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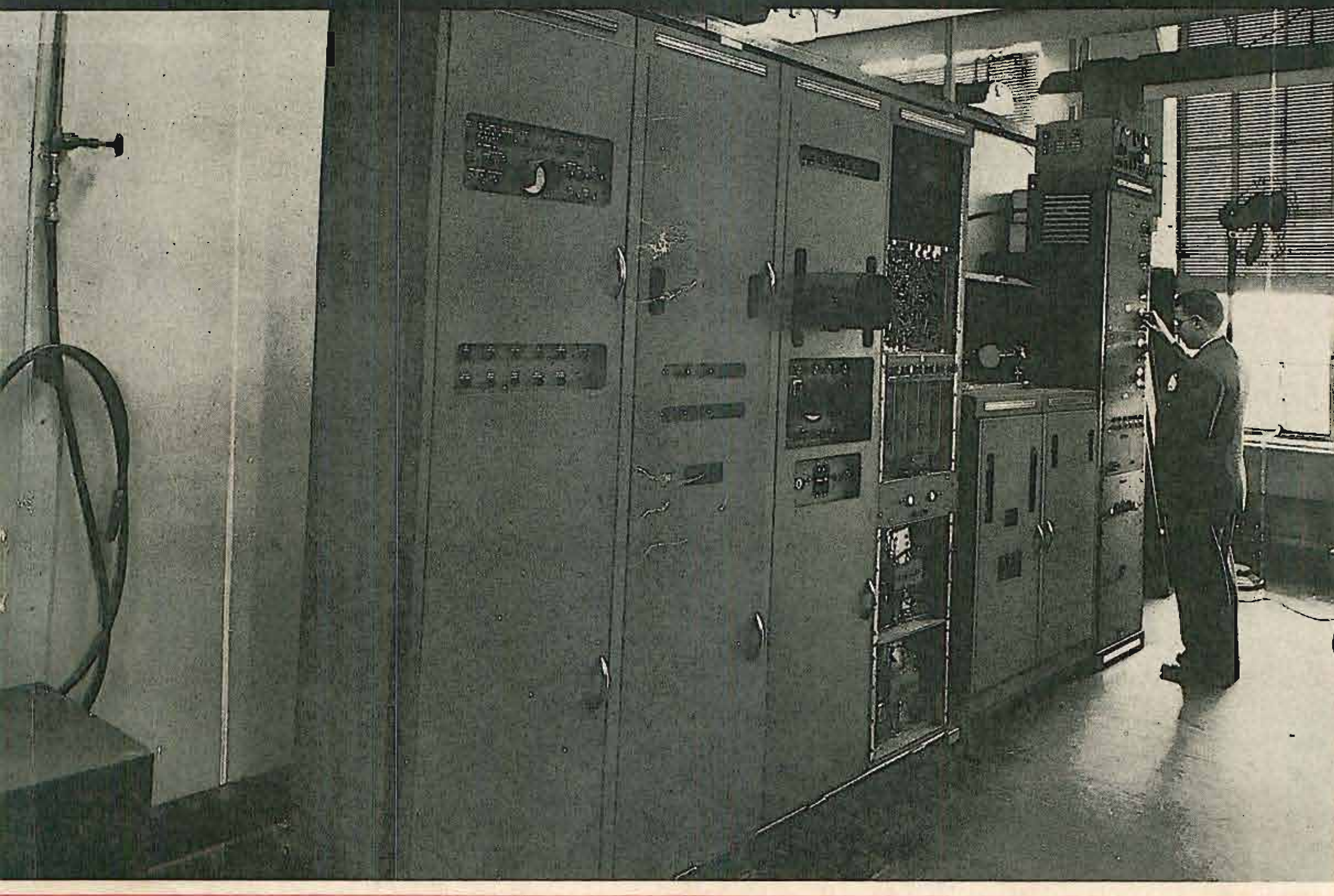

FEBRUARY

★ TV MONITOR RECEIVER DESIGN
★ AUTOMATIC TELETYPE BULLETIN ALARM
★ A TV DISTRIBUTION SYSTEM FOR LABORATORY APPLICATIONS

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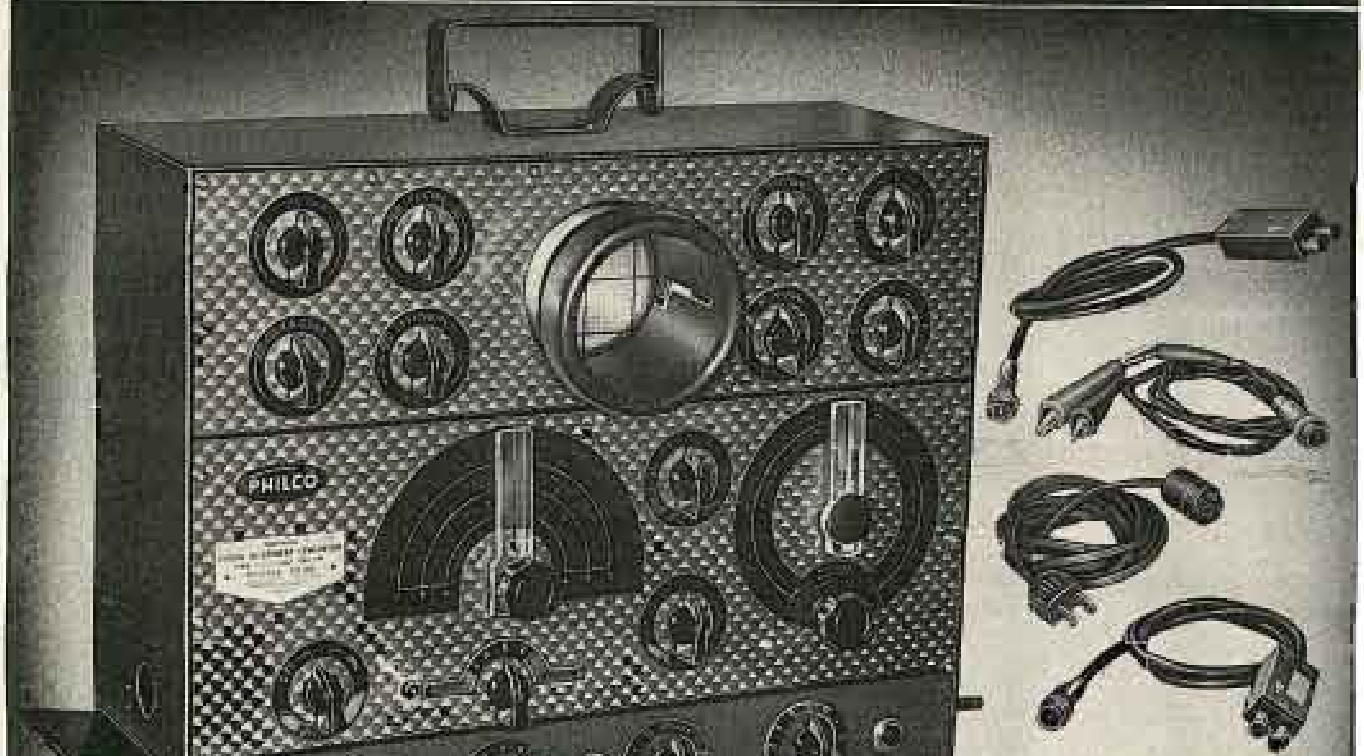

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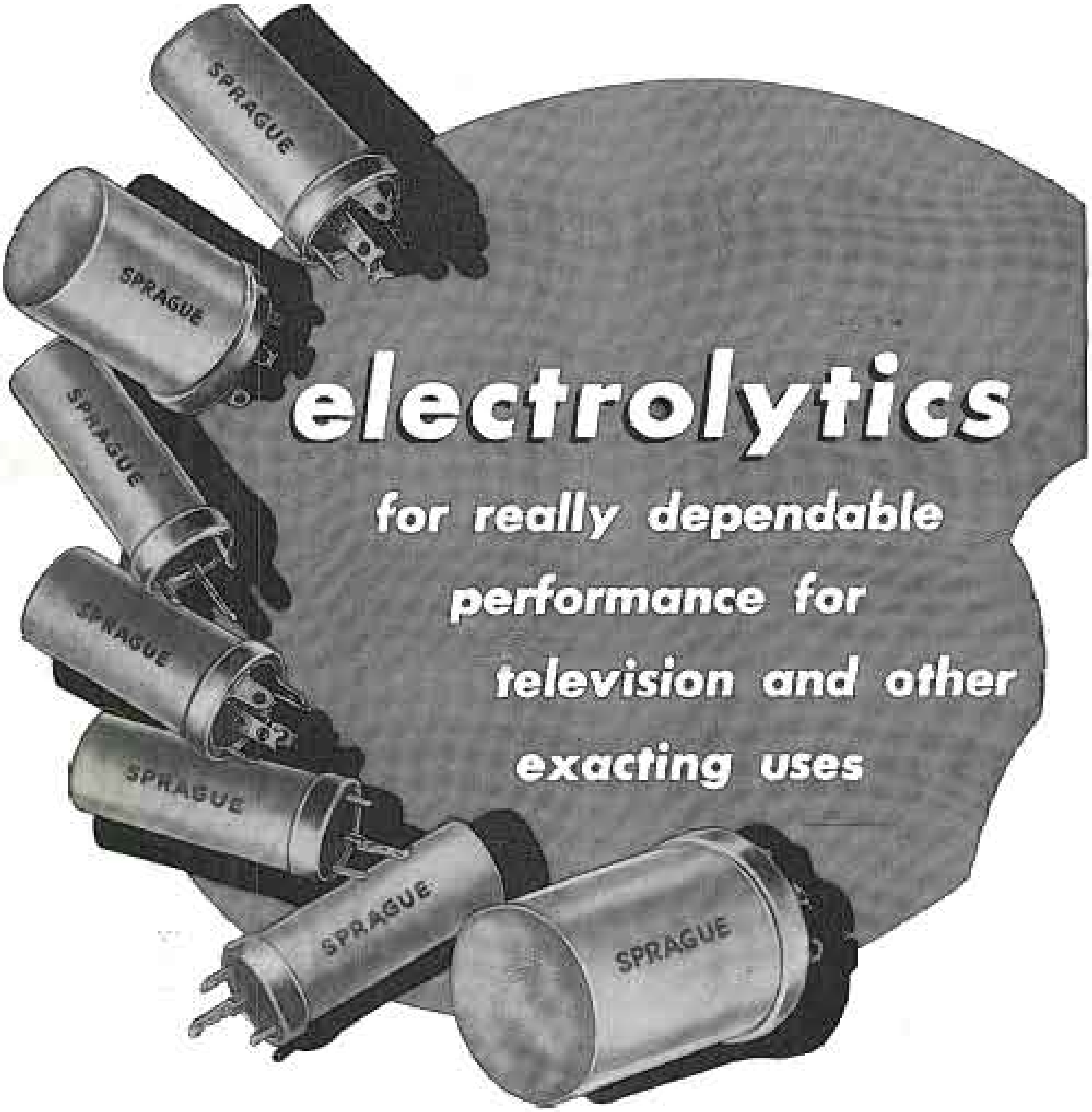

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FEBRUARY, 1949 **VOLUME 29** **NUMBER 2**

COMMUNICATIONS

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COVER ILLUSTRATION

Centralized TV distribution system room with, left to right, sync generator, monoscope chain, monitors, video distribution amplifiers, crt flying spot video signal generator and picture and sound rf television generators. *(See page 8, this issue, for complete discussion of the system.)*

(Courtesy Philco)

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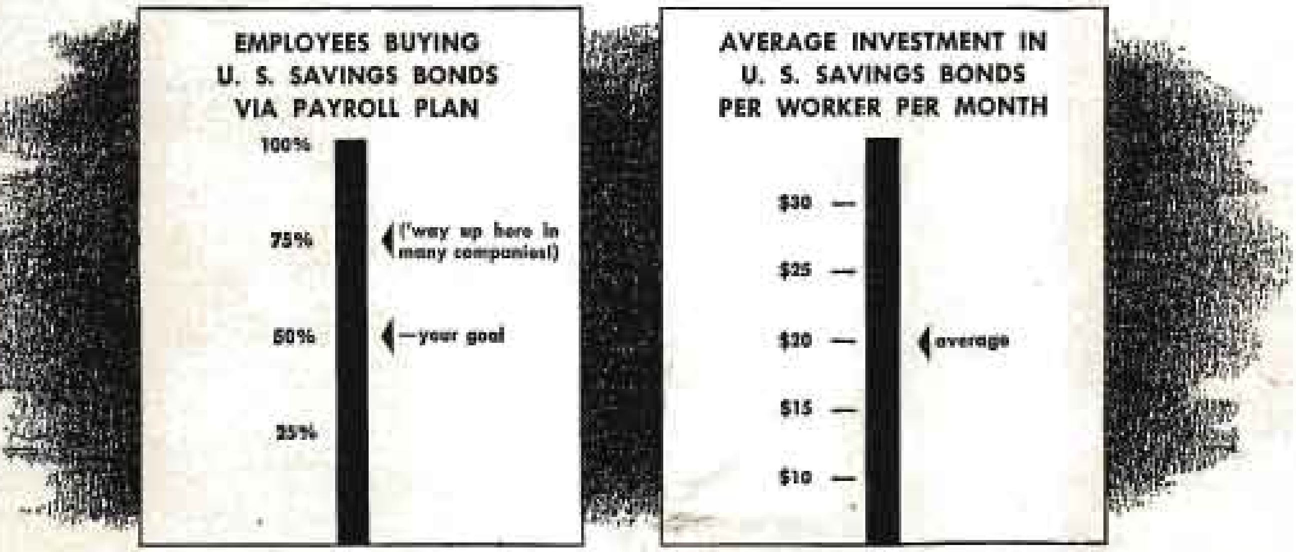

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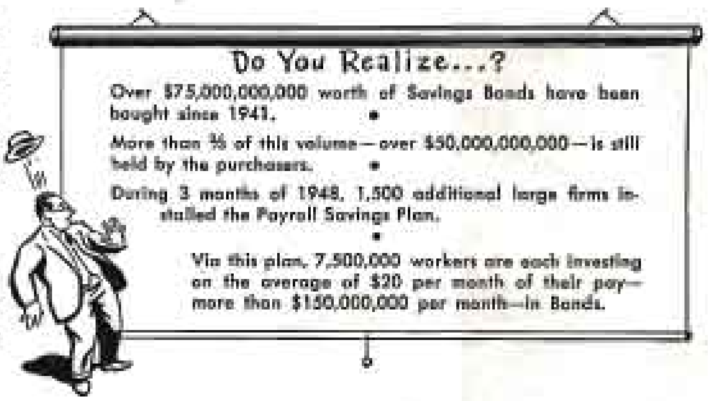

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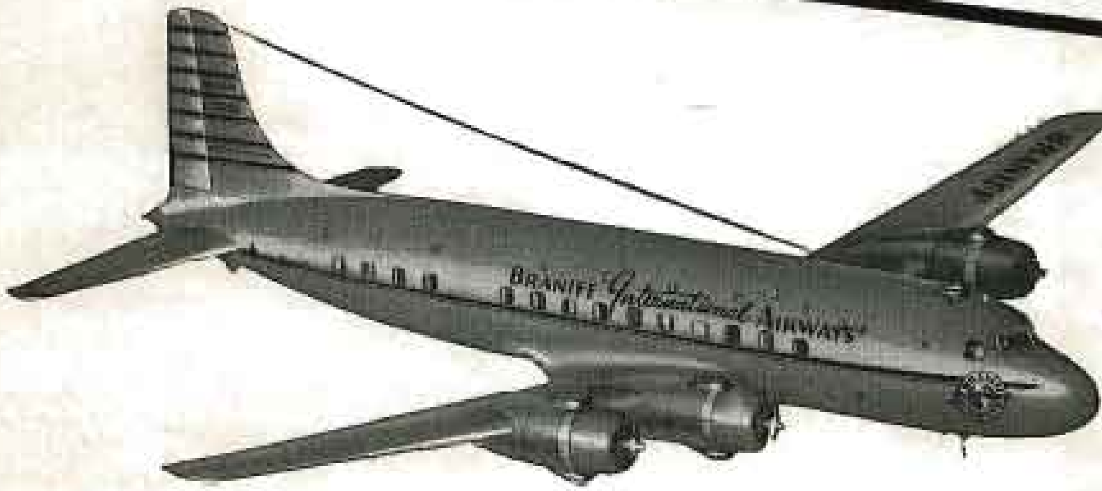

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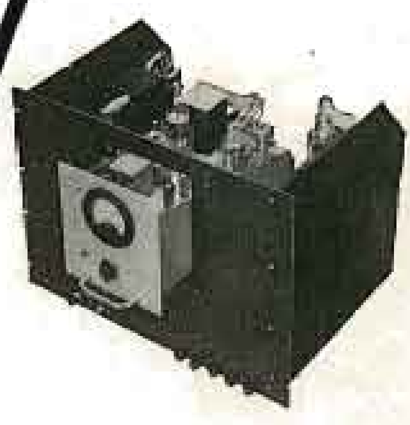

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COMMUNICATIONS

LEWIS WINNER, Editor

FEBRUARY, 1949

It's Show Time

The Big Three, the IRE, NAB and RMA, will roll their drums and ring up the asbestos on their annual spectacles in March and April in New York, Chicago and Philadelphia, and set the stage for a round of the most informative meetings ever planned.

All three get-togethers will be of particular interest to management and engineers in communications and broadcasting. In New York at the IRE (March 7 to 10) there'll be quite an assortment of papers on those spotlight topics, *vhf* and *uhf* in TV. One of the timely presentations will be made by Kenneth Bullington of Bell Labs who will analyze propagation variations at *vhf* and *uhf*, showing how the variations of received signal with location (*shadow losses*) and with time (*fading*), affect the usable service area and the geographical separation between co-channel stations. With an empirical method, he will illustrate that the required separation between co-channel stations is from three to ten times the average radius of the usable coverage area.

In another propagation study, Joseph Fisher of Philco, whose paper on a TV distribution system appears in this issue, will reveal the results obtained on 500 and 3,300 mc over varied terrain in Washington and Philadelphia.

George H. Brown, Wendell C. Morrison, W. L. Behrend and J. G. Reddeck, of RCA Labs, will describe a combining network, which allows two tubes to be operated simultaneously into a common load without interaction between tubes and without reduction in bandwidth, in an 850-mc transmitter, employing four tubes in multiple.

Thomas T. Goldsmith, Jr., of DuMont, will continue the *uhf* TV discourse with a complete report on the status of the 475 to 890-mc operational possibilities at this time.

Antennas, a particularly important phase of current engineering, will be featured in a series of sessions. During one of these meetings Arthur E. Marston and M. D. Adcock of Naval Research will analyze the theory of end fire helical antennas and provide a formula for the radiation field of a helix which yields a definite condition to be satisfied by the geometry of the helix and the propagation constant of the traveling wave of current in order that the radiation field of the helix be end fire with circular polarization on the axis. O. M. Woodward, Jr., of RCA Labs, will present another extremely interesting TV antenna paper and disclose a unidirectional dipole element receiving antenna with the elements united by a transmission line network which yields a directive pattern. This antenna has been effectively used during the sync-carrier tests between Washington, Princeton and New York.

Relays, another extremely pertinent factor in TV, will be a subject of several papers. One presentation, by William H. Forster, of Philco, will cover systems which employ second detection at each repeater which are said to be most suitable for intracity work and remote pickups, and heterodyne remodulation at the repeaters for intercity long line service. J. Z. Millar and W. B. Sullinger of Western Union will provide details on a 6,000-mc link between New York and Philadelphia. The relay analyses will continue with a description of a 10-repeater link setup by M. Silver, H. French and L. Staschover of Federal Telecommunication Labs.

AM broadcasting will also be covered liberally at the conference. In one paper by H. R. Summerhayes, Jr., of General Electric, will be described an AM monitor which features a local oscillator synchronized in constant phase relation with the carrier component of the modulated signal from the transmitter. The local oscillator signal energizes a quartz crystal discriminator which indicates deviation from the assigned frequency. The local oscillator signal from this monitor can also be added to the modulated wave to reduce the effective percentage of modulation and thus eliminate negative peak clipping in the detector.

The all-important 60 or 120-kc spacing problem in the 152 to 162 mc band will also be a topic of discussion at the IRE meeting. R. C. Shaw, P. V. Dimock, W. Strack and W. C. Hunter, of Bell Labs, will describe a mobile system now operating in Chicago using 60-kc spacing of carrier frequencies and featuring off-channel squelch in the land receivers, *agc* in the mobile equipment and connection of six land receivers to a common antenna.

At the NAB engineering conference in Chicago in April, there'll be three days of papers covering TV, recording and reproducing, and a variety of projects in AM and FM broadcasting. The conference, which will run from April 6 to 9, will be highlighted by an address by former IRE prexy Dr. William L. Everitt, head of the University of Illinois Department of Electrical Engineering, who for many years conducted the outstanding broadcast engineering conferences at Ohio State University.

In Philadelphia on April 25, 26 and 27, at the Benjamin Franklin Hotel, the RMA and IRE will hold their annual spring meeting and present twelve papers covering a 3-kw *mf* transmitter with iron-core interstage and output circuits; cavity resonators in mobile communications; *symmetron* 50-kw FM amplifier; instantaneous deviation control for PM transmitters; TV recording techniques; a TV visual modulator; high efficiency coolers for forced air-cooled power tubes; audio power amplifiers with positive and negative feedback, and commercial PTM telephone microwave link setups.

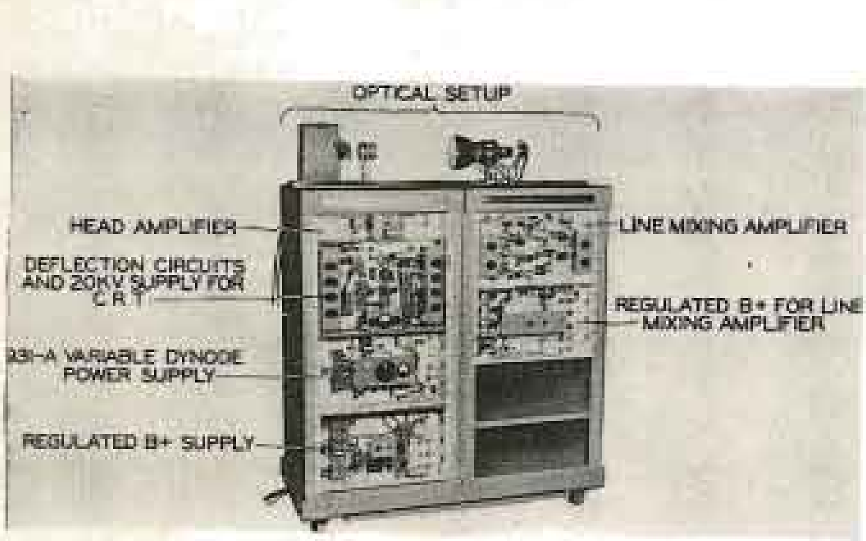
Seems as if March and April will be bristling with lively topical meetings for everyone in the broadcast and communications fields!

The Annual VWOA Soiree

On February 26 at the Hotel Astor, New York City, the Veteran Wireless Operators Association will hold their annual dinner-cruise, where oldtimers will rub shoulders, reminisce and do a bit of peering into the future.

A must event for the month!—L.W.

TV Distribution System



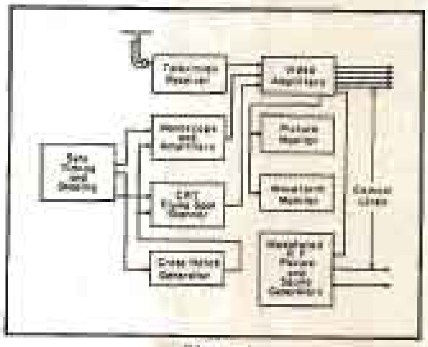


Figure 1
Block diagram of terminal equipment.

Figure 2 (left)
View of flying spot video signal generator.

A CENTRALIZED SYSTEM for producing the standard RMA composite video signal, and a means for distributing this signal with a minimum of distortion is a necessity for a large organization engaged in television research. To attempt to duplicate the terminal equipment in each laboratory would result in an overcrowding of floor space, a large increase in capital investment, and an increased maintenance cost. It is desirable that the terminal equipment produce both the composite video signal and means for modulating this signal on a number of the standard *rf* carriers. Many projects such as the development of video amplifiers, deflection circuits, high-voltage pulse supplies, and analysis of *crt* performance can be carried out by using the composite video signal, which is the same signal as that produced at the second detector output of a standard television receiver. Studies of the performance of the *rf* and *if* circuits are greatly enhanced by having an *rf* generator modulated with composite video, the output not being affected by noise or multipath transmission.

On the cover of this issue appears a view of a centralized equipment setup at our labs. Vertical mounting of chassis is used so that all components may be serviced from the front of the units while tubes may be changed from the rear. Each rack is a complete unit in itself containing all the power supplies necessary for its operation. The only interconnections between racks are *ac* power lines and coaxial signal lines. With a layout of this type a particular rack may be taken out of operation and serviced while the other units are providing signal.

The various units associated with the terminal equipment are indicated in Figure 1. Three sources of composite video signal are available for distribution: (*1*) Air signal from either of the three television stations, serving the Philadelphia area, operating on channels 3, 6, and 10; (*2*) monoscope signal; and (*3*) picture signal from a *crt flying spot scanner*. A cross-hatch generator producing a pattern of twenty vertical bars and fourteen horizontal bars is provided for deflection linearity adjustments. In addition a six-channel television *rf* generator which may be modulated with either of the video signals is provided. This generator provides both picture and sound signals conforming to television standards and has output attenuators by means of which the output level may be adjusted from 1 to 100,000 μv. The output of the *rf* generator is distributed to the television laboratories by means of coaxial cable.

The monoscope tube is a useful source of video signal, and since its output voltage is in the order of 5,000 μv the noise developed by the first amplifying stage is almost completely masked. A good monoscope is capable of resolution better than 400 lines; however, for general laboratory work one limitation is that only one pattern may be produced from a given tube.

CRT Flying Spot Scanner

Shown in Figure 2 is the *crt* flying spot scanner video generator. This unit is capable of producing an excellent quality picture, with a resolution of 600 lines or better, low noise, and a linear transfer characteristic between black and white. Combining the three aforementioned standards into a figure of merit for camera tubes, it is highly probable that the flying spot scanner is not excelled by any present television camera tube as a laboratory source of signal.

The concept of using a flying spot scanner is over twenty years old and some of the earliest television experiments were conducted with such a system. The developments over the past years of projection tubes operating at over 20 *kv*, photo-multiplier tubes such as the 931-A, and zinc oxide phosphor with very short decay time, have made possible the present high quality unit. The source of the flying spot is a four-inch *crt*, operating at 20 *kv*, utilizing magnetic deflection and focus, and a zinc oxide phosphor. The zinc oxide decays to approximately 50% of its initial light intensity in one microsecond. A standard television raster with blanking is applied to the face of the cathode ray tube, and this raster is focused by means of a lens on a double frame 35-*mm* transparent slide. The light passing through the transparency is collected by means of a condensing lens onto the cathode of a 931A photo-multiplier tube. The video signal produced by this tube at any instant of time is proportional to the light passing through the slide. A video level of about one-half volt is produced across the 931A plate load resistor. Equalization for the phosphor decay is provided by two *rc* networks in the

For Laboratory Use

Terminal Equipment Setup Employed at Research Lab Affords Composite Video Signal and Means for Modulating This Signal on a Number of Standard *RF* Carriers, Facilitating the Development of Video Amplifiers, Deflection Circuits, High Voltage Pulse Supplies, Analysis of CRT Performance, etc.

by JOSEPH FISHER

Project Engineer, Research Division
Philco Corp.

head amplifier. The output of the flying spot generator is a composite video signal containing sync signals, blanking, and the *dc* component.

Line Mixing Amplifier

Associated with both the monoscope chain and the flying spot generator is a line mixing amplifier. The output circuit of the line mixing amplifier is illustrated in Figure 3. The composite video signal is built up of four basic building blocks: (*1*) Sync pulses, (*2*) blanking, (*3*) video, and (*4*) *dc* component. A dual-input circuit, with gain controls in each channel, is provided at the input to the line mixing amplifier so that cross hatch signal may be blended in with picture video to adjust the linearity of deflection circuits. Referring to Figure 3, four volts of video with white negative are applied to the grid of the top 6V6. The plate of this tube is connected to the plate of the 6V6 which has 15 volts of positive blanking signal applied to its grid. Across the common load resistor appears a mixed signal of blanking and video which is capacity coupled to the grid of a cathode follower and adjusts itself about the bias set by the black level control. Another 6V6 having four volts of negative sync applied to its grid has its cathode connected to the cathode of the tube admitting video and blanking. During the blanking interval, the top 6V6 is cut off and black level voltage across the terminating resistor is the result of the plate current of the lower cathode follower.

The horizontal sync pulses drive this tube to cut off and the voltage across the terminating resistor drops to zero (*ground level*). The video signal averages around the bias set by the black level control, the setting of which produces the *dc* component. For a 75% modulated television carrier the composite video signal would be as illustrated (*one unit of sync and two units of picture*).

Composite Video Signal Distribution

Figure 4 illustrates the method used to distribute the composite video signal. Six amplifiers, each having a gain of two, and a frequency response flat to 7 mc are used. Each amplifier uses two 6AC7s and a 6V6 cathode follower output stage. The amplifiers operate at 360 volts *dc* and draw 60 *ma* each. By means of the switching arrangement shown, different video signals may be applied to the various distribution lines. Another switch is provided to monitor any of the outgo-

(*Continued on page 42*)

Figure 3
Line mixing amplifier: output circuit.

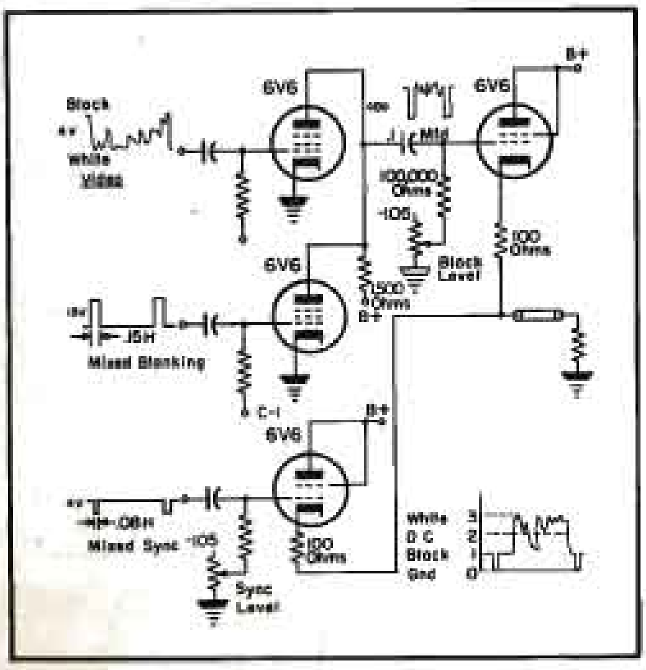
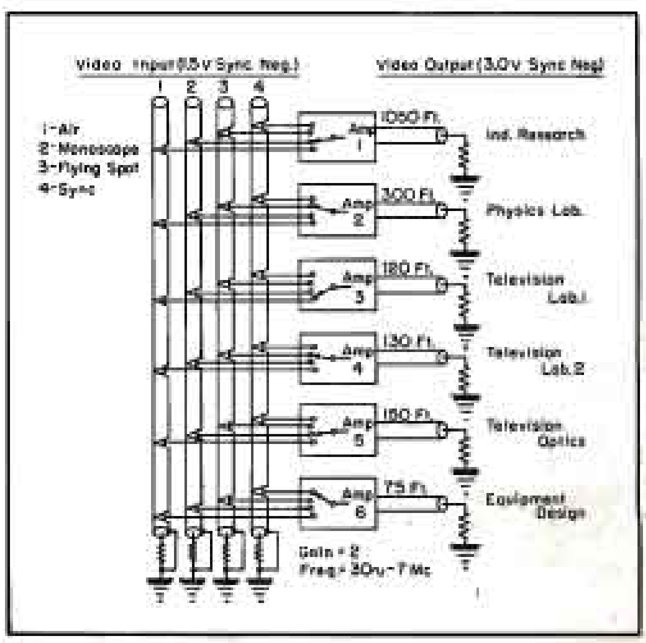
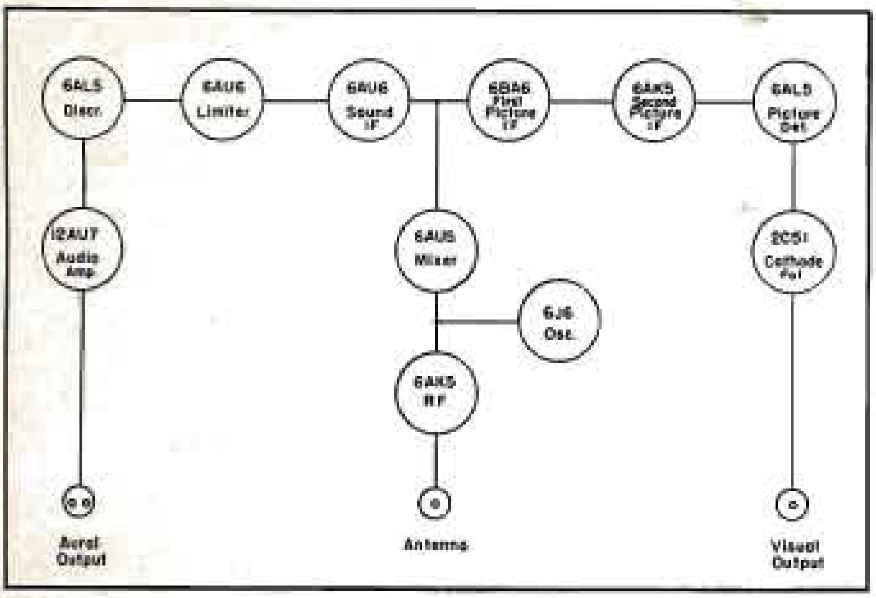


Figure 4
Block diagram of distribution lines.



A TV



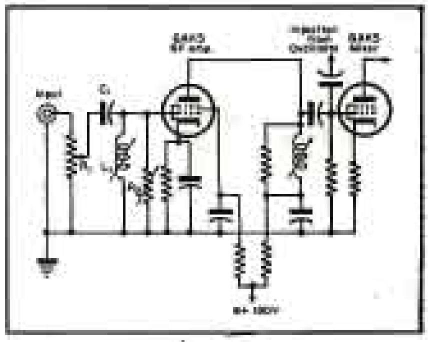


Figure 2
Circuit of the *rf* amplifier and mixer.

Figure 1 (left)
Block diagram of the TV monitor receiver.

Television broadcast transmitters require a considerable amount of auxiliary equipment for making essential performance measurements such as sync compression, modulation depth, bandwidth, noise, etc. Even after all these measurements have been made, however, the operator cannot be sure that he is transmitting a good picture unless he can actually see the picture being radiated. It is necessary, therefore, to provide a receiver at the transmitter site so that on-the-air signals may be examined.

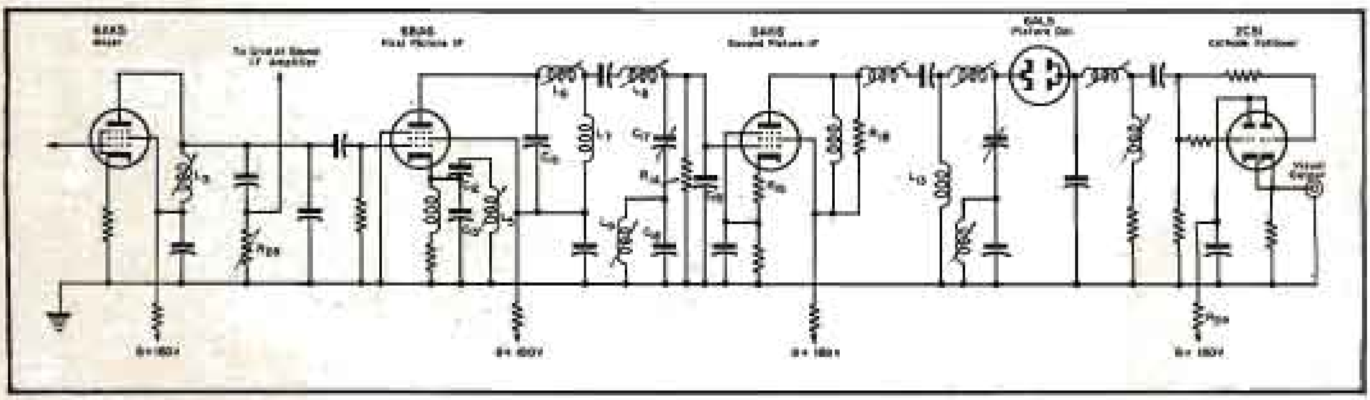
In contrast to a home receiver, a monitor receiver is subject to powerful interference sources. For instance, sites suitable for television are often selected for other *hf* services which may radiate high power close to the TV antenna. An FM station may even share the same antenna with the television transmitter. A monitor receiver without pre-selection would be subject to interference in these instances not only at frequencies corresponding to image and oscillator harmonic response, but also at all other frequencies, if the first tube were so overloaded as to cause modulation of the desired signal. Furthermore, the strong fields which may be present in the immediate vicinity of even the lowest powered television transmitters require that the monitor receiver be responsive only to the signal picked up by its antenna, and not to any stray fields if an accurate on-the-air signal indication is to prevail.

The characteristics, therefore, of a monitor receiver are that it have substantially all the attributes of the best home receiving instrument plus two additional features: protection against overloading by strong signals, and insensitivity to any *rf* field in which the receiver may be placed. Inasmuch as in all applications of the monitor receiver, there will be ample audio and video monitoring facilities available, it is not necessary to provide speaker and video display equipment as an integral part of the receiver itself. Furthermore, the guarantee of a relatively large input signal as a result of proximity to the transmitter eliminates the need for a large gain in the monitor receiver.

Receiver Input Circuit Design

Two principal requirements governed the design of the receiver input circuit; Figure 2. To eliminate reflections on the antenna transmission line with resulting production of *ghosts*, it was considered desirable that the receiver input termination be an actual resistor. In addition, two precautions were taken to minimize cross modulation and overloading effects in the first stage of the receiver. First, a variable attenuator to set the visual output level was placed ahead of the 6AK5 *rf* stage. This design provides a reduction of the cross-modulation type of interference by attenuating the interfering signal to the same extent as the desired signal, and also permits all amplifiers to operate at constant gain, thus eliminating the problem of the bandpass changing with gain control setting. Second, a tuned input circuit was used in the grid of

Figure 3
The visual *if* and cathode follower circuit used in the monitor.



Monitor Receiver

Receiver Which Can Be Located in High-Signal Transmitter Area, Features Protection Against Overloading by Strong Signals, Intensitivity to RF Fields in Which It May Be Placed, and High Input Level With Receiver Input Termination a Resistor to Eliminate Transmission-Line Reflections. Cross Modulation and Overloading Avoided by Use of Variable Attenuator Ahead of First Tube Which Controls the Visual Output Level.

by F. CECIL GRACE

Engineer, Special Projects Group,
Transmitting Equipment Division
Allen B. Du Mont Laboratories

the first tube to provide discrimination against possible interfering signals of such strength that cross-modulation would result in spite of the attenuator.

In the input circuit, the resistive termination and variable attenuation are provided by a carbon potentiometer, R_2. The tuned circuit consists of L_1 resonating with tube and stray capacitances. It is coupled to the arm of the potentiometer by a capacitor, C_1. This capacitor must be very small so that, on the one hand, there is negligible shunting effect on the potentiometer at any frequency within the pass band, and on the other hand, the tuned circuit is not so heavily loaded by the potentiometer and the line as to be ineffective. Only a small portion of the voltage on the line appears at the grid of the *rf* stage, with the result that this circuit is one in which gain is sacrificed to obtain other features.

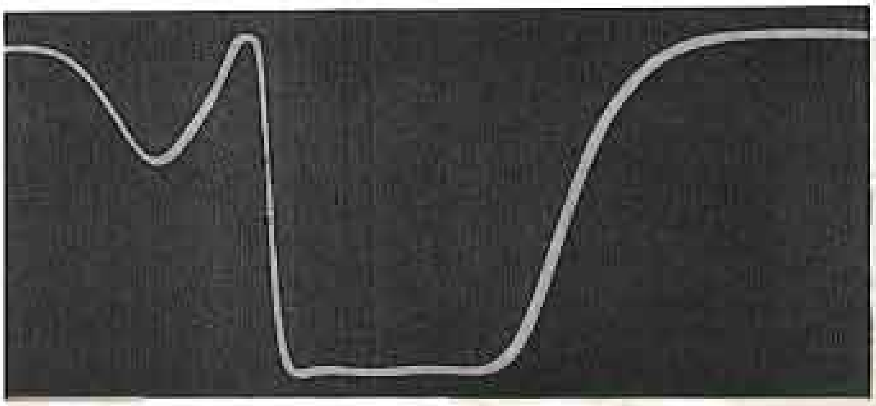
The converter, like the *rf* stage, uses a 6AK5. The tuned circuit in its grid, together with the tuned circuit of the input, form a staggered pair. To facilitate flattening the response of this pair, the *Q* of the input circuit is made adjustable by shunting it with a potentiometer, R_3. This potentiometer as well as one other used in the receiver is a hearing-aid type. The use of such miniature type components allows considerably more compact construction and shorter *rf* paths than is possible with larger types.

The design of the *if* amplifier differed from standard receiver *if* design in that only a relatively low gain was required, although the usual bandpass characteristics and sound traps were needed. The gain requirement allowed the use of only two amplifier stages, but immediately presented the problem of obtaining the necessary transmission characteristic with only three interstage networks. The manner in which this problem was solved is shown in Figure 3. The first two coupling circuits utilized a principle of combining a single humped curve with a lightly damped double humped curve to obtain an essentially flat triple humped curve.[2] The first coupling network is a single humped one, consisting of a single coil, L_{10}, resonating with the circuit and tube capacity. Since the *Q* of this circuit must bear a fixed relation to the effective *Q* of the second coupled circuit to produce a flat overall response, a potentiometer R_{20} was included in the grid of the sound *if* amplifier to provide adjustment.

The first picture *if* amplifier, a 6BA6, was provided with a sound trap in its cathode. This is one of three traps which attenuate the sound *if* so that the output will not contain a 4.5-mc beat. This trap consists of L_{13} resonating with a series capacitor combination of C_{22} and C_{23}.

The second coupling network consists of a primary coil L_{14}, a secondary L_{16} and a coupling coil L_{17}. The loading is all on the secondary side, consisting of R_{14}. This loading is light, resulting in a deep valley between the humps. As previously explained, this valley is *filled in* by the single hump from the first coupling network. The fact that the loading is all on one side means that a small change in the resonant frequency of either primary or secondary will produce a tilt in the response curve. This is an advantage since any tilt due to the sound traps can be compensated simply by changing the resonant frequency of the primary slightly in one direction and that of the secondary in the other. In standard television receivers, this effect is not desired because changes in tube capacitances will cause a tilt. In this receiver, this danger has been circumvented (at a sacrifice in gain) by shunting the tube capacitances with a pair of 15-mmfd capacitors, C_{24} and C_{26}. This coupling circuit also contains a sound trap, consisting of L_{18}, C_{27} and C_{28}. This trap has both series and parallel resonance to prevent reduction of gain at frequencies near the end of the pass band. The difference

Figure 4
The *if* amplifier response curve.



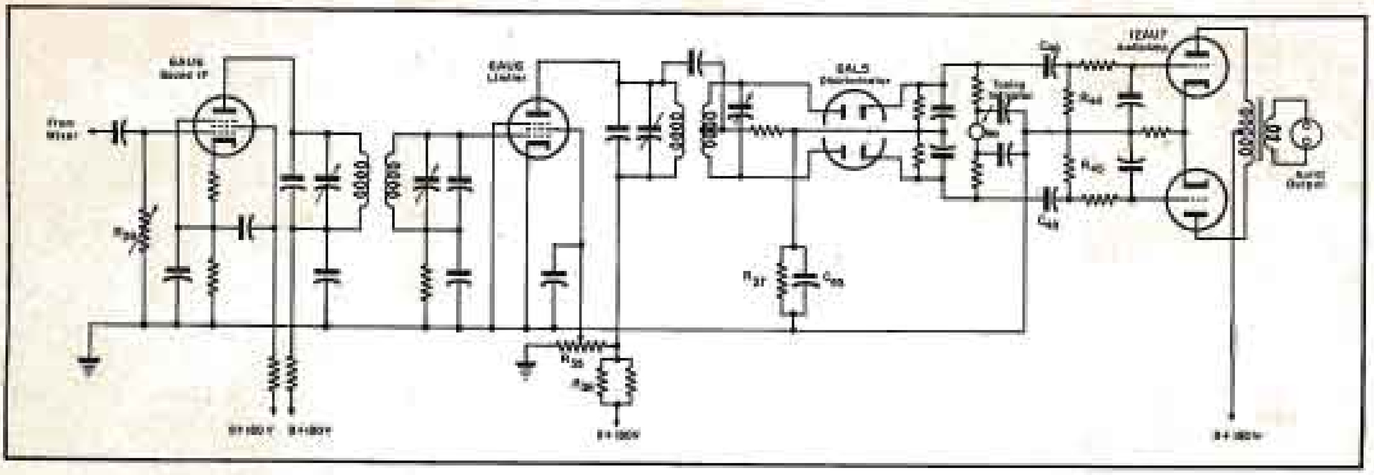


Figure 5
Circuit of the sound *if* and audio amplifier.

in frequency between the series and parallel resonant points depends on the value of C_{11}. This capacitor has been made variable to provide adjustment of the frequency difference.

The third coupling network is similar to the second, except that it is more heavily loaded and so produces a more nearly flat response. The slight valley remaining may be compensated by reducing the loading on the first (single humped) coupling network. The secondary loading is the detector itself, and there is also primary loading (R_{38}) so that the shunt capacitors are not necessary. Since the 6AK6 plate is shunt fed through an *rf* choke, L_{11}, grounding of the coupling coil L_{10} is permitted so that the coupling network presents a low video impedance to the detector. The sound trap in this circuit is identical to that previously described. The overall *if* response is shown in Figure 4.

A 6AK6 power tube, used as the second picture *if* amplifier, insures sufficient power to drive the detector without compressing sync. Cathode degeneration is used to improve linearity.

The picture detector uses a 6AL5 with both sections in parallel. It feeds directly into a 2C51 cathode follower also with both sections in parallel. An exhaustive test of currently available miniatures as cathode followers showed the 2C51 to be the only one capable of delivering 1 volt peak to peak into a 75-ohm load resistance with good linearity and without requiring such a low value of grid resistor that an excessively large coupling capacitor would be required. Furthermore, it was found that by reducing the plate voltage to 140 (by means of dropping resistor R_{36}), the tube would operate within ratings when the 75-ohm load was the cathode bias resistor, thus considerably simplifying the circuit.

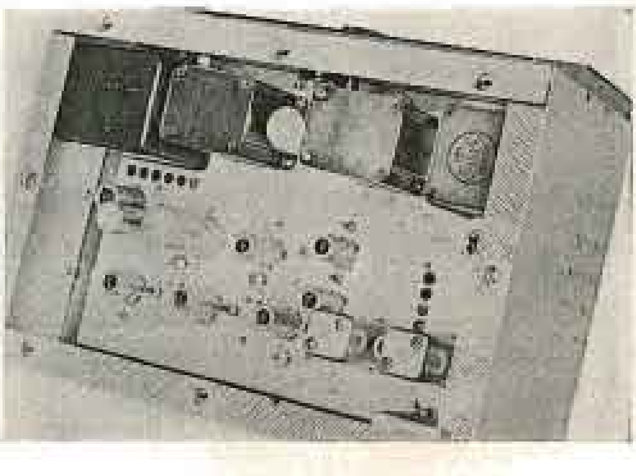
Sound Channel Circuit

The sound channel, Fig. 5, can be best described by working backwards from the output transformer. To avoid unbalanced *dc* in the windings, a push-pull output stage with a 12AU7 was used. The balanced audio voltage for the 12AU7 grids was obtained by taking a balanced output directly from the detector.

A Foster-Seeley discriminator circuit was included with neither output terminal grounded. The circuit is, in fact, completely isolated from ground except for the coupling capacitor in the discriminator transformer and a 27-mmfd, capacitor C_{65}, both of which are so small that they are effective only to *if* and a 10-megohm resistor, R_{37}, which is so large that it has negligible effect. Therefore, the output of the detector appears without reference to ground between the cathodes of the 6AL5. These cathodes, however, are connected through coupling capacitors, C_{64} and C_{66}, to resistors R_{41} and R_{42}. Since these resistors are equal and the junction is grounded, the detector output voltage will divide equally producing two voltages of opposite phase for application to the 12AU7 grids. A 75-microsecond deemphasis network is duplicated on both sides of the circuit.

In this receiver, the setting of the aural output level is accomplished by adjusting the level of limiting. Although this function could have been accomplished by the use of a dual potentiometer in the 12AU7 grids, past experience indicated that such units rarely track very well, thus introducing unbalance. An aural level control, R_{35}, changes the limiting level by varying the screen voltage on the 6AU6 limiter stage. The function of the limiter in this receiver is not to suppress noise, since close proximity

Figures 6 (*left*) and 7 (*right*)
Front and top views of the TV monitor receiver.



to the transmitter guarantees noise-free reception without limiting. Instead, it serves to flatten the sound *if* response curve thus eliminating a possible cause of distortion.

In a receiver of this type, circuit details alone are not the only items of importance. Careful attention must be given to the details of bonding and shielding so that the receiver will not respond to stray *rf* fields. To achieve this objective, double shielding was used throughout the instrument; Figures 7 and 8. An inner shield consists of the chassis with its bottom plate (the latter is removed in Figure 8). All objects mounted above the chassis such as the transformers, capacitors, etc., have grounded metal cases, and the tubes all have metal shields, so that the inner shield is not broken. The outer shield consists of the panel and the case with its top and bottom covers.

Double shielding is ineffective unless the two shields are connected together in only one region. If this precaution is not observed, there will be circulating currents through the connections and shields, and these will induce small fields inside the inner shield. The chassis is, therefore, secured to the case by two insulating blocks at the ends. One of these may be seen in Figure 7. The aural and visual output connections and the antenna connection are made to coaxial and twinaxial feed-through connectors which go through both the chassis and the case. These three connectors are located close together and their outer threaded tubes make the only connection between inner and outer shield.

Rf which may be on the power line is kept out by capacitors of the feed-through type used wherever such lines must pass through shielding. One pair of such capacitors is mounted on a shield box which covers the line-cord connector. From here the power travels along wires fastened to the outer shield through the fuse and power switch, and to the tuning meter light. To get into the chassis, it goes through *rf* chokes to a second pair of feed-through capacitors, which go through the chassis. A third pair which also go through the chassis, permit connection to the tuning meter mounted on the panel. As a further precaution, both the power transformer and the aural output transformer have electrostatic shields. The power supply uses selenium rectifiers, and the low heat dissipation of these units makes it possible to mount them within the chassis, a few small holes being punched for ventilation. Thus, there is no break in the shield as there would be if a glass rectifier tube were used.

It is of interest to note that in certain operating applications less shielding appears to be required than that actually incorporated. For example, this receiver has operated satisfactorily both at television stations WABD in New York and WTTG in Washington with the shield covers removed. Inasmuch as the receiver was designed as a general purpose instrument, however, it is believed that the additional shielding is desirable until such time as more definite information exists concerning the magnitude of fields surrounding commercial transmitters.

The question might well be raised as to why a simple diode detector, which is used to monitor most amplitude modulated transmitters, could not be used for the visual portion of television. Such diodes are useful for certain measurements, but when used for monitoring in a vestigial sideband system a degraded picture results. The reason may be noted from a study of Figure 9. In *A* is shown the ideal frequency response curve of the amplifiers, filters or other networks that the modulated *rf* signal passes through before reaching the radiating antenna. The effect is that the upper sideband corresponding to all video frequencies up to 4 mc is transmitted without attenuation, while only that portion of the lower sideband corresponding to video frequencies up to .75 mc is similarly unattenuated. Beyond this .75-mc point, the ideal curve allows .5 mc for the transition from zero to infinite attenuation, so that video frequencies below 1.25 mc produce no lower sideband and the portion of the spectrum thus saved may be assigned to another station.

When this ideal vestigial sideband signal is rectified by a diode which is equally responsive to all frequencies, the amplitude-frequency response of the resulting video will be as shown in *B*. Frequencies below .75 mc will have twice the amplitude of frequencies above 1.25 mc, because the former are

(*Continued on page 33*)

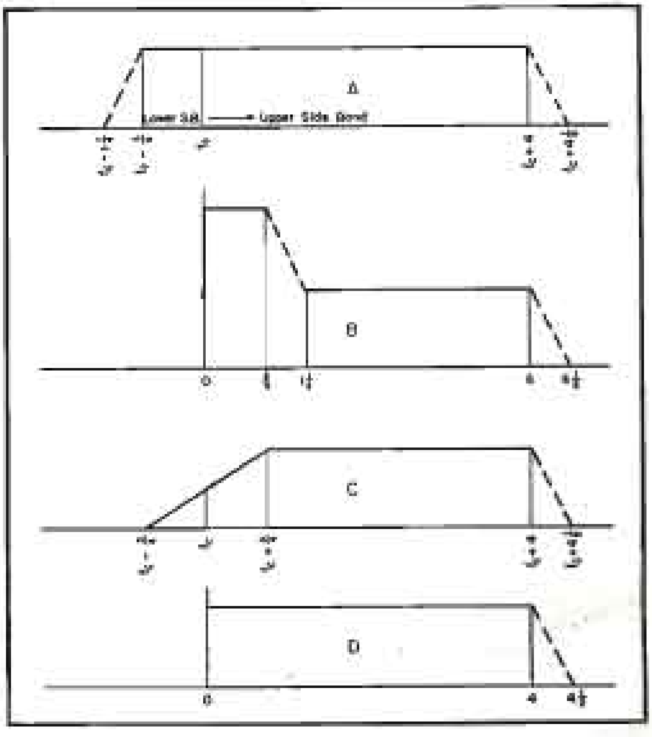
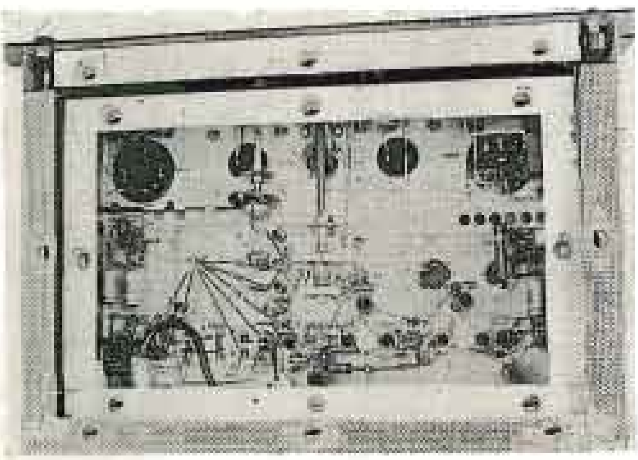
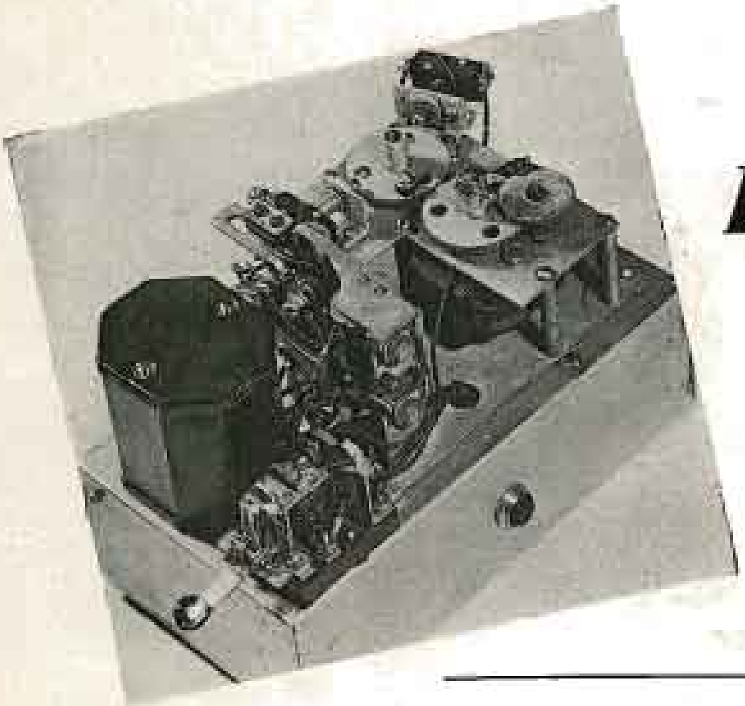


Figure 9
Ideal frequency-response curves. At *A* appears the transmitter *if* response; *B*, diode output; *C*, receiver *if-rf* response; and *D*, receiver output. Frequencies are in mc and f_c is the carrier frequency.

Figure 8
Bottom view of the receiver. Note the double shielding.



Automatic Teletype



BULLETIN ALARM

Device Automatically Signals Arrival of Bulletin Via a Visual Signal in Control Room Obviating Need for Watch in Teletype Room.

by GEORGE ING

Chief Engineer
KONO and KONO-FM
San Antonio, Texas

TODAY, THE TELETYPE PRINTER has become a necessary adjunct to the modern broadcasting station. Large stations have several machines and an elaborate newsroom with a staff of newsmen. Most small stations have only one machine, and usually no one to watch it most of the time. At the smaller stations the news is gathered from the machine just before a regular newscast and someone is delegated to glance at the machine at other intervals to see if a *bulletin* has come in.

The big stories, however, have a habit of breaking when no one is watching the machine. Inasmuch as teletypes are rather noisy machines and are usually located some distance from the studios and control room and usually are unattended, it occurred to our news editor that a device that would automatically signal the arrival of a bulletin by means of a red light in the control room would be an ideal solution. We therefore decided to probe the problem and came up with an alarm system (Figure 1) which has worked out very well.

Bulletin and Flash Signals

As is well known, the teletype provides an audible alarm when news of importance are about to come through; five bells for a *bulletin* and ten bells for a *flash*. The flash is reserved for news of the utmost importance only. Our device was not designed to signal a flash because of the rare occurrence. Furthermore, a bulletin always follows a flash in a matter of seconds. However, if desired, the device can be modified to signal the arrival of a flash.

Bulletin Alarm Components

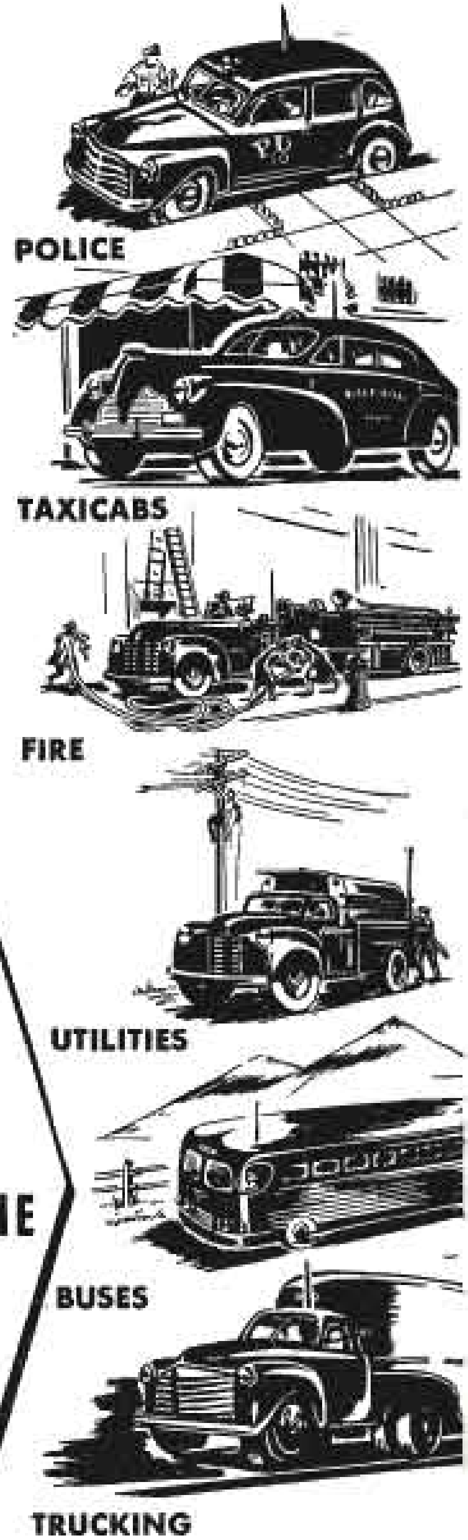
The main parts required for alarm are an ordinary telephone-type stepping switch, small motor driven timer and a latching relay with mechanical reset. The original alarm was built from war surplus parts at a total cost of $15. However, even if new parts are used, our experience has shown that the expense is well worthwhile.

The power source for the unit is 115 volts *ac*. Because the stepping switch was designed for 24-volt *dc* operation, a selenium rectifier with an *rc* type filter was used to excite the stepping and reset coils. Everything else was designed to operate from the 115-volt *ac* source.

Operation of System

In operation, a micro-switch is attached to the teletype machine in such a manner that the lever which operates the bell clapper also operates the switch. The micro-switch is in series with the 24-volt supply and the stepping coil. The instant the teletype bell

Above
View of the first model teletype bulletin alarm. In a later model, the switches were slightly repositioned to facilitate operation.



POLICE
TAXICABS
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BUSES
TRUCKING

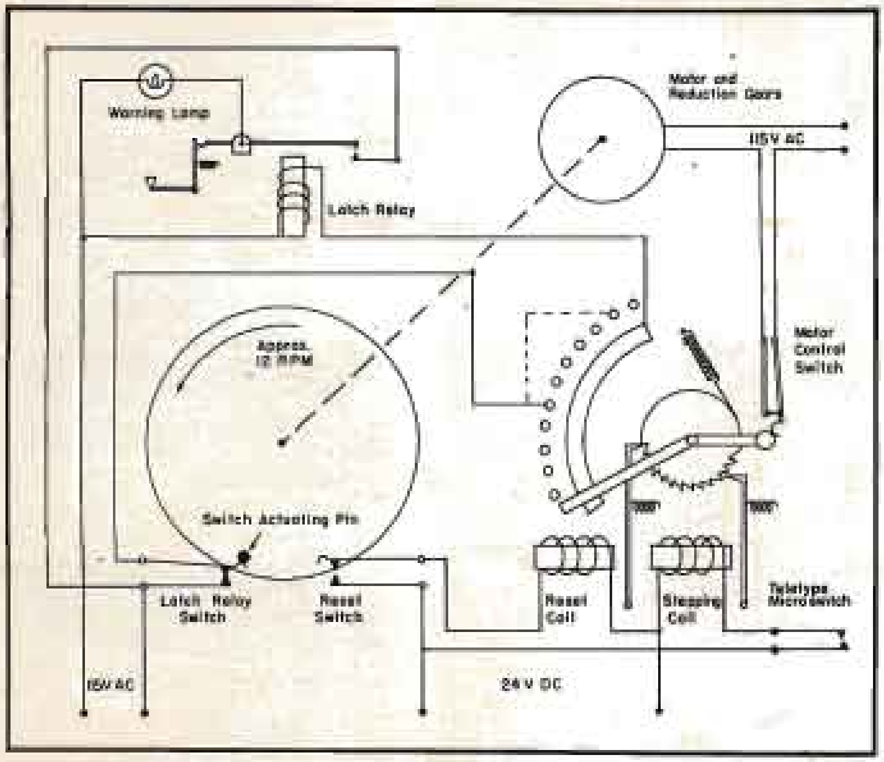


Figure 1

Circuit of the teletype bulletin-alarm system. If it is desired that the alarm work on both *bulletins* and *flashes*, the stepping switch must have more than ten contacts. Consequently contacts *5* and *10* must be connected together as shown by the dotted line.

is struck, the micro-switch closes the circuit to the stepping coil and the switch arm moves off the *home* position to the first contact. This initial motion of the switch arm starts the timer motor by allowing the motor control switch contacts to close. If a bulletin is about to arrive, the bell is struck five times in quick succession and the stepping action will advance the switch to contact number five.

Timing Disc Action

When the timing disc on the shaft of the reduction gear has made almost a full revolution (approximately five seconds), the switch actuating pin on the disc will close the latch relay switch, which is wired in series with the latching relay coil, contact number five on the stepping switch and the 115-volt supply. The latching relay contacts then close, lighting the warning lamp.

Motor Control

A moment after the switch actuating pin has passed the latch relay switch, it closes the reset switch which in turn energizes the reset coil on the stepping switch. The resetting action returns the switch arm to the home position and automatically opens the contacts of the motor control switch, stopping the motor.

Alarm Positions

The warning light will stay on until the latching relay has been reset manually by means of a pushbutton. In our particular installation the teletype alarm unit is placed in the teletype room and the warning light in the control room. When the warning lamp lights the control operator must visit the teletype room to reset the device.

False Alarms

For various reasons the teletype bell will ring many times during the day, but, normally, the unit will respond only to five bells in quick succession. When the teletype circuit opens due to trouble in the telephone lines, the teletype bell will ring continuously until the break is corrected. Occasionally, if this happens, a group of five bells will ring within the operating period of the timer and a false alarm will be registered. This was not considered a serious defect because management believed that the more trips to the newsroom the better. The announcers and control room men were instructed to inspect the machines at intervals even with an automatic alarm in operation.

The stepping switch which was used had only ten contacts. This is one reason no provision was made for flashes. If it is desired to use the alarm for flashes (ten bells) the stepping switch must have at least eleven contacts. If such a switch is used, then contacts five and ten can be wired together and the alarm will work for both bulletins and flashes.

Two Teletypes Used

Since KONO subscribes to two different wire services, there are two teletypes in operation. It seems that the policy of one service is to send bulletins only when the news is of great importance. The other service sends bulletins much more often. This is mentioned because when more than one machine is in operation there is a question as to which machine to attach the alarm. In our case it was decided to attach the alarm system to the teletype of the wire service which sent bulletins only on events of more than usual importance.

Wire and Mike Applications

Although no trouble with the wire service company was experienced at this station, there may be cases where the radio station will not be permitted to attach any device directly to the teletype. If this should be the case, an inexpensive microphone may be placed near the teletype to pick up the sound of the bell. The microphone signal may then be amplified through an amplifier, which through filter action, eliminates all frequencies except the fundamental bell tone. This amplified signal is rectified and applied to a relay whose contacts then can take the place of the micro-switch which was attached to the teletype machine.

Old and New Models

The illustration shows the first model of the teletype alarm. In a later model the latch relay switch and the reset switch were moved closer together as shown in the diagram and other minor changes were made to improve the operation.

This unit has been in operation for almost a year and has proved to be of great value to our news service.

Super-Power FM (546 Kw ERP) At WBRC-FM

THE DEVELOPMENT of high-gain antennas has afforded unusually high *erp's*. An interesting example of the extremely high powers which can be obtained was indicated recently when WBRC-FM, in Birmingham, Alabama, went on the air with its 50-kw job on 102.5 mc. Feeding into an eight-bay pylon[1] with a power gain of *12*, an *erp* of 546 kw was secured.

The antenna was mounted atop Red Mountain, over a thousand feet above the metropolitan area of Birmingham.

The 50-kw transmitter[2] at WBRC-FM features a concentric-line tank assembly which provides shielding of the driver and power amplifier grounded-grid circuits. The driver amplifier feeds two parallel-connected final sections. Electrically and mechanically, each one of these concentric-line tanks forms an integral part of the grounded-grid circuit. Thus, one unit that eliminates neutralization, radiation, and *rf* pickup in adjacent *rf* circuits is provided. Each section is similar in design and uses a 5592 forced-air-cooled triode in a grounded-grid circuit. The base of the concentric-line units form a plenum chamber for cooling air and contains the control wiring and high voltage bus. Front-panel tuning of the plate line is provided by shorting bars (with contact fingers) which move vertically along the center conductor by means of motor-driven lead screws. Input tuning is accomplished by two flat plate air-capacitors, one motor driven and the other manually operated.

Output coupling is accomplished by motor-driven rotatable loops which are reactance tuned by series capacitors.

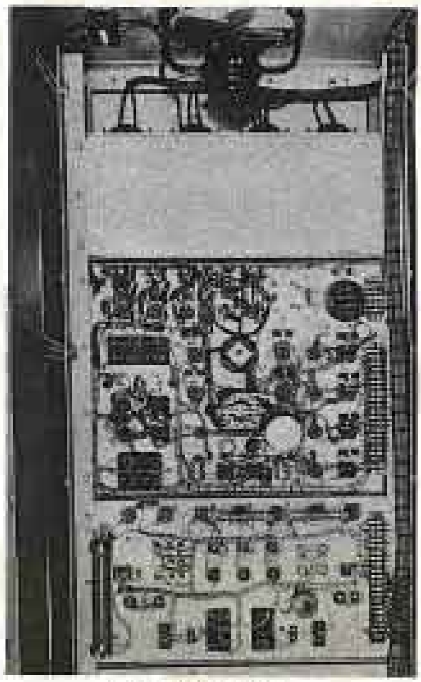
The supervisory console supplied with the transmitter has many interesting features. Essential operational controls and indicator lamps are duplicated on an *rf* turret. The audio turret has all the controls needed for program handling. Complete switching, mixing and control-circuit metering facilities are provided. Im-

(*Continued on page* 41)

[1]RCA. [2]RCA BTF-50A.

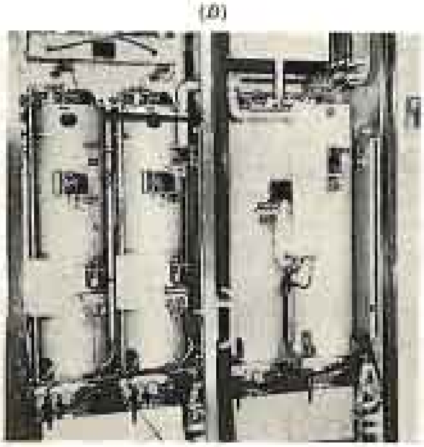
The 50-kw FM transmitter at WBRC-FM.

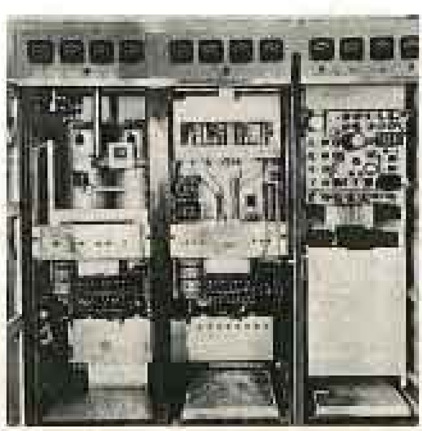
(*D*)



(*B*, left; *C*, above)

(*E*)





(*B*)
Closeup view of pylon showing trombone impedance arrangement and two-stub matches.

(*C*)
Rear view of the *direct* FM exciter cabinet. Vertical construction is used to provide accessibility to wiring and components.

(*D*)
Rear view of low power grounded-grid *rf* amplifiers showing concentric-line construction employed. All four units use 7C24s. Left to right: 1 kw, 3 kw and 10 kw amplifiers.

(*E*)
Open door view of, left to right: 10 kw *rf* amplifier with parallel 7C24 concentric-line tanks visible, 250 w *rf* amplifier (with 1 and 3-kw amplifier at rear, not visible), and *direct FM* exciter, at far right.

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CONTINUOUS TUNING FROM FRONT PANEL

20 KW
TRANSMITTER
C. W., F. S., PHONE

Improved Continuous Tuning
Continuously tunable from the front panel over a frequency range of 10 to 1. Tuning circuits simple to operate.

Maximum Operating Continuity
Recycling overload relays insure against loss of operating time due to temporary overloads. Control circuits fulfill rigid broadcast requirements.

Cool Operation
Electrical short circuiting of sources of resistance assures unusually cool and efficient operation.

Safe Operation
Automatic-safety grounding switches used on all cabinet doors and housing openings. All operating controls are grounded. Interlocked control circuits.

Easy to Maintain and Service
Components are readily accessible and individually removable for replacement and repair.

Continuous Tuning Plate Circuit

- Frequency changes can be made in a few seconds.
- Alternate paths for current around moving parts of circuit provide high efficiency and cool operation.
- Glass-bonded mica assembly supports inductances by holding coils rigid — permits precision adjustment of coil relationship.
- All parts removable and easily accessible to operating personnel.

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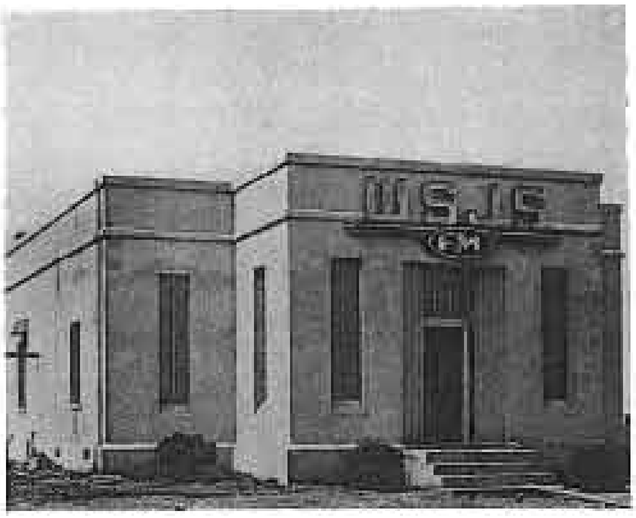
View of the main operating console, auxiliary turntable and other equipment at WSJS-FM. The bottom of the antenna may be seen through the window.



Modern building which houses the transmitter of WSJS-FM.

The Installation of WSJS-FM

10-Kw FM Transmitter, With a 6-Bay Circular Antenna, Ideally Located in Hills of North Carolina, Providing Coverage of Approximately 65 Miles in 50-Microvolt Contour.

by WILLIAM E. EAST

The Twin-City Sentinel
Winston-Salem, N. C.

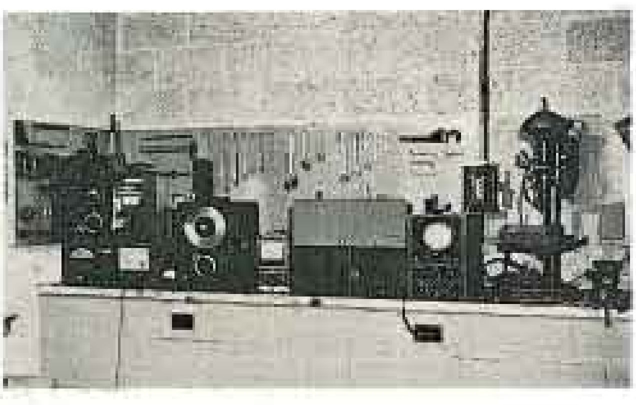
WHEN THE PIEDMONT Publishing Company decided to make its venture into FM broadcasting, it was faced with that all-important problem of selecting the best place for its transmitter for maximum coverage.

The company, publisher of the *Winston-Salem Journal*, morning daily newspaper, and the *Twin City Sentinel*, an afternoon daily newspaper, first had entered broadcasting in 1930 when it established WSJS. And Piedmont Publishing Company president Gordon Gray had quite a bit of personal FM experience with his famous experimental FM transmitter WMIT atop Mount Mitchell in western North Carolina.

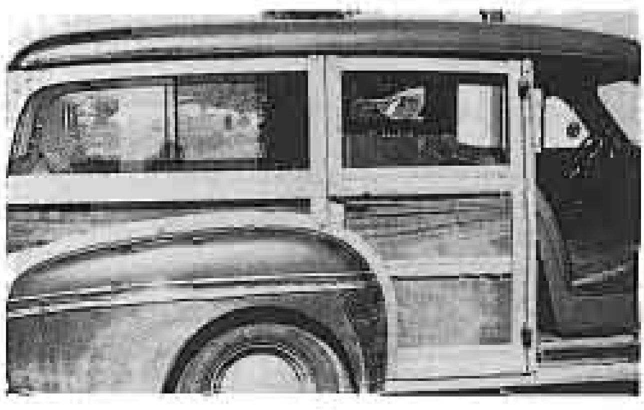
In considering the commercial FM project, it was found that it would be best to locate on a site which would serve the tri-cities of Greensboro, High Point and Winston-Salem, which form a triangle in the northern part of Piedmont, North Carolina. In addition, it was also felt that the site should be favorable for TV, which it

(*Continued on page 34*)

Test equipment and the tool room.



Station wagon which houses a portion of WSJS-FM equipment in its rear.



World's first super-power

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

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

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

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

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

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

Here are some of the transmitter features:

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

• • •

Type BTF-50A . . . *immediately available from stock* . . . can be used with an RCA FM Pylon to improve your station coverage *materially.* For the facts, see your RCA Broadcast Sales Engineer. Or write Dept. 23B, RCA Engineering Products, Camden, N. J.

VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

Personals

THREE NEW MEMBERS, all *old timers*, were recently approved for VWOA membership: Fred D. Boyd, Sam Cisenfeld and W. Milton King. . . . Boyd began his brass-pounding career by working for Marconi of London in 1920. He joined Tropical Radio in 1921 where he served on United Fruit ships for fourteen years. In '35 he became chief operator at HJW, Santa Marta, Col. For six years, 1935 to 1941, he operated his own radio sales and service business, Ridge Radio Research and Repair Lab., at Wilmette, Ill. In '42 he was commissioned a Major in the USAF serving at Churchill, Manitoba, Alaska, and the Aleutian Islands. He commanded the 119th Army Airways Communication Squadron from '43 to '45. In '47 he joined Lear as a radio engineer and in '48 he became affiliated with the CAA and is now assigned to duty in San Juan, P. R. . . . Sam Cisenfeld took to the keys back, back in 1910 (we probably should call him an *old old timer*), with United Wireless, sailing on the Chesapeake Line vessels between Baltimore and New York and without a license, too, his application stating that he received his *Certificate of Skill* in 1911 in Baltimore. Government inspectors were not so active in those days. He then moved over to the Merchants and Miners Line and extended his voyages to Jacksonville and Boston. In 1912 he started working at the Baltimore Coast station until 1915, when he was assigned to the Northern Pacific, which was the first passenger ship to pass through the Panama Canal. Arriving at San Francisco during the World's Fair he operated between that port and Flavel, Oregon, seaport for Portland in those days. He traveled east on a tanker which was routed via the Magellan Straits due to a landslide in Culebra. In 1916 he was assigned to a tug bound for Cardiff. During this voyage fire broke out, leaks developed and to cap the troubles mutiny followed, forcing the tug to dock at Fayal Horta, Azores. A little later SC joined the Naval Reserves and was assigned to Tuckerton. After World War I he followed the sea for a few more years and in '34 retired from wireless operations. He is presently

L. H. Marshall, who recently received the Mariner's medal from the Maritime Commission and a gold medal from the state of South Carolina for his heroism in saving the crew of the S.S. Atlas, which was torpedoed in 1942.

located in Washington. . . . King also began his wireless days by working for Marconi from 1925 to 1929. In '29 he joined Tropical Radio, sailing on United Fruit ships until 1932. He then went with WBIX, Utica, and remained there for a year. He then joined the IRE. From '35 to '37 he worked at broadcast stations WCHB and WNEL. In '37 he returned to the United Fruit line and in '38 started with the American Airlines where he is now working as assistant chief operator at Boston. During World War II he was navigator and Flight Radio Officer with the U. S. Air Transport Command. . . . Shocked to hear of the death of old time member E. W. Kreis, who resided at Milwaukee, Wis. . . . Congratulations to Rod Chipp upon his promotion from assistant chief engineer to director of engineering for the DuMont Television network. Rod was formerly with NCB. . . . Tom Brown writes to say that he is now representing Motorola in Bloomfield, Ill. . . . Wylie Paul reports that he was in Tangier, Morocco, but expects to be on hand for the annual dinner cruise. . . . Just received the good news that Henry Hayden and Fred Muller received leaves of absence from the hospital to enjoy the holidays at home. Both are doing nicely, but expect to spend a few more days in the sickbay for further treatment. Good luck, Fred and Henry. . . . G. V. Willets has dropped us a note saying that he has left the hectic life of San Francisco and has taken up residence at his new country home at Villa Grande, Sonoma County, Calif., where he will continue many of his activities. . . . Congrats to Bob Pheysey whose lovely daughter, Gail, recently won a prize in a beauty contest at Hempstead, L. I. Bob lives in Massapequa, L. I. . . . VWOA members continue to receive rewards for their outstanding radio work. There's R. W. Rentzel, who was appointed by President Truman to head the CAA as chairman; Jack Poppele, reelected president of TBA; and at the recent Radio Club of America thirty-ninth anniversary dinner, Paul Godley was honored for his work with amateur station 1BCG back in 1921. . . . Fred Klingenschmitt, another VWOA old timer, was also at the RC of A affair. Fred is a director of the club and on the banquet committee. . . . L. H. Marshall recently forwarded a few interesting biographical notes. When the Titanic struck the iceberg he received the SOS calls on a home-made receiver. In 1942, while on the S.S. Atlas, he was torpedoed off Cape Lookout and compelled to swim through water covered with burning high octane gas. He was so badly burned that for many months he was unable to use his hands. His wife played a major role in his recovery by forcing him to carry pails of water and sand as an exercise. He was awarded the Mariners' medal from the Maritime Commission, as well as a gold medal from the state of South Carolina for saving the S.S. Atlas crew. We are proud of men like Marshall! . . . G. W. Ahrens of Galveston, Tex., is still with RMCA and hopes to make a *cruise* soon. . . . J. H. Appel, Jr., now with FCC in Washington, misses the ship boys and sends season's greetings. . . . G. B. Angle of TRT's Miami WAX, since 1929, is now at their new location in Fort Lauderdale. He is a member of Naval Reserve V3. . . . Sorry to hear that C. S. Anderson, honorary member of VWOA, is very ill at his home in Brooklyn. CSA retired from RCA two years ago. Hope you recover soon, very soon, old timer.

NEW -hp- 805A SLOTTED LINE!

PRECISION ACCURACY FOR STANDING WAVE MEASUREMENTS

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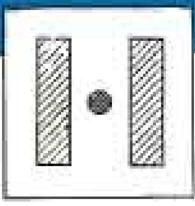


RADICAL NEW "PARALLEL-PLANE" DESIGN GIVES -*hp*- SLOTTED LINE UTMOST ELECTRICAL STABILITY

The new -*hp*- 805A Slotted Line employs two parallel planes and a large, circular central conductor, instead of the conventional coaxial configuration. This new design makes possible an electrically stable precision instrument capable of fast, easy measurements of unvarying accuracy. Parallel planes and central conductor are both mechanically rigid. Penetration depth of the probe is less critical than in coaxial slotted lines, and leakage is low because the effective slot opening is less than .001 referred to the coaxial system. Residual VSWR is held to less than 1.04. Probe position may be read to 0.1 mm.

This new approach to the Slotted Line problem makes possible the manufacture of an instrument of maximum accuracy at moderate cost.

SPECIFICATIONS

Frequency Range: 500 to 4,000 mc.

Impedance: 50 ohms.

Connections: Special Type "N" fittings designed for minimum VSWR.

Residual VSWR: 1.04 or better.

Slope: Negligible.

Calibration: Metric, in cm and mm. Vernier reads to 0.1 mm.

Size: 27" long, 8" high, 6" wide.

Carriage: Probe moved by cable drive. Probe depth adjustable. Probe resonant circuit tunable over freq. range of line. Detector may be standard crystal or employ barretters.

Data subject to change without notice.

WRITE FOR DETAILS

HEWLETT-PACKARD COMPANY

1824-E Page Mill Road • Palo Alto, California

-hp- laboratory instruments

FOR SPEED AND ACCURACY

NEW -*hp*- 415A

Standing Wave Indicator

The new -*hp*- 415A Standing Wave Indicator is used with the -*hp*- Slotted Line to determine coaxial flatness or measure impedance. It consists of a high gain amplifier of low noise level, operating at a fixed audio frequency. Amplifier output is measured by a voltmeter with a square-law calibration in db and voltage standing wave ratio. The -*hp*- 415A is direct reading, compact and easy to use.

SPECIFICATIONS

Frequency: Fixed at 1,000 cps. ± 2%. Other frequencies 300 to 2,000 cps supplied on special order. Amplifier "Q" is 30 ± 5.

Sensitivity: 0.3 uv gives full scale deflection. Noise level-to-input equivalent is 0.06 uv.

Calibration: For use with square-law detector. 60 db level covered in 6 ranges. Accuracy ± 0.1 db per 10 db step.

Gain Control: Adjusts meter to convenient level. Range is 50 db ± 5 db.

Detector Input: Connects to Xtal rectifier or bolometer. Bias of 8 v. ± .5 v. delivers approx. 8.75 ma. to a 200 ohm barretter.

Size: 12" long, 9" wide, 9" high.

Data subject to change without notice.

Pulse Power Measurement By A Heterodyne Method

Peak-Reading Method*, Facilitating Determination of Pulse Powers, Eliminates Need For Pulse-Width and Repetition-Rate Data.

by LEONARD S. SCHWARTZ

Senior Development Engineer [1]
Hazeltine Electronics Corp.

IN THE DETERMINATION of pulse powers by a method which reads average power it is necessary to accurately estimate the pulse width. This estimation is difficult if the pulse is not square. In the method to be described it is not necessary to know the pulse width and the repetition rate.

In the square-law detector of a synchroscope receiver, the *rf* pulse frequency is heterodyned with a *cw* frequency. Since grid circuit detection is employed the following formula, derived by Chaffee,[2] will be used as the basis for the argument.

$$\left[\overline{\Delta^2 E_p}\right] = \frac{-\mu_p \bar{R}_c}{r_g + \bar{R}_c} \cdot \frac{1}{2k_g} \frac{\partial k_g}{\partial e_g} (\Delta E_g)^2 \qquad (1)$$

In the expression, $\left[\overline{\Delta^2 E_p}\right]$ is the voltage of detection appearing in the plate circuit of a grid circuit detector. The *2* over the delta does not mean square but rather is Chaffee's notation for the voltage of detection. The bar over $\Delta^2 E_p$ means that this is the steady *dc* voltage resulting from the detection of an unmodulated carrier voltage.

$$\mu_p, \bar{R}_c, r_g, \frac{1}{k_g} \frac{\partial k_g}{\partial e_g},$$

may be regarded as constants of the tube and circuit, assuming small signal detection. Let us replace all of them by a single overall constant *K*. In this formula ΔE_g is the rms amplitude of the *rf* carrier voltage. If we replace this by the peak voltage, the expression becomes

$$\left[\overline{\Delta^2 E_p}\right] = \frac{K}{4} (\Delta \hat{E}_g)^2 \qquad (2)$$

This formula now represents a constant voltage of detection. But in the present case the input signal to the detector is the resultant of an *rf* pulse voltage and a *cw* voltage of nearly the same frequency. This resultant has an instantaneous amplitude given by

$$\Delta e_g = \sqrt{\hat{E}_p^2 + \hat{E}_c^2 + 2\hat{E}_p \hat{E}_c \cos \Delta wt} \qquad (3)$$

where $\hat{E}_p$ is the peak of the *rf* pulse voltage, $\hat{E}_c$ is the peak of the *cw* wave, and Δw is the beat angular frequency. If the instantaneous value e_g replaces $(\Delta \hat{E}_g)$ in equation (*2*), then the expression for the voltage of detection becomes

$$\left[\Delta^2 E_p\right] = \frac{K}{4} (\hat{E}_p^2 + \hat{E}_c^2 + 2\hat{E}_p \hat{E}_c \cos \Delta wt) \qquad (4)$$
$$= \frac{K}{4} (\hat{E}_p^2 + \hat{E}_c^2) + \frac{K}{4} (2\hat{E}_p \hat{E}_c \cos \Delta wt)$$

and we notice that the averaging bar is no longer over $\Delta^2 E_p$. The first term on the right is the *dc* voltage produced by the *cw* plus the envelope of *rf* voltage, and the second, the variable beat frequency term of the voltage of detection. This is the output of the rectifier tube, but the coupling capacitors of the video amplifier will not allow the *dc* part of the first term to pass, so the actual voltage applied to the deflecting plates of the scope is

$$(\Delta^2 E)' = \frac{K'}{4} \hat{E}_p^2 + \frac{K'}{4} (2\hat{E}_p \hat{E}_c \cos \Delta wt) \qquad (5)$$

(The prime sign over the K's takes account of the amplification of the intermediate stages)

The *cw* voltage is adjusted so that the beat voltage appearing in the pulse extends all the way to the base line, as shown in Figure 1. When this happens, the peak value of the variable component of detection equals the amplitude of the envelope of the *rf* pulse. Therefore,

$$\frac{K'}{4} (2\hat{E}_p \hat{E}_c) = \frac{K'}{4} \hat{E}_p^2 \text{ and } \hat{E}_p = 2\hat{E}_c \qquad (6)$$

In terms of power input to the square-law detector it means that for this adjustment the *rf* pulse power is 6 db above the *cw* power at the point of entrance into the detector.

*Method originally employed by J. L. Lawson and J. H. Perry at Radiation Laboratory.

[1]This article was prepared while the author was a member of the Naval Research Laboratory.

[2]E. L. Chaffee, *Theory of Thermionic Vacuum Tubes*, p. 515, McGraw-Hill Book Company, Inc.; 1933.

Frequency Adjustment

The difference in frequency is adjusted to one or two megacycles, that is one or two beat voltage cycles, so that operation will be within the flat portion of the gain-versus-frequency characteristic of the video amplifier of the synchroscope.

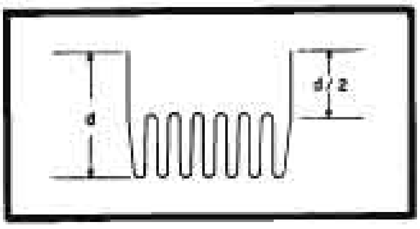
Effect of CW Frequency Change

It is interesting to note that if the *cw* frequency is changed from that of the pulse transmitter until the beat voltage level passes from the base line to a point half way down the pulse, as shown in Figure 2, then approximately six cycles of beat voltage appear. This means that there is a frequency difference of 6 mc between the transmitter pulse frequency and the *cw*, and the half-power position of the top of the beat voltage swing must correspond to the half-power position on the gain-versus-frequency curve of the video amplifier of the synchroscope. As a matter of fact a gain-versus-frequency curve obtained on another similar scope in the usual way gave a bandwidth of 6 mc, so it would appear that an incidental application of this method might be to make a quick check on the bandwidth of a video amplifier.

Experimental Data

Comparison measurements were made under the same conditions for

Figure 2
Peak *cw* voltage adjusted to ½ peak-pulse voltage.



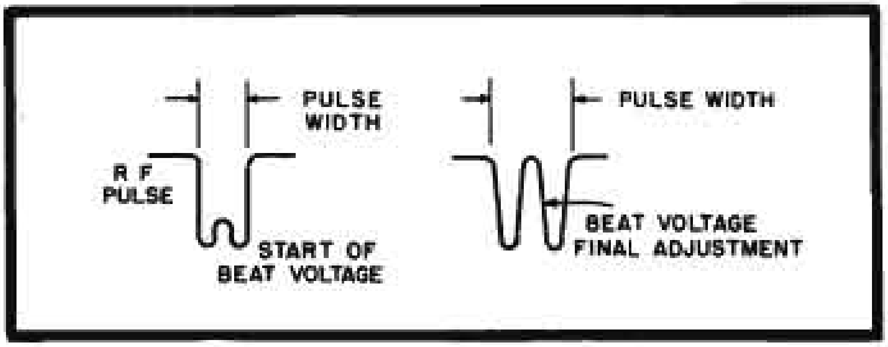


Figure 1
Cw voltage beating with pulse voltage.

the heterodyne and the usual average power reading method. The same thermistor bridge served as the wattmeter in each case. A square *rf* pulse insured fairly reliable power readings for the second method. The results are shown in Table 1.

Discussion of Data

The sources of error in the heterodyne method, as used in this experiment, were:

(*a*) Errors in determination of the insertion loss of the cables which served as the fixed attenuators, particularly the Bell Lab. variable attenuator.

(*b*) Frequency modulation in the beat voltage.

(*c*) A sloping-gain-versus-frequency characteristic for the video amplifier in the synchroscope.

Tube	Voltage	Heterodyne Method	Average Power Method	% of Deviation from Method of Average Power Readings
RCA 2C42 G. E. Lighthouse, (699)	3.0 kv	1150 watts	1250 watts	8%
	3.5	1610	1700	5%
RCA 2C42 G. E. Lighthouse, (698)	2.0	400	476	16%
	2.5	657	666	2%
	3.0	866	820	5%
	3.5	1160	1125	3%
GE 2C42 G. E. Lighthouse, (676)	2.0	510	518	2%
	2.5	650	725	10%
	3.0	1100	1070	3%
	3.5	1490	1520	2%

Table 1
Results obtained in a series of comparison measurements under the same conditions for the heterodyne and the usual power-reading method. The same thermistor bridge served as the wattmeter in each case.

Conclusion

If sufficient precautions are taken to limit the errors arising from the sources listed, it would seem that the heterodyne method would insure greater accuracy than the average power method without unduly complicating the procedure.

Figure 3
Equipment used to measure peak power by heterodyne method. At least 10 db attenuation is required for adequate isolation of the power detecting gear from the standing waves set up at the *T*.

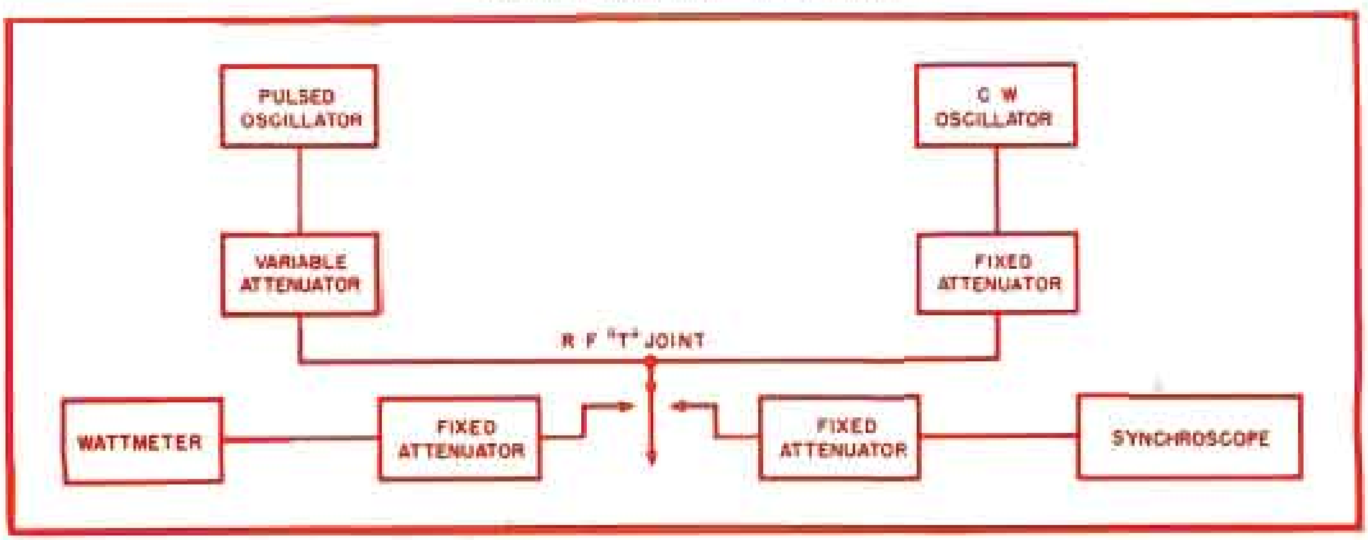
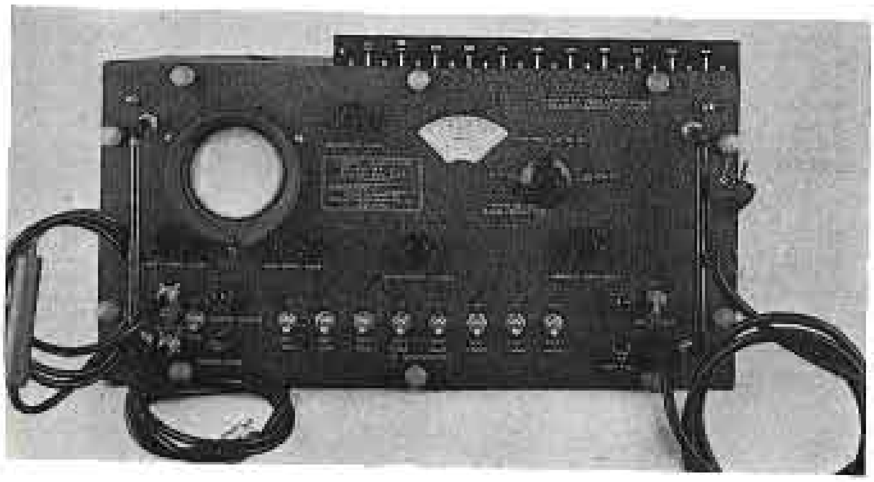


Figure 2
Front view of the test instrument.

A Self-Checking



by JOSEPH H. VOGELMAN

Engineer-In-Charge
Development Branch
Watson Labs, Air Matériel Command

With the advent of wide band *if* amplifiers in high resolution radar systems, navigational aids, relay systems and similar devices for military application, it became necessary to have a test set to facilitate field servicing of wide pass-band receivers. To meet this requirement, a self-checking wobbulator, which incorporated an FM signal generator, frequency meter, and a 'scope, in a single unit, was developed recently.[1]

The test set, which covers a range of 5 to 100 mc in six bands, incorporates a signal source, the frequency of which is caused to vary over a band of approximately ±20% about a fixed center frequency. The center frequencies are so selected that adequate overlap is provided for all possible center frequencies of the apparatus under test. FM is obtained from a motor driven capacitor whose rate of sweep is variable from 0 to 200 *cps*. The *rf* output level is held constant over the range by means of an *agc* circuit, and the output level is adjusted with an accurately calibrated step attenuator. The motor drive mechanically synchronizes the oscillator sweep with the baseline sweep produced on a *crt*. The output of the *if* amplifier or receiver under test, or of any stage thereof is fed to the *Y* axis of the *crt* through a probe, containing a germanium crystal rectifier, and a 'scope amplifier. A built-in frequency meter produces a blanking marker on the *Z* axis of the *crt* to permit frequency and band-width measurements. The width of the blanking marker is adjustable so as to permit easy location of the relative frequency and at the same time provide precision measurements when required.

Portable Test Set, Designed for the 5 to 100 Mc Bands, Contains a Frequency Modulated Signal Generator, Frequency Meter and 'Scope Which Can Be Used to Observe, Check and Measure Stage-Per-Stage Gain, Frequency, Bandwidth, and Tuning Characteristics of Broadband *IF* and *RF* Amplifiers and Receivers.

The Oscillator

A balanced push-pull oscillator, employing a 6J6 double triode, was chosen because of its low even harmonic content. Frequency band selection is provided by means of six plug-in coils which have the following ranges: 5-12 mc; 8-20 mc; 15-36 mc; 19-48 mc; 30-75 mc; and 40-100 mc.[2] These coils, when used with the oscillator, provide sufficient frequency overlap for all applications, so that with the proper coil the desired frequency will fall at approximately the center of the frequency sweep without the aid of an additional parallel variable capacitor for tuning. This arrangement has the advantage of simplicity of tuning, and permits very wide frequency sweeps. The frequency is swept through the range by means of a motor driven capacitor. A fractional horsepower *dc* motor is used to drive the capacitor, the *dc* motor being selected so that its speed would be independent of the input power source frequency, which would vary from 50 to 1,600 cps, depending on the application. The *dc* required to operate the motor is obtained directly from the 115-volt power source through a selenium rectifier. A rheostat is incorporated in the *dc* power circuit to the motor to permit varying the rate of sweep.

CRT Sweep and Synchronization

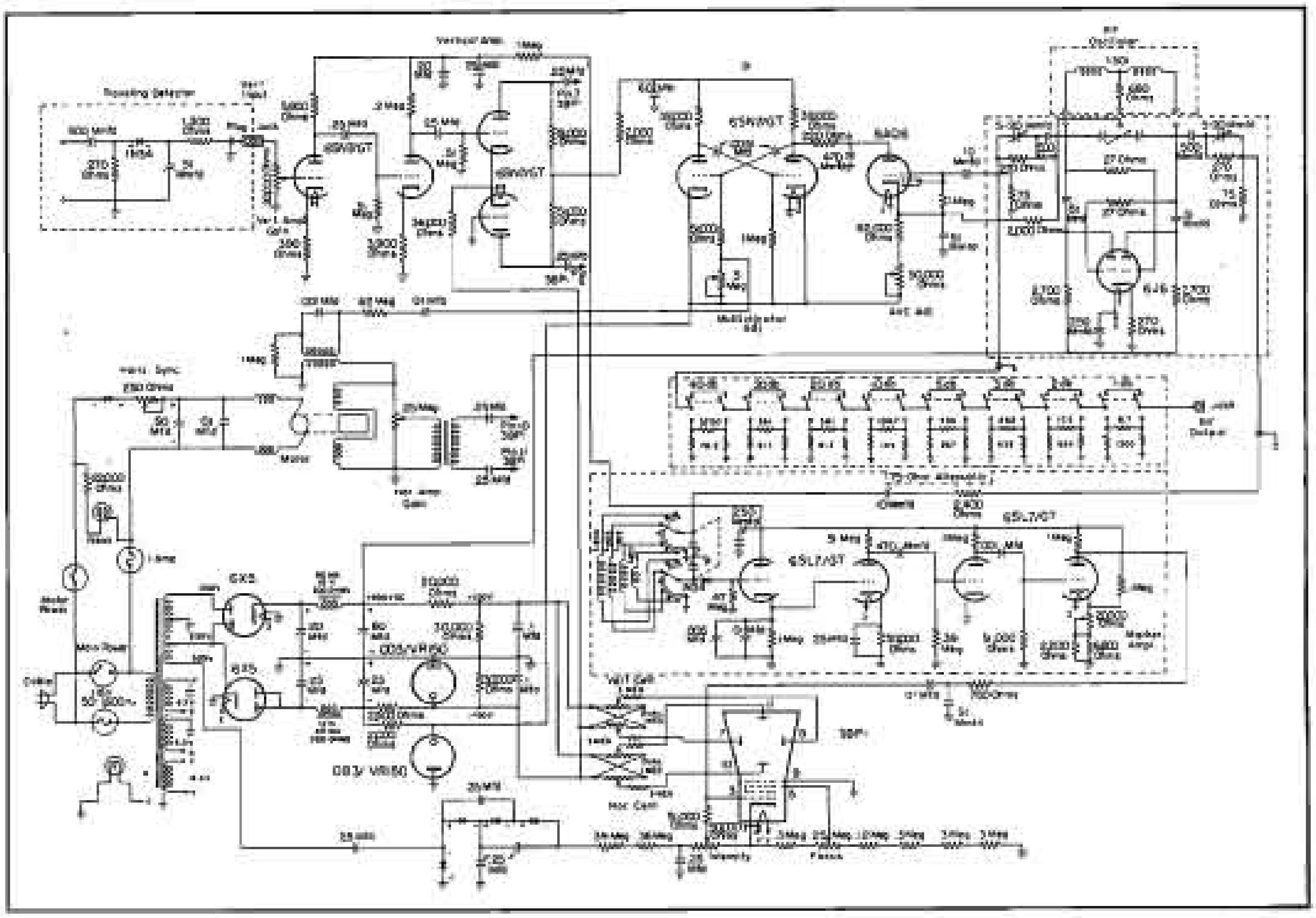
The sweep for the *crt* horizontal deflection plates is obtained from a variable reluctance generator. An eccentric cam revolving in a magnetic field produces a sine wave sweep for the *crt*. The cam is mounted on the same shaft as the motor driven capacitor so as to

[1] Developed under the sponsorship of the Watson Laboratories of the Air Materiel Command and designated by Army Navy nomenclature as *Signal Generator TS-452/U*.

[2] An additional coil has been designed to extend the frequency to 125 mc.

WOBBULATOR

Figure 1
Circuit of the self-checking wobbulator. L = 5 to 12 mc; L = 12 to 30 mc; L = 17 to 42 mc; L = 40 to 100 mc; L = 5 to 12 mc; L = 8 to 20 mc; L = 15 to 36 mc; L = 19 to 48 mc; L = 30 to 75 mc; L = 40 to 100 mc.



provide complete synchronization between the position of the electron beam of the *crt* along the *X* axis and the instantaneous frequency of the oscillator. By this method jitter resulting from poor synchronization is almost completely eliminated. The output of the variable reluctance generator is fed across a potentiometer which is used to provide a variable horizontal sweep-amplitude.

AGC and Return Sweep Blanking

An *agc* circuit is incorporated to maintain constant *rf* output level. A 6AQ6 dual-diode triode with a common cathode is used as the *agc* tube, which at the same time functions as the return sweep blanker. A square wave generated by a 6SN7 multivibrator synchronized to the sine wave sweep is applied to the *agc* tube so as to drive the oscillator tube below cut-off during the half cycle when the frequency is returning from maximum to minimum.

The 'Scope

The 3BP1 is used as the indicator. The 2,000 volts for the electron gun is obtained from a 500-volt transformer using four selenium rectifiers as a voltage quadrupler. A resistance capacitance network is used as a filter. All voltages for focusing, intensity, and positioning are obtained from this network.

Vertical Amplifier

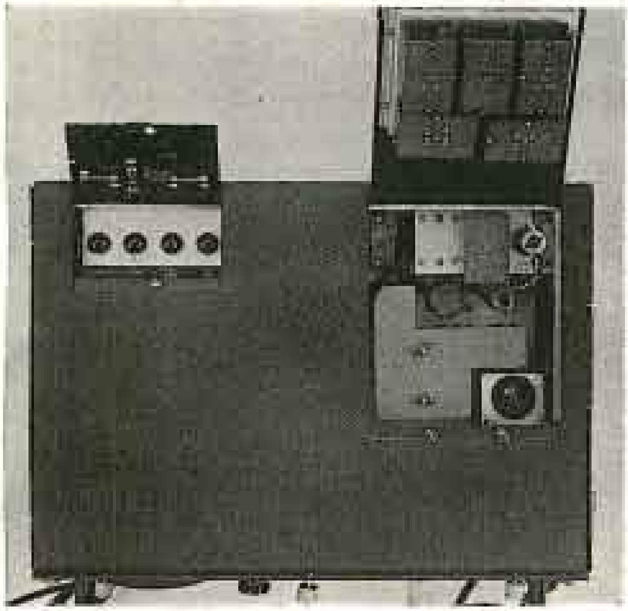
The vertical amplifier consists of two 6SN7 dual triodes. The first 6SN7 operates as two stages in cascade driving the second 6SN7 operating in push-pull. The output of the amplifier is fed to the two vertical plates of the cathode-ray tube.

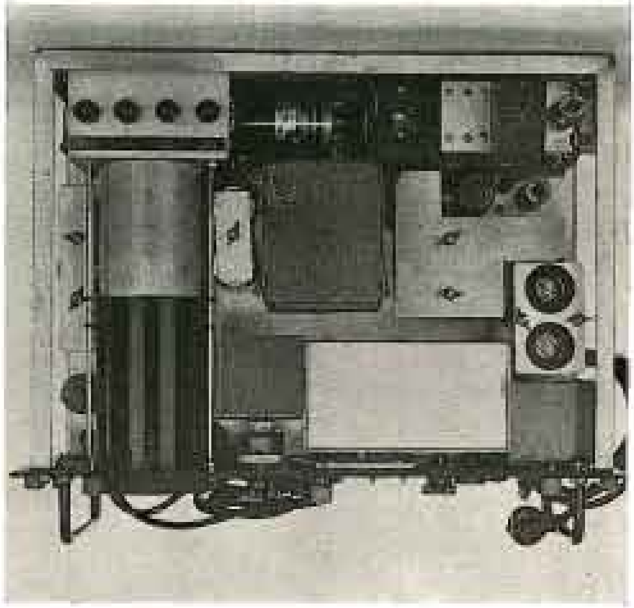
The Attenuator

The attenuator consists of a series of *pi* attenuators with a *dpdt* switch to add or remove each *pi* network independently. By proper combination of the available steps, the attenuation can be varried from 0 to 101 db. The steps provided are 1, 2, 3, 5. 10, 20, 20, 40 db. A constant impedance of 75 ohms is maintained for all values of attenuation. The individual *pi* sections and associated switches are mounted in individual shielded compartments to prevent undesirable coupling which would destroy the accuracy of the attenuator. The 3-db step is made extremely precise since it serves in the determination of receiver and *if* amplifier bandwidth.

Frequency Meter

The frequency meter consists of a tuned circuit with a variable capacitor





Figures 3 (*left*) and 4 (*right*)

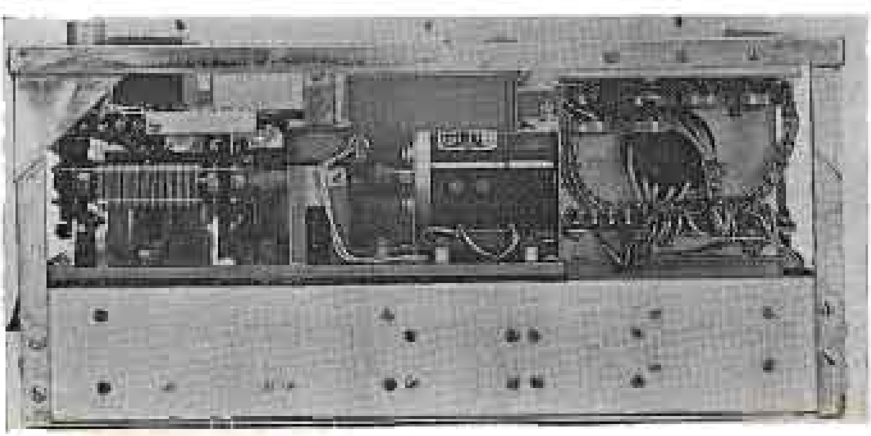
In Figure 3 appears a top view of the test unit and in Figure 4 a top view of the chassis showing the *crt* housing and motor-driven oscillator. The *crt* beam controls are mounted under a cover on top of the instrument. Oscillator coils are stored in cover of a second compartment on top of the test test and it is through this opening that the coils are changed to switch the bands.

for tuning. The frequency band from 5 to 105 mc is covered in four bands with band switching control (5-12, 11-25, 21-55 and 40-105 mc). The frequency meter is loosely coupled to the oscillator output, and is designed to accept a small portion of the oscillator output as it passes through the frequency to which the frequency meter is tuned. The output of the frequency meter is then rectified and amplified and inserted on the *Z* axis grid of the *crt* to produce a blanking marker. The frequency meter output is differentiated to provide a narrow blanking pulse. A rheostat in the cathode of one of the amplifier stages serves to vary the grid bias thereby varying the pulse width.

The instrument is housed in an aluminum cabinet, having an aluminum front panel upon which are mounted the *crt* light shield, attenuator, and grid blanking wavemeter controls, together with the necessary controls, jacks, switches, power cable, pilot light indicators, and fuses. Separate switches are provided on the front panel for controlling the main power input and the *dc* power to the motor, which drives the sweeping tuning capacitor and the sine wave sweep generator for the cathode-ray tube. Separate pilot light indicators are provided across each of the switches. A travelling crystal diode detector is supplied for direct connection to the output circuit under test. The travelling detector has an input blocking capacitor and its input is shunted by a 270-ohm resistor. The detector assembly is housed in a small diameter, shielded, bakelite covered test probe on the end of a 4' length of RG-59/U coaxial cable. The cable is equipped with a standard type *BNC* connector for connection to the vertical deflection amplifier input jack located on the front panel.

The test set may be connected directly to the input of the equipment under test, and the output of any of the *if* stages may be connected directly to the travelling detector. The connection between the receiver and the output or input cables of the test set provides a positive *rf* connection at all times.

The motor driven sweep oscillator, sweep capacitor and sine wave generator.



Check on Own Performance

The test set has a particularly unique feature; it is capable of checking its own performance. By connecting the travelling detector directly to the output of the *rf* oscillator, the output of the signal generator over the frequency band of the sweep can be viewed on the 'scope. The frequency meter marker can then be used to determine if the oscillator is covering the proper frequency band. The calibration of the various attenuator steps can be checked, one against the other, by observing the decrease in amplitude caused by a particular step, and comparing it to the decrease caused by several steps of lesser value combined to give the same total. The constant output achieved by means of the *agc* circuit affords a distinctive 'scope pattern as an indication of correct operation. Before making any measurements the output of the signal generator is fed directly into the travelling probe to the vertical amplifier. If a pattern in the shape of a rectangle appears on the 'scope, then the operation of the test set is satisfactory and measurements can proceed without further calibration.

Test Set Applications

(a) ***Frequency Measurements:*** The test set can be used to determine the frequency of a tuned circuit by feeding into it the output of the signal generator, and feeding the output through the travelling probe and applying it to the vertical amplifier. A pattern resembling the band-pass characteristic of the tuned circuit will appear on the 'scope, and by adjusting the blanking marker of the frequency meter so that it appears on the peak of the pattern, the center frequency of the tuned circuit can be read from the frequency meter dial. By the same technique, the frequency of individual *if* or *rf* tuned circuits can be measured. In the process of frequency measurement, the circuit can be tuned to any desired value, using the frequency marker to check the tuning.

(b) ***Band-Pass Measurements:*** Probably the most useful application of the test set is its ability to plot the band-pass characteristics of tuned circuits in *rf* and *if* amplifiers in broadband systems such as radar and television. With the same arrangement of connections as is employed in frequency measurements, the band-pass characteristics of the circuit under investigation can be displayed as a plot of amplitude against frequency, on the face of the 'scope *crt*. By means of the pattern, the circuitry can be adjusted to give the desired bandwidth, and the broadband characteristic desired. It has been found that only by means of the test set can a stagger-tuned *if* amplifier be successfully measured.

(c) ***Stage-by-Stage Amplification Measurements:*** The test set is particularly suitable as a design tool for the electronics engineer, since it permits stage-by-stage measurements of gain, and at the same time permits the experimenter to view the frequency response of the circuitry. By connecting the signal generator to the input of the stage under investigation, and connecting the travelling probe to the output, the various parameters of the circuit can be varied while their effect on the performance can be viewed on the built-in 'scope. By establishing a reference level with the signal generator output fed directly into the travelling probe, the gain of the stage or stages can be measured in terms of the amount of attenuation required to decrease the output signal to the original reference level.

(d) ***IF Amplifier and Discriminator Alignment:*** For *if* amplifier alignment, the *rf* output of the test set is fed into the stage under investigation, and the frequency meter blanking marker is adjusted to the desired intermediate frequency. The band-pass curve is moved across the face of the 'scope by adjusting the capacity or the inductance of the circuit until the peak coincides with the frequency marker. If required the characteristics of the band-pass can be adjusted to give the correct flat-topped response. In this manner each stage can be independently aligned. As a final step in the alignment procedure, the overall band-pass characteristic can be checked, and further alignment, broadbanding or other improvements can be made. In the case of stagger-tuned *if* systems used to achieve flat-topped broadband response curves, this system of alignment is almost mandatory. Transformer coupling can also be adjusted, by the same method, to give desired response. To align a discriminator, the output of the discriminator is fed directly into the vertical amplifiers rather than to the travelling probe. The standard discriminator characteristic curve will be seen on the 'scope. If the frequency meter blanking marker is set to the desired center frequency, the response can be adjusted to be symmetrical about this frequency.

(e) ***Overall Sensitivity Measurements:*** Sensitivity measurements on complete receivers or on *if* amplifiers are possible if the output of the signal generator is first calibrated with a *vtvm* with the attenuator adjusted for zero attenuation. The signal is then fed into the unit under test, and attenuation is added until the signal on the 'scope becomes equal to the noise level. The amount of attenuation required to achieve this level gives the value of signal in decibels below the calibration level. This can readily be converted to microvolts. In the same manner, attenuation can be removed until the signal seen on the 'scope ceases to increase. The value of attenuation still remaining in the circuit is used to calculate the signal amplitude which will saturate the receiver.

Though the test set was originally designed to operate over the frequency band of 5 to 100 mc with broadband frequency sweep, two modifications have been designed which increase the usefulness of the set for special applications. An additional coil has been made available for both the oscillator and the frequency meter which permits extension of the range to beyond 120 mc. The second modification consists of a replacement oscillator circuit which parallels a tunable air capacitor with a much lower capacity rotary capacitor. With the existing coils, it is then possible to cover the same frequency range with the variable capacitor, but with the sweep is now only

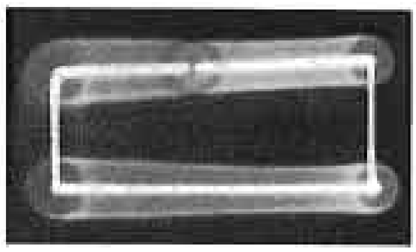


Figure 6

CRT indication with output of test set fed directly into probe showing frequency marker.

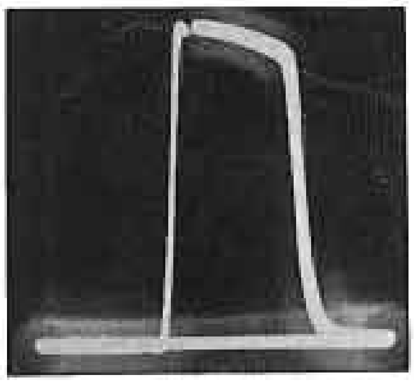
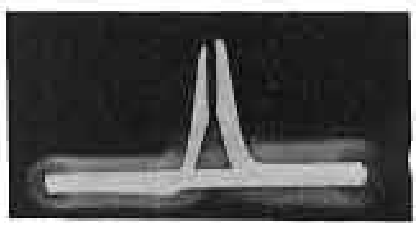


Figure 7

CRT indication response of 7 mc wide stagger tune if amplifier centered at 30 mc.

Figure 8

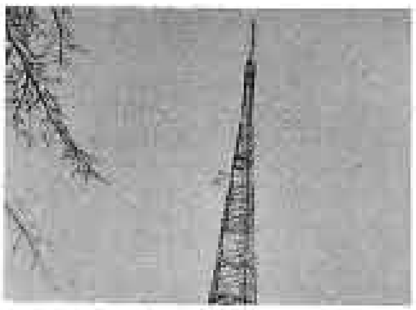
CRT indication of 1-mc wide 30-mc amplifier stage, variation in gain of stage with power supply change causing wide trace.



Recent AM/FM/TV Installations

Transmitting room of WVNJ, Livingston, New Jersey, which recently went on the air. Transmitter is a 5-kw job and feeds into a five-element in-line system consisting of four towers 300' high, with the central tower 483' to the top.
(Courtesy Federal Telephone and Radio Corp.)

Interior view of equipment room at WTAL and WTAL-FM, Tallahassee, Florida. The AM transmitter at this station is a 5-kw job and the FM a 710-watt affair. A six-bay cloverleaf antenna is used with the FM transmitter.
(Courtesy Caterpillar Tractor Company)



TV tower of WDTV, Pittsburgh, Pa. Structure, 500' high, weighs 100 tons, and is 60' square at the base, tapering to a 5½' square.
(Courtesy Blaw-Knox)

The TV mobile truck of WKY-TV, which was recently placed in operation.
(Courtesy The Flxible Company)

TV Monitor

(*Continued from page 13*)

produced by the combined efforts of two sidebands beating with the carrier in the detector, while the latter are produced by only one sideband. Thus, the high frequencies producing the fine detail are attenuated as compared to the frequencies producing the bold outlines. The result is a picture in which the detail, although present, lacks contrast, appearing as though the objects were covered with a film of dirt or mud. This boosting of the lower frequencies is avoided when the detecting device has a frequency response curve of the type standardized for television receivers. The ideal form of this curve is shown in *C*. The carrier, it will be noted, is attenuated 50%. The upper sideband corresponding to frequencies between .75 and 4 mc is unattenuated, while there is no sensitivity to lower sideband signals in this range. The sidebands corresponding to frequencies below .75 mc are attenuated in varying amounts, but it can be shown by geometry that for any given such frequency, the sum of the fractional responses to the two sidebands equals unity. Thus the two sidebands of frequencies below .75 mc combine to produce the same effect on the detector as the single sideband of frequencies above .75 mc and the result is a curve flat to 4 mc as shown in *D*. The response is brought to zero at 4.5 mc to prevent interference from the sound transmitter.

Ideal Curves

The curves of Figure 9 are ideal, as it is impossible in practice to produce the sharp corners and the infinite attenuation regions shown. Furthermore, if the corners were made as sharp as possible, excessive phase shift would result. In practice, therefore, it is desirable to have rounded corners, and also to have the flat portion of the curve extend to somewhat less than 4 mc, so that there will be a more gradual slope into the 4.5-mc sound trap.[9] It is to provide adjustment of this slope that sound trap capacitors C[illegible], and C[illegible] (Figure 3) were made adjustable.

Acknowledgments

The author wishes to express his gratitude to his associates in the Transmitting Equipment Division, particularly Dr. J. H. Mulligan, Jr., who offered many suggestions for rearranging and rewording the manu-

(*Continued on page 34*)

TV Monitor

(*Continued from page 33*)

script, and to G. E. Hamilton and P. F. Brown, who reviewed the manuscript and whose help was invaluable. He is also grateful to those members of the receiver division, without whose help the project could not have been completed, particularly Clee Marsh, Bernard Amos and Fred Schmidt.

References

[1]John Ruston, *Control Console for a Television Transmitter*, COMMUNICATIONS; October, 1948.

[2]Ho Shou Loh, *On Single and Couple Tuned Circuits Having Constant Response-band Characteristics*, Proc. IRE; April, 1938.

[3]Clee Marsh, *Recent Advances in the Design of Intermediate Frequency Amplifiers for Television Receivers*, a paper presented before the 1947 Winter meeting of the IRE.

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WSJS-FM

(*Continued from page 21*)

is hoped will come to the Tar Heel state.

The site finally selected has proved just about as perfect as it could be under the many existing circumstances which arose, Phil Hedrick, chief of the engineering staff, believes after the first year of operation; WSJS-FM first went on the air full time December 1, 1947.

The transmitter was located directly on U. S. Highway 421 seven miles east of Winston-Salem. This highway links Winston-Salem and Greensboro 29 miles away.

The ground level at the transmitter site, 956′ above mean sea level, is the second highest area in Forsyth County, the highest being 1,026′, a short distance further east towards the community of Kernersville, which lies approximately three miles away.

The airways and airports came in for some special figuring when the transmitter site was chosen. There is only one existing airport within 10 miles of the transmitter site, the Smith Reynolds Airport on the northern city limits of Winston-Salem, approximately five miles west of the transmitter. Another airport at Greensboro-High Point, located to the east of the transmitter site, is farther away, but had to be considered in the location selection. In addition, there are two existing airways, the center lines of which are within 10 miles of the transmitter location of the FM station.

They are Green Airway No. 6, the center line of which is approximately eight miles southeast of the location, and Red Airway No. 34, the center line of which is approximately 8.5 miles northeast of the location.

After both of these airways had been cleared according to current regulations, it was found that only a small area remained for the projected transmitter site.

In addition, it was found necessary to consider a location which would provide the best accessibility to existing power and telephone lines. This was important since the programs for WSJS-FM were to originate in the WSJS Radio Center on North Spruce Street in Winston-Salem.

A 10-kw[1] transmitter and auxiliary equipment[1] was housed in a modern-design building which was also equipped with one small studio for use in the event of an emergency, and shop, garage, furnace and auxiliary power plant rooms. In the transmitting room is an operating console with the cabinets housing the transmitter immediately in front of the operator. An auxiliary turntable is at the operator's right, with a loudspeaker above to his rear. To his left rear are two cabinets containing the frequency and modulation monitors and line and monitor amplifiers, also a patch panel to facilitate switching equipment.

The shop is in the rear of the build-

[1]G. E.

ing and is fully equipped with tools and equipment needed for spot repairs. An assortment of standard checking instruments also are on hand, one being an external standard for measuring the frequency of the AM and FM transmitters. This equipment is standardized on the Bureau of Standards' standard WWV.

Approximately seven miles of telephone miles from the studio to the transmitter building have been equalized by Southern Bell from 30 to 15,000 cycles within 1 *db*, with noise level being 68 *db* down from program level which meets FCC requirements.

The base of the antenna, a 6-bay circular type,[1] is approximately 50 feet west of the transmitter building. The antenna is supported on a structural steel tower, so that the center of the radiating portion of the antenna system is supported approximately 321' above ground level, or 1,277' above mean sea level. The height of the supporting structural steel tower is approximately 268'. The overall height of the antenna system above ground level is 348', and the overall height above mean sea level is 1,304'.

Power is fed to the antenna system through a 400' length of coaxial transmission line, having an outside diameter of 3⅛" and an estimated efficiency of 87 per cent.

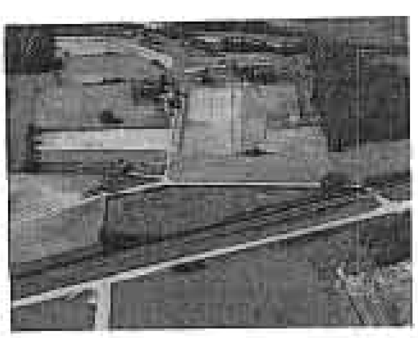
The power delivered to the antenna system is 8.7 kw, the effective radiated power being approximately 48 kw.

To insure continued operation in the event of a power failure, a 40 *kva* 4-wire power plant with automatic change has been installed. A gasoline-driven motor cranks up and delivers power within approximately 45 seconds in the event of a commercial power failure.

WSJS-FM now operates on a 17-hour day, from 8 A.M. to 1 A.M. In addition to local programs which originate in Winston-Salem, the station also carries NBC network programs.

Incidentally this area has become quite FM conscious, one out of every five families in the county owning an FM receiver.

Tract of land (outlined) along United States Highway 421 east of Winston-Salem selected as the site of WSJS-FM.



News Briefs

INDUSTRY ACTIVITIES

The Polytechnic Research and Development Company, Inc., formerly located at 56 Court Street, Brooklyn, New York, has opened research laboratories at 202 Tillary Street, Brooklyn, New York. The research group is headed by Dr. H. S. Rogers, president of the Polytechnic Institute of Brooklyn, and is under the technical direction of F. J. Gaffney.

Cornell-Dubilier Electric Corp., South Plainfield, N. J., has purchased from Maguire Industries, Incorporated, all of the stock of Radiart Corp., Cleveland, Ohio. Established in the early 1930's, Radiart manufactures auto radio vibrators and TV and auto antennas.

The Radiart plants will be operated in Cleveland as a separate division of Cornell-Dubilier.

New officers of Radiart are: Octave Blake, president; L. K. Wildberg, vice president; Verne Mitchell, vice president, and C. A. Staub, treasurer and assistant secretary.

WKRC-TV, Cincinnati, will soon install a 5-kw G.E. television transmitter.

The unit is designed to operate on channel 11.

The Acro Electric Company, Cleveland, manufacturers of rolling spring snap action switches, has been purchased by a group of Pittsburghers including Willard F. Rockwell, Jr., president of the Rockwell Manufacturing Co., Pittsburgh.

F. G. McCloskey is the new president of Acro, while Fred Lynn remains as vice president and general manager.

PERSONALS

W. H. Magne has been appointed general sales manager of Russell Electric Co., Chicago, subsidiary of Raytheon Manufacturing Co.

Joseph B. Elliott is now vice president in charge of all RCA Victor consumer products, and **L. W. Teegarden** has been named vice president in charge of all RCA technical products. **Henry G. Baker** has been appointed general manager of the Home Instrument Department, and **Richard T. Orth** has become general manager of the Tube Department.

J. B. Elliott

L. W. Teegarden

H. G. Baker

R. T. Orth

Palmer M. Craig has been appointed director of engineering, electronics division of the engineering department, Philco Corp.

Craig, who has been with Philco for 15 years, served as chief engineer in charge of radar and military radio development during the war and was named chief engineer of the company's radio division in 1943.

Sterling C. Spielman is now chief engineer of Philco TV receiver development; **Luke E. Clausen** has been named chief engineer of home receiver design; Arthur V. Nichol has become chief engineer of auto radio development; **Dr. James F. Koehler** has been appointed chief engineer of a relatively new phase of the company's development activities, the design of specialized government and industrial electronics equipment.

Terry P. Cunningham has become director of advertising and sales promotion for Sylvania Electric Products Inc. Cunningham will direct advertising and sales promotion for the lighting fixture, lamp, radio tube and electronics divisions and the Wabash Corp.

T. P. Cunningham

Robert M. Hanson is now chief engineer of the engineering department at Audio Development Co., Minneapolis, Minn. Hanson was formerly chief engineer of the Thordarson Electric Company, Chicago.

R. M. Hanson

Frank J. Stevens has been elected president of the recently reorganized Isolantite, Inc. Paul H. Mourand is now vice president and treasurer; and John Simons, secretary.

Isolantite is now located at Warren Street, Lyndhurst, N. J.

Frank Cazenove Jones, president and general manager of The Okonite Company, Passaic, New Jersey, died recently.

C. J. Burnside, associated with Westinghouse radio and electronic activities for 24 years, has resigned and organized an independent industrial consultant service with headquarters in Baltimore. He will continue his association with Westinghouse as a consultant.

Frank Lester has been appointed head of the engineering staff of the Insuline Corporation of America, 36-02 35th Ave., L. I. City, N. Y. Lester was formerly chief engineer for Electronic Corp. of America and Radio Wire & Television, Inc.

Sidney L. Chertok is now on the application engineering staff of Sprague Electric Co., North Adams, Mass., and will also serve as sales promotion manager of the Sprague Products Co.

LITERATURE

Welwyn Electronic Components, Inc., 234 East 46th St., New York 17, N. Y., have released an 8-page catalog covering technical data and price schedules on *high stability* carbon resistors, and *pyromatic* resistors.

Engineering data on the construction, tolerance and range, stability, as well as temperature and voltage coefficient are included.

The Broadcast Equipment Section of RCA Victor, Camden, N. J., has prepared three brochures describing an AM transmitter and AM/FM/TV consolette equipment.

One brochure (24 pages; form 2J-4267) describes the BTA-50F1 50-kw AM broadcast transmitter.

Another, a 20-page booklet (form 2J-4608), provides detailed information on a two-studio consolette (type 76C). Featured are pictures of typical installations for AM-FM and television use and suggested studio layout for a small or medium size FM or AM station with one or two studios.

The third brochure (form 2J-4622) contains 16 pages of information on consolette-type switching systems, models BCS-1A, -2A, and -3A, for AM-FM and TV networks.

General Radio Co., Cambridge 39, Mass., has released an 8-page catalog describing the design and applications of the *Variac* continuously adjustable transformers.

ANDREW FM ANTENNA

A *Multi-V* antenna for FM, which consists of two elements or bays of a folded *V* type antenna, spaced approximately one wavelength, has been announced by the Andrew Corp., 363 East 75th St., Chicago 19.

Antenna is said to have a power gain of 1.8 and a rating of 10 kw.

Can be mounted on top or sides of standard tower.

Each radiator is essentially an unbalanced folded dipole, with arms formed to resemble a truncated *V*. The effect of the *V* configuration is to produce circular horizontal radiation pattern.

Antenna is tuned at the factory by adjusting telescoping members in the radiators. These members are then soldered in place. If desired, the antenna may readily be tuned to a new frequency by unsoldering the telescoping members, changing the length, and resoldering.

To feed the two bays in phase, the transmission line between them is supplied in one of two lengths—one for the upper half of the FM band and one for the lower half. A quarter wave matching section below the bottom element matches the antenna to the 51.5 ohm coaxial transmission line.

Insulation resistance of the feed line may be checked at the transmitter. This isolation of the grounded antenna from its feed line is due to a series capacitor between the inner conductor and each end seal.

Voltage standing wave ratio in the antenna is said to be less than 1.4 from 88 to 91 mc, less than 1.3 from 91 to 95 mc, and less than 1.2 from 95 to 108 mc.

Elements are made of hard temper copper tubing. The mast for the self-supporting model is a twenty foot steel *H* beam, galvanized. Radiating elements are mounted on one side of the *H* beam, and climbing steps are attached to the beam on the opposite side.

* * *

RCA STUDIO CAMERA PEDESTAL AND DOLLY

A studio camera pedestal and studio camera dolly, TD-1A, have been announced by the RCA Engineering Products Department.

The pedestal provides mounting for the TV camera in the studio or other indoor telecast locations. Has three rubber-tired wheels. Crank handle on the pedestal raises or lowers the camera between levels 40" and 60" above the floor. Panning and tilting of the camera can be facilitated by means of a friction head which is supplied separately.

The studio dolly is similar to those used in Hollywood film production sites, except that the rear wheels of the television dolly can be turned at right angles. This allows the rear end of the dolly to be swung around while the front end of the chassis pivots on a caster. The crane boom on which the camera is mounted can be raised to a height of 74" or lowered to 23" above the floor.

* * *

The Industry Offers

GUTHMAN TV TUNER AND CHANNEL SELECTOR

A television tuner and channel selector, model 34-1024, designed in collaboration with the Hazeltine Laboratories is now being manufactured by Edwin I. Guthman & Co., Inc., Chicago. Has a tuned transformer input with adjustable slug tuning, plus a separate vernier for fine tuning.

Tuner can be used as a remote control tuner through the use of an accessory converter transformer.

Three tubes are used: 6BH6 *rf* amplifier, 6AG5 mixer and a 6C4 local oscillator. A 300-ohm twin-lead is used for input to the antenna matching transformer.

Tuner is said to have a gain of approximately 10 to 11 db per 1000 ohms of modulator plate *if* impedance on the low frequency channels; on the high frequency channels the gain is 3 to 4 db lower. Power requirements are .6 amp at 6.3 volts for the heaters and 30 ma at 190 volts for plate and screen supply. The intermediate frequencies are 21.25 mc for the sound carrier and 25.75 for the picture carrier.

Illustrated circular containing data and schematic circuits is available from Guthman International Corp., 75 West Street, New York 6, N. Y.

* * *

CHATHAM ELECTRONICS REGULATED POWER SUPPLY

A laboratory-type regulated power supply, model E-46, has been announced by Chatham Electronics of 476 Washington Street, Newark, N. J.

Input . . . 105-125 volts, 60 cycle, 750 watts; output . . . variable 160 to 1500 volts, 125 milliamperes dc. Ripple is said to be less than .05 volt peak-to-peak; less than .15% variation in output from no load to full load; less than .015% variation in output voltage per volt of primary source.

RAYTHEON TUBES

The special tube section of Raytheon Manufacturing Company, Newton, Mass., has announced the availability of a 6AN5 miniature pentode which may be used in many of the applications for which the metal type 6AG7 was previously used, and a CK5654, a ruggedized version of the 6AK5.

The 6AN5 can be used at high frequencies as a frequency multiplier, wide band *rf* and *if* amplifier and class *c rf* amplifier. The 6AN5 has a normal plate current rating of 35 ma and a transconductance of 8000 μmhos.

Heater of the CK5654 was designed to withstand at least 5,000 on and off cycles at 7.5 volts. Tube was developed especially for applications such as in aircraft equipment where it is claimed the standard type 6AK5 had not proved sufficiently dependable.

* * *

B & W PLUG-IN LINKS

Plug-in links to afford matching of standard tank coils to a variety of impedances, have been designed by Barker & Williamson, Inc., 237 Fairfield Avenue, Upper Darby, Pa. On present swinging link assemblies, it is only necessary to replace the swinging link arm with a new one into which the link coils are plugged. Links now available are made in 1-3-5 and 10 turns.

Type 3730 fits the HDV tank coil; type 3550 is made to fit TVH, TVL and BVL types.

* * *

MICROWAVE SIGNAL GENERATOR

A broadband microwave signal generator covering the frequency range from 4,200 to 10,300 mc, TS-909/U, has been announced by The Polytechnic Research & Development Company, Inc., 202 Tillary Street, Brooklyn 2, N. Y.

Instrument includes a direct reading frequency meter and a variable attenuator calibrated directly in db below one milliwatt. Provisions are made for both continuous wave and pulse operation with rise time of 1/10th microsecond.

EIMAC POWER TETRODE

An external anode power tetrode, 4X150A, for use as a *rf* amplifier or oscillator at *uhf* and *vhf*, has been announced by Eitel-McCullough, Inc., San Bruno, Calif.

Although it is capable of withstanding up to 1,250 volts on its plate, the 4X150A operates well at plate voltages of 400 to 500 volts, making it suited for high-power mobile applications. Said to have a high ratio of transconductance to capacitance and a maximum plate dissipation capability of 150 watts which makes it applicable as a wide-band amplifier for video applications.

A single 4X150A operating in a coaxial amplifier circuit will deliver up to 140 watts output at 500-mc.

BROWNING AMPLIFIER

An all-triode amplifier, model AA-20, which features all triode voltage gain and power stages for response within 1 db from 10 to 37,000 cycles with less than 1½% harmonic distortion at ¾ of the rated 15 watts output, has been announced by Browning Laboratories, Inc., Winchester, Mass. Hum level is said to be 65 db below maximum rated output. Voice coils from 1.2 to 30 ohms can be matched by tap selection. In the output stage are pushpull 6B4Gs driven by two triode sections of a 6SN7 in cascade with separate bias rectifier.

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HEWLETT-PACKARD STANDING WAVE INDICATOR

A standing wave indicator to measure relative audio voltages detected by a crystal rectifier or bolometer, model 415A, has been announced by Hewlett-Packard Co., 395 Page Mill Road, Palo Alto, Calif. Designed for use with the model 805A parallel-plane slotted line, but may also be used with other slotted line systems. In conjunction with a slotted line it will determine flatness of a coaxial or waveguide system, measure impedance, locate sources of reflection and determine percentage of reflected power.

Instrument consists of a high-gain amplifier which is said to have a very low noise level and operating at a fixed audio frequency. The output of the amplifier is measured with a square-law indicating vacuum tube voltmeter. The meter face of this voltmeter is calibrated both in decibels and in voltage standing wave ratio. Input circuits are provided for use with either a crystal or barretter.

As normally supplied, the indicator operates on a single fixed tuned frequency of 1,000 cps. However, other frequencies from 300 to 2,000 cycles per second can be supplied on special order. Equivalent Q of the overall amplifier is 30 ± 5.

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MILLEN 'SCOPE AMPLIFIER-SWEEP UNIT

A 'scope amplifier-sweep unit, 90921, for use with any of a line of basic 2", 3", and 5" rack panel 'scopes, has been announced by The James Millen Manufacturing Co., Inc., Malden, Mass.

Unit comprises horizontal and vertical amplifiers, a hard tube saw tooth sweep generator and power supply mounted on a standard 5¼" rack panel.

TELEX TWINSET

A lightweight twin headset, the Twinset, weighing 1.6 ounces, has been announced by Telex, Inc., Minneapolis, Minn.

Headset delivers sound directly into each ear canal through two miniature receivers. Receivers are connected to a sound arm by a locking ball and socket joint, permitting adjustment so that only plastic ear tips enter the ear openings.

Single-cord connection is used.

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CLARKSTAN TONE ARM

A Trionic arm for transcriptions and records, which permits replacement of the cartridge without soldering and instantaneous adjustment of needle force, has been announced by Clarkstan Corporation, 11927 West Pico, Los Angeles 34. The arm will accommodate any pickup cartridge, magnetic or crystal, not over ¾" wide. Silver plated plunger contacts are said to obviate soldering. A thumb screw clamp holds pickup cartridge in place. A quick-acting weight adjustment is said to make possible any needle force from 5 grams up.

Arm is made in two sizes, one to accommodate 12" records, the other for 16" and 17" transcriptions and acetates.

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MILLIVAC MICRO-MICROAMMETER

A micro-microammeter, type MV-171, with 23 ranges, for use with model MV-17A vacuum-tube millivolt meter has been announced by Millivac Instruments, P. O. Box 3027, New Haven, Conn. Measures currents from 10 micro-micro amperes up to 10 amperes.

• • •

KAY ELECTRIC MEGA-MARKER

A wider frequency range, of from 29 to 39 mc has been incorporated in the Mega-Marker, marker oscillator, made by Kay Electric Co., Pine Brook, N. J. Model is identical with the standard model, which has a frequency range of 19 to 29 mc. All models are said to have accuracy of .25% and a crystal oscillator for calibrating the variable oscillator and providing a marker at 4.5 mc for adjusting TV sound discriminator.

• • •

FAIRCHILD TAPE RECORDER

A tape recorder, with 15 inches per second speed, which is said to deliver high-fidelity performance formerly thought possible only at 30 inches per second, has been announced by Fairchild Recording Equipment Corporation, 88-06 Van Wyck Blvd., Jamaica 1, N. Y.

Specially-designed synchronous motor drive is said to provide an overall time accuracy of better than one-half second in 30 minutes' playing time.

Features of the instrument also include plug-in type construction, both mechanical and electrical, for uninterrupted service; interlock system to prevent accidental erasing; volume indicator for reading recording level, etc.; adjustment of playback head during operation, and, automatic control in event of tape break.

A unit developed by Dr. D. G. C. Hare is the basis for the new recorder.

CARTER CONVERTERS FOR DC TV

A converter, model DIOIOCT, providing ac power to tv sets from dc lines, has been announced by the Carter Motor Co., 2647 N. Maplewood Ave., Chicago 47.

Has a *picture control* which is said to regulate converter frequency and eliminate *frequency* weaver and picture flutter.

Picture control is designed as a separate unit and should be located near the television screen for visual control and adjustment. The Converter can then be operated in another room or closet if desired, to eliminate completely the slight audible converter hum, if necessary.

Converter is designed to operate 7" television receivers of 125 watts power or less.

Equipped with leather carrying handle, output receptacle mounted in the end cover, and dc cord for immediate operation. Complete details, and specifications are presented in bulletin 948.

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GOODELL MAGNETIC NOISERASER

An instrument designed to eliminate signals and background noise from entire reels of magnetic tape in a few seconds, the *Goodell magnetic noiseraser*, has been announced by the Minnesota Electronics Corporation, 6th and Minnesota Streets, St. Paul 1, Minnesota. Removes saturation signals and reconditions old tape to permit an indefinite useful life with minimum of background noise.

Noiseraser consists of a tuned magnetic circuit which provides optimum erasing flux densities, suitably oriented for maximum effect.

• • •

PLASTICON CAPACITORS

Plasticon TS capacitors and TS pulse-forming networks have been announced by Condenser Products Co., 1375 North Branch Chicago, Illinois.

TS capacitors are recommended for ultra high temperature *dc* applications and for *rf* bypassing and coupling duty. Typical example is TSG103-3, an .01-mfd, 3,000 v *dc* capacitor in a Glassmike style container 29/32" *OD* × 2¾" long. The *dc* resistance is in excess of 100,000 megohms at 150° C; dissipation factor at 1 mc is .0005 at 70° C and .001 at 150° C. The temperature coefficient is negative, 300-400 parts per million per degree C.

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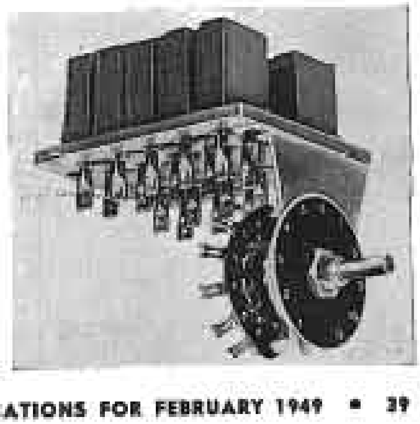
JOHNSON CRYSTAL SELECTOR

An Instant Crystal Selector, providing selection of ten frequencies, has been announced by E. F. Johnson Co., Waseca, Minn.

The unit accommodates all crystals with ½" spacing. With adaptors it is possible to use up to six of upright ¾" spaced crystals, plus four with ½" spacing. There is an extra position on the switch for *vco*.



FM Broadcast Monitor*

by MARTIN SILVER

Federal Telecommunication Labs.

Part II

IN ANALYZING the voltage regulation circuit,[1] it was pointed out that the circuit is so designed that the increased voltage drop is exactly equal to the voltage increase so that there is no net change.

If there is a drop in the original *dc* output, each step is reversed giving the same final result. To make sure that the characteristics of amplifiers V_4 and V_5 will not be effected by changes in filament current caused by a varying line voltage, a constant current tube, V_6, was placed in series with the filament transformer.

Constant Voltage Tube

V_8, the constant voltage tube, has two functions. In the first place it is a voltage dropping media so that the cathode bias of V_3 will not be too high. Secondly, it increases the sensitivity of the circuit. This is best explained by an example. Let us assume that the normal potential between the plate of V_2 and ground is 200 volts. Now, due to a change in line voltage, this is increased to 205 volts. The voltage drop across V_8 is always 150 volts so that the normal cathode bias is 50 volts. When the aforementioned voltage increase occurs this is stepped up to 55 volts. Thus the full 5 volts increment is reflected across R_8.

Now let us consider what would have happened if a conventional volt-

*Illustration of monitor which appeared last month was presented through the courtesy of *FTR*.

[1]COMMUNICATIONS, January, 1949.

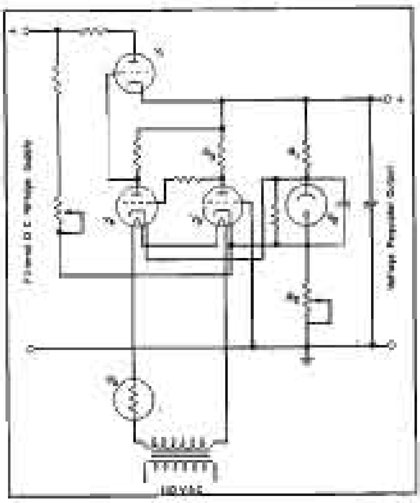


Figure 1
Voltage regulation circuit used in monitor.

age divider circuit were used. Instead of V_2 we would have a resistor whose resistance would be three times that of R_3 to give the same cathode bias. When the 5 volts increase occurred, the voltage increased across R_3 would only be 1.25 volts. Obviously the sensitivity of the circuit is thereby reduced.

To reduce the ripple voltage to a minimum of ripple a feedback circuit is utilized. This circuit, feeding from the cathode of V_3 to plate of V_1, presents a high impedance to slow changes in the *dc* output but is virtually a short circuit for ripple voltage frequencies. As before changes in the *dc* output are reflected across the V_3 cathode bias, but now these fluctuations are fed back directly into the plate circuit, 180° out of phase with the original ripple.

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WBRC-FM

(*Continued from page* 18)

portant control-circuit keys such as *transmitter on*, studio and local switches are protected from accidental tripping by chromium-plated guards.

Antenna cutback equipment consisting of triple-latch transmission line switches is provided. Electrical switching is accomplished by utilizing impedance characteristics of shorted, quarter-wave transmission line sections.

A single control switch transfers the antenna to the 10-*kw* stage, and at the same time isolates the final amplifier, driver, and high-power blower. Final and driver tube changes or maintenance are thus possible in safety while program continuity is maintained.

A harmonic attenuator is provided to insure maximum suppression of harmonic radiation. A self-contained unit, it consists of a pre-tuned low-pass filter capable of 38 db attenuation. Use of generous size line elements assures low-insertion loss. A transmission line monitor acts as a *watch dog over* the antenna and transmission line. Any unwarranted change in signal intensity actuates the monitor and shuts down the transmitter. A reclosing mechanism returns the transmitter to air, if the fault is cleared. If fault persists, process is repeated and locks out on third attempt.

TV Distribution System

(*Continued from page 9*)

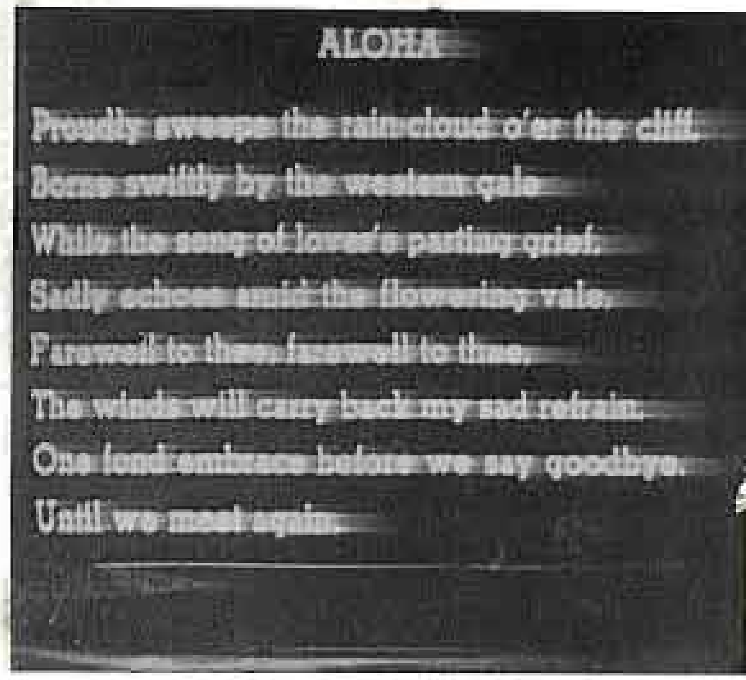
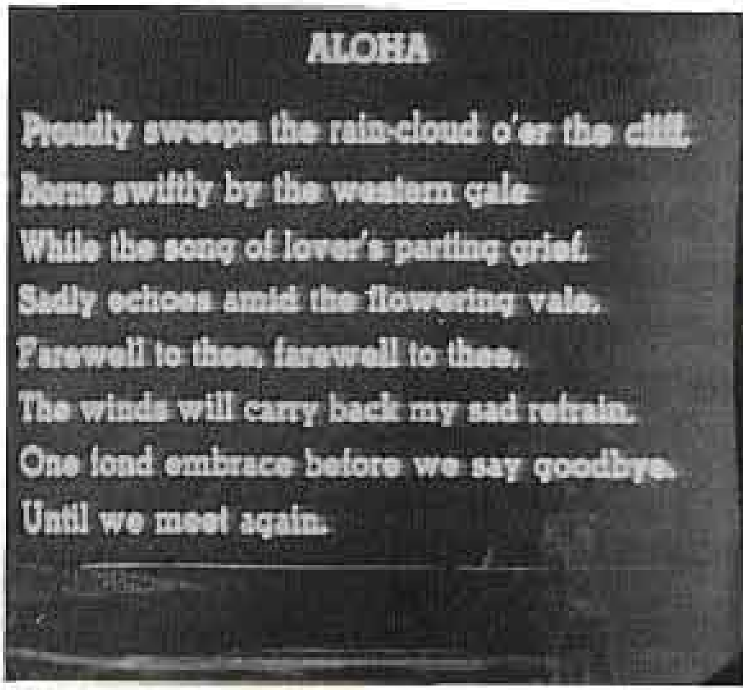


Figure 5
Picture transmitted over 1000′ of unequalized coaxial line.

ing lines both for picture quality and oscilloscope presentation.

When video distribution lines are run more than 300′, the series resistance of the inner conductor of the coaxial line causes a phase shift of midrange frequency components resulting in a smearing appearance of the picture. Figure 5 is a picture produced by the flying spot generator, running through 1,000′ of uncompensated RG6/U coaxial cable. This picture was photographed from a 10″ *crt* monitor bridged across the input to the line. The method used to equalize long

Figure 7
Picture transmitted over 1000′ of equalized coaxial line.



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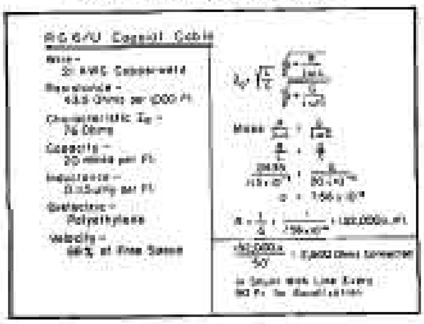
video lines is illustrated in Figure 6.

A coaxial cable using copperweld wire was selected because the variation of R caused by skin effect is much less than with copper. This means that all of the parameters effecting the characteristic impedance of the line can be considered as approximately constant. Since the conductance of polyethyline at video frequencies is practically zero a finite value can be assigned to it which makes the numerator under the radical equal the denominator. Solving the equation for R shows that substantially perfect equalization can be attained if a shunt resistance of 132,000 ohms is placed across the line every foot. Actually a shunt resistor of 2,600 ohms was used every fifty feet (*approximately a quarter wave at 4 mc*). Figure 7 shows the picture produced by the flying spot generator after passing through 1,000′ of compensated coaxial line.

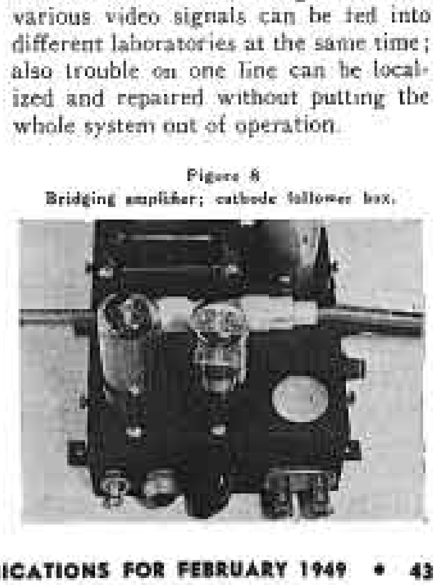
Figure 6
Formula for line equalization.



Cathode follower boxes, pictured in Figure 8, are used to bridge the lines for picking off video signal. These units have a built-in power supply and utilize a 6SN7 operating as a cathode follower. The gain of the follower is 0.8, and has an output impedance of 200 ohms. Three volts peak-to-peak of composite video signal is transmitted over the coaxial distribution lines and 2.4 volts is available at the output of each box. A control is provided on each box so the output level may be varied from zero to maximum.

This system is augmented by separate antennas mounted on the roof fed into the various TV laboratories by feed line. There is a distinct advantage, for research and development work, in having a video distribution system employing a number of short lines rather than one long line, since various video signals can be fed into different laboratories at the same time; also trouble on one line can be localized and repaired without putting the whole system out of operation.

Figure 8
Bridging amplifier; cathode follower box.



Last Minute Reports . . .

Tape Recording has become quite a factor in broadcasting. ABC has not only established complete tape recording facilities for its own use, but its clients too, with \$15.00, \$20.00 and \$35.00 rates selected for ¼-hour, ½-hour and one-hour recordings. These charges include an original and protection tape recording which may be used for broadcast, dubbing to disc, or for editing and assembling. Supplemental service charges have also been established for editing and assembly and re-recording. For editing requiring one engineer and a recorder, the charge is \$25.00 for the first hour and \$10.00 for any additional half hour or portion, and for re-recording tape-to-tape or tape-to-disc, the first hour charge is \$7.00, half hour, \$5.00, and ¼ hour or less \$3.00. . . . Sixty-nine broadcast engineers attended the recent sixth RCA TV technical training program at Camden. Among those at the meeting were:

F. Crandon, WCSH, Portland, Me.; E. Littlejohn and F. J. Kern, WFIL, Philadelphia; N. R. Olding, CBC, Montreal; M. L. Poole, CBC, Montreal; W. J. Carter, CKLN, Windsor, Ont.; James Carlisle, CBC, Montreal; W. H. Fattig and R. L. Newton, WCON, Atlanta; J. W. Keller, Jr., WKOK, Sunbury; Robert Schroeder, WBNS, Columbus, O.; I. V. Sanderson, WSGN, Birmingham; George Cuthbert, Famous Players Canadian Corp., Toronto; T. A. M. Craven, Craven, Holmes & Culver, Washington; C. Eastwood, CFRB, Toronto; E. L. Markman, Western Conn. B/C Co., Stamford; E. L. Cordes, WTMJ, Milwaukee; Chester Beachill, CFRA, Ottawa; Jack Siegel, WLOW, Norfolk; Edwin S. Busby, WTAR, Norfolk; C. F. Halle, WXEL, Cleveland; William George, WXEL, Cleveland; N. L. Straub, WJAC, Johnstown; Obert Erwin, WJAC, Johnstown; R. E. Cannon, Jr. WINX, Washington; A. Bates, KFAB, Omaha; Vinton Wight, KFAB, Omaha; H. R. Wehrman, KLZ, Denver; C. Harris, WIP, Philadelphia; L. E. Kilpatrick, WSAZ, Huntington, W. Va.; Willard Hines, WKY, Oklahoma City; W. A. Smith, WROK, Rockford, Ill.; G. R. Ryan, WBBC, Flint; H. J. Nafzger, WBNS, Columbus, O.; William Orr, WELD, Columbus, O.; Francis Jacob, WWL, New Orleans; D. F. Hynes, WWL, New Orleans; J. D. Bloom, WWL, New Orleans; R. J. Sinnett, WHBF, Rock Island; J. T. Helland, WDAY, Fargo; C. F. Quentin, KRNT, Des Moines; D. G. Sinclair, KVFD, Ft. Dodge; Roger Perry, WPOR, Portland, Me.; Roland Hale, WGOP, Boston; Harold Durschag, WEEI, Boston; J. M. Burke, WAAM, Baltimore; G. W. Fordham, KFKU, Lawrence, Kansas; A. H. Chismark, WTRY, Troy; H. W. McCrae, CBC, Montreal; L. G. Stevens, WLAV, Grand Rapids; Jack Jiruska, KCRG, Cedar Rapids . . .

G. H. Felt, professor of electrical engineering, University of Illinois, has been elected president of the 1949 National Electronics Conference which will be held at the Edgewater Beach Hotel in Chicago on September 26, 27 and 28. . . . R. W. Wassenberg is now operations manager of KPIX in San Francisco. . . . Bernard J. Kellom is chief engineer of WVNJ which recently went on the air with its transmitter in Livingston, New Jersey, on 620 kc. . . . Brigadier General David Sarnoff, chairman of the board of RCA, will officiate at the third annual meeting of the Armed Forces Communications Association, of which he is president, in Washington March 28 and 29.

At the recent TV clinic conducted by CBS: CBS vice president Larry Lowman, W. B. Lodge, CBS vice president in charge of general engineering and former FCC Commissioner E. K. Jett, now vice president and general manager of WMAR-TV, Baltimore.

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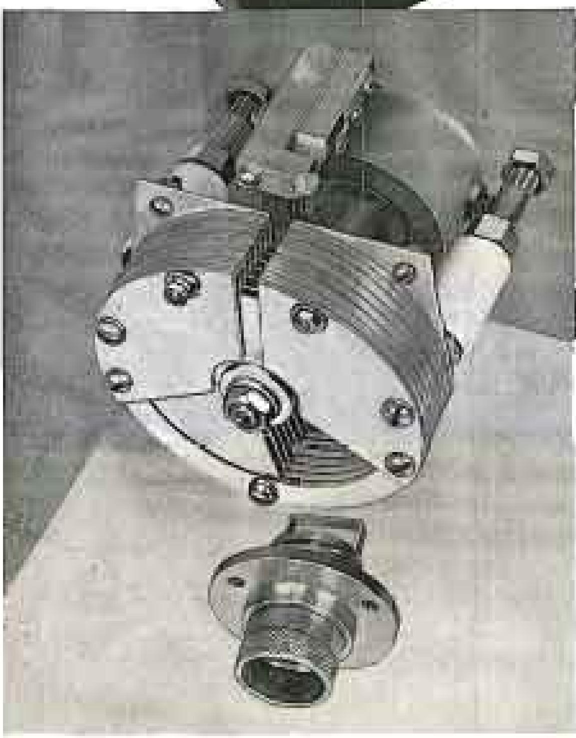
FEBRUARY, 1949

100 to 500 Mc OSCILLATOR



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

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

FEATURES

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

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

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Five tubes with improved internal constructions that contribute to their more efficient operation and longer service life.

These five new RCA tube types are "musts" for designers of broadcast, communications and industrial electronic equipment where design and operating economies alike are important considerations.

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RCA Application Engineers are ready to consult with you on the application of these improved tubes and accessories to your specific designs. For complete technical information covering the types in which you are interested, write RCA, Commercial Engineering, Section 58BR, Harrison, New Jersey.

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