I_{sc} is required, and because the short circuit current will almost invariably be very badly distorted.

It is desirable to have available a method for finding Z which requires only simple measurements and simple treatment of the data of these measurements. A method has been evolved which requires only the measurement of output voltage magnitudes. The treatment of experimental data employs a simple semi-graphical procedure.

In applying this method, let E_R be the terminal voltage magnitude when the load is a known resistance R_e; and E_x, the terminal voltage when the load is a known reactance X_e.

E is the open-circuit terminal voltage, and Z is of the form $R + jx$.

Therefore:

$$E_R = E\frac{R_e}{\sqrt{(R+R_e)^2+X^2}} \qquad (1)$$

$$E_x = E\frac{X_e}{\sqrt{R^2+(X+X_e)^2}} \qquad (2)$$

These equations can be rewritten as

$$(R+R_e)^2+X^2=\left(\frac{E}{E_R}R_e\right)^2 \qquad (3)$$

$$R^2+(X+X_e)^2=\left(\frac{E}{E_x}X_e\right)^2 \qquad (4)$$

Inspection shows that these are the equations of circles in an $R - X$ plane. The circle represented by (3) has its center at $R = -R_e$ and $X_e = O$, while its radius is $\left(\frac{E}{E_R}R_e\right)$. It is called an R_e - *circle.*

Equation (4) represents a circle with its center at $R = O$ and $X = -X_e$, whose radius is $\left(\frac{E}{E_x}X_e\right)$. This is called an X_e - *circle.*

These circles can be very easily drawn on an $R - X$ plane. A point of intersection of the two circles is one with R and X coordinates which satisfy

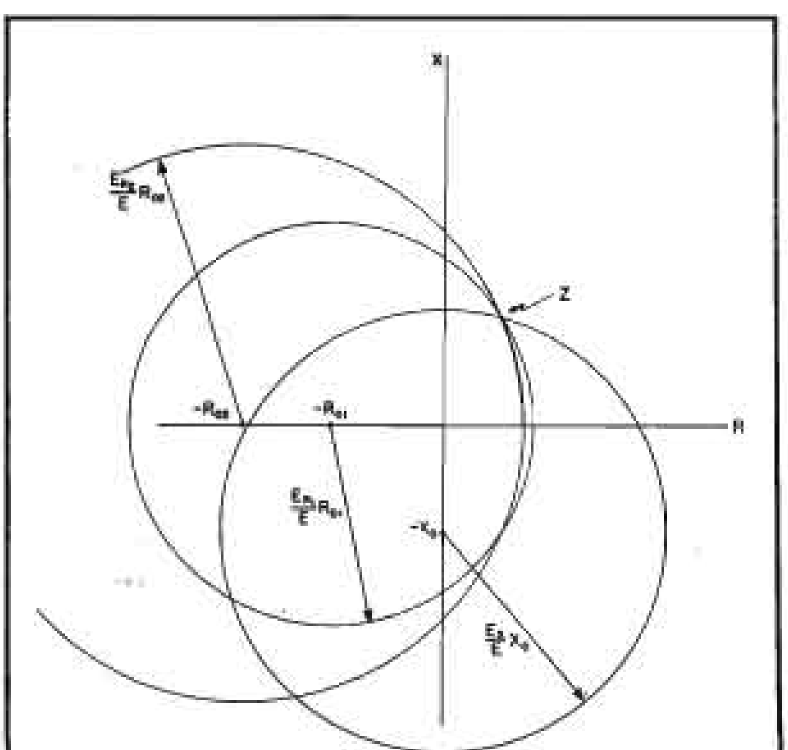


Figure 2
A sample circle diagram.

Internal Impedance

Using Semi-Graphical Procedure

both (*3*) and (*4*), and is therefore a solution for Z.

In general, two circles intersect at two points. One of these points is the true Z, the other an extraneous solution. To resolve this difficulty it is necessary only to take one more reading of output voltage with a second value of R_e or of X_e, giving a third circle that will pass through the point at which the two other circles intersect at the true Z. It will also generally intersect the other two circles individually to register two more extraneous solutions. The actual Z is given by the coordinates of the point at which all three circles intersect.

If the two original circles intersect at two points such that one point indicates the R component of Z to be positive, and the other indicates the R component to be negative, then the second intersection can be discarded immediately since it represents a solution which is physically unreal. The first intersection yields the true solution for Z, and a third circle is unnecessary. The situation first described is the most usual, so two circles, one R_e – *circle* and one X_e – *circle*, ordinarily are sufficient. In a physical system no case can arise in which both intersections of two circles indicate negative values for R.

Since all R_e – *circles* have their centers on one axis, the R axis, all intersections of R_e – *circles* will represent conjugate impedances. That is, if two R_e – circles intersect at $R = R_1$ and $X = X_1$, they must necessarily also intersect at $R = -R_1$ and $X = -X_1$. There is, therefore, always an ambiguity of sign if only resistances are used as loads in the tests, and this procedure can be rejected as not useful. The remaining combinations of R_e and X_e loads for the three tests, all of which are satisfactory, at least in principle, are as follows:

(*a*) Two tests, each with different known resistance loads and a

(*Continued on page 32*)

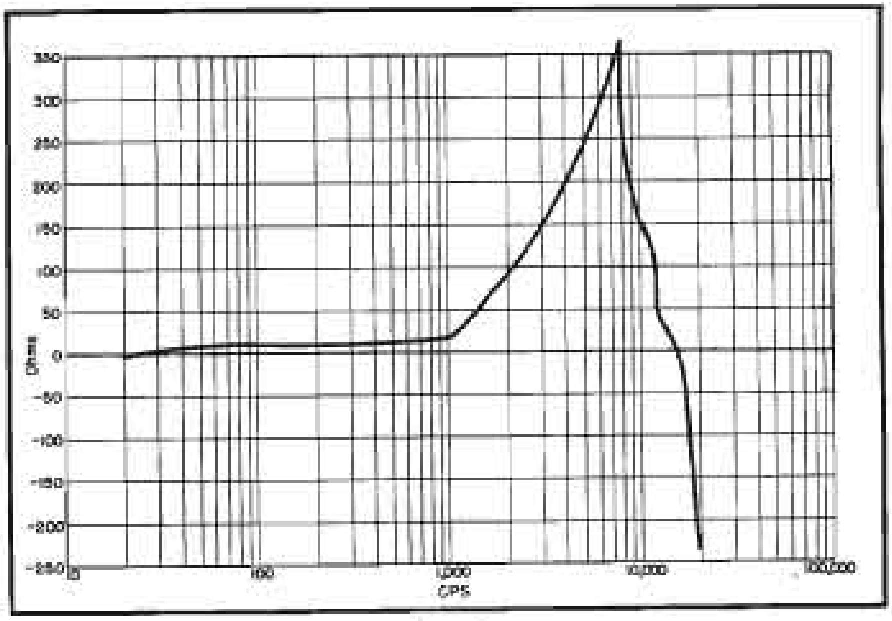


Figure 3

Plot of the reactive component of Z in a test generator.

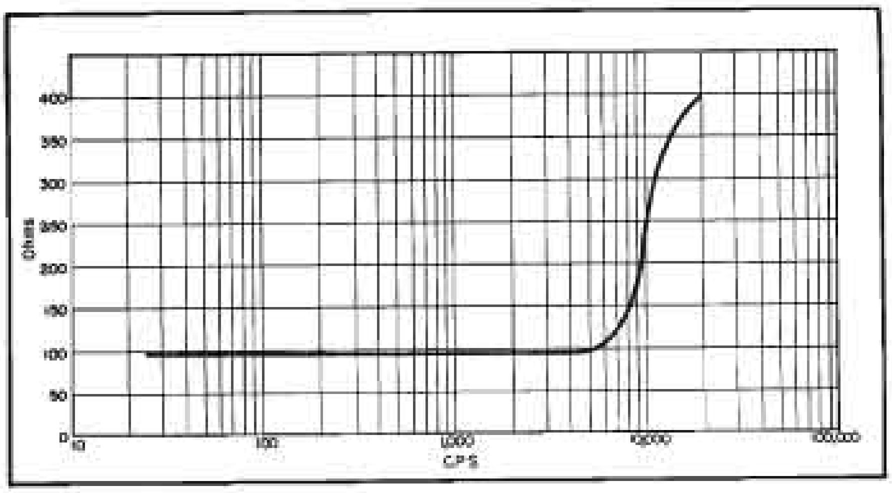


Figure 4

Plot of the resistive component of Z in a test generator.

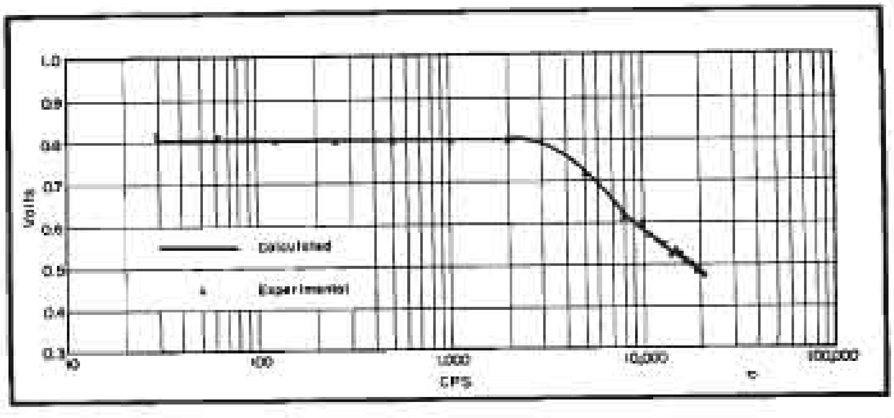


Figure 5 (Right)

Plot of calculated and experimental results: Ratio $\left\{\frac{\text{load voltage}}{\text{open-circuit voltage}}\right\}$ with a 400-ohm resistance load.

Remote Broadcast — PA

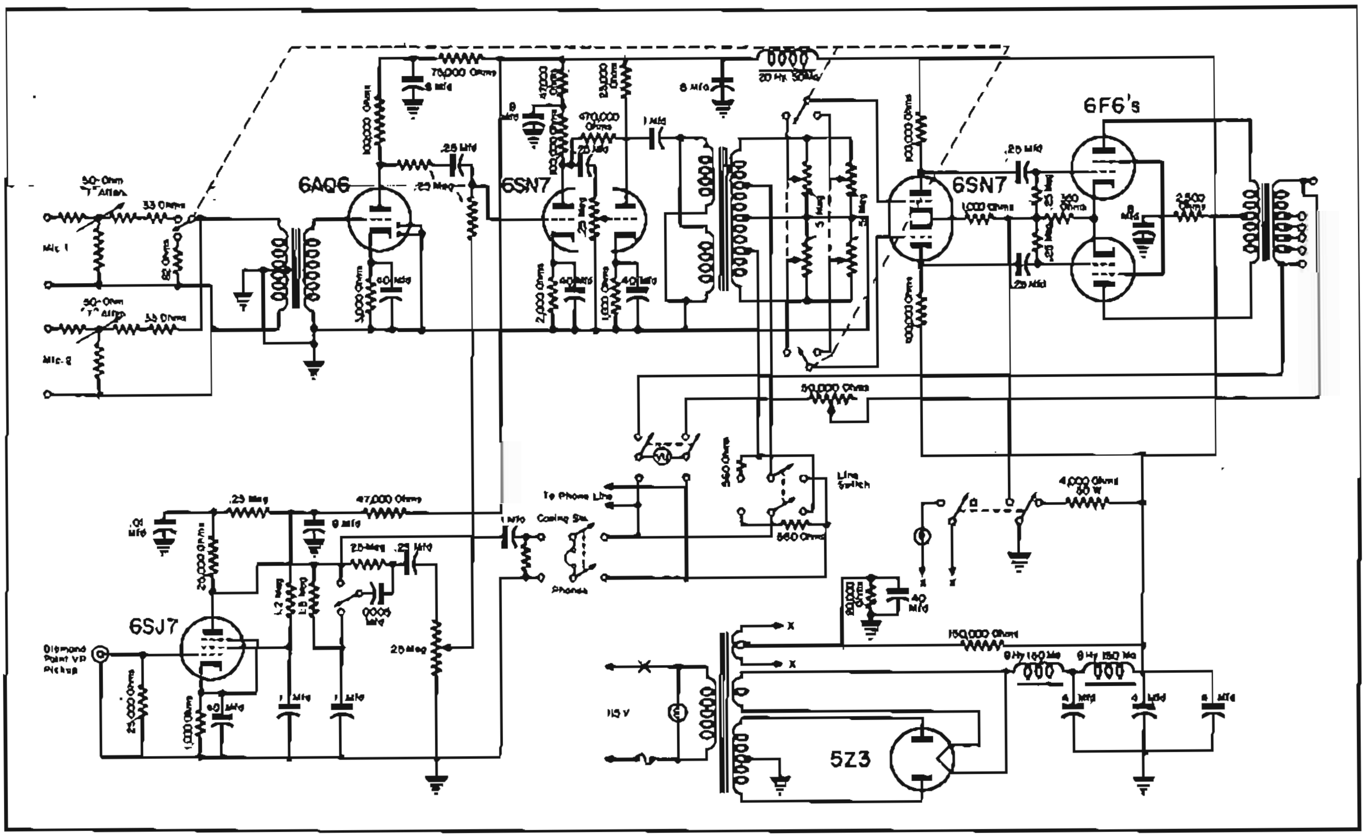


Figure 1
Circuit of the KXIC console designed for remote broadcast and public address operation.

PATTERNS for integrated community services have been found to be quite a factor by many broadcasters, particularly those covering the small towns. In our area provision for such a setup, involving broadcasting of disc programs from nearby hamlets and the local 'teen club appeared to be a program *must*. Accordingly it was decided to develop a facility for this type of transmission. As a result of this consideration a special type of console was designed to permit the community-type broadcasts and in addition provide the feeding of public-address circuits.

The console features a switch to change the *vi* meter from the broadcast line to the output of a *pa* 500-ohm line. In the latter position there is a 50,000-ohm pot in series with the meter. The pot is located inside the cabinet on the chassis, and when connected to the 500-ohm public-address output, the meter can be used for a visual indicator of public address coverage. In that application pre-calibration is necessary.

Since the public-address amplifier bridges the 500-ohm broadcast line, any *pa* feedback would seriously affect the broadcast. For that reason a rather novel, yet highly effective and easy-to-operate method was developed for controlling the *pa* volume when a mike is turned on.

One of the microphone faders was wired in so that it would be in the circuit at all times. Another fader, which is used more often, was set up so that it could be switched in and out of the circuit.

Ganged on this switch are the arms of two double pots. Thus, when the main mike is on, one double pot can be used to control the public address volume. When that mike is off, the other pot is used.

These pots can be preset before the broadcast so that no feedback, under any expected conditions, is obtained. If any unusual conditions arise, the appropriate *pa* control can be changed. The operators at the station found that both gains could be advanced as the crowd noise rose during broadcasts.

The coupling transformer, a *600-ohm and bridging to push-pull grids* transformer, was installed backwards, with the split secondaries paralleled to match the plate of the second section of the 6SN7. Inverse feedback was included across this section; it was found to minimize distortion caused by the phone line's effect on the dynamic load line.

The phono amplifier was designed so that the unit could provide good bass response, and retention of the highs with sufficient attenuation so that on most records no scratch filters would be necessary. One side of a high-boost .0005-mfd capacitor in the 6SL7 plate circuit can be switched to a point of zero audio potential, to provide an increase of high-frequency attenuation. Themes and old records can be played in this position.

By switching this capacitor to a point of equal *dc* potential, no click is heard on the air when the switch is thrown.

Line-Out Circuit

The system also features a *line-out* circuit which enables the operator to switch off the broadcast feed and sub-

PORTABLE CONSOLE

Console, Which Enables Operator to Feed Both Public Address and Broadcast Lines, Features Two Microphone Inputs, Phono Input with Booster Circuit for Variable Reluctance Pickup and Cueing Facilities.

by ELLIOTT D. FULL

Technical Director
KXIC, Iowa City, Ia.

stitute 580-ohm resistors as both amplifier loads and line loads.

Headphones can be left monitoring the broadcast line for cue. Thus, if the main studio should want to *take it back*, the remote operator can continue to feed public address to his local audience and still hear the program being broadcast.

Because of this feature, it has not been necessary to install a separate *order wire*.

The filaments were wired with a small positive potential on them to minimize hum. All of the input circuits were well shielded and grounded to a common point.

Some operators who are used to high-impedance circuits might hesitate to use the same switch for a microphone and for a driver-grid circuit. However, feedback due to intercontact-point capacities will not be encountered, if all other low level components are shielded, since the microphones and the faders are 50-ohm units.

It was found advisable to take the phono-cueing audio voltage from the plate side of the high-boost network, because when using earphones in a noisy location the audio voltage across the volume control would not be sufficient to be heard.

To cue in a record, phones can be switched over to the phono amplifier, and the phono volume turned down. This feature has not been used very often. However, on several occasions, the operator has been very happy to use this cue circuit for transcribed commercials on remotes.

A public-address standby, also provided in the console, has never been used during operation of the console. However, our ops have found that turning on the console with the public-address switch in standby position, protects the equipment from a high-voltage surge.

Both the power switch and the public-address standby switch operate pilot lights so that the operator knows the status of his equipment at all times. Admittedly, showmanship enters as an element here, too. For instance, some of KXIC's remotes are handled from a 6" x 6" x 6" remote amplifier, and spectators almost always express surprise at the lack of pretentiousness of the equipment. (Be you a *pa* operator or

(*Continued on page 33*)

Figure 2

The console, with remote turntable, bass-reflex cabinet, and accessory case. At the extreme left is the cueing-microphone control and to the right of this control are the microphone, phono and master controls. The switch above the phono dial is a tone and high-fidelity selector. The switch beneath the *vi* meter, in the center at top, is for line and public-address operation. The two dials at the right are public-address controls and the three switches next to these controls are for *pa*, *ac*, and line.

Iron-Core 3-KW MF

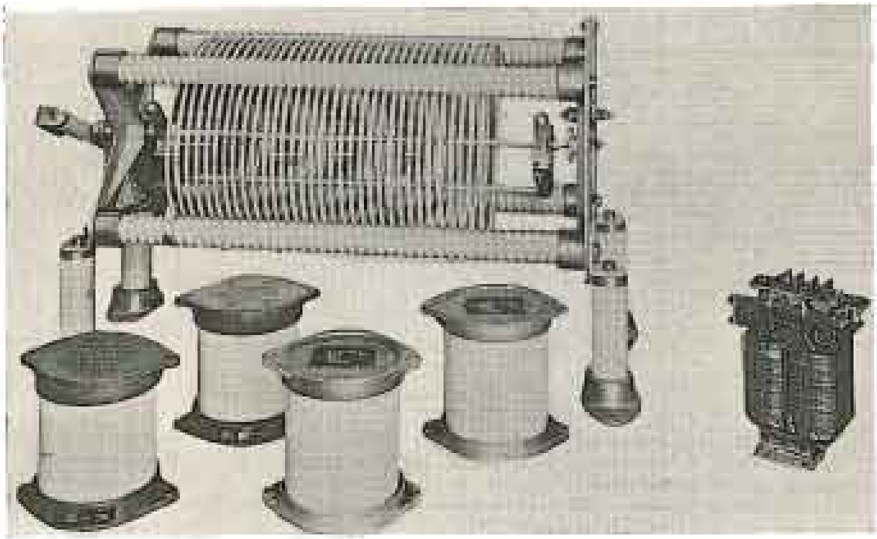


Figure 1
Comparative size of the conventional *LC* tank circuit and high-frequency iron core output transformer. The use of the transformer has been found to eliminate all moving parts, high current circuits and tuning in the *pa* stage.

Figure 2
Comparative size of the π coupling network and *hf* iron-core matching transformer.

MEDIUM FREQUENCIES, which use ground waves and are thus capable of providing substantially reliable communications regardless of atmospheric conditions, have been found to be ideal by the aeronautical services for communication, beacon and control purposes along the airways and at the airports. The frequency band has also been found excellent for beacon and communication purposes in the maritime field and by the armed services.

As a result, there has been accelerated interest in the development of *mf* transmitters for these services. In our study of the problem it was found that there were five general and three *must* requirements for such transmitters. The general characteristics included a power output of 2.5 kw up; frequency of 250-540 kc; frequency stability of ±.01%; emission of A1, A2, and A3; and keying speed to 100 wpm. The three absolutely necessary factors were: Two frequency operation (capable of operation by instantaneous selection on one of any two frequencies between 250 and 540 kc); inverted *L* and *T* antennas whose characteristics vary from 0 to 650 ohms capacitive reactance, and 3 to 20 ohms reflected resistance; and beverage antenna operation (capable of operating into beverage antennas fed by transmission lines whose characteristics impedance varies from 150 to 350 ohms).

In probing the design problems presented by two-frequency operation and a limitation on physical size, the power amplifier stage and the antenna coupling system were found to demand the bulk of attention. At these frequencies conventional amplifier tank circuits usually consist of fixed mica capacitors and a variable air inductor. Since this circuit must be tuned to resonance at the operating frequency, it is necessary to change the tuning with changes in operating frequency. Antenna coupling systems for conventional inverted *L* and *T* antennas usually consist of a *loading* inductor for tuning out the capacitive reactance of the antenna and a π or *T* network for matching the reflected antenna resistance to the amplifier tank circuit. Since the reac-

Interstage and Output TRANSMITTER DESIGN

Transmitter Developed for Two-Frequency Operation in the Aeronautical, Maritime and Point-to-Point 250 to 540 Kc Band, Uses High-Frequency Iron-Core Transformers to Reduce Size of Equipment and Eliminate the Need for Tank-Circuit Tuning.

by I. F. DEISE and L. W. GREGORY

Westinghouse Electric Corp.

tance and reflected resistance of these types of antennas change with frequency, it is necessary to change the tuning of the *loading* inductor and matching network with changes in operating frequency. This change in tuning for different operating frequencies would still be necessary even if the antenna reactance and resistance were not frequency sensitive, because frequency sensitive elements are used to compensate for the antenna characteristics.

Tuning of these circuits is usually accomplished with a continuously variable inductor or an inductor with a variable section and taps. For two frequency operation, the circuits must be tuned alternately from one operating frequency to the other. This is often accomplished by using two inductors, each tuned to the proper operating frequency and switched by relay or manual switch. Another method is to have a motor-driven continuously variable inductor.

All of these types of conventional circuits are extremely large in physical size at these frequencies and powers. It is difficult to obtain high Q air inductors in this frequency range, and often Q must be sacrificed in order that the reactors may be variable. Besides the extremely large space requirements, the relaying or switching of these circuits presents a decidedly large mechanical and electrical problem.

To solve these problems, it was decided to use a high-frequency iron-core transformer[1] as the output circuit of a class B power amplifier. Iron-core transformers at these frequencies were found to be small in size and eliminate the necessity of tank-circuit tuning.

In Figure 1 the comparative size of a conventional LC tank circuit and the high-frequency iron-core output transformer selected for the transmitter are shown. Two inductors and a switching relay are used for two-frequency operation. The tank inductor shown illustrates the equivalent size required for this power and frequency (not designed for this particular application).

For excitation, an untuned crystal-controlled oscillator circuit was used in which the only frequency sensitive element was the crystal. Crystals at these frequencies can be readily switched by conventional relays and as the frequency determining element, would provide the desired frequency stability.

Untuned, reactance coupled, class A amplifiers were chosen for the intermediate stages of the *rf* unit.

It was also decided to place the antenna coupling system in a cabinet separated from the transmitter proper so that the antennas could be located remotely from the transmitter. A high frequency iron-core autotransformer was used in place of π or T network for matching the reflected antenna resistance to power amplifier. A 51.5 ohm circuit was used to connect an antenna matching autotransformer to the power-amplifier output transformer. The autotransformer was provided with 5% taps to operate with antennas having reflected resistance of 3 to 20 ohms. For two-frequency operation, with antenna resistances that change with frequency, a relay was included to switch taps on the autotransformers.[2]

The comparative size of a conventional π coupling network and the high-frequency iron-core *matching* transformer are illustrated in Figure 2. Two inductors with a switching relay are used for the two equivalent sizes required for this application. (The inductor shown is used to illustrate the equivalent size required for this application.) The relay contacts which switch the impedance taps on the *matching* transformer are a part of the relay that switches the antenna *loading* coils and are not shown.

A conventional *loading* inductor is used for tuning out the antenna reactance. For this application inductances up to 400 microhenries were required. Since the *kva* developed in the *loading* inductor is the same as developed in the antenna, it is important that the inductor have a high Q. An air inductor was chosen to give high Q inductive reactance at these inductances and frequencies. Since the inductors must be capable of tuning out widely different antenna reactances, it was found to be more efficient to use two *loading* inductors and relay switch for two-frequency operation.

The transmitter designed for the *mf* application was arranged in three separate units; crystal oscillator for excitation, an *rf* unit for amplification and an antenna coupling unit for antenna matching. The crystal oscillator and associated circuits were chassis mount-

[1] Using Hipersil iron.

[2] The autotransformers can be supplied with different values of input and output impedance for matching beverage antennas and other transmission lines.

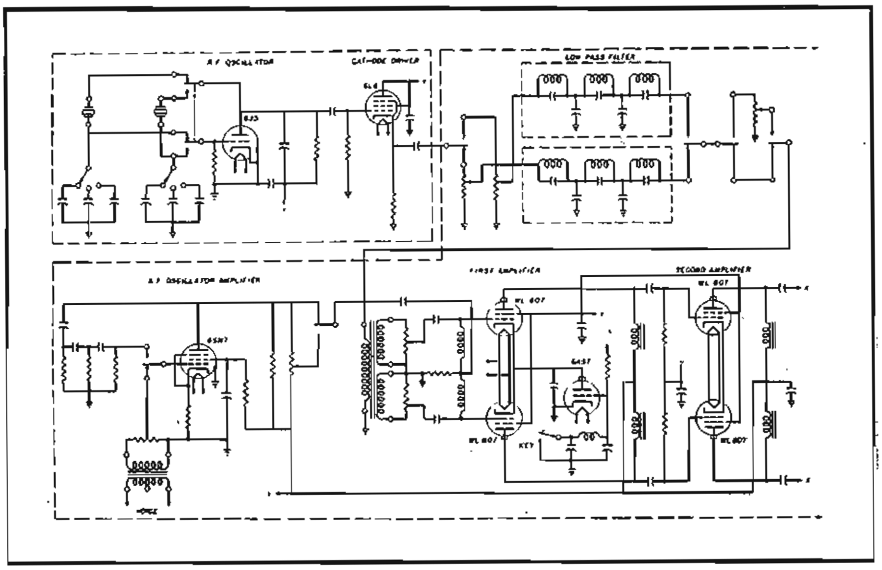
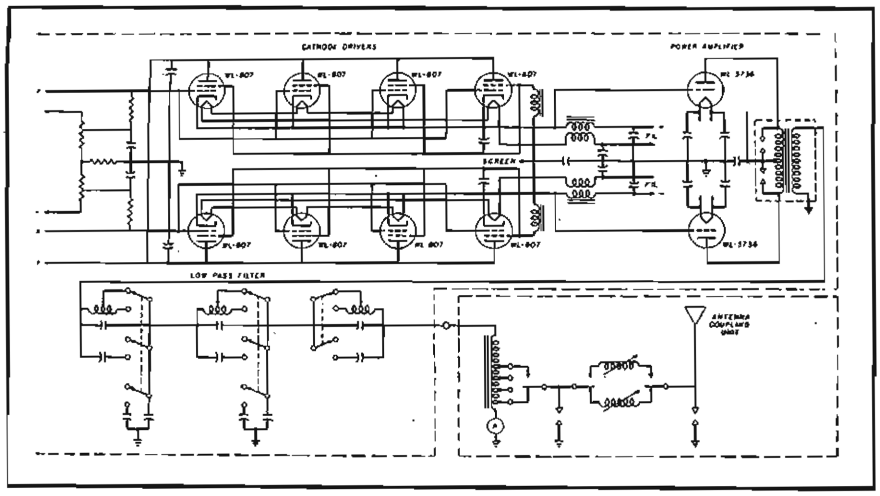


Figure 3
Above and below: Schematics of the medium-frequency transmitter using iron core interstage and output transformers.



ed, to permit the oscillator to be mounted in the *rf* unit or externally on a rack panel. External mounting was found necessary for *rf* patching purposes where a number of crystal oscillators or tunable electronic oscillators are used interchangeably with a number of *rf* units. In the oscillator using a 6J5 in an untuned Pierce type circuit, we included a plated-wire mounted *CT* cut crystal as the frequency determining element. The crystal, mounted in a temperature-controlled oven, has a frequency stability of ±.005% (50 parts per million) from –30 to +70° C. In this type of oscillator, the value of the oscillator grid capacitive reactance influences the amplitude and wave shape of the oscillations. Crystal current is a function of the amplitude of oscillations. To secure optimum performance, the oscillator frequency range was divided into three bands (250 to 350 kc, 350 to 450 kc and 450 to 540 kc), and a different value of grid capacity provided for each band. A switch was provided to select the proper grid capacity for the operating frequency. Two-frequency operation was accomplished by the use of two crystals and two sets of oscillator grid capacitors with their associated switches, a relay being used to select the desired crystal and associated oscillator grid capacitor. The oscillator output, coupled to a 6L6 cathode driver, provides a low impedance output from the crystal oscillator unit.

The output of the oscillator unit, coupled to the *rf* unit input with a 75-ohm coaxial transmission line, is dependent upon crystal activity which varies with frequency as well as with individual crystals. Because of this variation, a separate *rf* input control was provided for each of the two operating frequencies. A third *rf* input control compensates for *A2* and *A3* emission. The compensation is necessary because low-level modulation is used and the modulated carrier peaks should not exceed the carrier peaks represented by full power output with *A1* emission. This means of adjustment is such that smaller percentages of modulation are accompanied by larger average carrier output. Two low-pass filters were provided in the *rf* unit input to reject any harmonic output of the crystal oscillator. If odd harmonics were present in the excitation, the positive and negative components of the *rf* cycle would not be identical. Since these two components are amplified separately before being applied to the grids of the class *B* amplifier, it is necessary that the excitation be symmetrical. Filters were designed to cover the range of 250 to 375 kc and the other 375 to 540 kc. Two relays in the *rf* unit input were included to select the proper input control and harmonic rejection filter consistent with the desired output frequency and emission. These relays and the oscillator-frequency relay are controlled remotely or from a switch on the front panel of the *rf* unit. The output from the harmonic rejection filters and input controls was fed to an iron-core transformer which produces two sources of *rf* potential 180° out of phase for the first amplifier stage; two WL-807s operating class *A*, cathode keyed by a 6AS7 vacuum-tube keyer. Keying was accomplished by grounding the keyer tube grid. A filter was inserted in the keying circuit to prevent steep leading and trailing edges in the keyed wave. Cathode bias for the first stage was provided in the voltage drop across the keyer tube.

The first amplifier stage was grid modulated. A 6SH7 was included as an audio amplifier to modulate the stage of A3 emission. The circuits of the audio amplifier are relay switched so that the 6SH7 operates as an *rc* oscillator to modulate the stage for A2 emission. The output of this stage was connected to the second amplifier through a high pass filter to prevent the passing of the audio components of modulation to the second amplifier. The filter was found to be necessary due to the small separation between the audio and *rf* frequencies and the fact that succeeding stages pass audio as well as *rf* frequencies. Fixed bias was used in the second amplifier stage using two WL-807s operated class *A*, a gain of approximately forty being achieved by this design. High-frequency iron was used in the plate-circuit reactors, in which was included a low distributed capacity winding to provide maximum output voltage and

(*Continued on page* 35)

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VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

Personals

TED D. HAUBNER, a very active VWOA member a decade ago, reentered the limelight a few months ago during the fortieth anniversary of the first transmission of the S O S. TDH, the first op to use the distress call, recalled how he made his first voyage as a wireless operator at 19 in June, 1909, on the Mallory liner San Marcos. In August he transferred to the Arapahoe and on this first voyage south the ship's propeller shaft parted off Cape Hatteras and she was in imminent danger of being dashed on shoals in a gale.

Just before TDH had sailed from New York he had been notified that S O S had been adopted as a distress signal because its three dots, three dashes and three dots was most easily read, while the old distress call of C Q D could become confused with C Q, a general call. When the emergency arose he clicked out the S O S calls and the old distress calls, too, fearing that all ops might not be familiar with the new call for help. An immediate reply was received from Cape Hattress and aid was dispatched promptly.

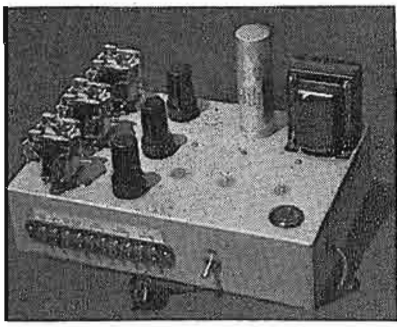
TDH revealed, too, that it was he who received the second S O S from a ship. In November of the same year, he picked up an S O S from a sister ship, the Iroquois, which had lost her rudder in a gale off Cape Hatteras. The Arapahoe steamed under forced draft to the rescue.

Haubner is now an executive with a company who buy for wholesalers in hardware and industrial supplies and radios.

He also operates, with Benjamin Tillson, Jr., NA3CC, a Coast Guard radio auxiliary station at Montclair, N. J., and still sends and receives messages in a weekly radio drill. . . . Arthur E. Ridley, Winthrop, Mass., reports that he enjoys reading the reports and memories of his old timer friends in COMMUNICATIONS. . . . We trust that Roscoe Kent has fully recovered from his illness earlier this year. . . . A. F. *Steve* Wallis, who is pounding brass aboard the SS Alcoa Partner, reports that going to sea today is really a fine job. . . . Fred J. Gommo, now in San Jose, Costa Rica, was married recently to Cora Jane Lovett. Best wishes to the happy couple. . . . Alfred T. Witts of England has asked if we could locate George A. Danby, who back in 1920 was a *wireless pal*. Perhaps some VWOA member can furnish the information. . . . F. K. Bridgeman, who is with Illinois Bell Telephone, has become a TV bug. . . . *Stan* W. Fenton, ITT's resident rep in Athens, Greece, has sent us a note revealing that since leaving the U. S. in '46 he has been on several other assignments for the company in India, Pakistan and Afghanistan. . . . Joe W. Graham is quite busy these days helping the FCC police the airlanes from the monitoring station at Millis, Mass. . . . It was good to hear from E. K. Seyd, who by now is an *old, old-timer*, because he started his career back in '09 as an amateur using the call 2DX, when licenses were first assigned. He studied under Bucher to get his commercial license. He recalls that about that time David Sarnoff was an office boy in the Marconi Wireless School on Cliff Street. After sailing on several vessels EKS entered the engineering department of Marconi at Aldene, N. J. For the last sixteen years he has been in business as a radio components manufacturer's rep in New England. . . . We were glad to see M. G. Carter at the spring gathering. . . . It was a pleasant surprise to hear from I. T. Barnes who has not been very active for the last few years. ITB is connected with Boston Edison as chief draftsman. . . . F. J. Grim has forwarded his 73's from Everitt, Mass. . . . VWOA member L. C. Herndon has been transferred from Chicago to Washington and promoted to assistant chief of the FCC field engineering and monitoring division in the Bureau of Engineering. Congratulations LCH. . . . George I. Martin, who is regional sales manager for RMCA in St. Louis, has sent in some interesting facts about his background. A graduate of the Marconi Wireless school in N. Y. about '14, he recalls sailing on, among many other ships, the SS Commewijne (PJO), Bill McGonigle's old ship. After leaving the SS Resolute (RXK) in '26 he joined RMCA in Cleveland as manager of WCY. GIM has been very active in VWOA work for many years. In fact he attended the first meeting in N. Y. when the association was formed. He has served as our Chicago chairman for three years. GIM is a member of RMCA's Quarter Century Club. . . . I. E. Showerman reports he is very busy in Chicago as a vice president of NBC. . . . Ye prexy visited Columbus, Ohio, recently during a business tour. . . . R. W. Hale now lives in Ft. Wayne, Ind. . . . American Airlines radio officer Dave Little works at La Guardia as supervisor of the airway aids. He occasionally pilots a plane to probe the variety of aids to navigation. . . . G. J. Maki, with the California State Division of Communications as Senior Communications Engineer, is located in Sacramento. . . . Congratulations to P. L. Stocum who has become station manager of the CAA radio station at Moses Point, Alaska. He does a bit of ham work also under the call KL7BD, so if you want news from the Bering Sea area contact Stocum on *cw* on 20, 75 or 10 phone.

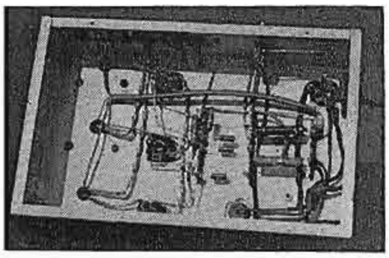
Major General Harold M. McClelland, USAF, who has appeared at many VWOA cruises and presented illuminating talks on government and industry communications, at his new post, as Director of the newly-established Office of Communications-Electronics of the Department of Defense. He was formerly Deputy Commander for Services of the Military Air Transport Service.

A Signal-Light



Top view of the signal light relay unit.

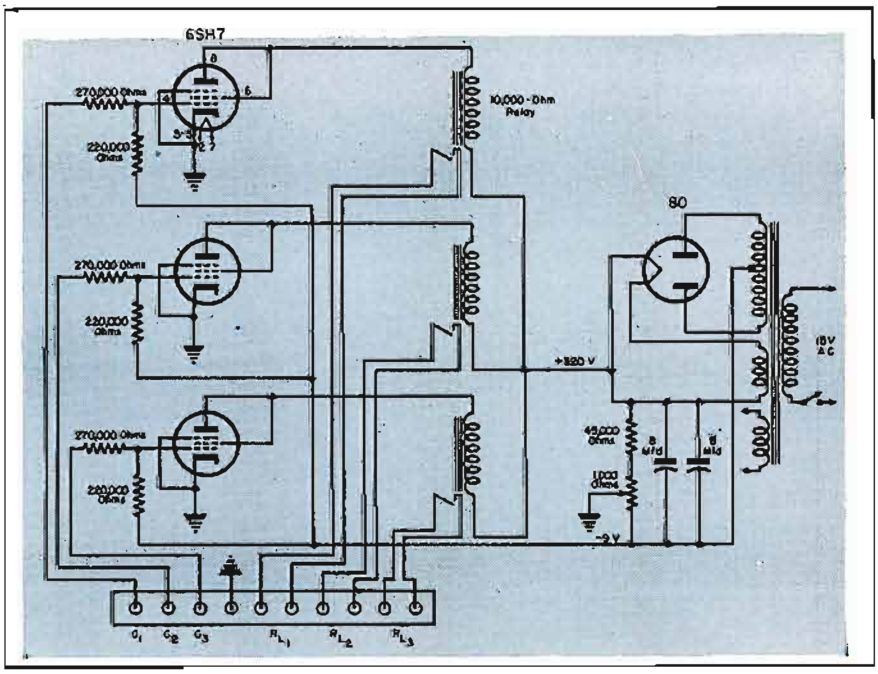
SINCE THE conception of commercialized radio the audio engineer has been plagued with the *clicks* and *pops* caused by the opening and closing of switches. The lower the audio level at which the circuit is broken, the more skill, experience, and aspirin required to locate this elusive type of interference. No new circuit can be pronounced noise-free without trial, regardless of whether the given line is being opened or any circuit remotely related to it. It is a common experience to hear dial-telephone interference in audio equipment, even when the dial is at some remote point. And 110-volt *ac* light switches have been known to cause a very troublesome type of noise which is sometimes difficult to suppress.



Bottom view of the WIS light relay.

Figure 1

Circuit of the light relay system used at WIS. The power transformer employed in this circuit provides 5 *v* at 2 amps, 6.3 *v* 1 amp, and 650 *v* (center tap) at approximately 40 ma. The filter capacitors have a rate of 450 *v* working.



Key Sequence

To this writer's knowledge there are no commercially-built studio consoles that do not use the standard setup of a multiple set of contacts on a given microphone key or switch, so that several electrical operations take place almost simultaneously at the simple throw of the switch. When the key is placed to *on* position three operations follow:

(*1*) The contacts, which are associated with the given studio speaker relay, operate to silence the speaker in the studio. This is to prevent acoustical feedback.

(*2*) A second pair of contacts operate to close the associated relay to illuminate the *on air* studio signs.

(*3*) Lastly, another pair of contacts open the circuit from the microphone so that its output will excite the console amplifiers, and thus will be heard on the air.

Interference Silencing

To reduce the pickup of electrical interference, which is caused by the surges of current used to operate the speaker and light relays, to a minimum it is imperative that the input of the amplifier be a closed circuit during the first two steps of the key sequence. In low-level audio types of switching, the microphone is shorted out by a set of contacts. Such an arrangement serves two purposes: Silencing of the

RELAY UNIT

Circuit Developed to Eliminate *Pops* Caused by Studio Signal-Light Circuit Going Into Operation When Microphone Key Is Placed in *On* Position in Studio Control Console.

by HERBERT G. EIDSON, Jr.

Chief Engineer, WIS and WIS-FM
Technical Director, WIST

microphone and effectively shorting of the preamplifier input. In high-level audio types of switching the preamplifier output is opened and closed, while the microphone output remains *alive* at all times into the preamplifier. The problem of *pops* in this case is greatly reduced.

Suppression Method

The normal method used to suppress interference is a simple series *rc* circuit, placed effectively across the console key contacts, one filter for the speaker relays and one for the signal light relay for each studio. The *rc* values depend upon the current drain of the relay and the voltage used. These values are best determined by trial and error.

The WIS Problem

This station had the misfortune to inherit a very tough unwanted-noise problem. When the speaker relays operated no *clicks* were noticed, but they were very loud on the signal-light relay operation, on open and close. Everything that this station's engineers' combined experience of 65 years in the art could uncover was tried to no avail. Questions puzzling us included: Were the mike contacts opening last in the sequence? Were any set of contacts touching another set? Was the current too great through the key contacts? Did we have the wrong *rc* value for a filter? Would another type of filter work better?

Solutions Employed

After long sessions of mental debate, it was decided to begin a series of measurements to determine how much current the key contacts would pass before the *click* would be heard. To our dismay we found that if over 40 μa were allowed to flow in the key circuit then the interference would be heard on the air. It was then realized that our solution was a signal-light relay operating through the use of a vacuum tube, designed in such a manner that the current flowing through the key contacts would be less than 40 μa. It was later determined that the current could be held to as low a value as 8 μa through the grid circuit and the key contacts. However, because of tube aging and other varying conditions, the operation was not completely reliable over long periods. Accordingly the circuit was readjusted to draw approximately 25 μa, which was still well below the allowable limit of 40 μa.

Relay Characteristics

Only three relays were used for our three studios. The relays were 10,000-ohm, sensitive plate type, which will close on 2 ma and open on 1 ma. For consistency of operation, however, 4 ma was allowed for each relay. Positive closing was then assured.

Circuit Operation

With none of the grid returns grounded through the key contacts (grid returns are grounded when key is in *on* position), and the signal light relays not energized, series 270,000-ohm resistors in each grid lead of 6SH7s are floating. A bias of −9 volts is applied to all three control grids through 220,000-ohm isolation resistors. This reduces the tube currents to almost cutoff. The slight amount of current allowed to flow is not enough to operate any plate relay.

Operation of Mike Key

When the microphone key on the console is thrown to *on* position, the associated grid return lead is grounded through the proper key contacts and the bias on this tube is effectively reduced. This allows greater plate current to flow; the relay immediately operates, turning on the studio signal light.

Results Obtained

Two of these units have been in use now for over a year at different stations. Their operation has been completely reliable and very little maintenance has been required.

TUBE *Engineering News*

Application of VHF Beam Power Amplifier as Frequency Multiplier Up to 175 Mc.

IN THE LOW-POWER multiplier stages of high-frequency transmitters the operating requirements are often too severe to be met adequately with receiving type tubes, and it becomes necessary to use beam-power amplifiers, such as the 5763.

HF and Class C

The *hf* characteristics of a tube in class *C* amplifier service depend in part upon the *lf* properties of the tube such as: high current at low plate voltage (because the *rf* output peak voltage is subtracted from the supplied *dc* voltage to determine the actual instantaneous plate voltage), a large change in plate current between cutoff and a moderately positive grid, and sharp cutoff. In the curves of the average plate characteristics for the 5763, a grid-No. 1 voltage $E_{c1} = -15$ volts may well be taken as the value for plate-current cutoff at a plate voltage of 60. A grid-voltage swing from −15 to +15 causes a 280-milliampere change in plate current. These increments in grid voltage and plate current show the effective amperes per volt to correspond approximately to 10,000 micromhos, a high value for the conduction part of the cycle.

Heater-Cathode Design

The peak value of cathode current required of a tube in class *C* amplifier service is high; in multiplier service, this value is increased because smaller plate-current conduction angles are required for efficient operation. In addition, tubes for mobile service are quite likely to be operated at heater voltages above or below rated values because of supply voltage variations. To take care of such operating conditions the 5763 is provided with a cathode having a large emitting area. In normal operation, the heater must be operated at 6 volts rather than the usual 6.3 volts. When this tube is used with stationary equipment having a 6.3-volt *ac* heater supply, a series resistor must be used to drop the heater voltage to 6. Failure to observe this precaution can result in slightly reduced tube life and a tendency toward grid emission at high line voltage. As a result of the heater and cathode design, the oscillator power output drops less than 10 per cent for a change in heater voltage from 6 to 5.25 volts.

HF Tube Features

The 5763 has several interesting features which contribute to its performance at high frequencies. One of these is the 9-pin miniature envelope with its integral base and stem which provides a structure with low values of lead inductance, reduced interelectrode capacitances, and low *rf* losses. The low *rf* losses permit application of full plate power input at frequencies up to 175 mc. Above 125 mc, greater power gain is obtained when the tube is used as a doubler rather than as a straight-through neutralized power stage because loading of the driving stage due to the input resistance of the 5763 is less severe at the lower frequency.

The tube has been designed so that a relatively high value of grid resistance (up to 100,000 ohms) may be safely used. This high resistance value makes it possible to obtain the moderately high value of grid bias required for good multiplier plate-circuit efficiency with low value of *dc* grid current.

Control-Grid Connections

Two control-grid connections, pins *8* and *9*, are provided to aid in cooling the grid. These connections should be tied together at the socket. As a further aid to heat conduction, it is recommended that heavy copper leads be used for all grid and plate connections at the socket. The normal operating temperature of the tube is 200° to 250° C. Sufficient ventilation must be provided to keep the tube temperature within this range.

Application as Frequency Multiplier

In the circuit of Figure 1, the tube appears as a frequency multiplier in a conventional manner. The same circuit employing tapped coils is used for either doubler or tripler operation. Al-

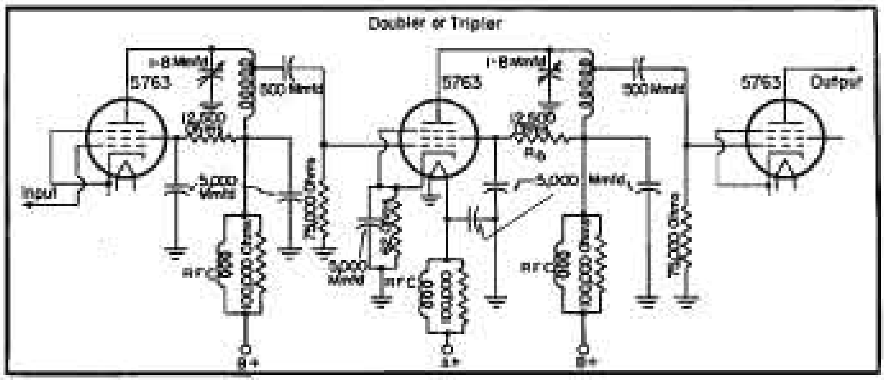


Figure 1
A frequency multiplier circuit with the 5763s. The *rf* choke (*RFC*) contains No. 24 enameled covered wire close wound on the 100,000 ohm-resistors in the plate and filament circuits.

though the use of tapped coils can lead to parasitics, no difficulty was experienced with these circuits. Because of the high amplification factor of the tube, a small cathode resistance of 62 ohms can furnish sufficient bias voltage to protect the tube for a limited time in the event of temporary failure of excitation and resultant loss in bias developed by the grid resistor.

Push-Push Doubler Circuit

A *push-push* doubler circuit using a pair of 5763s appears in Figure 2. In this application, in which the plates of the tubes are connected in parallel, the low value of output capacitance (4.5 mmfd per tube) is advantageous. A single tube used as a tripler provides more than adequate driving power for the *push-push* doubler. This circuit arrangement is particularly suitable for low-power transmitters.

Frequency Doublers

An important application of the 5763 is as a frequency doubler to drive the *vhf* transmitting tube 2E26.

Because of the possibility of spurious radiation resulting from the use of a final stage which is improperly neutralized, it may be preferable for mobile transmitters operated by non-technical personnel to substitute a doubler stage which does not require neutralization. In such cases, the use of a 5763 *push-push* doubler stage may be advantageous.

Credit

[Based on copyrighted data prepared by the tube department of RCA.]

Figure 2
A *push-push* doubler circuit. C_8 is a split-stator tuning capacitor, the value of which depends upon the operating frequency, *f*. The values of C_{18}, C_{19}, and C_{20} depend upon the doubler frequency, 2*f*. The tank inductance, L_1, value also depends on the operating frequency, and the value of T_1 depends on the doubler frequency, 2*f*. As in the circuit of Figure 1 the *rf* choke (*RFC*) has No. 24 enameled-covered wire close wound on the 100,000-ohm resistors in the plate and filament circuits.

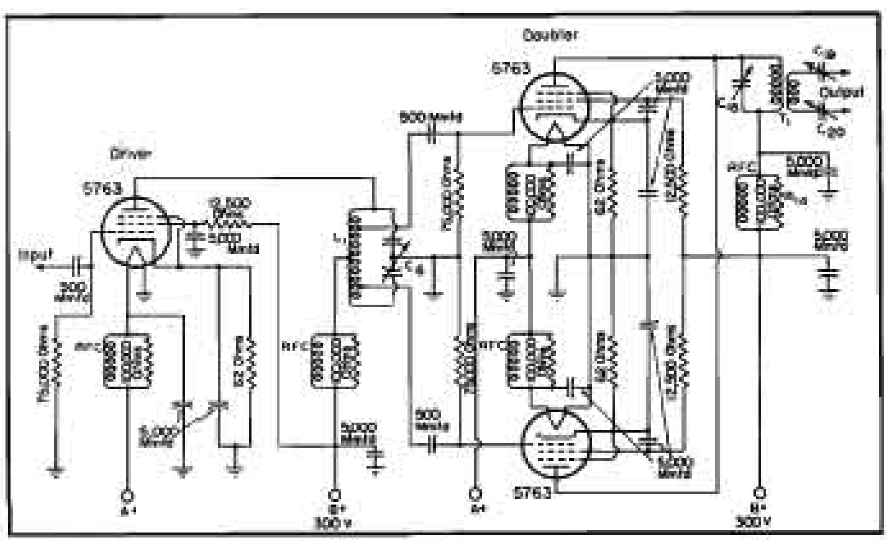
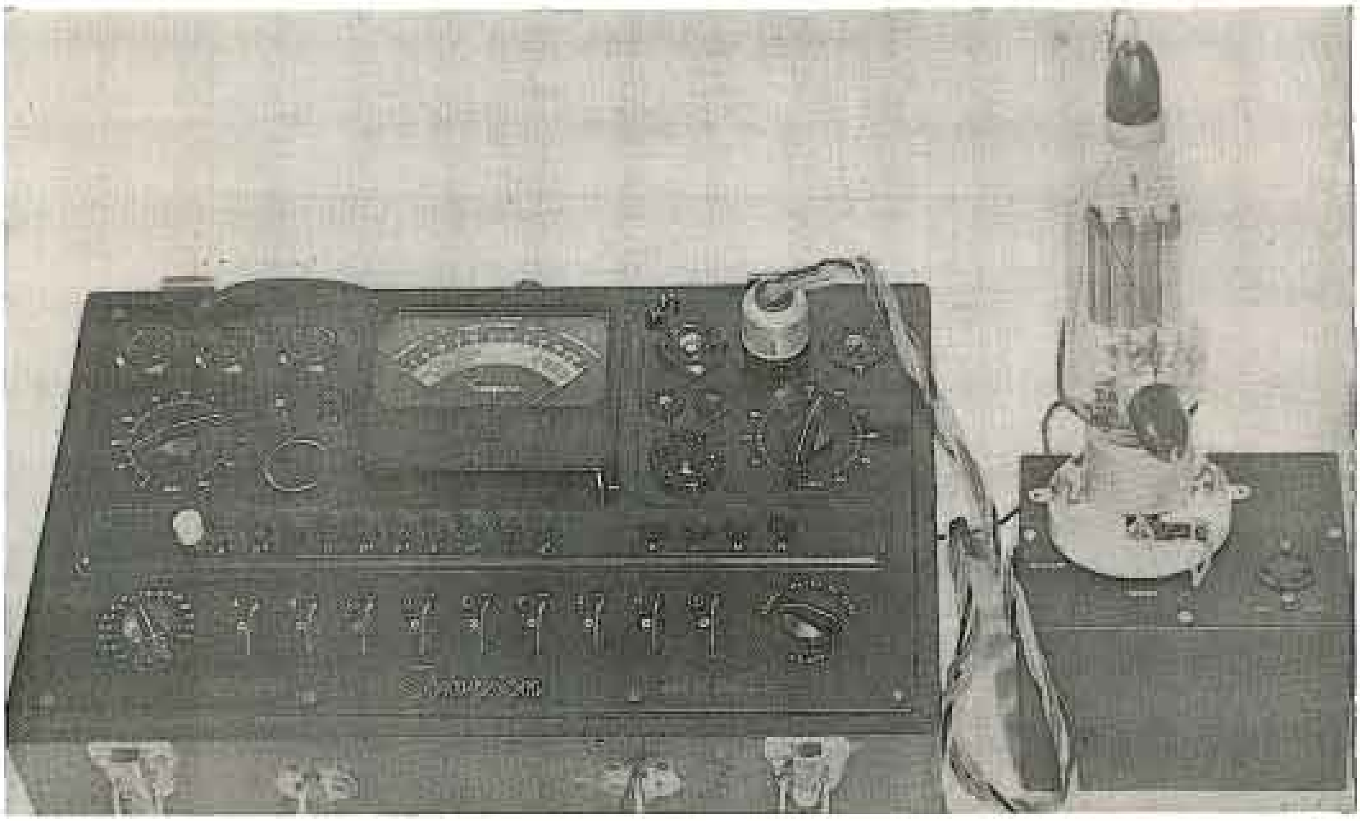


Figure 1
Transmitter tube checker setup developed by William Marsh of WHHM.

TRANSMITTING



Novel Test Unit Checks 807, 810, 828 and 8008 Tubes.

by WILLIAM MARSH

Chief Engineer
WHHM, MEMPHIS, TENN.

A RECEIVING TUBE CHECKER is standard equipment at most broadcast stations, because it is necessary to be assured of the condition of the hundreds of receiving type tubes used.

Transmitting Tube Checker

The piece of test equipment which is conspicuously absent at most broadcast stations is a transmitting tube checker. We found that such a device would certainly come in very handy in eliminating not only much of the guesswork of tube replacement, but avoiding the trial-and-error method of tube testing in the transmitter itself, a practice universally followed.

Unit Developed

It was thus decided to develop such a unit, and after a bit of experimenting, the checker shown in Figure 1 was evolved. Actually the unit is an adaptor which is used in conjunction with a standard tube checker.[1]

Construction Features

In constructing the tester, all similar tube element leads were paralleled from socket to socket, and brought out through a six-wire cable to an octal plug for insertion into the regular tube checker.

Control Settings

The settings of the various controls on the standard checker were experimentally determined, using known bad and good tubes as standards. Listed receiving type tubes having characteristics similar to the transmitting tubes were used as guides. Arriving at a definite setting by this method was not

[1] Simpson 330.

Tube Checker

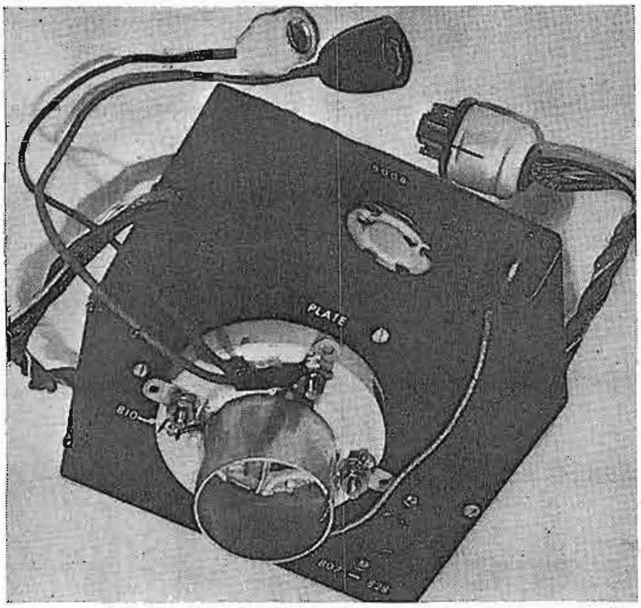


Figure 2
Closeup view of the transmitter tube checker[1].

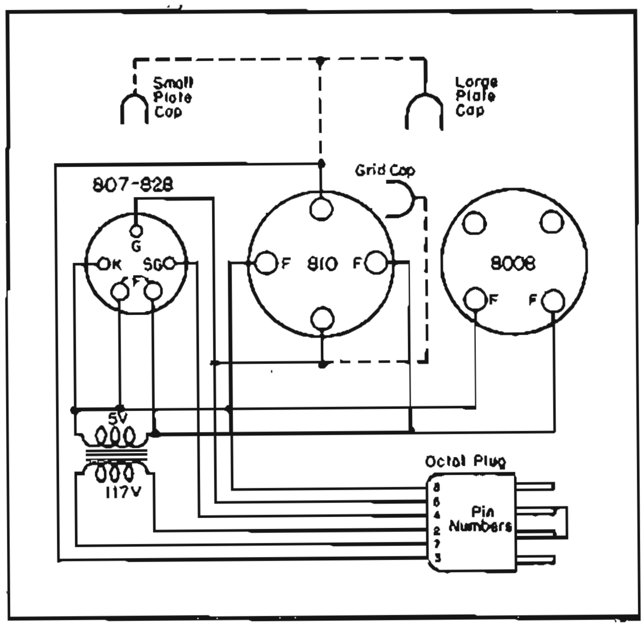


Figure 3
Schematic of the transmitting tube checker.

particularly difficult, and the results have been found to be subsequently consistent.

Experimental Work Results

Experimental work on the original model of this checker disclosed a number of interesting and pertinent facts. The first model used a filament transformer which was powered externally to the manufactured checker. This, of course, seemed necessary because the checker's filament supply was not designed to handle a three to seven-ampere load. Filament voltage was established at ten volts under full filament load. When the device was connected to the standard checker, all tubes, good and bad, checked good.

Filament Emission Problem

Apparently the average bad transmitting tube has such abundant emission at its full filament voltage that true variations from normal are not apparent. Accordingly the filament voltage was reduced to five volts, which was approximately half voltage for the larger tubes. When this change was made, true operational characteristics of the tubes began to show up. The mercury vapor 8008s seemed to test as consistently as could be expected with the limitations imposed by the standard tube checker.

Importance of Phasing

The tube checker was subsequently used with an externally-powered five-volt filament transformer until it was discovered that the phase of the filament power circuit was important to the operation of the checker. Accordingly, to insure correct phasing, the filament transformer was powered from the standard checker by connecting the filament transformer's primary to pins *2* and *7* on the octal cable plug. Then the standard checker's filament selector switch was set at 117 volts. This not only insured correct phasing between the small and large checker, but also limited interconnection of the units to one cable and plug. Also, use of the 117-volt supply from the standard checker avoided the possibility of overloading the transformer due to the abnormal filament current requirement of transmitting tubes.

Tube Checker Choice

The standard tube checker used as the basic metering equipment is the percentage of transconductance type. However it is felt that an emission type tube checker would have served just as well.

Checker's Uses

This transmitting tube checker has been valuable not only in removing doubt as to the condition of tubes, but also has repaid its original cost by reclaiming used tubes. For example, it is the general procedure to replace modulator or final amplifier tubes by pairs. After removal, the tubes are checked. One each of the pairs will generally be found to be at fault and the other is placed in the spare compartment. It was discovered that a number of tubes formerly removed by guess were perfectly good, and these have since been placed in service for many more useful hours. When a tube is checked now and found to be bad, it can be thrown away with a clear conscience because it *is* bad.

[1]Chassis box is Bud type CU72A.

Transmission Line Conversion NOMOGRAPHS

Nomographs Permit Inter-Conversion of Units Variously Expressed on Different Types of Transmission-Line Charts.

by ROBERT C. PAINE

Various charts have been prepared to facilitate computations of impedance at required points on a transmission line, as well as computation of voltage and current distribution.[1]

Expression Variations

The quantities, wavelength, attenuation, and reflection coefficient, used in these charts have been expressed in several different units. To permit conversion from one unit to another the nomographs shown in Figure 1 were developed.

Use of Nomograph A

The distance along the line for transmission-line problems is measured in wavelength, the distance of a complete phase shift of voltage or current through 360°. Wavelength has been variously expressed as 360°, 2 π radians, or in hundredths of a wavelength. With nomograph *A* it is possible to convert each of these units; a hundredth of a wavelength, $.01\ \lambda = 360°/100 = 3.6°$, and 0.1 radian $= 360°/20\ \pi = 5.73°$.

Nomograph B

Attenuation or drop in voltage or current along the line due to losses is expressed in the classical formulas as nepers and symbolically expressed usually by α. Referring to the voltage or current ratio, V_1/V_2 or I_1/I_2, at two points along the line, the neper equals the natural logarithm (to the base ε) of these ratios, $\log_e V_1/V_2$ (or I_1/I_2). These ratios can also be expressed directly, or in decibels equal to $20 \log_{10} V_1/V_2$ (or I_1/I_2). Nomograph *B* permits conversion between each of these units.

Nomograph C

When a line is terminated by a load not equal to its own characteristic impedance reflection occurs. The ratio of the reflected voltage (or current) to the incident voltage (or current) is known as the reflection coefficient and is usually designated *K*. The absolute value of this coefficient $|K|$, determines the standing wave ratio, *swr*, also known as *Q*, of the maximum and minimum voltages, or currents, along a line of negligible losses; $Q = (1 + |K|)/(1 - |K|)$.

Conversion Characteristics of C

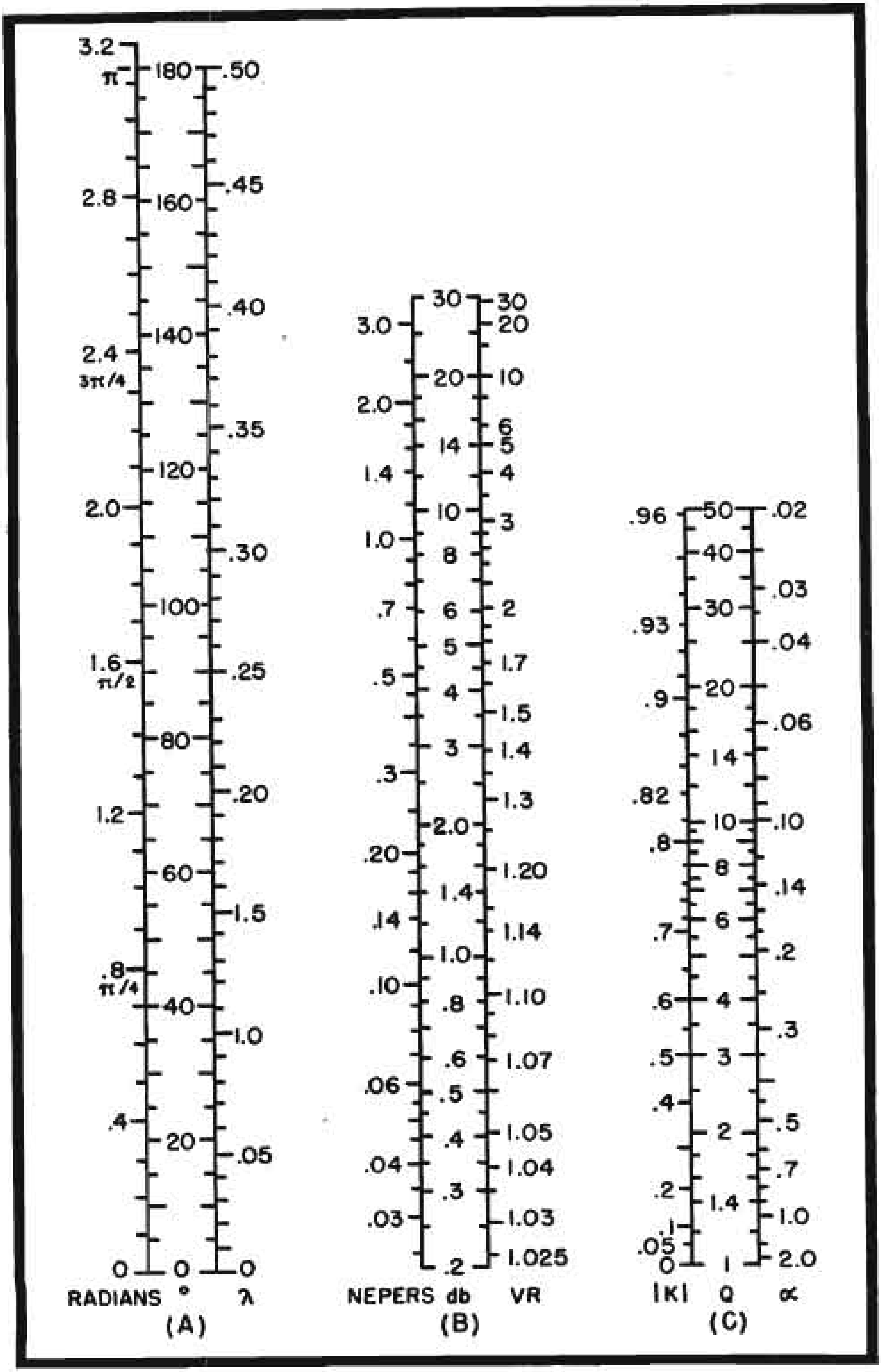
Various types of transmission-line charts show circles of constant *Q* or $|K|$. Other charts show similar no-loss circles of constant attenuation, usually designated α, where $1/\tanh \alpha = Q$. Nomograph *C* permits conversion between each of these units, *Q*, $|K|$, and α.

References

[1]Carter, P. S., *RCA Review*; Jan. 1939.
Smith, Philip H., *Electronics*; Jan 1944.
Paine, Robert C., *Proc. of the IRE*; Nov. 1944.
Paine, Robert C., *Electronics*; March 1945.
Selgin, P. J., Communications; Feb. 1944.
Slater J. C., *Microwave Transmission*, McGraw-Hill.
Chart published by Addison-Wesley Press, Inc., Cambridge, Mass.

Right: Transmission Line Nomographs

Transmission line conversion nomographs: Nomograph *A*, units of phase, for line distances in wavelength(λ), degrees or radians. Nomograph *B*, units of attenuation, in nepers (α), decibels (*db*) or voltage (or current) ratio (*VR*). Nomograph *C*, units of mismatch, for no-loss circles of constant attenuation (α), standing wave ratio (*Q*) or reflection coefficient($|K|$). In each nomograph, values on either of the outer scales can be directly converted to values adjacent to one of the center scales or vice versa; values on the two outer scales can be converted to each other by reading along a straight edge placed across corresponding points on the two parts of the center scale.


RADIANS
°
λ
(A)
NEPERS
db
VR
(B)
|K|
Q
α
(C)

Site Testing

(Continued from page 7)

mixed with the proper amount of air is explosive. A rubber tube was run from the pressure regulator to a round wooden dowel, with a hole through the center. The neck of the balloon was fitted over this dowel and the gas allowed to slowly inflate the balloon. Nearly all the gas in a standard size cylinder was required to inflate properly the balloon. It must be remembered that the balloon will be much larger than one realizes and will exert a stiff lifting pull as it nears its fully inflated size.

With the balloon inflated, the antenna was tied on to the neck and the stay lines placed in readiness. Then the balloon was allowed to rise to a ten-foot level above the ground and was held there by restraining it with the transmission line which was secured to the center of the dipole. The balloon and antenna were then held in this ten-foot position by fastening the transmission line with a suitable clamping arrangement. The antenna was oriented in the desired direction and held there by means of the stays. This same arrangement was used at each additional ten-foot interval. As the antenna and supporting balloon rose higher above the ground prevailing winds tended to cant the antenna and transmission line away from a vertical position with respect to the starting point. To overcome this a back stay line was used to pull the antenna and balloon back into the direction of the wind far enough to bring the antenna in a vertical location directly over the starting point. This insured exact heights above the ground. No difficulty was experienced with this arrangement up to heights of 250'. Everything was now in readiness for the tests.

It was desired to find out the effect of the height of the antenna in the direction of the least drop off of the terrain and in the residential area of the city. The profile of the terrain is shown in Figure 1 and it can be observed that the transmitting and receiving antennas are in line of sight except for the trees and houses which might intervene during the first few points of measurement. The signal being picked up by the receiver was measured by first noting the deflection of the meter in the *rf* circuit of the receiver. Then a signal from a standard signal generator was fed into the receiver across a 72-ohm resistor and adjusted for the same deflection obtained previously. The output of the calibrated generator was then noted to obtain the equivalent microvolts at the terminals of the receiver. This procedure was carried out for each ten-foot interval of elevation of the antenna up to 180'.

The result of this test, which appears in the plot of Figure 2, shows that after about 70' in elevation is reached the signal does not increase but rather starts to go through a series of maximum and minimum points caused by alternate addition and subtraction due to the change of path distance between the direct and reflected rays. Thus it may be seen, that as far as any local requirement is concerned in the principal city which is to be served, any height above 70' would be unnecessary for this particular receiver location.

Since this first test was about ideal as far as receiver location was concerned it was believed prudent to try an extremely adverse location; Figure 3. Here the receiver antenna was no longer in line of sight under any condition of transmitter antenna height and the sharpest drop off prevailed at the transmitter location. Here again the antenna was raised by ten-foot intervals starting at ten feet above the earth and the signal measured as before at the receiver input terminals. These data appear in the plot of Figure 4 and though exhibiting something in common with the results shown in Figure 2 were subject to much wider variations. But here again it is evident that after about the height of 130' not much could be gained by still greater elevation as the signal would be settling into the familiar maximum and minimum condition.

Application of Test Data

These two cases have been used to show typical conditions and the results which might be obtained. No particular difficulty was experienced in keeping the balloon aloft. We used the balloon for three days and then allowed it to deflate. The data accumulated were of extreme value in enabling a decision to be made concerning the feasibility of installing a simple short mast in place of a much taller and expensive fabricated tower. Furthermore it was demonstrated in advance that the installation would perform according to certain predictions. Since the erection and use of the antenna, which was elected from the results of these tests, no difficulties have been encountered. The transmitter site is at an elevation of 505' and the service radius of the station appears to be all that was anticipated.

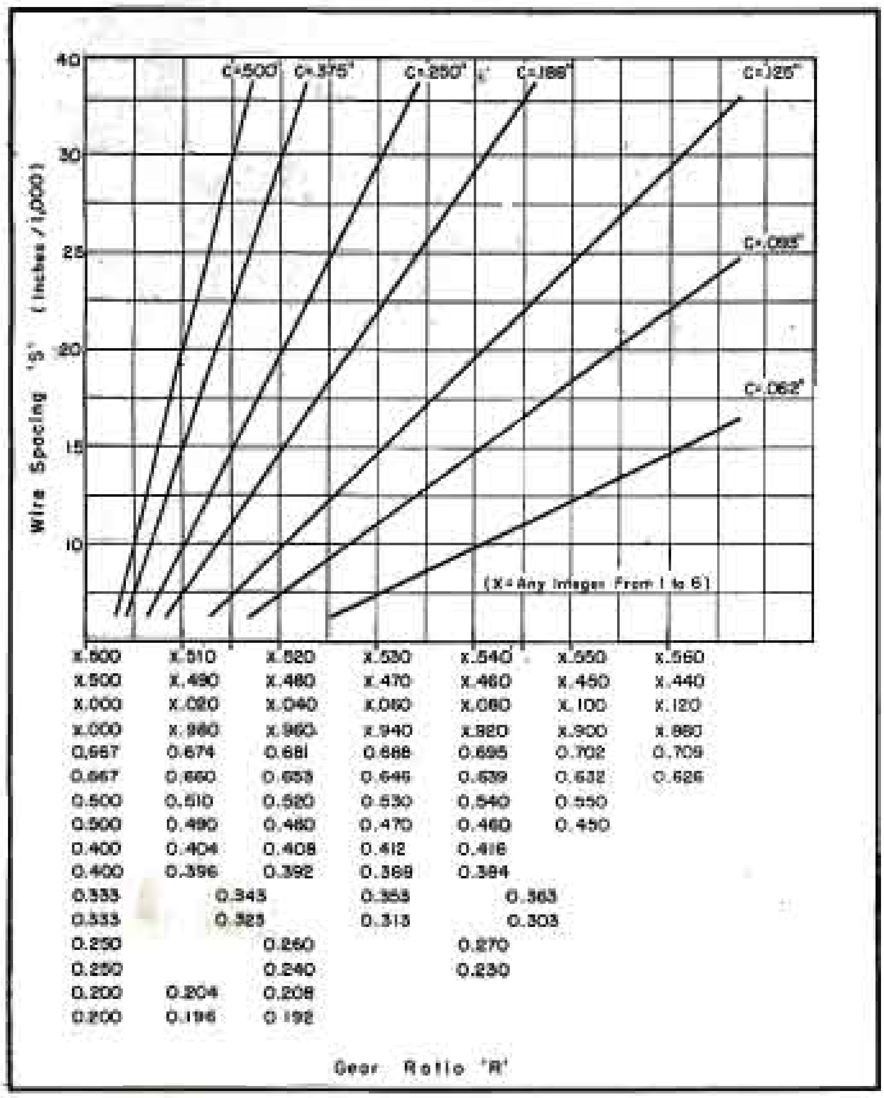
Universal Coil-Winding Graph

Problem of Determining Proper Gear Ratios for Winding Universal Coils Reduced to Two Steps: Simple Arithmetic Division and Extraction of Required Ratio from a Graph. Method Can Be Generalized for Machines Utilizing Various Combinations of Gears.

by DONALD ARANY and MERTON MACOMBER

Design Engineer — Coil Engineer

Mackay Radio and Telegraph Co., Inc.



Left: Chart of gear ratio, R.

THE DEGREE TO WHICH NEWLY-WOUND coils represent the desired electrical and geometric design parameters depends to a large extent upon the coil-winding technique. The most important single factor in winding universal coils is the gear ratio. For a properly adjusted coil-winding machine in good mechanical condition, the choice of the gear ratio determines the electrical and mechanical merit of the coil.

In current practice, the method of determining gear ratios depends largely on the personal preference of the coil designer. Experienced engineers and coil technicians often employ empirical curves relating gear ratios to various desired parameters. Winding machinery manufacturers provide tables listing gear ratio combinations. However, such tables are not amenable to interpolation and their utility is thereby decreased in practical development and design. The literature[1, 2, 3] on universal wound coils presents a number of methods for computing gear ratios. These methods vary in complexity and generally require some *trial and error* manipulation.

The method presented in this paper provides desired gear ratios for a wide range of electrical and geometric constants. It entails the computation of a simple quotient which allows the desired gear ratio to be obtained from a graph. Once the gear ratio is obtained, the number of teeth on the cam and the dowel gears can be selected from a single setting of a slide rule.

Nomenclature

c = cam throw (inches)
d = dowel diameter (coil form o.d. inches)
w = wire diameter (o.d. inches)
T_c = No. of teeth on cam gear
T_d = No. of teeth on dowel gear
$S = 1.25\ w$ wire spacing
$R = T_d/T_c$ gear ratio

Procedure

Step 1: Compute the first approximation for R, using the formula

$$R \cong \frac{d}{3c} \qquad (1)$$

Step 2: Select on the graph the line corresponding to c desired. Pick off the point whose ordinate corresponds to the value of S. The abscissa of that point corresponds to a series of ratios for R listed below the point. Use that ratio which is closest in value to the approximation computed in equation (1). This ratio referred to the C and D scales on a slide rule will give, finally, the actual gears to be used.

Example 1

Given: $c = .25''$
$d = .375''$
$S = .0071''$

Step 1: $R \cong \dfrac{d}{3c} = \dfrac{.375}{(3)\,(.25)} = .5$

Step 2: Pick off point on straight line $c = .25''$, corresponding to $S = .0071''$. Nearest R to value calculated in *Step 1* among the various abscissal scales tabulated below is $R = .507$. Setting .507 on the C scale opposite the index number *1* on the D scale on a slide rule the following sets of gears might be used: $\dfrac{36}{71}$ or $\dfrac{37}{73}$.

Example 2

Given: $c = .188''$
$d = .75''$
$S = .030''$

Step 1: $R \cong \dfrac{d}{3c} = \dfrac{.75}{(3)\,(.188)} = 1.33$

Step 2: Pick off point on straight line $c = .188''$, corresponding to $S = .030''$. Nearest R to value calculated in *Step 1* among the various abscissal scales tabulated below is: $R = X\,.4595 = 1.4595$, where $X = 1$. The slide rule will give the following sets of gears: $\dfrac{57}{39}, \dfrac{73}{50}$.

[1]A. W. Simon, *Radio*, February-March, 1947.
[2]A. W. Simon, *IRE*, January, 1945.
[3]M. Kantor, *IRE*, December, 1947.

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TAPE RECORDER DUPLICATOR

Contact printing setup for duplication of magnetic tape recordings, described by Robert Herr, chief physicist of the central research department of Minnesota Mining and Manufacturing Co., St. Paul, Minn., at the recent National Electronics Conference in Chicago. In the process, two tapes are brought together in the presence of a magnetic field. Used are an oscillator (left, above) designed to generate 2000 cps and the recording unit (right, above) which contains the magnet, motor, and winding equipment.

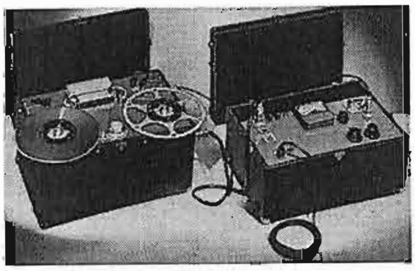
The Industry Offers

WEBSTER MAGNETIC TAPE RECORDERS

Two professional models of Ekotape magnetic tape recorders have been announced by Webster Electric Company, Racine, Wisconsin.

One model, 105, consists of a single unit which contains both record and playback amplifiers in addition to the magnetic tape recorder mechanism. The other, model 107, consists of two compact units, one of which contains the recording mechanism, the other containing the amplifier chassis. Both units, without carrying cases, may be secured for permanent rack installation.

Both models are provided with a single knob control for record, stop, listen and rewind. Synchronous two-speed motor of model 107 provides a tape speed of 15" per second for a half-hour program or a tape speed of 7½" per second for an hour program. Tape speed of 7½" per second with model 105 provides for a full half hour program.



Model 107; one unit contains magnetic recorder mechanism, the other contains amplifier chassis.

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AIRBORNE INSTRUMENTS POWER OSCILLATOR

A wide-range power oscillator, type 124A, for measurement and testing procedures in the 300 to 2500 mc range, has been developed by Airborne Instruments Laboratory, Inc., 160 Old Country Road, Mineola, N. Y.

Oscillator consists of a grid separation coaxial oscillator employing a 2C38 disc seal triode, audio oscillator and modulator section and a self-contained rectifier power supply. Cathode-grid and grid-plate lines are coupled to a single tuning control with provision for individual adjustment of the grid cathode line, if desired. Counter type indicators show the position of the tuning elements. An output coupling control with counter indicator is also provided.

• • •

DUMONT TV POWER AMPLIFIER

An amplifier unit which steps up the output rating of the basic Du Mont acorn TV transmitter from 500 watts of 1 kw, to 2½ kw or 5 kw, respectively, has been announced by Allen B. Du Mont Laboratories, Inc., 2 Main Ave., Passaic, N. J. Transmitter acts as a driver for the single-stage power amplifier, which unit consists of a pair of air-cooled tubes.

Grounded-grid amplifier circuit used which is said to permit tube replacement without requiring neutralizing adjustment. No vestigial side band filter required as lower side band is attenuated by over-coupled circuit and one notching filter that is built into the equipment.

• • •

G. E. ALNICO IMPROVEMENTS

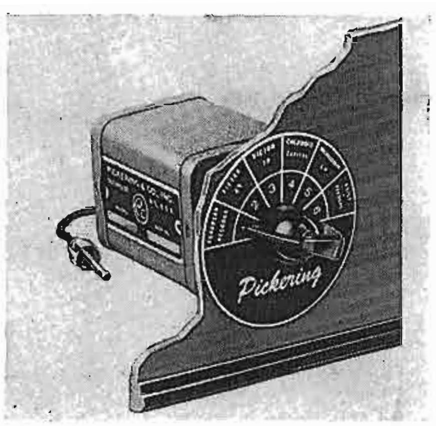
Two new Alnico developments have been announced by G. E.

One is Alnico 5 DG, a modification of Alnico 5, in which the crystal structure of the magnets is aligned in the direction of magnetization; the letters DG refer to directional grain. A change in the manufacturing process has made this new structure possible, and the corresponding processing of smaller magnets.

The other material is Alnico 7, developed specifically for applications where a high demagnetization force is present such as in motors, generators, and variable air gap devices. This magnet is said to show a higher coercive force than any other grade of Alnico.

PICKERING RECORD COMPENSATOR

A record compensator, model 132E, which is said to provide the flexibility required to equalize for different recording characteristics used by various record manufacturers, has been announced by Pickering Company, Oceanside, L. I. Six positions are said to equalize for all established recording characteristics including microgroove and standard records, domestic or foreign. Uses linear circuit elements.



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SYLVANIA HF NOISE GENERATING DIODE

A miniature noise generating diode, T5½ type 5722, suitable for measurements at frequencies up to 500 mc has been announced by the Radio Division of Sylvania Electric Products Inc., 500 Fifth Avenue, N. Y. 18.

Operated with 150 volts on plate and at filament voltages ranging between 2 and 5.5 depending on desired plate current or noise output. In intermittent service maximum plate dissipation is five watts.

• • •

LEAR VHF RECEIVER AND TRANSMITTER

Instrument type *vhf* receivers and *vhf* transmitters in narrow panel designs for installation and location in aircraft instrument panels, have been announced by Lear, Inc., Aircraft Radio Division, 110 Ionia Avenue, N.W., Grand Rapids 2, Mich.

Receiver, model LR-5BN, has continuous tuning for *vhf* tower, radio range and *vor* reception facilities.

Transmitter, model RT-10CH, is a 2-watt 6-frequency unit.

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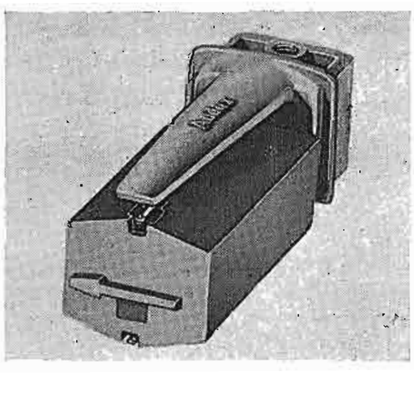
AUDAK REPRODUCER

A *polyphase* reproducer, which permits ten different combinations of styli, such as microgroove and 78, transcriptions and 78, etc., has been announced by the Audak Co., 500 Fifth Avenue, New York 18. Point pressure about 7 grams. Output about 30 mv. High or low impedance.



CLARKSTAN STANDARD RECORD

A steady-state frequency record, No. 2000S, cut on 12" vinylite, 78.26 rpm, recorded at constant velocity above 500 cps, constant amplitude below that point, has been announced by the Clarkstan Corporation, 11927 West Pico Blvd., Los Angeles 34, Calif. Frequencies are from 50 to 10,000 cps in seventeen steps.

A steady-state recording, No. 2001/2002S, for *lp* microgroove use is also available. One side of this record is recorded flat, the other side with NAB curve.

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STACKPOLE FLYBACK TRANSFORMER CORES

Ceremag flyback transformer cores for television, which are said to offer permeability on the order of 10 to 1, have been announced by the Electronic Components Division, Stackpole Carbon Company, St. Marys, Penna.

• • •

JENSEN OPTICAL-LENS PRINCIPLE SPEAKER

An optical-lens principle speaker, type H-510, has been developed by the Jensen Manufacturing Company, 6601 South Laramie Ave., Chicago. Employs a direct radiator low end with a separate high-frequency horn and compression driver for the high channel. Presence is said to have been enhanced by attaining a wider angle polar pattern in the extreme high-frequency region.

• • •

THORDARSON REPLACEMENT TRANSFORMERS

A line *(24 line)* of power and output replacement transformers has been announced by the Thordarson Electric Manufacturing Division, Maguire Industries, Inc., 500 West Huron St., Chicago.

Specific duty transformers available in four models; 2,000 to 25,000 primary impedance with 5 watts output.

Two models, universal output replacements, available in four or eight watts output, with primary impedance of 4,000 to 14,000, and secondary impedance of .1 to 29 ohms.

Also available is a universal line to voice coil transformer with 70 v output taps; 10 watts with secondary taps from ¼ to 10 watts.

• • •

E-V CRYSTAL AND DYNAMIC MICROPHONES

General-purpose crystal and dynamic microphones (mercury) have been announced by Electro-Voice, Inc., Buchanan, Michigan.

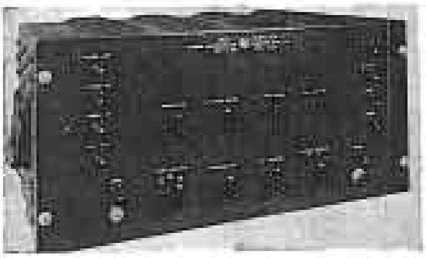
Tiltable head for non-directional or semi-directional use. Frequency response of mikes is said to be substantially flat, 50-8000 cps. Output level is —48 db for crystal (model 911) and —53 db for dynamic (model 611).

The dynamic uses an *acoustalloy* diaphragm. The dynamic is available in high and low impedances.

BROWNING LAB SWEEP CALIBRATOR

A sweep calibrator, model GL-22A, has been announced by Browning Laboratories, Inc., of Winchester, Mass. Calibrator is designed to provide markers for accurate time calibration of synchroscopic sweeps. Markers at intervals of 0.1, 1.0, 10.0, and 100.0 microseconds are provided and are suitable for deflection indicating or beam blanking presentation.

A self-contained trigger generator with positive or negative output can be used to drive the calibrator and associated equipment or it may be triggered externally up to approximately 100 kc. Positive or negative gates of variable amplitude are available for obscuring retrace or timing purposes. Offered in either rack mounting or cabinet style with panels finished in black leatherette.



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HEWLETT-PACKARD SECONDARY FREQUENCY STANDARDS

Secondary frequency standards 100C and 100D have been developed by the Hewlett-Packard Co., 395 Page Mill Road, Palo Alto, Calif.

Model 100D offers rectangular wave output, timing pips at intervals of 100, 1,000 and 10,000 microseconds, and an interval 'scope for convenient frequency comparison. This instrument may be standardized against WWV with the aid of a standard oscillator and a communications receiver.

Both models employ crystal controlled oscillator and divider circuits. Internal impedance has been held to around 200 ohms, so the standard frequencies can be delivered at some distance from the instrument.

100D offers sine waves at 5 frequencies and rectangular waves at 4 frequencies. Accuracy is said to be in the order of 2 parts in 1 million. The 100C offers sine waves only, at 4 crystal controlled frequencies.

Both instruments provide 5 volts output at all frequencies, and operate from a self-contained 115 v regulated ac power supply.

* * *

ELECTRODYNE IMPEDOMETER

An *Impedometer*, for comparing the voltage drop across the unknown impedance and the voltage drop across a resistive standard, when the same current is flowing in both circuits, has been developed by Electrodyne Co., 899 Boylston St., Boston 15, Mass. Unit is used in conjunction with a suitable oscillator and a vacuum-tube voltmeter.

The instrument uses standard resistors accurate to 1%.

Determinations said to be possible by *Impedometer* measurement are: impedance changes due to mechanical changes; effect of *dc* in circuit components; transformer characteristics; separation of resistive and reactive components; ac characteristics of batteries, vacuum-tube circuit studies.

Instrument was developed by Edward S. Shepard, Sr., of the seismological department of Boston College.

* * *

EBY MOLDED-IN-THE-LINE FUSE HOLDER

A fuse holder for in-the-line service has been announced by Hugh H. Eby, Inc., 4718 Stenton Ave., Philadelphia, Penn. Positive contact is said to be assured by attaching the wire lead to the socket-type contact by a solderless crimp connection, thus making these two parts an integral unit.

After three insertions of a .253" (±.0005") diameter pin there is said to be a maximum voltage drop of five millivolts at 20 amperes when measured with a .247" (±.0005") silver-plated copper pin.

RCA TV PORTABLE POWER SUPPLY

A lightweight power supply, type TY-25A, capable of providing a regulated source of *dc* at loads from 200 to 300 milliamperes, has been announced by the TV section of the RCA Engineering Products Department. Equipment is adapted for use as either a portable or a rack-mounted unit.

Adjustable between 260 and 290 volts, with variations said to be less than 0.5 per cent from minimum to maximum load; *ac* ripple of less than 0.01 per cent from peak-to-peak.

* * *

ELECTRONIC TUBE CORP. 'SCOPE

A dual-channel 'scope, H-21, providing observation of two independent and rapid phenomena occuring simultaneously, has been announced by the Electronic Tube Corp., 1200 East Mermaid Lane, Philadelphia 18, Penna.

'Scope contains two separate and complete electron guns in a single, 5", flat face tube. Each channel has individual controls for intensity, focus, and *X*, *Y*, and *Z* axes. Vertical deflection sensitivity is said to be less than 0.1 v dc/in. Vertical amplifiers have conductive differential input in the 1X attenuator setting, allowing the use of push-pull preamplifiers for medical purposes. Vertical and horizontal amplifier outputs are interchangeable. Triggering is in continuous sweeps of 2 cps to 50 kc; ½ second to 20 microseconds. Range, up to 100 volts, is governed by attenuator setting.

* * *

INTERNATIONAL RECTIFIER HIGH CURRENT DUAL RECTIFIER SELENIUM ELEMENTS

Dual selenium rectifier elements measuring 7¼" x 12¾" have been developed by the International Rectifier Corporation, 6809 South Victoria Avenue, Los Angeles 43, Calif. Each dual element consists of two 5⅝" x 7¼" plates strapped in parallel and rated in a three-phase bridge circuit at 34 amperes for continuous duty self-cooling, 85 amperes for continuous duty fan-cooling, and 340 amperes for highly intermittent duty.

* * *

BENDIX DC MOTOR

A *dc* motor, specially designed to meet the requirements of the Army-Navy specification ANM-40, has been announced by the Red Bank Division, Bendix Aviation Corp., Red Bank, N. J.

Motor is completely shielded to eliminate radiated *rf* noise and equipped with an integral filter to suppress conducted noise. It is guaranteed to be noise free within specification limits from .15 to 156 mc; limits maintained through the required ambient temperature range of —55° C to +71° C.

Motor can be supplied for voltages from 12 to 64 volts *dc* and is normally furnished with a standard AN connector.

MEASUREMENTS SIGNAL GENERATOR

A standard signal generator covering 20 cycles to 50 mc, model 82, has been announced by Measurements Corporation, Boonton, N. J.

Two oscillators are employed to cover the frequency range. Low frequency oscillator, continuously variable from 20 cycles to 200 kc, has a metered output from 0 to 50 volts across a resistance of 7500 ohms. An *rf* oscillator covering the range from 80 kc to 50 mc provides output from 0.1 microvolt to 1 volt and may be modulated with the low-frequency oscillator.

Instrument features a mutual inductance type attenuator which is said to insure a higher degree of accuracy than may be obtained with the resistor attenuator or mutual inductance type attenuator of earlier design.

* * *

CB AUTOMATIC AUDIO SWEEP GENERATOR

An automatic audio sweep generator which is said to have a frequency of from 25 to 12,000 cycles in one continuous range, has been announced by Clough Brengle Company, 6014 Broadway, Chicago 40, Ill. Sweep may be adjusted to any spread from 100 to 10,000 cycles, or the instrument may be operated manually.

Wave form distortion is stated to be less than ½ of 1%, and the sweep calibration is linear, sweep frequency being adjustable from 2 to 10 sweeps per second.

Construction and operational data appears in bulletin 16A.

* * *

TRANSVISION SWEEP SIGNAL GENERATOR

A sweep signal generator, model No. SG, for TV and FM featuring frequency coverage from 0-227 mc with no band switching, variable sweep width from 0-12 mc and a calibrated built-in marker generator has been announced by Transvision, Inc., New Rochelle, N. Y.

Unit has directly calibrated markers, 20-30 mc for trap, sound and video *if* alignment; *rf* for alignment of traps for *if* channels when a *dc* voltmeter is used as the indicating medium, unmodulated *rf* signal to provide marker pips simultaneously with the main variable oscillator and phasing control.

* * *

TRIPLETT VOLT-OHM-MIL-AMMETER

A pocket-size *volt-ohm-mil-ammeter*, model 666-R, providing readings of 0-3,000 ohms (.5 ohm low reading) to 3 megohms, ten *ac/dc* volt ranges to 5,000 and three *dc* ranges, has been developed by The Triplett Electrical Instrument Co., Bluffton, Ohio.

Features unit construction with all resistors, shunts, rectifier, and batteries housed in a molded base integral with the switch.

* * *

G.E. PORTABLE AUDIO AMPLIFIER

A portable audio amplifier for AM, FM, and TV broadcasting has been announced by the transmitter division of G.E.

The amplifier, type BA-6-A, features four microphone channels, each with an individual preamplifier, and a program amplifier which raises the signal to the level required for telephone transmission. Also has a low-level output connection for feeding *pa* systems or other amplifiers.

The unit contains a built-in *ac* power supply. If *ac* power is not available or fails, the amplifier can be operated on its own battery system.

Noise level is said to be 70 db at normal fader positions, while distortion is less than 1 per cent at 30 to 15,000 cycles. Frequency response under similar conditions is within 1 db.

Built into the amplifier is a test-tone setting for remote line testing and a large-size illuminated *vu* meter for reading the program level fed into a telephone line and checking the condition of the batteries.

Determination of Internal Impedance

(Continued from page 9)

third test with a known reactance load.

(b) Two tests, each with different known reactance loads, and a third test with a known resistance load.

(c) Three tests, each with different known reactance loads.

The only factor which makes any of the above arrangements more desirable than others is the consideration of the angle at which the circles may intersect. Two successive resistance tests yield R_o circles which will be most likely to intersect at a rather small angle, so that on a plot using a pen or pencil drawing a curve of finite width, the circles will intersect on a short segment of curve rather than at a sharp point. The same is true of successive X_o – *circles*, if the reactances are of the same sign. As a further consequence of the ordinarily small angle between two R_o circles at their intersection, very slight inaccuracies in the circles will cause large error in the X coordinates of their intersections. Similarly, two X_o – *circles* drawn for reactive loads of like sign will yield an R component of poor accuracy.

Summing up we find that the intersection of circles based on loads of the same nature generally cannot be relied upon to yield an accurate solution for Z. Since the reactive elements used in an application of this sort will usually be capacitances, because of their convenience and low dissipation, case (c) would usually involve reactances whose signs are all alike, and this case can therefore be rejected as ordinarily unsuitable. The remaining cases, (a) and (b), will yield accurate results, since they are based on both resistance loads and reactance loads. Generally, an R_o – *circle* and an X_o – *circle* will intersect when reasonably near to being normal to each other, and therefore the intersection is sharp and accurate.

The foregoing considerations indicate a best method for taking the results from the circle plots. Suppose we consider case (b), using two R_o – *circles* and one X_o – *circle*. These three circles should intersect at a common point to register the true Z. The intersection of the two R_o – *circles* will probably be inaccurate, so that actually no three-way intersection will occur. However, the X_o – *circle* will intersect both R_o – *circles* at very nearly the same point, this point representing the true accurate components of Z. The nearby intersection of the R_o – *circles* will serve to indicate that the solution thus obtained is not an extraneous one.

The method discussed is not restricted to measurement of the internal impedance of a generative source. It is quite applicable to general impedance measurement. Any unknown impedance can be measured by arranging it to be Z in Figure 1. The test setup then requires only a voltage source, voltmeter, and some known resistances and reactances.

As an example and check, the internal impedance of a laboratory signal generator was found by the method described. The results are shown in the curves of Figure 3. By way of verification of these results, calculations were made of the ratio of load volts to open-circuit volts for a load resistance of 400 ohms, and the calculated values of this ratio compared to values obtained by direct measurement. The comparison is illustrated in Figure 4.

Portable Console

(Continued from page 11)

broadcaster, a little showmanship always helps.)

A dual-speed turntable[1] with a pickup carefully oriented to minimize induced hum is in use at our station. Since the rumble is very low, and the speeds are accurate and easily changed, this turntable has been found ideal for the job.

Setting Up On Remote

In a typical installation, one or more speakers are first connected to the multi-match output transformer, the *line out* terminals are connected to the phone line, and the microphone and turntable are plugged into the console chassis.

Speakers are oriented for the maximum coverage possible without endangering the broadcast operation by causing feedback. Then, the public-address controls are preset, one (top) to give ample coverage, and another (bottom) to give as much coverage as possible without feedback or too much of the *echo effect*. A time-check with the studio and a level-check complete the preliminary operations.

A unit such as this could be used to feed highpower boosters located at a distance in a large *pa* installation.

Since *KXIC* is equipped with only one studio console, as are most 1-kw stations, this remote console furnishes a feeling of security.

Studio Aid

Several times we have had calls for recordings that would require most of our large console's facilities.

To provide this service, we have fed the transmitter from the small console, located in an office or studio, and proceeded with the recording through the main console without the additional worry of program feed.

(In such a case, the *microphone on, public-address control* would be turned off, and the operator and the announcer could be located in the same room.)

The small console has also been used to feed prepared programs into salesmen's wire recorders. This has been found to add broadcast quality and production to audition recordings made for potential sponsors, save time and effort for everyone involved in the task.

Salesmen have found that it is easier to sell on-the-spot programs from small nearby towns, when they can say the station will be using a good, adequate public-address system, and therefore the local, immediate audience will hear the commercials just as the radio audience does.

The console has been used, too, for chamber of commerce dollar day novelty shows. Here, versatility and the ability to handle an audience-microphone without feedback are very great assets. The emcee's comments still can be heard by the immediate audience, because his voice can be brought in through the unswitched channel.

KXIC is beginning to feel that the small console is vital to its well-rounded operation. The solder had hardly cooled, before the station's program director was building shows around this versatile unit.

Even the sales manager was using it. For the console could be set up to feed programs between offices to allow prospective sponsors, who had come up to the studios, to hear how their proposed shows would sound.

It has been our experience that remotes draw listeners. The small console releases the lid on stored-up plans to schedule more numerous and more varied remote shows which will exploit the audience potential.

[1] G-I.

News Briefs

INDUSTRY NOTES

The Du Mont TV transmitter division has announced plans to repurchase Du Mont *vhf* transmitters from TV broadcasters and CP holders who, for the best interests of the public and television broadcasting industry, may be required to change operations from the *vhf* to the *uhf* band.

The plan, outlined in individual letters to purchasers of complete Du Mont video and audio transmitters, provides for the repurchase of Du Mont *vhf* transmitters at an amount equal to the total depreciated value of the transmitter at the time it is repurchased by Du Mont.

PERSONALS

James M. Blacklidge, Standard Transformer Corp., Chicago, has been elected chairman of the Association of Electronic Parts and Equipment Manufacturers. A. L. Tuttle, Centralab, Milwaukee, has become vice chairman; Helen Staniland Quam, Quam Nichols Co., Chicago, treasurer for the fourteenth consecutive term and Kenneth C. Prince, Chicago, executive secretary for the fifteenth year.

Joseph F. Bozzelli has been appointed assistant sales manager of the L. S. Brach Corp., Newark, N. J.

Charles P. Soper has retired as head of the patent department of the Kellogg Switchboard and Supply Company, Chicago. John I. Bellamy, associated with the company since 1941, succeeds Soper.

Robert A. Seidel, formerly vice president and comptroller of the W. T. Grant Co., is now with the RCA Victor Division as vice president in charge of distribution.

F. P. Barnes has been appointed sales manager of communications equipment for the G. E. transmitter division.

Maurice G. Staton has been appointed sales manager of microwave relay and channelling equipment in the RCA Engineering Products Department.

R. M. Karet is now on the board of directors of the Pentron Corp., 611 W. Division St., Chicago 10, Ill. Karet will also act as national sales consultant for the company which manufactures magnetic wire and tape recorders. **Paul A. Sahlins** is president of Pentron. **Irving Rossman** is vice president and sales manager.

LITERATURE

The Radio Division of Sylvania Electric Products, Inc., Emporium, Pa., has released a 418-page revised edition of a tube manual containing basic application data for 637 receiving and cathode-ray tubes.

Data supplied includes characteristic curves for tube types in common use; resistance coupled amplifier data; interchangeable tube charts; dictionary of tube, circuit, FM and TV terms; and instruction on the use of characteristic curves.

Priced at eighty-five cents per copy.

Ward Leonard Electric Co., Electronic Distributor Division, 53 W. Jackson Blvd., Chicago 4, Ill., have released a relay catalog, D-20A, which illustrates and describes various types of relays, gives contact ratings, coil specifications, sizes, current list prices, and other helpful data on ac and dc units.

Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Penna., have published a booklet, DB-19-035, which describes standard and high-voltage selenium rectifiers for power supplies and electronic circuits.

Efficiency curves for both the standard (type M) and high-voltage (type H cells) are included, together with discussions entitled *Efficiency—Aging—Life, Back Leakage—Reverse Resistance, Forward Resistance.* Life characteristics of types H and M cells, for various overload conditions or high ambient temperatures, are plotted graphically.

Federal Telephone and Radio Corp. publication division, 67 Broad St., N. Y. 4, N. Y., has published a 640-page third edition of *Reference Data for Radio Engineers.*

The new edition contains an expanded chapter on selective circuits and now includes design formulas for double-, triple-, and stagger-tuned circuits. A completely new chapter on filter networks has been compiled, and includes impedance and phase-shift curves and design equations for low- and high-pass, and band pass and band-stop networks.

A section including twenty-four of the more widely used variations of the impedance bridge and its use in measurements has been included. Descriptions of grid-controlled gaseous rectifiers as used in high-power, high-voltage supplies are given, together with design information for all types of filter circuits for power supplies.

The chapter on electron tubes now includes information on high-frequency types, including traveling-wave, magnetron, and klystron tubes, with a table on cathode-ray-tube screen phosphors.

Also given is the latest information on all types of modulation, including pulse-time-division multiplex, of which the characteristics of several variations are described.

A new chapter on *radio noise and interference* has been added. Tables and a chart dealing with the location of spurious frequency responses are included here.

Book is priced at $3.75.

Polytechnic Research and Development Co., Inc., 202 Tillary Street, Brooklyn 1, N. Y., has published a catalog describing microwave test equipment covering the frequency spectrum up to 40,000 mc.

Allied Radio Corp., 833 W. Jackson Blvd., has published a 196-page catalog covering equipment for broadcast stations and for industrial maintenance, research and broadcast use. Among the listings of broadcast station supplies are: power tubes, distortion analyzing equipment, pickups, equalizers and arms, CAA approved tower light controls, patch cords and panels, etc.

The E. F. Johnson Company, Waseca, Minn., have prepared the sixth edition of the *Johnson Antenna Handbook and Rotary Beam Instruction Book*, a 47-page book.

Copies are priced at 60 cents.

The International Rectifier Corp., 6809 S. Victoria Avenue, Los Angeles 43, Calif., has published a bulletin, PC-649 describing a line of selenium self-generating photoelectric cells. Bulletin contains diagrams, curves, etc., describing the construction, performance characteristics and applications of the photocells.

The Hewlett-Packard Co., 395 Page Mill Road, Palo Alto, Calif., have published the first edition of the *H-P Journal* with an article on a milli-microsecond wide-band amplifier.

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3-Kw MF Transmitter

(*Continued from page 14*)

stage gain from the low voltage plate supply in the rectifier unit.

The second amplifier stage was capacity coupled to the cathode-driver stage; eight WL-807s operated class *AB1*. Four tubes were arranged to operate in parallel to drive each final amplifier tube. The driver cathodes were directly connected to the grid of the power amplifier tube and operate at the same potential as the power amplifier grid. Independently adjustable fixed bias was used for each set of cathode drivers. Since the input impedance of a class *B* amplifier varies widely over the cycle, it was necessary to have a driving source that had extremely good regulation with wide variations of loading. Good regulation was required to assure constant grid bias and good wave shape of the driving potential to the class *B* amplifier.

In this transmitter, the cathode-to-ground capacity of the cathode driver is composed of the cathode-to-heater capacity, the class *B* amplifier grid input capacity and capacity of the associated wiring. This causes the cathode driver to operate on an elliptical load line instead of the theoretical straight line. Operation on an elliptical load results in increased drive requirements, higher cathode emissions and decreased efficiency. The cathode driver must be capable of supplying the class *B* peak grid current and the capacitive currents produced by the cathode-to-ground capacitive reactance of the cathode driver. In selecting a cathode driver, a tube was required whose characteristics were such as to provide high values of plate current at low anode potentials without having to be driven in to grid current. The anode potential must be kept low since this potential multiplied by the cathode capacitive current composes a large part of the plate dissipation. By limiting the operation of the cathode driver to class *AB1*, which does not require any grid current, the design of the preceding stages was simplified.

[To Be Continued]

Last Minute Reports . . .

MICROWAVE RELAYS, which have become increasingly important factors in broadcasting, served recently as a medium of bringing complete TV programs to Canada, during the annual Canadian National Exhibit. Telecasts, relayed through the facilities of Philco pickup points, came from WBEN-TV, Buffalo, about 65 miles from Toronto where the exhibit was held, and VE9KE in the Philco factory in Toronto. . . . KNBC-FM has installed a REL 946-mc studio-to-transmitter unit, linking the transmitter located on top of San Bruno Mountain and the studios in San Francisco. . . . M. H. A. Lindsay has succeeded M. P. Farmer as chief engineer of the A. D. T. Company, Inc., N. Y. C. . . . Automatic Electric Company, Chicago, have been named distributors in this country for G. E. radiotelephone equipment suitable for telephone use. . . . The French Government will soon install an RCA ground-controlled approach system at Orly, municipal airport for Paris. . . . Radio Inventions, Inc., will hereafter be known as the Hogan Laboratories, Inc., 155 Perry Street, New York 14, New York. . . . Hendley Blackmon has returned to Westinghouse as assistant manager of engineering association activities. . . . Robert H. Robinson is now sales manager of William Brand and Co., 276 Fourth Avenue, N. Y. 10. . . . Frank E. Mullen, former executive vice president of NBC and later president of the George A. Richards radio stations in Detroit, Cleveland and Hollywood, has been retained as a consultant by WPIX. . . . C. G. Roberts has been appointed product manager for broadcast and television equipment of the G. E. transmitter division. . . . Dr. Oliver D. Sledge, former professor of electrical engineering of the Georgia School of Technology, has joined the staff of the National Bureau of Standards in the microwave standards section. . . . Ed J. Meehan, Jr., has been appointed as a broadcast equipment field sales rep in the Dallas, Texas, region by RCA. . . . Howard V. Carlson is now with the Communications Equipment and Engineering Co., Chicago 44, Illinois. . . . Percy L. Spencer, manager of the Raytheon power tube division, received recently the Navy's Distinguished Public Service Award from Rear Admiral Hewett Thebaud. . . . Allen B. Du Mont Laboratories, Inc., held dedication ceremonies recently of its new TV receiver and electronic parts manufacturing plant, at 35 Market Street, Paterson, N. J.

ADVERTISERS IN THIS ISSUE

COMMUNICATIONS INDEX

OCTOBER, 1949

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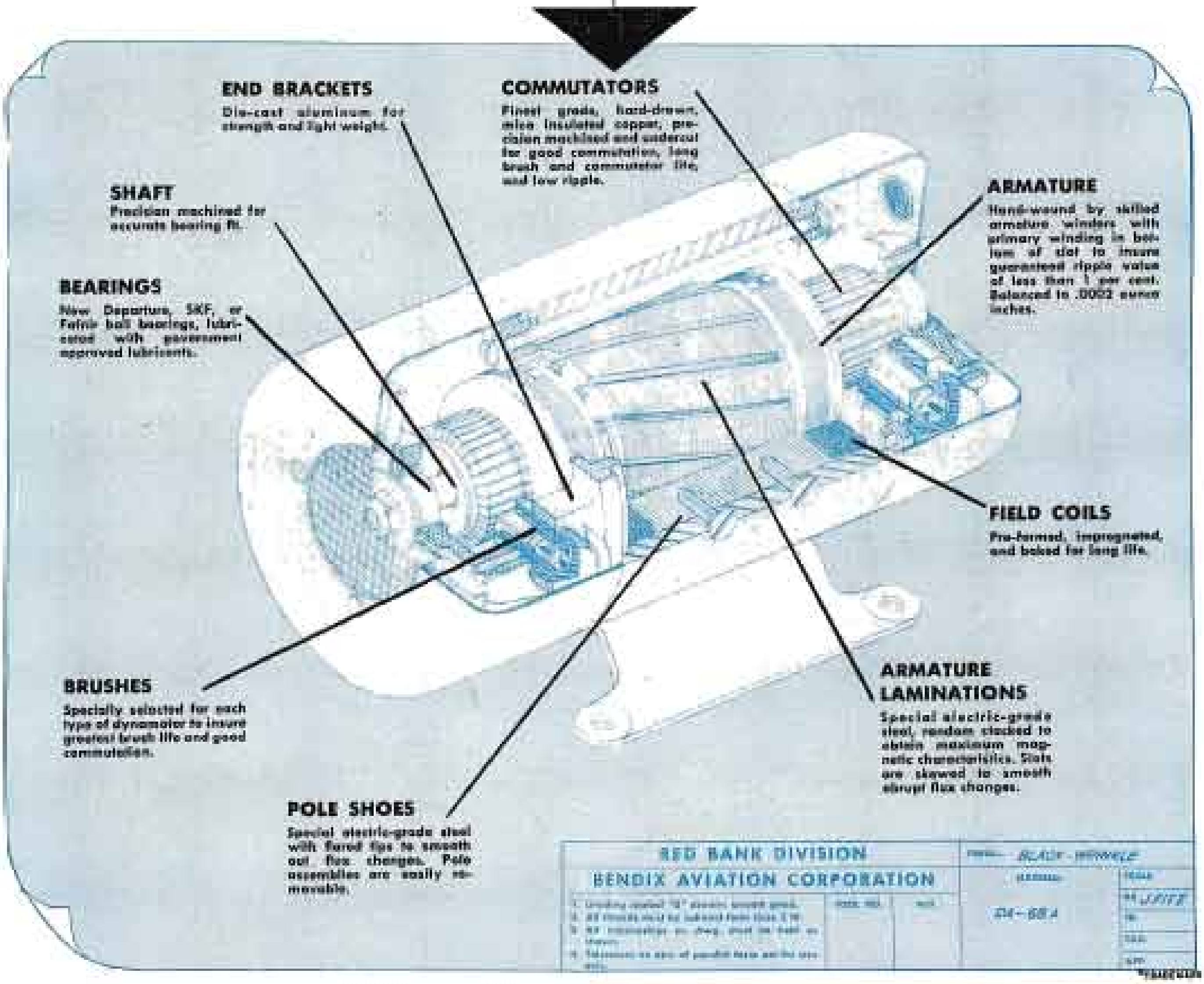

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