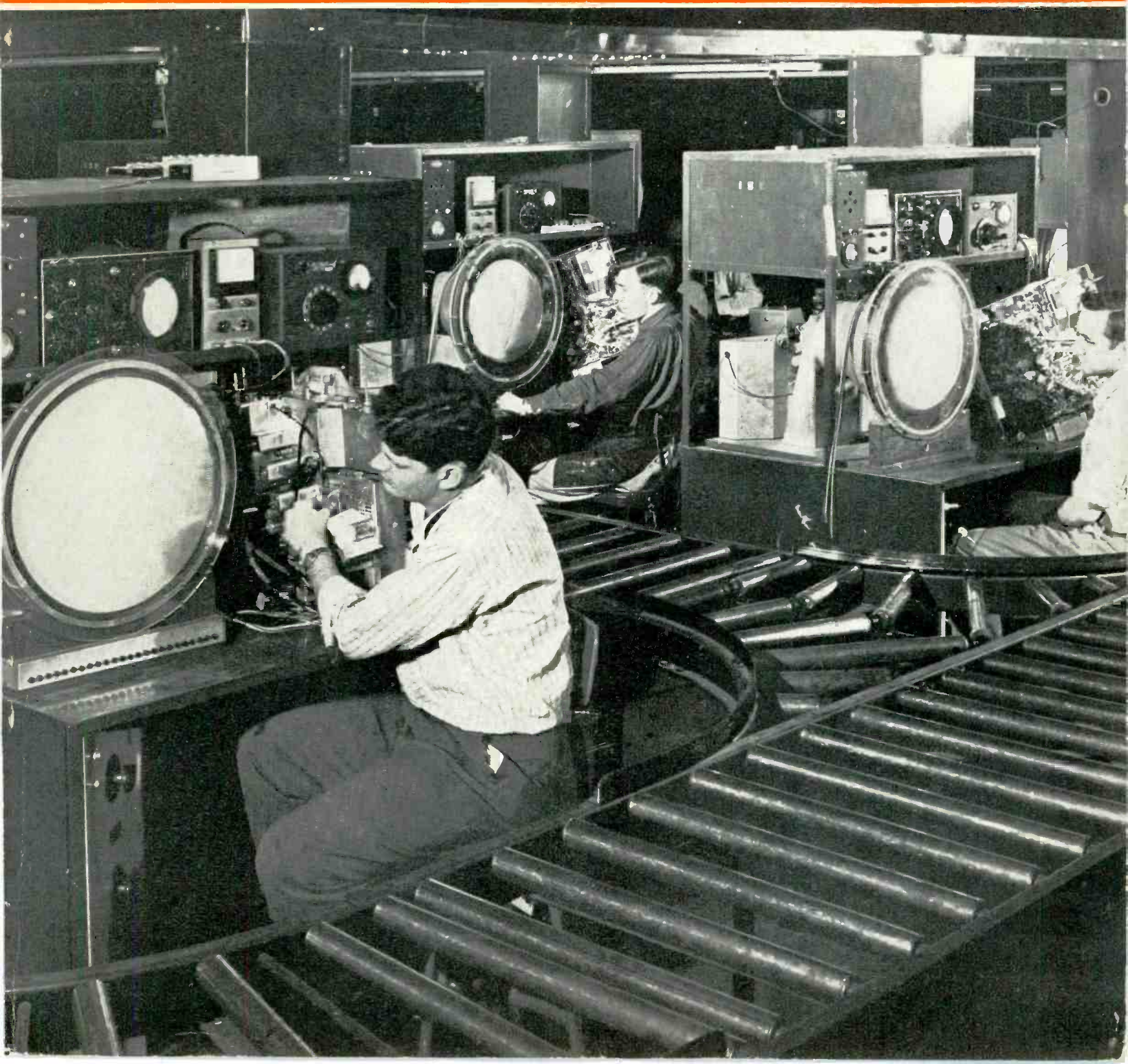
TELEVISION ENGINEERING

JANUARY, 1950



With more and still more telecasters it's Du Mont TV camera equipment because of outstanding

DEPENDABILITY

DU MONT
Type TA-124-B
Image Orthicon Chains

Many TV stations either on the air or under construction, are Du Mont-equipped throughout. That means the Du Mont Type TA-124-B Image Orthicon Chain for studio and remote pick-ups, alike.

But of even greater significance is the growing use of Du Mont cameras and auxiliary equipment by TV stations originally using other makes of equipment; by intra-store television demonstrations; by wired television installations; by movie producers experimenting with television production possibilities; by TV training schools; by government agencies both here and abroad.

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But the outstanding characteristic of this popular Du Mont Type TA-124-B Image Orthicon Chain is DEPENDABILITY. That, in the final analysis, is the all-important consideration. For "The show must go on," regardless.

$$SD+QW=\frac{D}{FWFT}$$

(Simple Translation)

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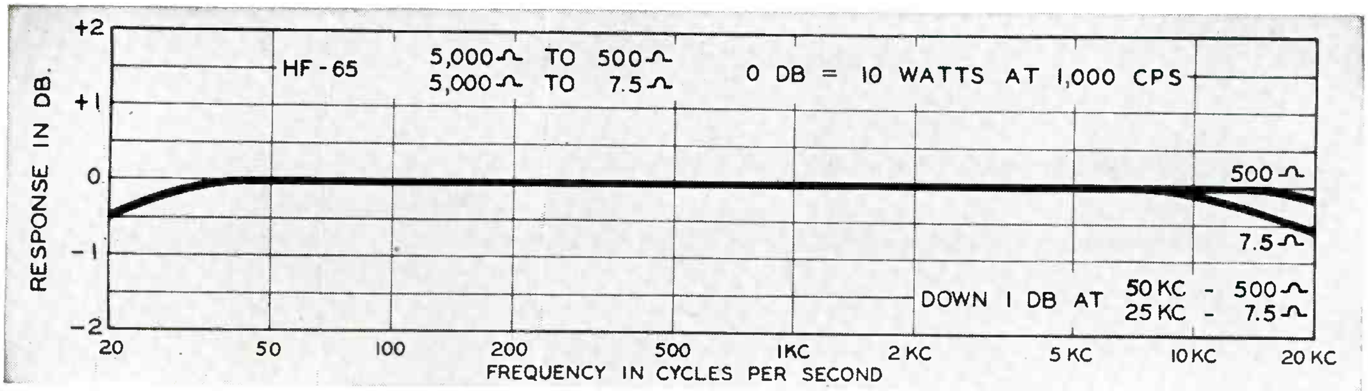

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Part Number	Application	Primary Impedance in Ohms	Secondary Impedance in Ohms	Response ±1 DB From	Max. Pri. DC Unbalance	Max. Level	*Hum-Pickup Reduction
			LOW IMPEDANCE TO GRID				
HF-20	Low Impedance Microphone, Pickup or Multiple Line to Grid	50, 125/150, 200, 250, 333, 500/600	60,000 ohms overall, in two sections	20 to 20,000 cps	0.5 ma	15 db	-74 db
HF-20X	Low Impedance Microphone, Pickup or Multiple Line to Grid	50, 125/150, 200, 250, 333, 500/600	50,000 ohms	20 to 20,000 cps	0.5 ma	14 db	-92 db†
HF-22	Low Impedance Microphone, Pickup or Line to P.P. Grids	50, 125/150, 200, 250, 333, 500/600	120,000 ohms overall, in two sections	20 to 20,000 cps	0.5 ma	15 db	-74 db
HF-22X	Low Impedance Microphone, Pickup or Line to P.P. Grids	50, 125/150, 200, 250, 333, 500/600	80,000 ohms overall, in two sections	20 to 20,000 cps	0.5 ma	14 db	-92db†
			INTERSTAGE				
HF-29	Single Plate to P.P. Grids—2A3, 6A3, 6L6, etc.	15,000 ohms	95,000 overall 1.25:1 each side	20 to 20,000 cps	.0 ma	17 db	-50 db
HF-31	Single Plate to P.P. Grids, Split primary and secondary	15,000 ohms	135,000. Turns ratio 3:1 overall	20 to 20,000 cps	.0 ma	14 db	-74 db
HF-32	P.P. Plates to P.P. Grids, Split primary and secondary	30,000 Plate to Plate	80,000 Turns ratio 1.6:1 overall	20 to 20,000 cps	0.25 ma	26 db	-50 db
			MIXING				
HF-40	Low Impedance Mixer, Microphone, Pickup or Line to Line	50, 125/150, 200 250, 333, 500/600	50, 125/150, 200, 250, 333, 500/600	20 to 20,000 cps	0.5 ma	17 db	-74 db
			OUTPUT				
HF-65	P.P. 2A3, 6L6, etc. to Line or Voice Coil	3,000 to 5,000 Plate to Plate	1.2, 2.5, 5, 7.5, 10, 15, 20, 30, 50, 125, 200, 250, 333 or 500	25 to 20,000 cps	5.0 ma	20 watts	....
HF-67	P.P. 2A3's, 6A5-G's, 300A's, 275A's, etc. to Voice Coil	3,000 or 5,000 Plate to Plate	30, 20, 15, 10, 7.5, 5, 2.5, 1.2	25 to 20,000 cps	5.0 ma	20 watts	....
HF-68	P.P. Par. 2A3's, 6A5-G's, 300A's, 6A3's to Line or Voice Coil	1,500 or 2,500 Plate to Plate	500, 333, 250, 200, 125, 50, 30, 20, 15, 10, 7.5, 5, 2.5, 1.2	25 to 20,000 cps	5.0 ma	40 watts	....

*As compared to standard uncased units. †Quadruple alloy magnetic shield.

WE WELCOME COMPARISON, under identical test conditions, of Stancor "HF" units with equivalent types of any other brand of high fidelity transformer, regardless of published claims. Frequency response curve charts sent on request.

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TELE-VISION ENGINEERING

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VOLUME 1 — JANUARY, 1950 — NUMBER 1

MONTHLY FEATURES

Cover Illustration

Aligning TV receivers in a receiver test booth at the East Paterson plant of Allen B. Du Mont Laboratories. Equipment used includes speaker with output meter, vtvm, 'scope and volt box (variac voltage control). Test signals are piped in to the booth; these include video and sound sweep signals (with appropriate markers), AM and FM trap signals and monoscope picture signal.

Editor: **LEWIS WINNER**

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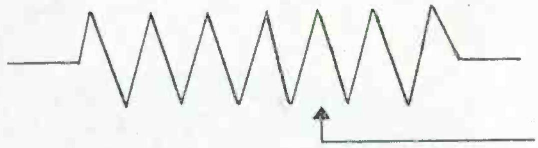
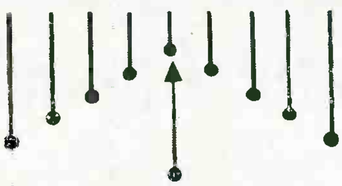
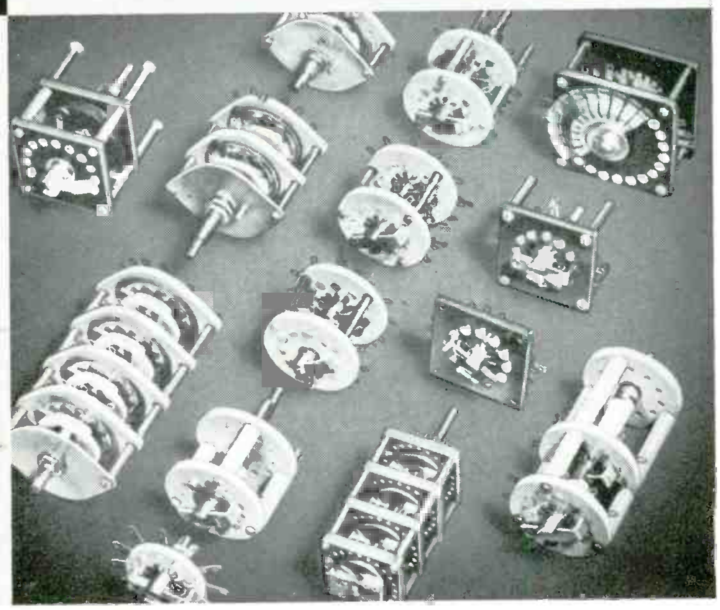
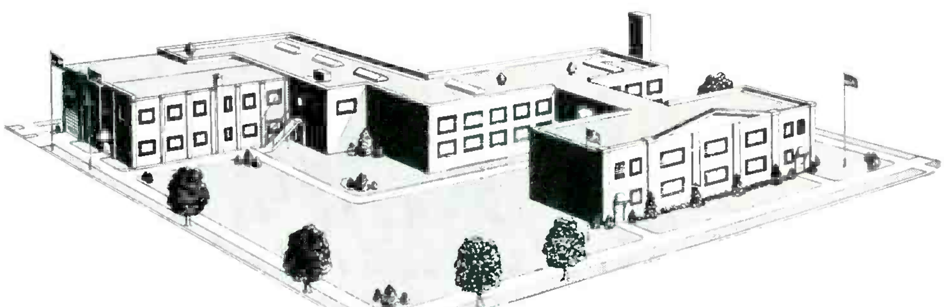








TELE-VISION ENGINEERING

LEWIS WINNER, Editor

January, 1950

TVE

WITH THE SIGHT AND SOUND calendars of practically every manufacturer, laboratory, broadcaster and consultant in this country and across the seas, brimming with the most enthusiastic plans ever recorded and with predictions of unparalleled progress in every phase of the art on the books, television appears to have reached that epic stage which spiralled radio to such heights in its early days.

To serve this new surging industry, a new journal has been founded, a new journal which we introduce this month. . . . TELEVISION ENGINEERING.

TVE will serve industry completely, as COMMUNICATIONS did, a point on which we take pride in quoting J. R. Poppele, TBA prexy.

Reports Poppele: "For many years the Bryan Davis Publishing Company, through its valued publication COMMUNICATIONS, has served the rapidly-expanding communications industry with an authoritative vehicle, for the expression of varying viewpoints of the significant advances in the art.

"With television now forging forward as the most absorbing and all-encompassing electronic achievement of the modern era, it follows that the name COMMUNICATIONS should yield to the trend of the times. Hence a new title, TELEVISION ENGINEERING has replaced the mast-head of this publication.

"Through the medium of TELEVISION ENGINEERING, a new common ground has been established through which manufacturers may bring to the attention of engineers new products and services for the betterment of television, and by the same token, individual engineers may air their views on current advancements in the science of television broadcasting and reception. In all, this common meeting place will redound to the benefit of the entire industry.

"It is with great pleasure that I salute ye editor and all members of the staff of TELEVISION ENGINEERING on the birth of this new publication. Long may it continue to serve the industry and the public."

On The Horizon

IN THE MOST OPTIMISTIC series of year-end statements issued in a decade appears quite an exciting picture of TV's future in '50. According to Allen B. DuMont Laboratories prexy, Doc DuMont, figures show that television represents one of the fastest growing industries in the nation's history. At the end of last year, he reported there were only 49 stations on the air in 29 cities, and at this writing there are 98 stations operating in 58 cities.

Commenting on 1950, Doc DuMont said: "A great deal depends on the FCC's action on lifting the freeze. However, regardless of this factor, the total investment in the television industry will top five-billion dollars. . . . If the FCC ban is lifted soon enough there could be 100 new stations by the end of the year, with an increase in the number of sets to at least 10,000,000."

RCA prexy, Frank M. Folsom, called TV a billion-dollar industry in his report.

Said Folsom: "At the end of 1949 the wholesale value of TV sets purchased by the American public exceeded one-billion dollars. The automobile industry, operating at a much higher price bracket, required more than ten years to achieve a similar status. . . . To achieve new production records in '50, industry reports indicate that capacity will be increased by nearly 50 per cent. . . . The impact of television on the national economy is already having far-reaching effects. Vast amounts of raw materials are being drawn from all sections of this country, and tens of thousands of workers are being employed to turn these materials into television set components and subassemblies."

Brigadier-General David Sarnoff, RCA chairman of the board, predicted in his statement that by the end of 1954 there would be about 20,000,000 television receivers in American homes for a total viewing audience, at that time, of approximately 75,000,000 people. General Sarnoff emphasized that television shook off its *adolescence* and came into *man's estate* in '49.

Dr. W. R. G. Baker, G. E. vice-prexy, disclosed in his report that television dominates the electronic business. According to Dr. Baker: "The public will spend over $800,000,000 for TV receivers in '50, plus $60,000,000 for installation. To support this demand the industry is setting its production sights for a 30 per cent increase over '49. . . . At the end of '50 television programs will be available to 65 per cent of the American people. . . . Looking ahead to the end of '51, I believe that the nation will have a total of 300 TV stations."

TV's impact on industry was also evident in a report from IRE covering their annual national convention for 1950 (March 6-9). More papers on television have been scheduled than ever before. Up for discussion will be the *vidicon,* a new photoconducting pickup tube; filters for TVI; wideband *rf* problems in transmitters; techniques for closer channel spacing at the veryhighs and ultrahighs; electro-optical filters for color television; hybrid ring diplexers for ultrahigh TV; noise suicide circuits; printed-circuit tuner design, etc.

The TV horizon indeed looks bright for '50 and the '50s, too. — L.W.

Trends in

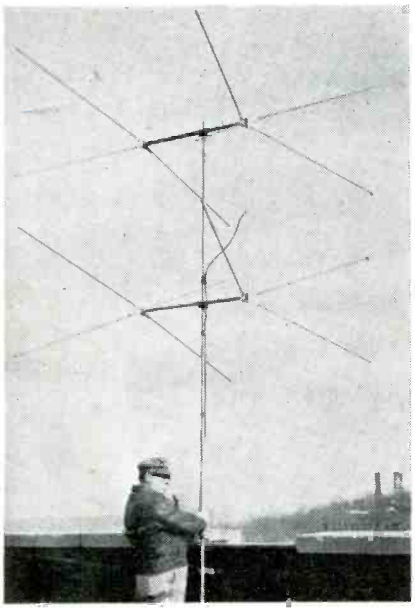


Figure 1

A conical V-beam type of antenna.[1]

(Photo by William Kirby)

THE TV receiving antenna, which during '49, went through an interesting cycle of design and production, will during the coming months become quite standardized and employ those basic patterns which extensive tests have proved to be most reliable. Inclusion of accurate curves, assurance of guaranteed results under given conditions and provision of mechanical assemblies designed with the understanding that time consumed in assembly is as important as all the other features of the antenna, will be highlight features of these antennas. The intensive desire to insure results may accelerate the effort to begin operation under a program of industry standards now being probed. In reviewing the possibilities of such a procedure, three factors, predicated on field experiences,[18] have been found to be particularly significant for such a plan.

Performance Standards

These points, covering the broadband, high-gain broadband and combination antennas are:

(1) A broadband antenna should provide a signal pickup on all channels (2 to 13) which is greater than a dipole adjusted for each individual channel.

(2) A high-gain broadband fringe area antenna should have a signal pickup on all channels, which is at least 3 db greater than a dipole adjusted for each individual channel.

(3) All combination antennas (*lf* and *hf* units adjustable as separate assemblies) which are designed to operate into a common transmission line through a divider or mixer network should have a signal pickup on all channels which is comparable (within 3 db) to a dipole adjusted for each individual channel.

Conical V Beam Antennas

One type antenna, which will be quite prevalent during the year is the conical V beam. This model, which meets two of the foregoing specifications, is a broadband type. It conforms to specification *1* when installed as a simple *V* beam and exceeds specification *2* when used as a double stacked array, as shown in Figure 1.

Essentially, each conical is a stacked dipole in which the apex of the lower dipole is adjacent to the apex of the upper dipole. At the open ends of the dipoles there is a 1/8 wavelength spacing for channel 2 and a 1/2 wavelength spacing at channel 13. This method of spacing of the dipoles has the effect of increasing the gain of the antenna without going through the sharp resonant points so common with the standard lazy *H* application of straight dipoles. Although the dipoles are slanted they still tend to cancel noise

[18]Based on a series of tests of over forty types of antennas submitted by more than twenty manufacturers.

Figure 2

A conical three-finger fan-type antenna.[2]

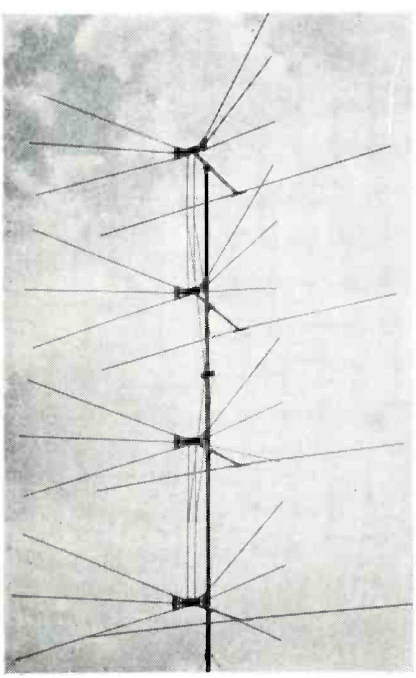
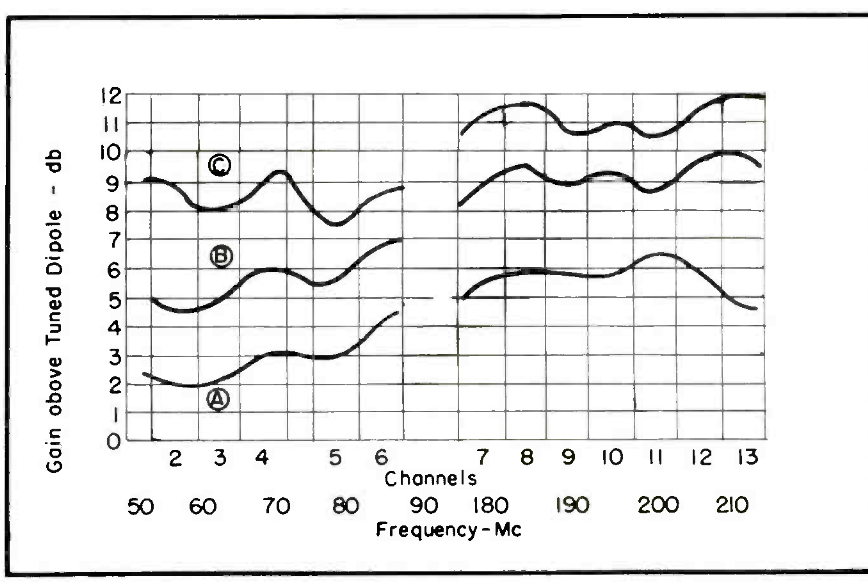


Figure 3

Gain curves of the three-finger fan-type antenna plotted for a single, two and four-bay array.



TV Receiver ANTENNA DESIGN

Critical Analysis of Eight Types of Antennas Found to Represent Trends for 1950: Conical V Beam, Fanned or Three-Dipole Conical, Folded Dipole with Forward Tilt, Stacked Double Folded Dipole In-Line Type of Array, Reversible Beam, Full-Wave Stacked Dipole Array, LF and HF Combinations with Divider or Decoupling System and the Yagi.

by IRA KAMEN

Manager, Television Department
Commercial Radio Sound Corp.

pulses induced from vertical sources in the same manner as straight stacked dipoles. The slanted dipoles which form a conical figure are tilted forward. The tilting of the conical elements in the forward direction is the most important fundamental in the antenna's design since this tilting confines the pickup angle to a single frontal lobe, thereby increasing the gain of the antenna and the signal-to-noise ratio, as undesired signals emanating from sources at the rear of the antenna are attenuated. The gain of this antenna is further increased by the application of conical type reflectors and antenna stacking.

A single stack of conical elements provides a reasonably good match to a 300, 225, and 150-ohm line over the complete band. A mismatch of not more than 2½:1 can be considered reasonable. When the conical elements are stacked in a two or four-bay array, best matching is achieved with a 75-ohm coaxial cable, although more than satisfactory results are assured with higher impedance lines.

Another type of conical is the fanned or three-dipole arrangement (Figure 2) which has been found to favor gain on the higher channels, to compensate for the increased cable and transmission losses at these frequencies. This antenna may also be stacked in two and four-bay arrays to satisfy fringe area requirements.

Benefits achieved through stacking are illustrated on Figure 3 (a, b and c). Incidentally, this type antenna also features a forward tilt and conical configuration.

Tests have indicated that this antenna provides a reasonably good match to all transmission lines as a single stack, and a better match to coaxial cable as a stacked two and four-bay array.

In Figure 4 appears another practical type of design, which may be considered as a trend for the year. This antenna employs the forward-tilt principle applied to a folded dipole. The three reflectors shown are cut to the mean frequency of channels 2, 4 and 5, the *lf* channels being used in the New York, Chicago, and Los Anegeles areas. The reflectors are also spaced the correct distance from the folded dipole elements; that is the channel-2 reflector element is furthest from the folded dipole and the chan-

Figure 4
Folded dipole with a forward tilt, set up with low frequency reflectors[3] for channels 2, 4 and 5.

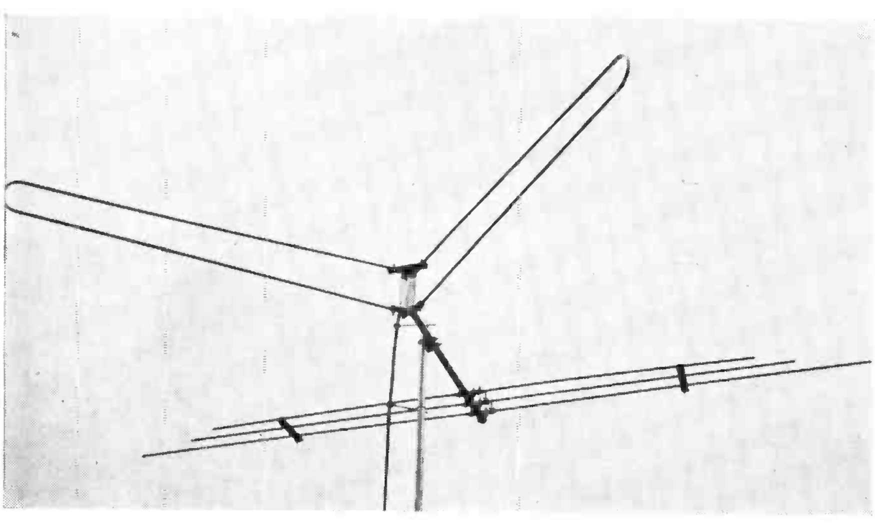


Figure 5
The forward-tilt folded-dipole in a stacked installation. Note the single channel yagi over this array which was installed to provide pickup of a weak channel transmitting from another direction.

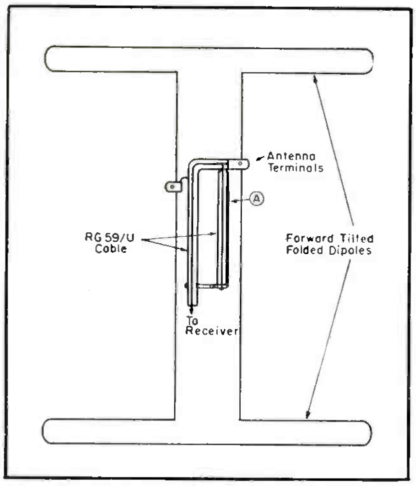


Figure 6
How the stacked array shown in Figure 5 can be connected to a coax cable through the use of a balancing transformer circuit. A represents the balanced stub.

Figure 7
Three-top installation of a stacked array.[4] Turnstile antenna below the TV stack was installed to improve FM reception.

(Photo by A. W. Schneider)

nel-5 element is the closest. While as a single array, with reflectors, this unit meets specification *1*, in our table, we find that it favors the low-frequency channels because of the efficient operation of the folded dipole, with respect to an individual reflector which is cut and adjusted for a specific low-frequency channel. As a double-stacked array (Figure 5) this antenna meets specification *2*; measurements of the antenna in a stacked form revealed that the antenna assembly does tend to favor the low-frequency channels in antenna gain.

This model antenna is furnished for matching a 72- or 300-ohm line. As a double-stacked unit, for matching 300-ohm line, a standard cable harness is supplied. To match a balanced stacked array to a coaxial line a coaxial-line balancing transformer can be used, as illustrated in Figure 6.

LF-HF Folded Dipole Array

Figure 7 illustrates an *in-line* type of array (assembly of a *hf* folded dipole in front of a *lf* folded dipole and reflector) which has been found to be highly acceptable, the single array meeting our specification *1* and the double stacked array meeting specification *2*. Incidentally, the *hf* folded dipole raises the gain of the *lf* assembly by acting as its director.

This type of antenna affords a reasonably good match to 300, 225 and 150-ohm transmission lines.

The *in-line* tree installation shown in Figure 7 represents probably a mounting trend in some areas. In selecting a tree mount, it is necessary to avoid those sites where foliage may subsequently surround the antenna.

Reversible Beam Antenna

The reversible beam antenna (Figure 8) represents another '50 trend type of antenna. In this arrangement we have an array of dipole elements and 45° high-frequency *vee* attachments, which can be added to the low-frequency elements without introducing a loading effect on the low-frequency patterns.

This antenna assembly has quite a tricky network (Figure 9), which operates, with the dipoles, in the following manner:

(1) The upper and lower dipole elements are joined in phase at midpoint, while the end-dipole *1* and end-dipole *2* elements are joined out of phase at midpoint by means of transposed line.

(2) These transmission-line arrangements have been found to assure independent operation of the upper and lower dipoles and the end dipoles at all frequencies.

(3) The two midpoints are used to feed the unterminated ends of a diplexer network. One of the feed lines between the antenna and the diplexer network is made a quarter wavelength longer than the other to solve the quadrature phasing problem between the two pair of dipole arrays.

The diplexer network illustrated is a bridge circuit of three straight sections and one transposed piece of quarter-wavelength line. One end of the bridge feeds the television receiver and the other has a 150-ohm terminating resistor.

(4) The TV signals received from the transmitter (*X* in Figure 9) are induced into the four dipole assemblies, transferred down lines *A* and *B* and appear at ends of the bridge as in-phase voltages. There is no potential across the resistor, however, because

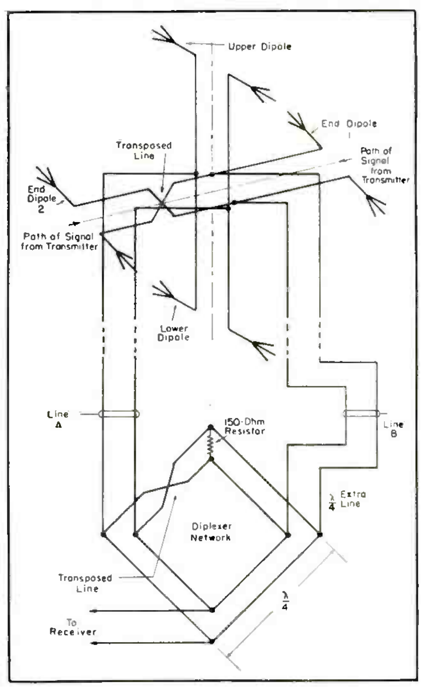


Figure 9
Wiring diagram of reversible beam-antenna array and diplexer, and receiver. The path of the signal from the transmitter, shown at left, has been referred to as X in the text, and the path of the signal from the transmitter at the right, as Y.

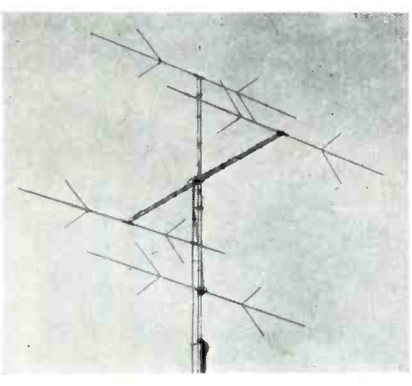


Figure 8
Reversible beam TV antenna.[5]

the transposed line on one side of the bridge to the resistor develops voltages of opposite polarity across the resistor and therefore no power is dissipated in this resistor. The in-phase and additive voltages at the opposite end of the bridge then become available to drive the television receiver input.

(5) The TV signals received from the transmitter (*Y* in Figure 9), which feed the dipoles from the opposite direction, are transferred down lines *A* and *B* and appear out-of-phase at the ends of the bridge and across the receiver input. However, they are in phase and additive across the resistor (which absorbs the signal) and therefore unidirectional reception is assured. This is a very desireable arrangement which prevents venetian-blind effects in a fringe area, where it's possible to pick up two stations on the same channel, such as channels 4 in New York City and Boston.

If the signals are desired alternately from transmitters *X* and *Y*, it is only necessary to transpose either line *A* or *B* via a transposition switch, which can be of the *rf dpdt* knife type. The diplexer network can be installed close to the receiver in this instance. A relay circuit can be employed when the diplexer network is located at a remote point from the receiver.

This antenna is designed for application with a 300-ohm transmission line exclusively and conforms to our specification 2. Care must be taken when switches or relays are inserted in the 300-ohm transmission line, so that they do not upset the characteristic impedance of the transmission line. To check this point, tests should be made of the circuit performance with and without the switch or relay in the diplexer circuit.

Another antenna which has been found theoretically sound and can be applied to trend thinking (meeting specification 2) appears in Figure 10. Here we have an assembly of four pairs of full-wave stacked dipoles. In this model, over the *lf* dipole cut for channel 4 is a *hf* dipole cut for channel 9. Thes dipoles are parallel connected.

Three engineering principles have been followed in the assembly of these dipoles to secure additive gain into a common transmission line:

(*1*) As the mean frequency impedance of the full-wave dipoles is approximately 1200 ohms, it is possible to set up a cable harness linking the signals on the four pair of dipoles, so that the impedance at the midpoint (1200/4) is around 300 ohms.

(*2*) It is generally known that when dipoles are stacked with half-wave separation they have more gain and a broader bandwidth characteristic than with quarter-wavelength spacing. This antenna realizes the benefit of half-wave separation, although the vertical separation between the dipoles is only a quarter wavelength, for the cable harness joins alternate dipoles. It will be noted from the illustration, that the *lf* and *hf* dipole *1* is connected to *lf* and *hf* dipole *3* and *lf* and *hf* dipole *2* is connected to *lf* and *hf* dipole *4*, thereby achieving effective half-wave separation. The two midpoints are then joined to match a 225 or 300-ohm transmission line.

(*3*) The reflectors in this stacked dipole assembly are also dipoles; that is they are not a solid bar but are insulated at the midpoint. The dipole-type reflectors provide a broader-band lower-gain characteristic than solid reflector bars, although higher gain can be obtained on channels 4 and 9 (the frequencies to which the dipoles and reflectors are cut) by shorting the reflector dipoles to resemble a solid bar, at the sacrifice of gain on the other channels.

A practical installation of the foregoing antenna with a remotely controlled antenna motor is shown in Figure 11. Experience has shown that in many mountain areas, the reinforced reflection from a nearby hill or mountain provides a stronger signal than the direct *on target* antenna adjustment.

Combination antennas* of many types using divider and decoupling network arrangements represent another trend setup, which meets our specification 3.

For at least another year many areas will be served by only one TV channel and the 300 and 72-ohm yagis, the last of our trend-type antennas, will be found to be the most efficient low-cost solution.

Figure 10
Circuit of a four-bay stacked full-wave straight-dipole[1] arrangement.

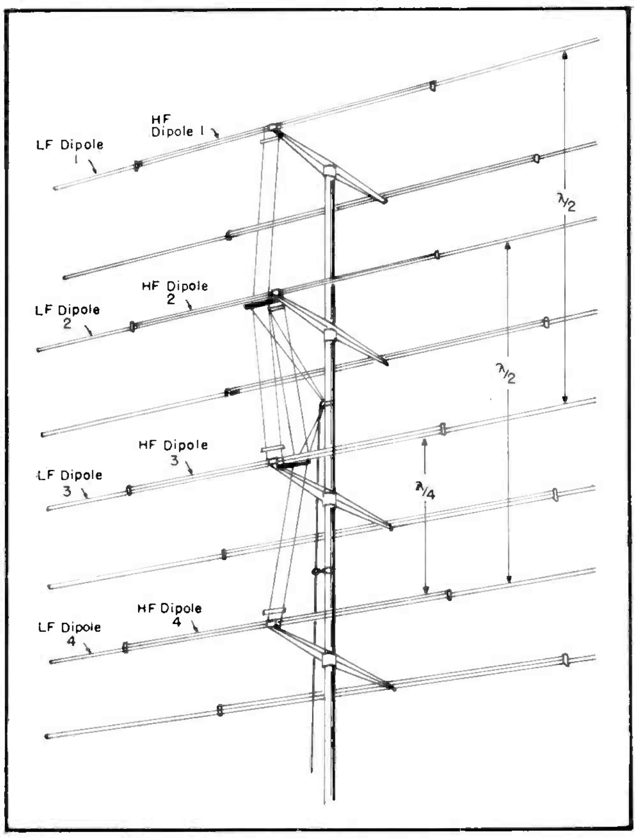
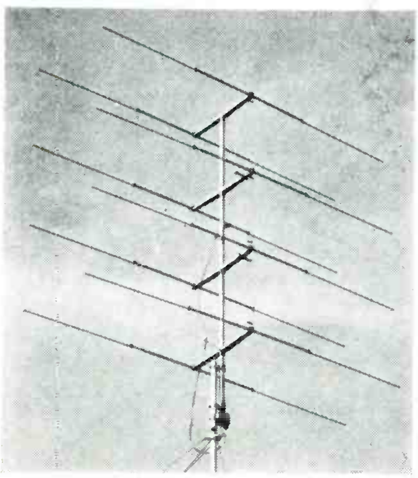


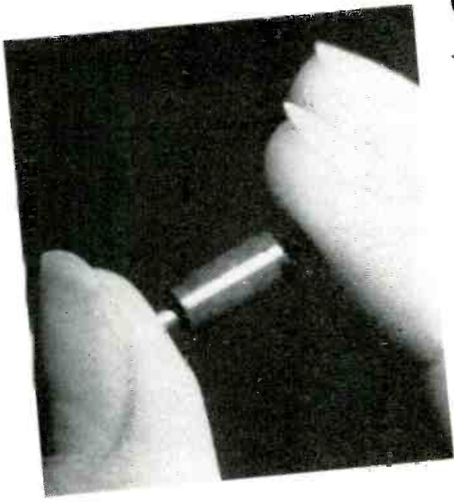
Figure 11
A four-bay full-wave stacked array installed with an antenna motor in a mountainous fringe area.



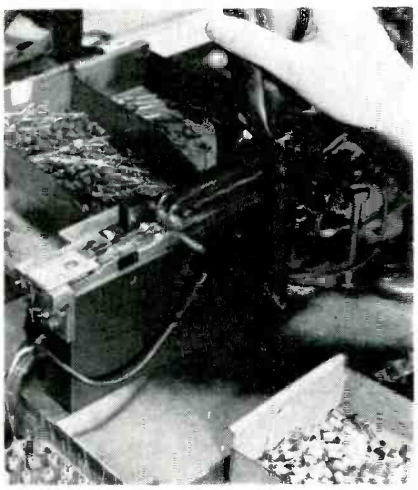
[1]Telrex.
[2]Channel Master.
[3]Dielectric Products.
[4]Amphenol.
[5]RCA.
[6]Vee-D-X.

*For complete review see *TV, FM Antenna Installation* by Ira Kamen and Lewis Winner, Chapter X, pages 88 and 89.

Germanium Diodes for



Left: The germanium diode developed for uhf TV converter applications.



(Above)
Welding the whisker to the pellet inside of the plastic case.

THE ANTICIPATED use of converters and receivers for the proposed 475 to 890 mc band has propelled interest in the application possibilities of the small size mixer diodes, which appear to have many operational advantages at these frequencies.

Most of the equipment operating in the ultrahigh range to date has used the silicon 1N21A and 1N21B diodes. While this type diode has been found to work well as a mixer at the higher frequencies, it does have the disadvantage of extreme susceptibility to accidental burnout.

Specifically germanium diodes have been found to offer such advantages as:

(*1*) Absence of heater supply, permitting circuit simplification and less *rf* loss when applying them to *rf* circuits.

(*2*) No possibility of *ac* hum from heater supplies.

(*3*) Lower input capacity than normal run of vacuum tube.

(*4*) Better signal-to-noise ratio than tubes at *uhf*.

(*5*) No contact potential.

(*6*) Greater forward conductance.

Unlike the vacuum tube the diode has finite back resistance which must be considered. This resistance is not constant but decreases with increased temperature. By choosing the proper load resistance it is often possible to obtain a circuit with negligible change in rectification with temperature.

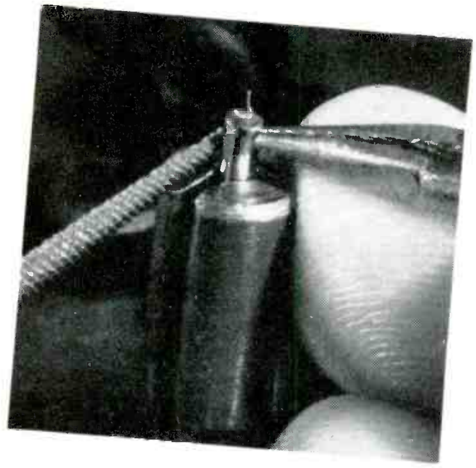
In developing one type of ultrahigh diode, a model[1], sufficiently small to be introduced into lumped tuning systems,

(Left and below)
Sawing pellets from a thin slice of germanium from the ingot.

UHF TV

by F. J. LINGEL

Crystals Section, Electronics Department
General Electric Company



Straightening the whisker point of the germanium diode under a microscope.

Crystal-Type Mixer Diodes, Featuring Welded Whiskers, Which Can Withstand Microsecond Pulses of 500 Ma in the Forward Direction and I Ma in the Back Direction, Developed for 475-890 Mc Band Converter-Unit Application.

characteristic of *uhf* circuits, was evolved.

The diode, in a plastic assembly approximately ½″ long and slightly less than ¼″ in diameter, is supplied with connecting pins 1/16″ diameter and approximately 1/16″ long which project from each end along with 1⅛″ wire leads.

The units may be wired into the circuit or the leads may be snipped off and the diode plugged into spring clips where this is desirable. The plugin assembly was found to make up a unit approximately 2/3 the size of the present 1N21 type.

Germanium, obtained by reducing the highest purity germanium dioxide powder under carefully-controlled conditions in hydrogen reducing furnaces, was found best for this type diode, with the resulting germanium reprocessed, control cooled and annealed to make a finished ingot, approximately ½″ in diameter and 1″ long. These ingots, sawed into pellets .050″ square by 0.020″ thick, and then soldered to small brass plugs, provided the miniature size units sought.

In processing the diodes, it was found necessary to record the temperature, gas flow, rate of cool, etc. Thus uniformity of the germanium could be established. To insure freedom from unwanted impurity contamination, periodic cleaning and inspection of the containers was also effected..

The welded - whisker - to - germanium construction used in previously made types of diodes[2] was also incorporated in the *uhf* diode. In producing this type of contact, it was found possible to weld the whiskerpoint to the germanium pellet by passing high *dc* through the contact. Tests shows that this provided a firm bond.

Prior to this welding step, a pin to which is welded a formed and pointed 3 mil platinum-alloy welded whisker is force fitted into one end of a plastic housing, and carefully advanced until the whisker contacts the germanium.[3]

Electrical Characteristics

Sensitivity and noise measurements[4] on the ultrahigh germanium diode have indicated close correlation with the ultrahigh silicon types. For example, typical sensitivity of the *uhf* germanium diode has been found to be between 4 and 8 microvolts, while the silicon type sensitivity is approximately 5 microvolts. Germanium diode noise values have been found to be between 2.5 and 5 microvolts as compared with about 3 microvolts for silicon. The peak inverse-voltage rating for the germanium diode has been set at 5 volts.

Basically the noise factor of a receiver is the ratio of its noise output compared to that of an ideal receiver having the same gain, bandwidth and antenna, but with no internally generated noise. The noise index used in this test, however, was the signal required to double the power output of the converter above noise power. Similar measurements were made on 1N21B diodes.

Diode Circuit Adjustments

One of the essential requirements for a good mixer diode operation is that its impedance closely match that of the signal voltage source. In the welded type ultrahigh diode there is a mean input impedance to match the 300-ohm antenna. For example, the diode has been found to work well when inserted at the 400-ohm point of a tuned line connected to a 300-ohm antenna.

The impedance of the mixer diode looking into the *if* transformer has also been set at around 300 ohms.[5]

The *if* impedance of the diode is an important factor in establishing the proper *if* bandwidth. The diode impedance, in turn, is partially a function of the local oscillator circuit, so that the bandwidth can be set by varying the plate voltage on the local oscillator. Accordingly, most of the *uhf* diodes are being processed to provide the best performance with the local oscillator rectified current set at approximately 1 milliampere.

Wherever possible, screw-driver adjustments should be provided to utilize

(*Continued on page 39*)

[1]G-7.

[2]Employed in several G.E. diode types.

[3]In production, the pin assembly is secured and sealed to the plastic case with a baked on thermosetting cement. As a final protection against humidity changes, the final assembly is given a vacuum pressure coat of moisture-resisting finish.

[4]Measurements were made with Measurements Corp. model 84 signal generators; RCA model A converter, with a 1 ma rectified local oscillator circuit; and a GE model 814 receiver with channel 3 or 60 mc used as an *if* frequency.

[5]These are not fixed values and actual production diodes, the average capacity of which is around 1 mmfd, may run between 200 and 800 ohms.

Measurement of Transient Response of TV Receivers

Figure 1
Setup of the rf signal generator developed at DuMont (right) connected to a standard vhf standard signal generator.

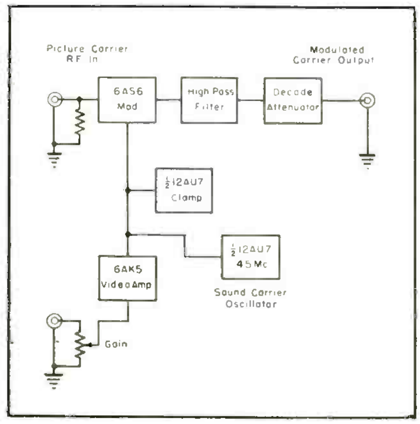


Figure 2
Block diagram of the video modulator.

The designer of television receivers has long been plagued by the problem of specifying and controlling the *electrical fidelity* of the picture channel of his creations. Early methods used were based on the generation of a so-called *standard test pattern* by means of a monoscope or similar equipment. Then electrical fidelity was rated in terms of the number of resolution *lines* visible in the receiver's reproduction of this standard pattern. A still cruder version involved observation of *off-the-air* program or test-pattern material.

Subjective picture quality tests using the foregoing procedures have not been very effective. The methods introduced the problem of correlating amplitude versus frequency *if* amplifier alignment procedures with the requirements of good electrical fidelity. Generally, there may be several combinations of *if* alignment or (misalignment) which can result in acceptable picture quality, especially as viewed subjectively, but at the expense of some other desirable *if* amplifier characteristic such as gain, selectivity, or stability. It has been found that the designer must direct his circuitry, component specification, and alignment procedures, so that the only possible alignment is that in which good electrical fidelity, high gain, adequate selectivity and stability concur. An invaluable aid in reaching this highly desirable combination of circumstances has been the *standard visual signal generator*.[1]

Of course, in design, it is possible to calculate the electrical fidelity of a system to a simple transient such as the Heaviside unit step, or its practical, repetitive equivalent, the rectangular wave. Such methods have been described in the literature.[2,3] However, in the evaluation of the closeness with which the resulting receiver production approaches the original design goal, a direct measurement of *electrical fidelity* has been found to be practically a necessity.

The electrical fidelity of the picture channel of a TV receiver may be described[1] by the responses of the set to a carrier modulated with a low-frequency rectangular wave near the field frequency, an intermediate value of frequency, and finally a high frequency, rapid enough to have fairly high energy content near the upper frequency limits of the video channel, and yet long enough in duration to allow resumption of steady state conditions between each reversal of the rectangular wave. These considerations, plus that of synchronism with the line and field scanning rates, resulted in the selection of 60, 2400 and 94,500 cps for the three rectangular-wave repetition rates.

Granting that the use of rectangular waves of the preceding repetition rates would permit adequate measure of the electrical fidelity of a television receiver picture channel, we come to the question of what equipment is necessary and available to make these measurements. Four categories of equipment have been found effective:

(*1*) Video signal-generators
- *a*—Square wave generator
- *b*—Synchronizing waveform generator
- *c*—Monoscope or synthetic pattern generator

(*2*) Receiver output display units
- *a*—Wide-band 'scope
- *b*—Device to permit 'scope to simulate load of picture tube

(*3*) A *rf* signal generator with wide-band modulation capability

(*4*) Time-axis calibration equipment

The problem of video signal-generating equipment has been found to be well under control in most TV receiver laboratories. Of course, if the monoscope or synthetic pattern equipment is

[1]Described in IRE *Methods of Testing Television Receivers.*
[2]Kallman, Spencer and Singer, IRE Proceedings; March, 1945.
[3]Bedford and Fredendall, IRE Proceedings; October, 1942.

Test Methods Involving Video Generators, Output Display Equipment, Time-Axis Setups and *RF* Generating Apparatus, Found Ideal for Plant Checking of Electrical Fidelity or Picture Quality of TV Sets; Fidelity Referring to Ability of Receiver to Produce a Video Signal at Grid of Picture Tube as Nearly Like the Video Content of the Transmitted Signal as Possible, i.e., a Minimum of Phase, Frequency and Non-Linear Distortion. Procedure Features Method Developed to Provide Modulation of *RF* Carrier with a High-Quality Video Test Pattern or Rectangular Wave of Known Characteristics, Using a Video Modulator and VHF Standard Signal Generator.

by J. VAN DUYNE

Receiver Engineering Department
Allen B. Du Mont Laboratories, Inc.

to be used in studies of electrical fidelity, it must have substantially less inherent distortion than the system to be measured.

Minimum Requirements for Rectangular Waveform Generator

It has been stated previously that repetition rates of approximately 60, 2400 and 94,500 cps must be available and that the rectangular wave must be well synchronized with the system scanning rates. The 60 cps and 2400-cps frequencies permit close examination of the low video frequency portion of the system pass band for phase non-linearities and frequency distortion. The 94,500-cps rate also permits evaluation of the distortions present in the high-frequency portion of the video pass band.

In setting up a format for the desirable characteristics of a rectangular waveform generator, the conventional specification of rectangular wave characteristics was adopted for our study, *transition time* representing the time required for the waveform to progress from 10% to 90% of the final steady-state amplitude, and *overshoot* being expressed as a percentage of the final steady state amplitude. The cut-off transient, or *ring*, may be described in terms of its per cent amplitude, the number and frequency of visible oscillations, and the angle between the axis of the cut-off transient and the horizontal axis of the display. With these terms as a basis, it has been found that three factors determine the acceptable properties of a rectangular waveform generator, as viewed on a 'scope serving as an output indicator:

(*1*) Transition time small compared to that of device to be measured; it will be shown that reasonable measurements may be made if this transition time is less than one-half of the resulting transition time of the output display.

(*2*) No noticeable overshoot or cutoff transient oscillation.

(*3*) Good symmetry: i.e. identical rise and fall characteristics.

These requirements obviously place a burden of considerable magnitude on the 'scope used for display purposes. Also, it should be noted, that the slower transition times of the test generator and 'scope can only be tolerated if the no-ring, no-overshoot conditions hold. Under these circumstances, an assumption of so-called *Gaussian* cutoff characteristics may be safely made and hence very simple calculations yield accurate rise time correction data.[4,5]

The question of 'scope gain may be answered by a consideration of the output level available from the test demodulator used with the *rf* equipment. The lowest video level encountered in our work has been .05 volt peak-to-peak which required an additional amplifier in cascade with the 'scope.[6]

The time-axis 'scope calibration method used in our work employed an internal 0.2 microsecond calibrating

[4]MIT edition, *Vacuum-Tube Amplifiers*; Volume 18.

[5]Kallman, IRE Proceedings; August 1940.

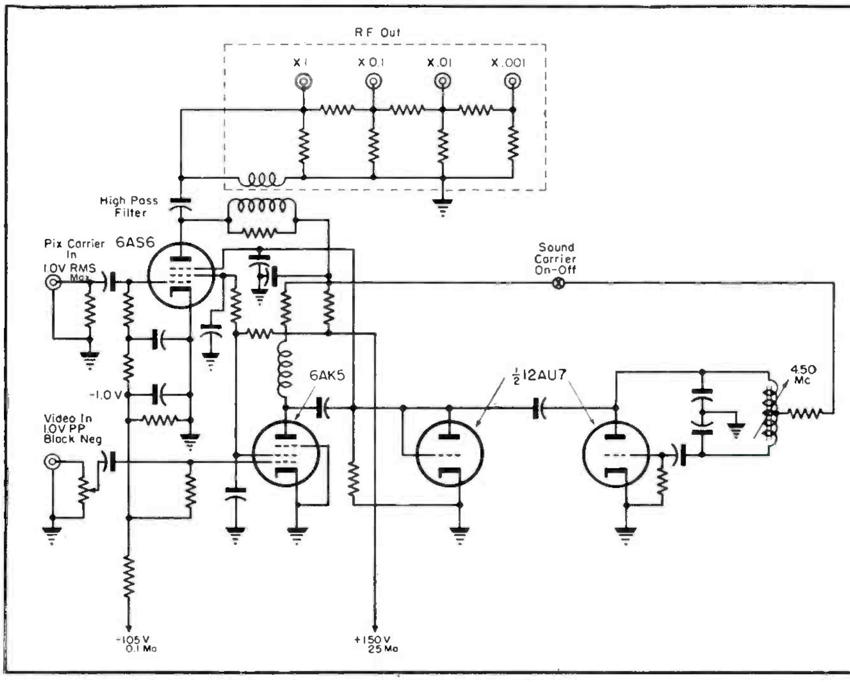


Figure 3
Circuit diagram of the video modulator.

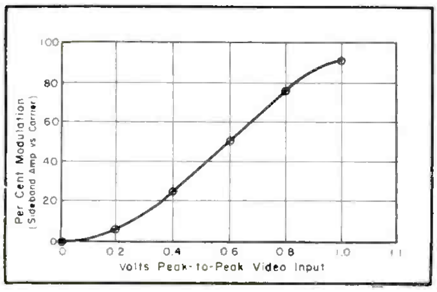


Figure 4
Modulation linearity obtainable with signal generator. Modulating frequency of 2.5 mc used to obtain this plot.

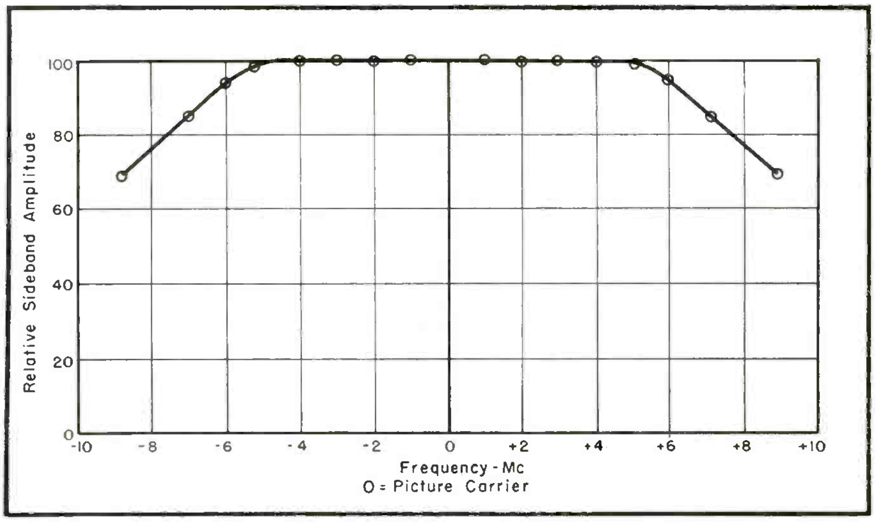


Figure 5

Envelope response of the video modulator.

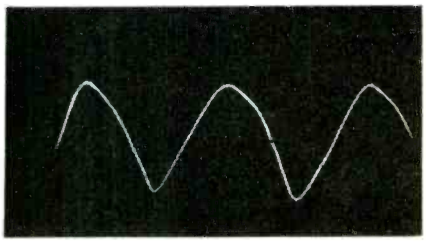


Figure 6 (above)

A .2 microsecond calibrating waveform which establishes 1 inch as the .2 microsecond interval.

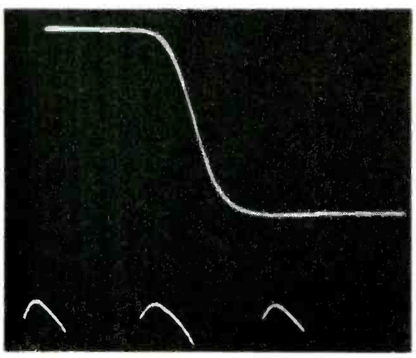


Figure 7 (above)

Black and white transition of the 'scope and the rectangular wave form generator.

sine wave of the 'scope.[6] The deflection linearity was found to be very good, the parallax error being minimized through use of photographic recording with an oscillograph record camera[7]. The resulting time axis errors were found to amount to less than 0.002 microsecond at sweep rates of 0.2 microsecond per inch.

RF Generating Equipment Requirements

It has been found that there are five basic factors which normally control a satisfactory *rf* generating setup:

(*1*) Sound and picture carriers of excellent stability, especially the sound-picture difference frequency stability, must be available at all TV channels, as well as the standard *if* frequencies. Continuous tuning is desirable if, as in our case, continuously-tuned receivers are to be tested.

(*2*) The modulation characteristic of the system should introduce negligible phase, amplitude, and non-linear distortions, or stated in transient terms, should not appreciably slow the video transition time, produce no overshoot or *rings*, and introduce negligible non-linear distortion between white and black levels; infra-black non-linearity may be taken care of by the synchronizing waveform generator adjustment.

(*3*) There should be available an output attenuator system to allow simulation of antenna impedance and to permit continuous level variation over a 80-db range.

(*4*) Experience indicates that at least 0.1 volt rms (at synctip) of signal is desirable.

(*5*) Several limiting conditions may be imposed:

a—Negligible FM (less than 1 kc) of sound carrier and picture carrier

b—All spurious outputs at least 60 db below carrier

c—Video input 75 ohm impedance, no more than 1.0 volt peak-to-peak for full modulation

d—Modulation depth to at least 90% with negligible non-linear distortion

e—Automatic *dc* insertion

f—Full double sideband operation[1]

g—Low *rf* leakage (less than 10 microvolts)

To provide this type of service, a special unit, called a video modulator, was developed for use with a *vhf* standard signal generator. Several of these instruments have been in use in our laboratories for over one year with excellent results.

In this video modulator, the *rf* picture carrier, at approximately a 1-volt rms level, is applied to the grid of a 6AS6. The plate circuit is connected to a resistance ladder attenuator of 75-ohm iterative impedance through a high-pass filter which nominally cuts off in the region of 12 mc. The gain of this stage at picture carrier frequency is approximately 0.2 throughout the television channels and falls gradually to .1 at 20 mc. This gain change has been charted and mounted on the front of the instrument. Since the 6AS6 is operated class *A*, the output bears a linear rela-

[6]DuMont 280.
[7]DuMont.

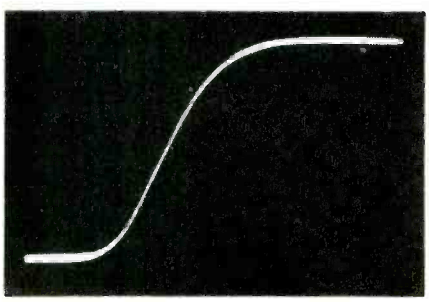


Figure 8 (left)

Transition resulting from demodulation into an RC load of .040-microsecond time constant.

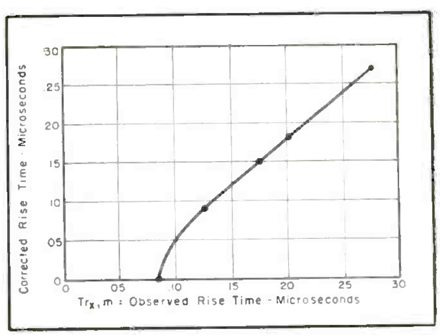


Figure 9

Plot of corrected rise time for video modulator when used with a .080-microsecond scope and square wave generator. Trm equals .090 microsecond.

tion to the input over a wide range of input levels, thus allowing fine variation of output to be accomplished via the attenuator of the standard signal generator. Usually, only 20 db of such variation has been found necessary.

Diode Clamper

The incoming black negative video signal is amplified in a 6AK5 stage and applied to the 6AS6 suppressor grid. A simple diode clamper is used and has been entirely satisfactory.

Output Circuit

As a result of this circuitry, the output circuit contains direct video, double sideband modulated picture carrier, and its harmonics. The harmonic content is no greater than that of the signal generator used (barring overload) and the direct video is 60 db below the .1 *v* picture carrier at channel 2. Reduction of the input (unmodulated) carrier reduces this ratio by the amount of input reduction. However, by limiting this input reduction to 20 db, no trouble with direct video output has been experienced with any TV receiver tested.

The Sound Carrier

A sound carrier is supplied by modulating the picture carrier with a 4.5-mc sideband. By limiting the depth of modulation of this signal to less than 70%, no intermodulation difficulties have been experienced. Hence this carrier may be left on during measurement to keep a check on receiver tuning. A crystal oscillator could have been used, but the maximum of 10-kc drift of the self excited oscillator employed has not been a problem.

Ladder Attenuator

The ladder attenuator used in the unit was made in our labs and of the several made, no errors greater than 5% have appeared. A very satisfactory push-button attenuator of similar characteristics is available commercially and has been used with good results.

Power Supply

The power supply features a line filter so that the total leakage is considerably below 10 microvolts. This low leakage is attained with simple filtering and shielding, since there are no *rf* high current resonant circuits and no high potential anti-resonant circuits in the device.

Also, due to the excellent resistive isolation between the modulator and the signal generator oscillator, practically no FM of the output picture carrier is detectable. An actual figure cannot be given, since the amount has been found too low to measure by any usual means. The residual signal generator 60 cps FM is far greater than that due to modulation.

Modulation Linearity

In the modulation linearity obtainable with this unit, there is nearly a straight line between 75% and 10% of sync tip. The curvature above 75% (infra-black region) is readily compensated for in the synchronizing waveform generator. These data were taken at 2.5 mc. modulating frequency as the relative *rf* sideband amplitude versus peak-to-peak video signal input.

Effective Bandwidth

The effective *rf* bandwidth of the unit is illustrated in Figure. 5. These data were taken at 80% modulation depth by plotting the actual side band amplitude, as measured by a calibrated narrow band receiver versus constant amplitude, varying frequency modulation. The 3-db point is seen to be 9 mc from picture carrier.

Transient Response

We now come to the question of the transient response of our measuring system. In Figure 6 appears the .2 microsecond calibrating waveform which establishes 1″ as the 0.2-microsecond interval. The black to white transition of the 'scope and the rectangular waveform generator appears in Figure 7. The resulting .080-microsecond transition time is largely due to the rectangular waveform generator, since the 'scope is capable of less than .050-microsecond transition time with a .01-microsecond exciting pulse. When this waveform is applied to the video modulator and ideally demodulated, the resulting transition is degraded to .090 microsecond, with no ring or overshoot. Figure 8 illustrates the transition resulting from demodulation into an *RC* load of .040-microsecond time constant. This results in the transition time being degraded to .12 micro-

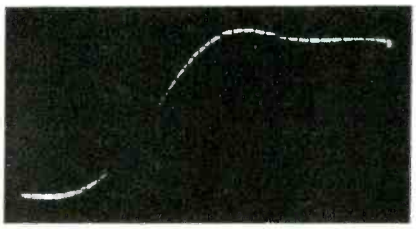


Figure 10
Resulting black-to-white transition of a TV set which produces what is considered subjectively to be a good picture.

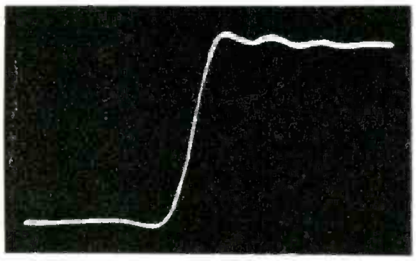


Figure 11
Another view of the Figure 10 curve, but at a faster horizontal sweep rate.

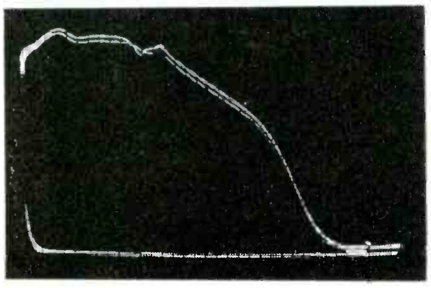


Figure 12
Resulting video response of entire receiver and measuring system; note the marker at 2 mc and the sound carrier birdie at 4.5 mc.

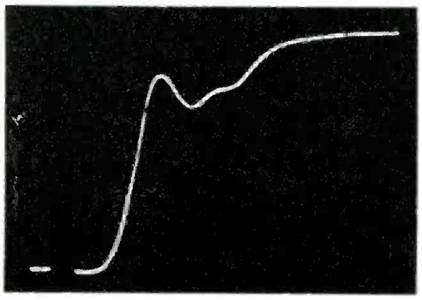
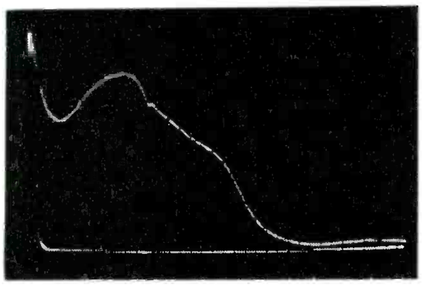


Figure 13
Transient response of a misaligned receiver.

Figure 14
Overall amplitude response of a misaligned receiver.



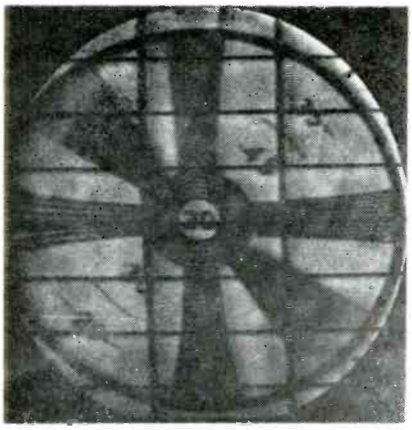


Figure 15
Resulting picture of misaligned model revealing the smeary appearance due to mid-frequency phase distortion.

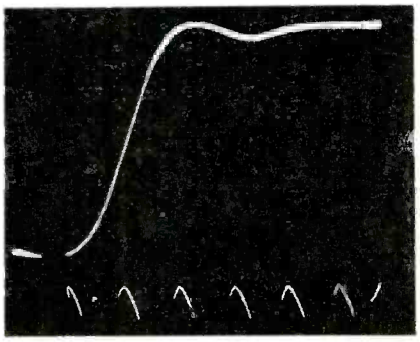


Figure 16
Transient of a properly aligned set.

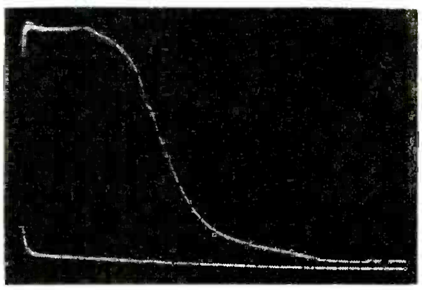
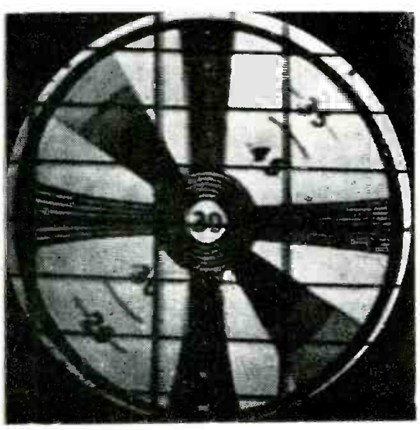


Figure 17
Amplitude response of a properly aligned receiver.

Figure 18
Picture resulting when set is properly aligned.



second, but with no change in the total absence of ring and overshoot.

Gaussian Cutoff

By assuming a *Gaussian* cutoff, the transition times of each component may be calculated from the relation $T_r = 0.35/fo$, where fo is the 3-db bandwidth; 9 mc in the video modulator. Thus, its transition time alone would be $0.35/9 \approx .04$ microsecond; that of the 'scope and rectangular wave generator was measured as .080 microsecond. Similarly, since the 3-db bandwidth of the .040-microsecond time constant demodulator is

$$\frac{1}{2\pi RC} = \frac{1}{6.28 \times .04} = 4 \text{ mc.}$$

we may then calculate the transition time of the demodulator as $.35/4.0 =$ .088 microsecond.

Then, using the relationship that the transition time of cascades of these circuits is the square root of the sum of the squares of the individual times, we arrive at .089 microsecond for the rectangular wave generator, video modulator, ideal demodulator, and 'scope which agrees closely with the .090 microsecond measured. Again, calculating for the addition of the .04-microsecond time constant demodulator, we arrive at .125 microsecond which agrees well with the measured .12 microsecond shown in Figure 8.

Having checked the validity of this correction, we may then proceed to draw a transition time correction curve for the entire equipment. This curve is shown in Figure 9 and has been found experimentally to hold well for most TV receivers, with a resulting overshoot of less than 7%.

Actual TV Receiver Transient Response Measurements

In Figure 10 appears the resulting black-to-white transition of a television receiver which produces what is considered subjectively to be a good picture, substantially free of objectionable ring and overshoot sweep at 0.5 microsecond per inch. Figure 11 illustrates a repeat of this transition, but at a faster horizontal sweep rate. The calibration is now .2 microsecond per inch or .02 microsecond per division. In Figure 12 we have a curve which represents the resulting video response of the entire receiver and measuring system, obtained by modulating the video modulator with the output of a video sweep generator and rectifying the output of the receiver video amplifier before display; note the marker at 2 mc and the sound carrier *birdie* at 4.5 mc. This curve is especially useful in tracking down phase distortion in the *if* amplifier in the region of double sideband operation.

Instrument Test Results

To illustrate the usefulness of this equipment a misaligned receiver was measured. The transient response appears in Figure 13; note *if* phase distortion. The overall amplitude response of this model is shown in Figure 14 and the resulting picture in Figure 15. The *smeary* appearance due to the mid-frequency phase distortion is quite obvious. This receiver was then properly aligned and the resulting transient appears in Figure 16; note the slow T_r. This picture, shown in Figure 18, does not display the horizontal resolution of the first picture presented due to the restricted video bandwidth typical of lower quality receivers.

Equipment Uses

Types of measurements other than electrical fidelity may be made with this equipment. One which immediately suggests itself is sensitivity measured directly with TV signal.

Generally, the following measurements may be made with this equipment:

(*a*) Electrical fidelity of picture channel, especially correlation between subjective observations of pictures and objective measurements of response to good rectangular waveform.

(*b*) Receiver sensitivity and subjective observation of signal-to-noise ratio.

(*c*) Amplitude non-linearity resulting in high signal level areas. Addition of wideband 20-db gain distributed amplifier desirable.

(*d*) Co-channel interference ratios.

(*e*) Adjacent-channel interference, if suitable band-restricting filters are added.

(*f*) Effects on picture quality of antenna resonance, transmission line reflections, noise susceptibility, etc.

KBTV, Dallas, Texas

Detailed Report on Design, Installation and Operation of Channel 8 TV System in One of the Largest Cities in the Southwest. ERP of 27 Kw (Video) and 13.5 Kw (Audio) Obtained Through Use of a Six-Bay Super Turnstile Antenna Installed atop a 377-Foot Hilltop-Mounted Tower.

by **BILL SADLER** and **MORT ZIMMERMAN**
Director of Continuity — Transmitter Engineer

PLANNING A TV station, with its extensive sight and sound facility requirements, has been and probably will be for a long time, quite a challenge to engineers and management. Audio and visual problems are rampant and the need for a comprehensive, practical program is imperative.

When the idea for KBTV was born, these facts were recognized and an extensive planning stage was therefore instituted. Plans included answers to such questions as: What do you do with a television station? Should it be in a hotel penthouse? Should it be in the downtown area? Where should the transmitter and antenna be located?

It was decided that KBTV should have its own building and that it should be a one story building, capable of expansion. The site chosen for studios and antenna was a hill overlooking the skyscrapers of downtown Dallas and providing a 377-foot tower[1], selected for the six-bay super-turnstile batwing antenna, the advantage of several hundred feed additional height.

A modernistic masonry-constructed type building was designed with provision for offices, studios and transmitter room. One studio, 30 by 40 feet, was included and a second room of the same dimensions, provided for, with an eye for later expansion. That room now serves as space for the work shop and storage. Also included was space for a control room and announcer booth overlooking the studio in the lengthwise direction.

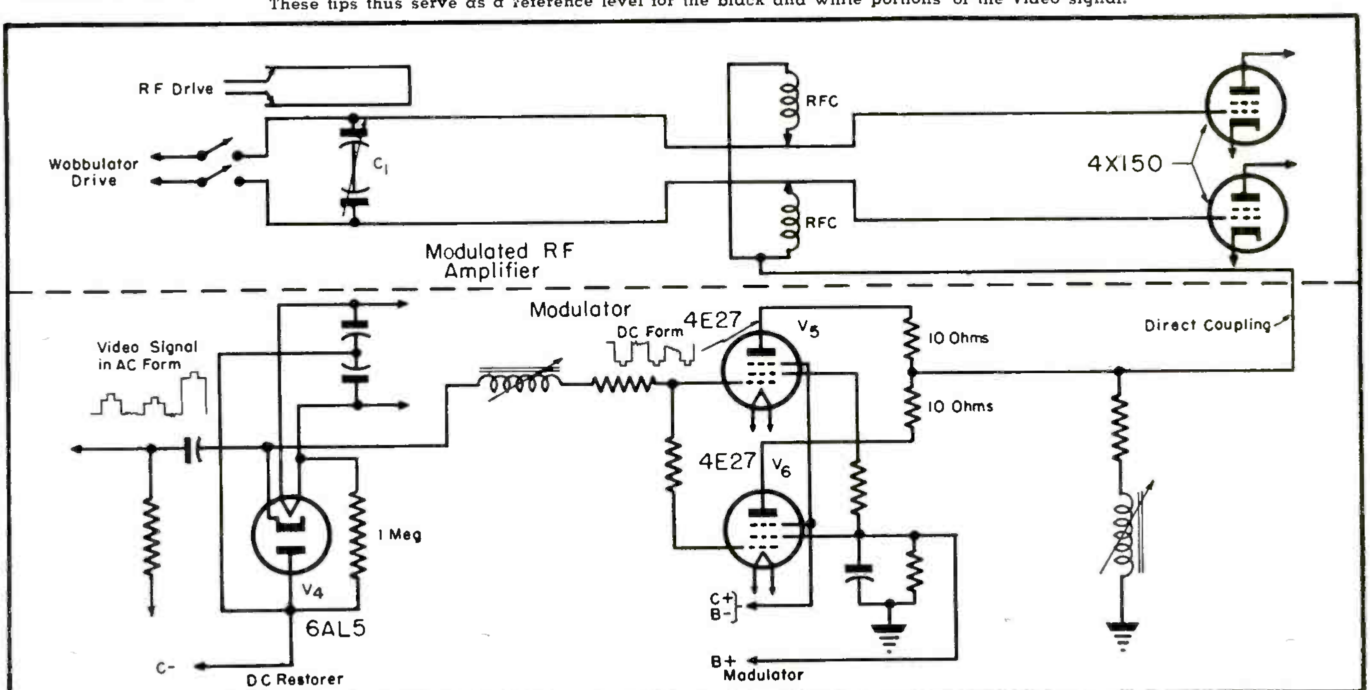
The Transmitter

A 5-kw video and 2.5-kw audio transmitter[2] was selected.

Featured in the visual transmitter is a basic 7552.083-kc crystal frequency circuit the output of which is multiplied twenty-four times through three doubler circuits and one tripler producing sufficient signal to drive a pair of 4X150s. The video signal, fed into a low-level modulation unit, is amplified, applied to a *dc* restoration circuit and finally directly coupled to the grids of the 4X150s through two paralleled 4E27 modulation tubes. The action of the *dc* restorer in the modulator unit results in clamping at the sync tips of the video signal rather than at the black level. An input video signal of 30% sync to 70% blanking level is needed to result in a modulated envelope of 25% sync to 75% blanking[3].

The modulated carrier is fed to the inputs of two 4X500s, *ipa* stage, which in turn is fed to two 3X2500A3 final *pa* tubes. The resultant 5-kw video modulated carrier *rf* signal is fed into one

Schematic of the directly-coupled grid-modulation system used at KBTV. The *dc* restorer serves to refer the sync tip signals to the same level. These tips thus serve as a reference level for the black and white portions of the video signal.



Looking in, from the director's table in the control room to the studio; at left, two film-shading generators and monitors, and at right, three camera-chain control units.

side of a diplexer (the other side containing 2.5 kw of aural power) and up through two lengths of 385 feet of 3⅛″ transmission line[4] to the base of the six bay turnstile antenna containing *north-south* and *east-west* radiators to produce a circular field intensity pattern. With a gain of approximately 6.6 in the antenna and with 86% efficiency in the line the erp is 27 kw visual and 13.5 kw aural.

The visual transmitter contains three wide-band stages, and wobbulation of these stages is necessary periodically to produce a reasonable response to the picture signal. A built-in wobbulator has been provided for this purpose with observation of the response curves possible on a built-in 'scope. It has been found that changing any tube in any of these wide-band stages makes it necessary to re-wobbulate the transmitter.

General Studio Installation

For camera work we selected three field-type camera chains[5] utilizing the 5820 image orthicon with an assortment of complementary equipment: image orthicon pickup head, *electron-view finder*, pickup auxiliary unit, low-voltage supply, image-orthicon control and monitor, portable sync generator, complete set of interconnecting cables, telephone headsets and a tripod. The image orthicon pickup head may be divided into three sections; the image multiplier section which consists of a photocathode, an electron-lens system, and a target (the scanning and the electron multiplier section). The electronic view finder is mounted on the pickup head to permit the camera operator to see the scene being televised. It contains a type 5FP4 view-finder tube and associated sweep and video circuits. The pickup auxiliary unit is used as the connecting link between the pickup head proper and the pickup control unit. This is an extremely important unit since it provides well-regulated voltages, adjustable regulated focus-coil current, centering voltages, and vertical and horizontal driving pulses for the pickup head and view finder.

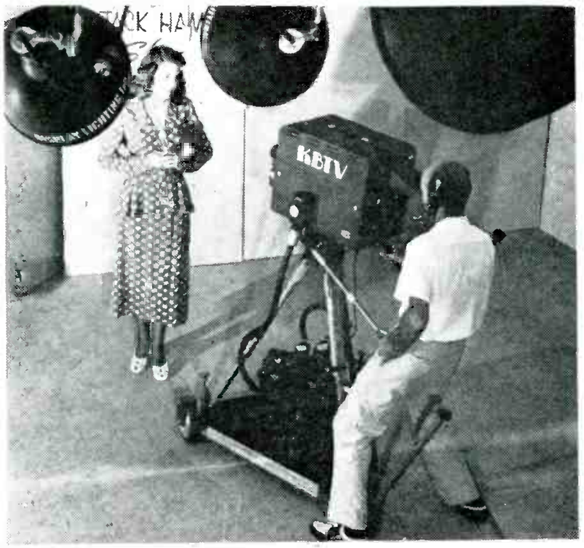
The pickup control and monitor serves three functions: Monitor the out-going picture signal with both a picture and wave-form monitor, accept video from the pickup head and blanking and sync from the sync generator and amplify this composite signal, and finally adjust the beam current, beam focus, target voltage, and photocathode focus. Thus it can be seen that this unit is the controlling element in the system. The portable sync generator is used to supply the complete camera chain with wave forms required for a standard RMA signal.

Two studio-type film chains have been incorporated, each containing shading generators and picture waveform monitors. Two 16-mm film projectors are employed. Each film chain uses an iconoscope, the mosaic of which receives the picture, the output of the iconoscope being fed to a video preamplifier which immediately amplifies the output signal. Since spurious missions occur as a result of varying film contrasts on the mosaic, an iconoscope shading-control generator is used to correct for these unwanted signals. By injecting sine, saw-tooth and parabolic waves through adjustable controls, these spurious missions can be counteracted, thus adding to over-all picture quality. The output of the preamplifier is fed to an intermediate amplifier where sync can be inserted at will, and finally, the picture signal is fed to a mixer unit.

Camera-Film Chain Operation

In our setup, the three cameras and two film chains are fed into a mixer

[1]Ideco.
[2]DuMont air-cooled.
[3]According to FCC specifications.
[4]Andrew Teflon. [5]DuMont.



In action in the KBTV studio.

Film-chain equipment arrangement.

desk where the TV director calls off his *take* shots. The video operator at this desk responds with push-button control through slow, medium, or fast fades. Switches are also available for lap or fade operation. A picture monitor and wave form monitor have been incorparated in the mixer desk. The mixer unit works in conjunction with a studio line amplifier. It is at this unit where sync is inserted to form the composite video signal. This, of course, means that the outputs of the cameras and film chains must not contain sync. It was mentioned previously that all these units can produce their own composite signals. In the case of the camera chains a composite signal is produced only when on a remote; however, when in the studio the portable sync generator is not used, the cameras receiving sync at the mixer desk through the regular studio sync generator, plus a field-to-studio sync adapter. In the case of the film chains sync can be applied at the intermediate amplifier when it is desirable for the film chain to produce a composite signal for test purposes, etc. It must be emphasized that ordinarily the only sync applied when cameras and film chains are operating in the studio is the sync applied at the mixing unit.

Available also at KBTV are two complete synchronizing generators[5a], plus two complete sync distribution amplifiers. By a throw of one master switch, one complete sync generator can be connected to the system and the other disconnected, or vice-versa. This also applies to the two sync distribution amplifiers.

The sync generator provides horizontal and vertical driving pulses, blanking signals, and the composite synchronizing signals required by studio cameras and film cameras. There are forty-nine tubes in the generator, which consists of a timing generator, sync-shaping unit, blanking driving unit, low-voltage supply, and a high-voltage supply.

The generator also contains a unit for producing linearity test signals (900 kc and 157.5 kc) for checking of the scanning linearity of picture monitors and television receivers. These signals are mixed with blanking by means of a switch. In addition, an electronic marker is produced by the generator for use with an ordinary 'scope in the calibration of pulse widths and *front porch*. All frequency counts may be checked or adjusted without the use of an external 'scope by observing the two 3-inch crt's permanently mounted in the unit for simultaneous monitoring.

At the transmitter console the operator can observe, through his monitor and line switching systems, the picture going on the air from both a frame and line-frequency wave-form monitor, plus a picture monitor. The switching system provides a means of observing signals at the *ipa* cathode, *pa* cathode, transmission line and a monitor receiver, thus providing a perfect means of signal tracing checks through the transmitter. A one-volt peak-to-peak signal is applied at the output of a video-line amplifier in the console which is fed directly into the transmitter modulator.

Remote Receiving

For remote receiving we installed a terminal facilities rack[6] which contains a picture monitor, a frame and line-frequency line wave-form monitor, and a sync stretching unit. When a remote is brought in through a microwave system, this unit serves to monitor the signals and apply the signals to the studio system. It is often necessary to expand the sync level of the composite video signal from a remote. This is done through the use of the sync stretching unit.

Audio Facilities at KBTV

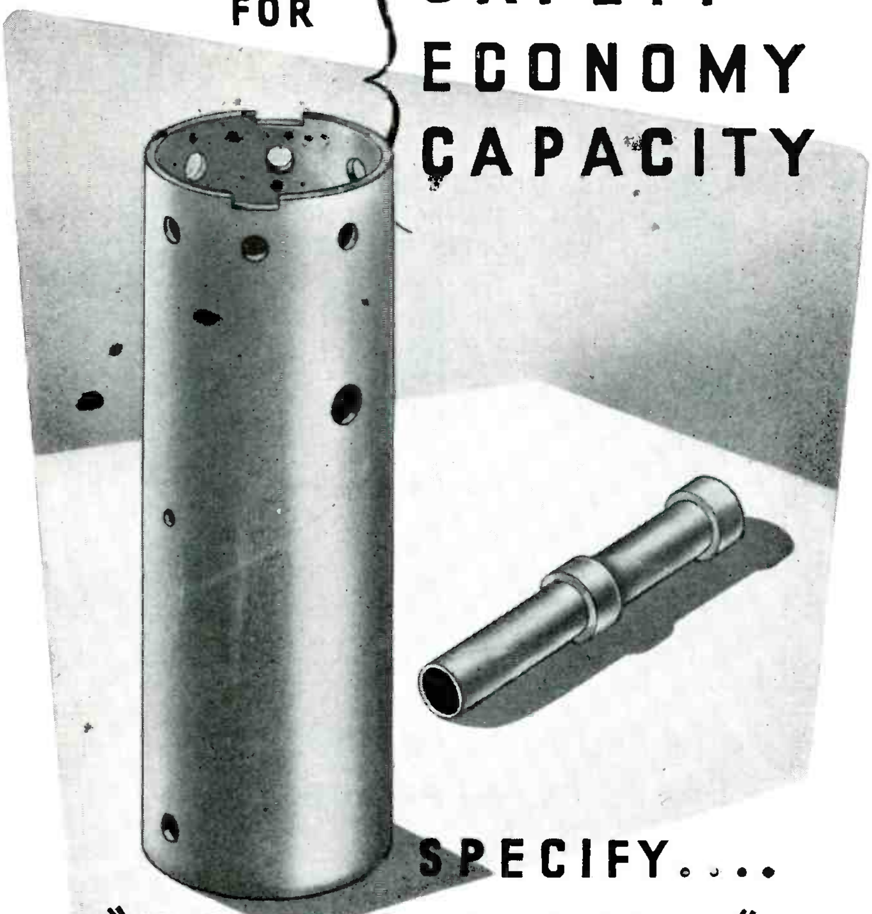
An audio console[7] operating in conjunction with all its microphone and speaker circuits, provides an audio signal of approximately 10 *vu* to the transmitter console, which contains a switching system for monitoring up to five audio input lines. The program signal is fed from the transmitter console to the input of a limiting amplifier,[8] the output of which feeds the FM transmitter reactance modulator. Inputs to the audio console are studio microphones, announce-booth microphones, two turntables,[9] and the outputs of the two film projectors, which contain their own preamplifiers.

A master control jack-panel system has been incorporated in the transmitter room audio rack, all remote lines, console outputs, and transmitter console inputs being terminated at this panel. On remote broadcasts, remote amplifiers[10] are utilized.

KBTV is Dallas' first television station and the third in Texas. Yet in the short space of time that TV has been in Texas, the people have taken it to themselves like an old friend. Very few knew what to expect from television, and still don't, but they eagerly await each new development, and each new program. There is no doubt that television in the Southwest, with Dallas as one of the leaders, is looking forward to an ever-expanding future with new developments in both the program and engineering fields.

[5a]DuMont TA-107-A/B.
[6]DuMont. [7]Collins. [8]Collins 26W. [9]Fairchild. [10]Collins 12Z and 212U.

* FOR { SAFETY
ECONOMY
CAPACITY



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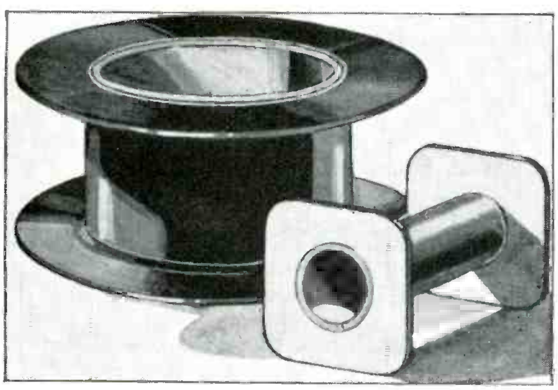

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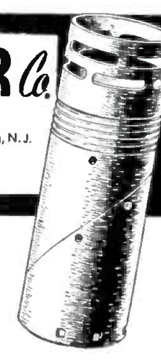

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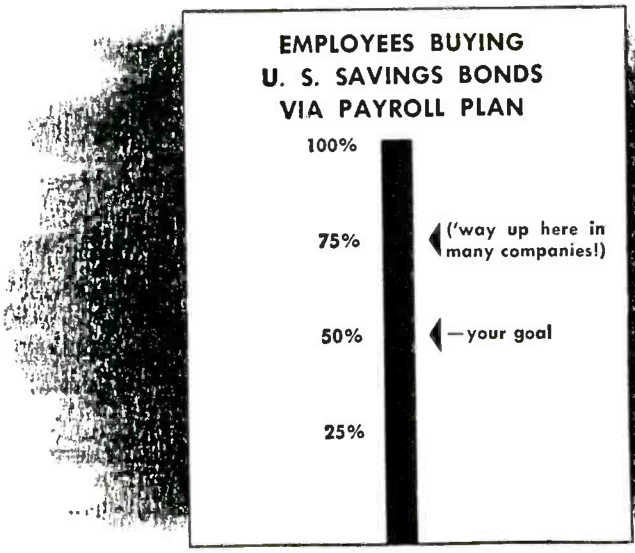

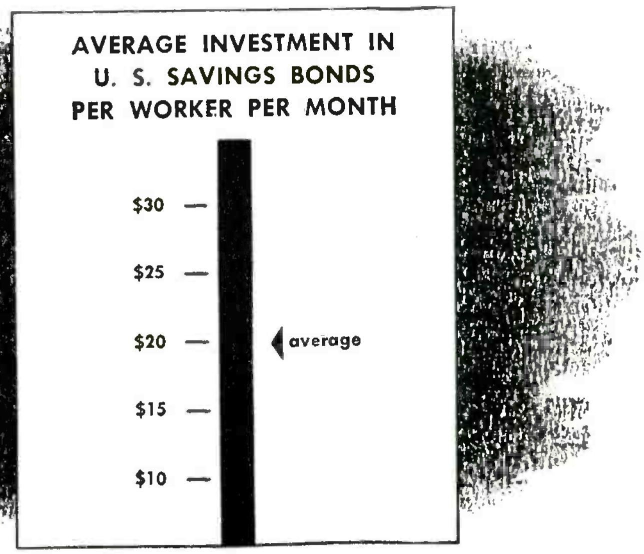

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If the figures for your company fall below those shown above, you're missing your share of benefits of the Payroll Savings Plan! These benefits are described below. Nation-wide experience proves that when top management puts the "OK" on the Plan, its benefits rise sharply.

BENEFITS TO *EMPLOYEES:* Every $3 invested in Savings Bonds pay $4 at maturity. Workers gain a 33⅓% return on their money—enabling them in the future to buy more of the things they will want—plus the peace of mind that goes with regular saving.

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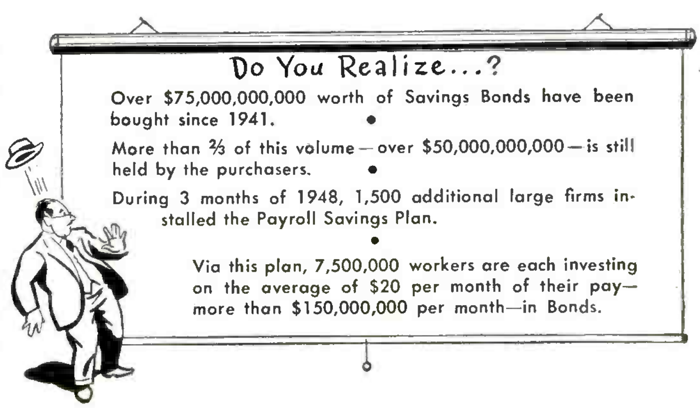

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TELEVISION ENGINEERING

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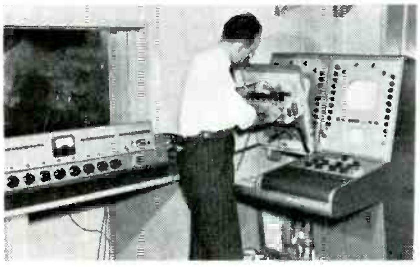
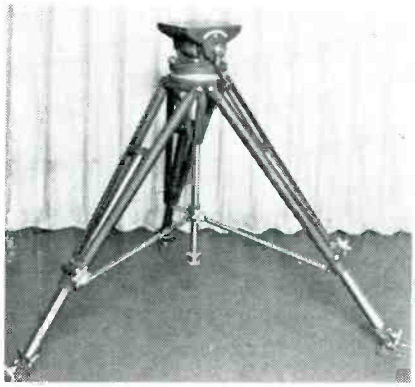
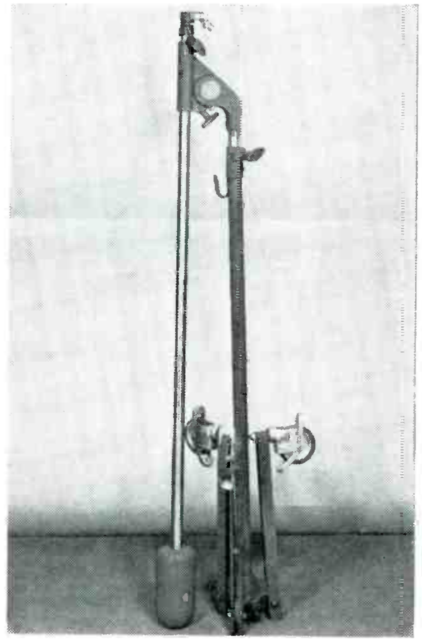
On the TV Broadcasting Front



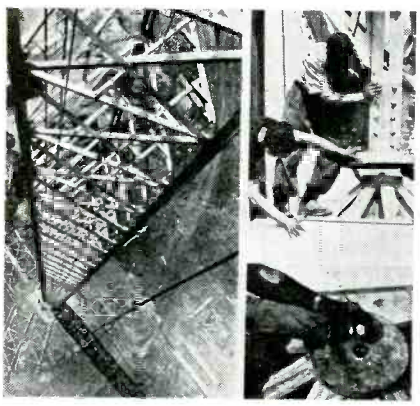
(Above)
William C. George, engineering supervisor of WXEL, Cleveland, examining a recently installed film-camera control. Transmitter, a 5-kw channel 9 unit,[1] feeds into a 6-bay antenna mounted atop a 438-foot tower.



Lightweight tripod[2] developed for mounting microwave relay receiver or transmitter, or field or studio television camera. Range of working height is approximately 25" to 42", while the maximum diameter at the feet with legs extended is 70". Designed for use with either friction or tilt-head attachments, or with a tripod dolly.



Lightweight boom stand[3] designed for proper microphone positioning in broadcasting and television studios. Boom can be adjusted for heights from 5' 2" to 8' 8", with horizontal arm extensible from 3' to 6'. Tripod base with casters has foot-operated locks for positioning.



(Left)
A 750-foot TV mast, which weighs around 90 tons, and has been designed to pivot on a ball bearing 2 inches in diameter, by the British Insulated Callender Construction Co. Ltd., for the BBC. To allow for give in a high wind the shaft has been placed on a curved base plate in the centre of which is the bearing. Mast is being built at Sutton Coldfield, near Birmingham.

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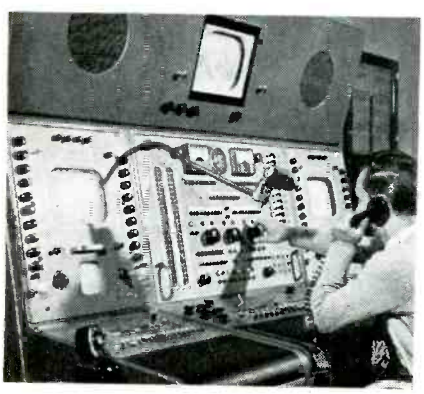
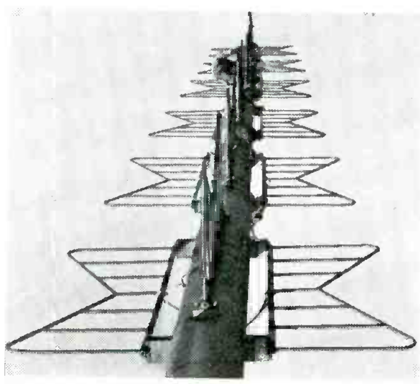
[1] G.E.
[2] RCA TD-11A. [3] RCA KS-3B.
[4] Bird Electronic Corp., type 824.

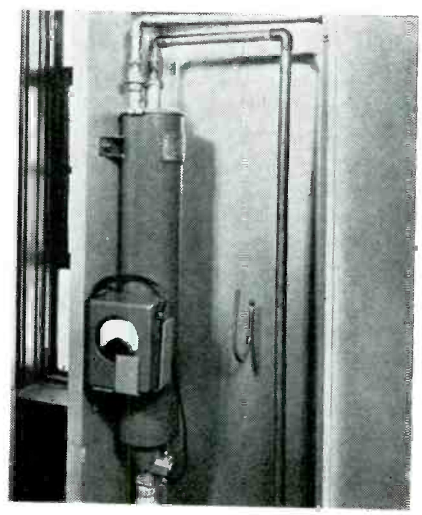
(Below)
Stanley Godell at the master control of WRGB, Schenectady, which recently celebrated its tenth anniversary. Now in use at the station is a 5-kw transmitter[1] feeding into a 3-bay antenna, and assortment of new equipment including two film cameras, two 35-mm and two 16-mm projectors, a two-camera field pickup unit and 2000-mc relay setup.



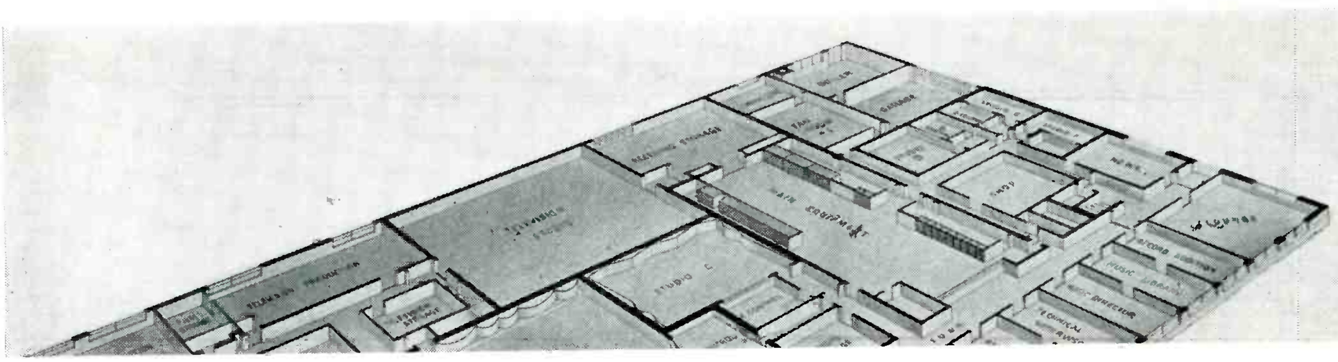
Checking KRLD-TV, Dallas, Texas, antenna, which weighs 10,000 pounds and is 99 feet long.



An rf load and wattmeter[4] in use at WBNK, Cleveland, operating on channel 4 with 5 kw.



The Air-Conditioning System at



Cutaway-view of the first floor plan of the WBZ studio building, showing the space allotted for the air-conditioning equipment.

In installing an air-conditioning system, involving the complex problems encountered in a building housing such a variety of equipment as is required in TV operations, and providing for the comfort of station personnel and studio audiences, many factors have to be considered.

Probably the most common problems to solve are those which affect the human element. The studios, for instance, must not be too cold or *clammy*. In reviewing this condition, the physical principles of air conditioning must be probed. We know that air is capable of containing varying amounts of moisture. As air is cooled, it contains less moisture than when warm, since part of it condenses on the cooling coil. Thus, the air leaving the cooling coil will actually contain less moisture than it had before it was cooled, but—and this is important—the air may be so nearly saturated with moisture at this temperature that it can not absorb any additional moisture from the skin of people and therefore, they feel uncomfortable.

In stores, restaurants and similar air-conditioning installations, the air entering the room is nearly saturated as described, but due to the heat given off by the lights, the people and the sun's rays transmitted through windows and walls, the temperature of the incoming air is raised and thereby its ability to absorb moisture, which is necessary for comfort cooling, is increased.

In a station, there are long periods during which the studios are neither lighted nor occupied. Due to the fact that studios are insulated for acoustical purposes, which also acts as thermal insulation, there is no heat gain obtained from outdoors. Therefore, after operating for a period under these conditions, the room air becomes too cool and the humidity becomes too high. The answer to this problem is quite obvious; heat must be added to lower the humidity.

At WBZ the return air and fresh air enter an electronic air cleaner[1] where 90 per cent of all airborne dirt particles are removed.* The manner in which these dust and dirt particles are removed from the air is interesting because it is not done by passing the air through filters. Therefore, the cleaning of the air is not limited to the removal of a percentage of the dirt particles of a certain size or weight by filtering through some medium. In fact, it has been found that particles of dirt too small to be seen by the eye are removed.

The electronic air cleaner consists of three major parts: ionizing unit; dust-collector cell; and power pack.

Ionizers in the cleaner are supplied with 13,000 volts of *dc* that creates a strong electrostatic field. As the air passes through this electrostatic field, particles of foreign matter receive a positive electrical charge. Within the area of the dust-collector cell are parallel mounted metal plates spaced 5/16" apart. Alternate plates are grounded with the intermediate plates charged at a positive potential of 6,000 volts *dc*. Inasmuch as unlike electrical charges attract, the positively-charged dust particles are attracted to the negatively-charged plates, where airborne dust particles, including cigarette smoke in the air stream, are precipitated.

The electronic unit is cleaned by washing the accumulated dirt from the plates periodically, the frequency depending on location and use. After cleaning, an adhesive is applied to retain the accumulated dirt. The power pack operates on 115 volts at an input load of approximately 400 watts.

From the air cleaner, the clean air is drawn through cooling coils supplied with chilled water from a 2" circulating line, from the chilled water pump and refrigerating equipment located in the equipment room, at the rear of the first floor of the station building. Locating the refrigerating equipment in the rear of the first floor served to isolate the refrigerating equipment noise.

The temperature of the air leaving the cooling coils is controlled by a duct thermostat that operates a three-way valve which either admits the chilled water to the coil or bypasses the coil. The temperature of the air leaving the coil is set low enough to carry the cooling load of any of the studios.

From the coil, the air enters a main supply fan which puts it under pressure in a trunk duct, from which branches lead to the various studios and control rooms. There's a small re-heat coil in each branch duct where it leaves the main trunk duct. Steam is admitted to these coils by thermostatic valves controlled by the room thermostats. In this manner, the final temperature of the air entering each room is controlled by a room thermostat that quickly responds to changing loads in the room. When a studio is unoccupied a higher temperature of air is admitted. This prevents the uncomfortable cold and *clammy* feeling so often experienced.

The air enters each studio through ceiling outlets that are adjustable as to the angle of throw. This makes it possible to direct the air horizontally or to force it down toward the floor so

[1]Westinghouse Precipitron.
*By blackness or discoloration test: United States Bureau of Standards.

WBZ Radio-TV Center, Boston

System, Designed for Building During Blueprint Stages, Employs an Electronic Air Cleaner Featuring a Minimum of Controls, Effective Cooling for Transmitter Room and Studios with Their Extensive TV Lighting Setups, Seasonal Change-over Facilities and Quiet Operation.

by H. H. THAYER

Registered Architect and Engineer

it will mix thoroughly with the room air. Warm air is removed through a system of return air grilles and ducts that connect to the return air fan. Part of the air discharged by this fan is exhausted outside, while the balance is mixed with fresh air to repeat the cycle described.

The refrigerating equipment consists of an eight cylinder compressor[2] driven by a 60 hp hermetically-sealed motor. This unit has been found extremely free from vibration. From the compressor, the hot *freon* gas is taken to an *aquamiser* or evaporative condenser located just outside the building. In this unit, water is sprayed over the copper coils containing the hot *freon* gas, while air is drawn over these coils to remove the heat by evaporation. This apparatus saves up to 90 gallons of water per minute which is no small item in the annual budget of a station. The condensed *freon* from the *aquamiser* evaporative condenser returns to a *freon* receiver from which it passes to a water chiller where the actual refrigeration takes place.

The circulating water that serves the cooling coils in the fan rooms returns to the chiller bearing the heat which was removed from the air. This water circulates through the coils of the water chiller which are surrounded by liquid *freon*. The heat of the water boils the *freon* before it passes to the compressor as a gas which is compressed. As the *freon* boils, the water is cooled and it is again circulated to the fan rooms.

Thermostatic control is often quite a headache to the station engineer. To minimize the problem at WBZ, a pneumatic-type control system[3] was installed.

The refrigeration equipment is put into operation by depressing the starter buttons for the *compressor, condenser* and *chilled water pump*.

As soon as the water temperature is reduced to a predetermined level, an unloading device depresses the intake valves in half of the compressor cylinders so the compressor capacity is reduced 50 per cent. If the temperature continues to drop, the compressor shuts off until the temperature rises when the cycle is repeated. Thus, the only attention required is the initial starting of the equipment which can be once-a-day or once-a-season operation. Safety controls further guard the system against failure of the regular controls, excessive head pressure, low suction pressure, oil pressure failure or the danger of freezing the water in the *aquamiser* which is located out of doors.

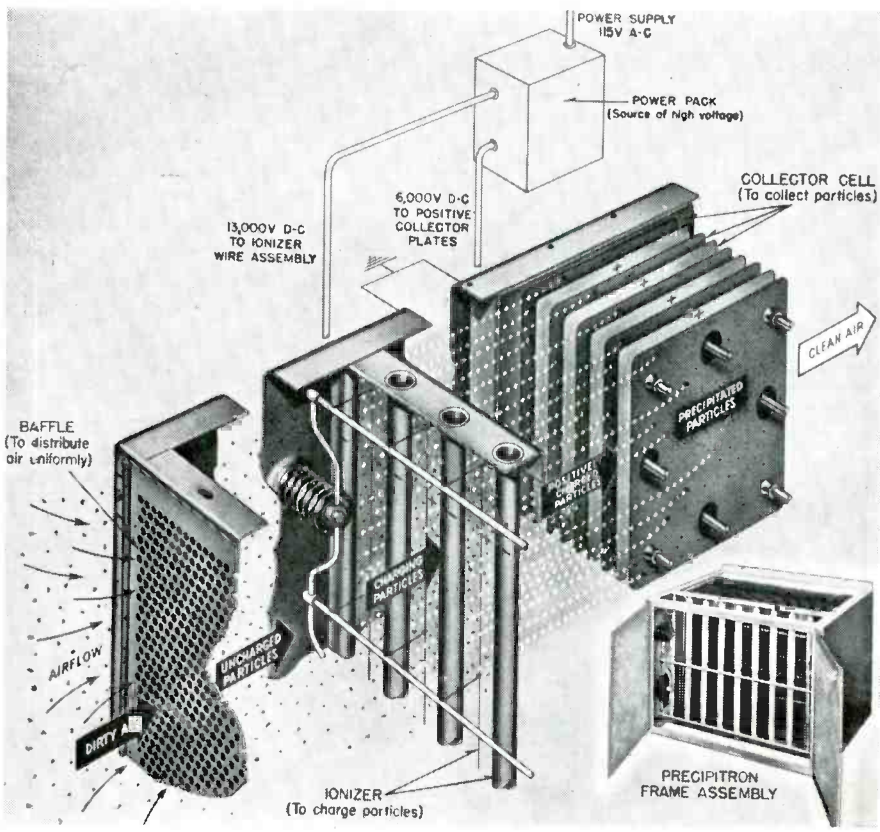
[2] Westinghouse Freon-12.
[3] Minneapolis-Honeywell.

The fan systems are also controlled automatically with the exception of the initial starting of the fans and a hand operated positioning switch that varies the minimum amount of fresh air which is supplied to the system.

Seasonal control is automatically handled. In the winter time, a minimum amount of fresh air is admitted as long as the system is turned on. As the outdoor temperature rises, the amount of fresh air is increased to maintain a suitably low temperature in the trunk duct to satisfy the cooling load in any studio. As the outdoor temperature rises above this point, the outdoor dampers return to a minimum position and chilled water is allowed to enter

(*Continued on page* 38)

Three-dimensional drawing illustrating the operation of the electronic air cleaner. The directional arrows, indicating air flow, depict the steps in the precipitation process.



TV CAMERA Tube Design

THE CAMERA TUBE, that indispensable element in the TV transmitting chain, appears to have captured the interest of everyone . . . those in application and operation at the station, as well as those engaged in research and design in the lab and plant.

Replete with intriguing optical and electronic characteristics[1], the tube has demonstrated that its possibilities seem to be limitless.

The Image Dissector Tube

Development of the tube began over two decades ago. On one front this work resulted in the design of a camera tube using an image dissector[2] principle. The tube featured use of a glass cylinder with light entering through a camera lens at one end. At the far end of this tube appeared a photoelectric cathode, with a nickel coating on the inside of the cylinder, and a rod-like anode mounted in the tube near the optical lens. This anode was covered by a shield so that only a tiny portion could be available through a small hole in the shield structure. The name, *image dissector*, which means . . . *"to take apart a picture"* . . . is exactly what the tube did.

In operation, light from the scene to be televised was focused upon the photoelectric cathode by means of an optical lens. The cathode operated as a photoelectric cell, the number of electrons from any elemental area being determined by the intensity of the light falling upon this area; for a dark portion on the original scene, no electrons were emitted from the cathode and for a highlight portion a great number of electrons were emitted from the cathode.

These emitted electrons produced an electron image or a cloud of negatively charged particles leaving the cathode, the electron image having the exact configuration of the original light image. Placement of a fluorescent screen so that the electron image could fall upon it, provided the visual image. This electron image traveled down the tube in the direction of the positive anode. Since there was only a small aperture in the anode shield, however, only a tiny section of the image could be converted into light energy at any given moment.

The anode structure was fixed in place and thus to produce a scanning pattern, the electron image had to be moved (relative motion between the two was needed for scanning). Two coils were used to deflect magnetically the electron image much in the same manner as magnetic deflection in a receiver picture tube. By means of a rapid horizontal scanning and a slow vertical scanning (corresponding to the standard 525 interlaced standard pattern) the image was moved in front of the aperture and an electrical signal produced. Since only a tiny portion of the completed picture was scanned at any one time the relative output level and efficiency of this tube was exceedingly low.

To produce a usable signal, that is one which exceeds the masking level of the circuit, a method of electron multiplication was used. The anode structure was modified so that it consisted of a series of small plates each having a slightly higher potential than the one before. Secondary emission electrons (in the ratio of 5 to 10 for each individual electron striking the plate) were used to provide a multiplication of several thousand times of the output. In practice, this multiplication factor was severely limited.

In addition to the magnetic deflection coils, a focus coil was used, surrounding the tube, to prevent the mutual repulsion inherent in an electron stream.

Due to its small signal output, the image dissector was found to be useful only in areas of relatively high light intensity.

The Iconoscope

In 1928 came the invention of the iconoscope[3] type of camera tube, the

Figure 1
Basic design features of the image dissector.

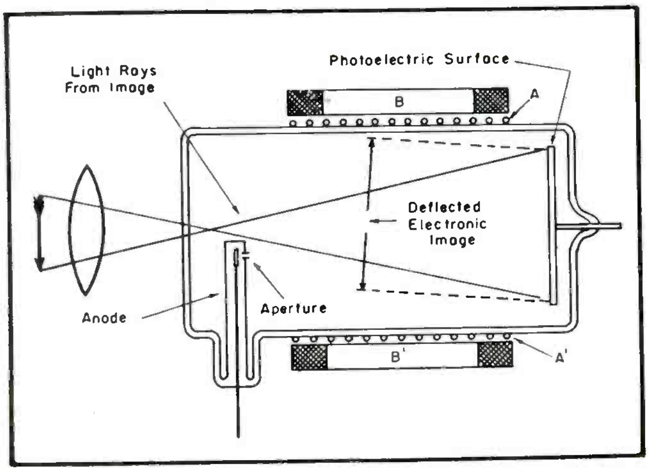
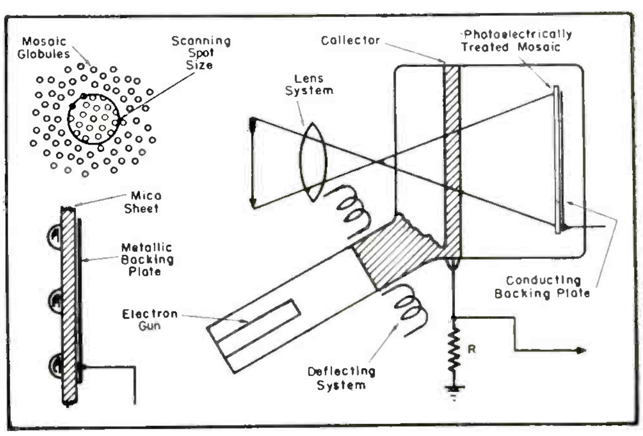


Figure 2
The basic element arrangement in the iconoscope.



Mechanical, Electronic and Optical Characteristics of Nine Types of Pickup Tubes Which Have Been Developed During the Past Twenty Years.

by ALLAN LYTEL
Temple University Technical Institute

feature of which was its memory to retain the illumination of a given scene until it could be converted into electrical signals.

The electron gun of this tube is essentially the same as the electron gun in the picture tube used in home receivers. About the neck of the tube are deflection coils which sweep the electron beam over the light sensitive section in accordance with the standard television scanning pattern. In a light conversion section is a mica sheet coated on one side with many minute photocathode or *globule* areas providing photo sensitivity. The other side of the mica sheet is coated with colloidal graphite; a collector ring mounted in the inside of the glass tube is used for a return path of the photo electrons.

Light, from the scene to be televised, is focused upon the photo-sensitive mosaic. A combined photoelectric action and the electron gun provides an electrical signal. After the picture is focused upon the mosaic, electrons are emitted by each individual globule and the mosaic is then scanned by the stream of electrons from the gun. Electrons are released from the individual globules in proportion to the light arriving at each globule. These emitted electrons go to the collector ring which forms a part of the signal circuit. These is no conncetion except through capacitance between the globules and the signal plate of graphite; mica acts as the dielectric of this capacitance.

[*To Be Continued*]

[1]All of the present day methods used to produce a signal in the TV camera tube are based on the fundamental action of photoelectrics, studied by early experimental workers including Hertz, Hallwachs, and Thomson. Einstein established the quantum theory which introduced the relation that light was made up of very small bundles of energy known as *quanta,* which had the ability to transform this energy into electron motion.

Developments have revealed that there are four basic factors normally involved in the photoelectric effects and its applications:

(*1*) The conversion of light energy into electrical energy is virtually instantaneous.

(*2*) The number of electrons emitted from a cathode per unit of time is directly proportional to the intensity of incident light.

(*3*) The maximum energy of the released electrons is independent of the intensity of the incident light.

(*4*) The maximum energy of released electrons is proportional to the frequency of the incident light; maximum energy increases with an increase in the frequency of the incident energy.

Alkali type metals have been found best suited as cathode materials, providing an effective color-sensitivity range, as the table below illustrates:

Element	Symbol	Range of Color Sensitivity*
Lithium	Li	2,800-4,050
Sodium	Na	3,400-4,270
Potassium	K	4,100-4,560
Rubidium	Rb	4,600-4,810
Caesium	Cs	4,800-5,500

(**In terms of the Angstrom unit: 1 Angstrom unit* = 10^{-8} *cm.*)

In a fundamental photoelectric cell we have a compound of one of the alkali metals on a base metal cathode. This emitting surface has the shape of a semi-cylinder, a rod-like anode with a positive potential being used as a collector element. In operation incident light energy releases electrons from the photocathode. This current flow to the anode and across the plate-load resistor forms the output voltage. A television picture may be produced by breaking up the light in the individual scene to be transmitted into individual elements of light. These picture elements are fed to a photoelectric cell whose output in the proper sequence become the television picture. Mechanical light scanners were originally used in television transmission, *crt* scanning of a photoelectric cell still being used in the *flying spot scanner* type of equipment. In application, appropriate deflection and focusing is applied to the *crt* whose sharply focused point of light scans the object to be televised; a photoelectric cell gathers this light and converts it into the signal output. Modern television camera tubes utilize the photoelectric effect in more complex arrangements.

[2]E. P. Farnsworth, 1931; U. S. Pat. 1,773,980.

[3]V. K. Zworykin, 1928; U. S. Pat. 1,691,324.

Figure 3

Image orthicon developed for outdoor use; type 2P23.

(*Courtesy RCA Tube Department*)

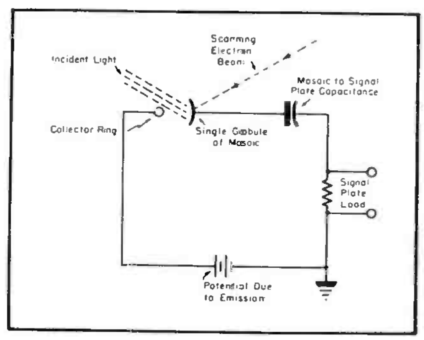


Figure 4

Individual elements of the iconoscope mosaic.

Figure 5

An early type of iconoscope; type 1850-A.

(*Courtesy RCA Tube Department*)

Underwriters' Laboratories

The TV Receiver, with its high-voltage requirements, has pyramided the importance of fire- and shock-hazard prevention. As a result, a variety of measures, which would assure safety, have been formulated and probed by members of industry and the Underwriters' Laboratories.

Many of the preventive suggestions, patterned by the engineering section and the electrical council of the laboratories, after conferences with such groups as the RMA Safety Committee and the Radio Industry Advisory Conference, have already been adopted as standards in manufacture.

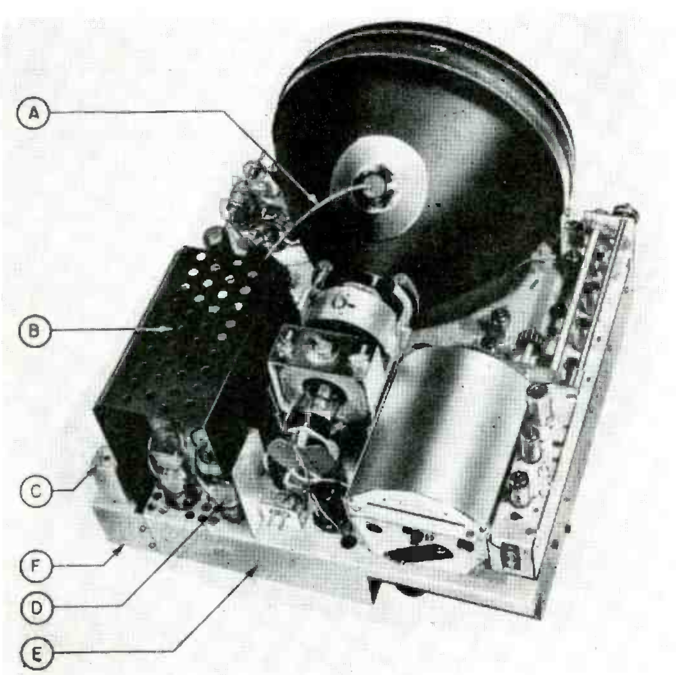
The vulnerable sections of the TV set, such as the power-supply area, have received the closest scrutiny by all concerned.

At the labs, studies of this and other areas of the receiver have disclosed quite a few interesting facts, which have prompted the preparation of some new preventive proposals. In the investigations, it was found that postwar TV receivers employing inherently low-power output, high-voltage units were considered by many to be less hazardous. It has been found though that fires have occurred in these models, the fires being caused by not one, but a number of different components. In view of this problem it has been proposed that a complete metal housing be used for the high-voltage section of the receiver. This approach has been studied for quite awhile by industry. Manufacturers have cooperated in the meantime by providing partial metal enclosures, even though there has been some doubt as to the amount of protection afforded. It is realized that a complete enclosure of the high-voltage section may introduce a number of complications. However, if a continued adverse fire record prevails it may become necessary to adopt this method of protection, if no other alternative can be found.

Among other preventive proposals that have been advanced recently are complete metal enclosures for filter chokes, nonflammable insulating compounds on high-voltage transformers, nonflammable polyethylene insulating wire, and nonflammable insulating parts having improved performance at high operating temperatures.

Shock Hazards

The items discussed thus far relate primarily to fire hazard. There are also a number of conditions in the shock hazard category that have received serious consideration at the labs. After study and discussion of the problem with other authorities in the field, it was agreed that exposed live parts of receivers should be so arranged that the leakage current to ground through 1500 ohms would not exceed 5 *ma*. For protected parts such as the receiver chassis, this must be increased to 10 *ma*, on the basis that the additional protection is provided. These values were primarily intended for 125-volt circuits and, when high-voltage parts of television receivers were first discussed, it was expected that such parts would be insulated and that they would not be exposed to user contact while energized. One of the earliest postwar receivers was so arranged that personal contact could be made with the high-voltage anode lead and terminal. The instantaneous discharge on this lead involved a current of less than 5 *ma*, with an additional discharge current resulting from the filter and tube capacity. It was interesting to note that a discharge on the order of 12½ kv with a total capacitance of 800 mmfd was considered acceptable. In fact, a number of the engineers made deliberate contact to determine the physiological effect of the current, but when the voltage was increased to 25 kv, no one was interested in making the test and it was generally agreed that even though the current did not exceed 5 *ma*, some type of interlock protection should be used. Although there is some likelihood that the effect of capacitor discharge at the high voltages may not be injurious, there are no data avail-



Adopted and proposed Underwriters' Laboratories' precautionary standards for TV sets: a, non-flammable high-voltage cable; b, shield over high voltage supply; c, interlock arrangement; d, fuse for 6BG6; e, chassis ground; f, shielded filter choke.

(Illustration, courtesy Zenith Radio)

Requirements for TV Receivers

UL Standards, Developed to Eliminate Hazards of Fire and Shock, Cover Variety of Components and Materials from Metal Enclosures for Power Systems, Chokes and Horizontal Output Transformers to Non-Flammable Polyethylene-type Insulating Leads for Picture Tubes.

by K. S. GEIGES

Associate Electrical Engineer

Underwriters' Laboratories, Inc.

able as in the case of the lower voltages. It appears, however, that manufacturers will use interlocks for the high-voltage supplies. The labs' interlock requirements have been modified over the past three years and there is some indication that the present requirement calling for an informative marking near a defeatable interlock will meet the general need.

Metal Tube Problems

The labs' investigations have also covered the metal tube with its large area of metal, operating at high voltage, and exposed within the receiver cabinet. The insulators, normally required for potentials on the order of 15,000 volts, were not considered feasible by manufacturers and the labs and a test method was devised where a 200% voltage dielectric test could be made between a metal lining in the cabinet and the live metal parts. This requirement has proved to be a reasonable one, and, although it involves lining the cabinet at points where breakdown would be likely, it has not offered the mechanical difficulties that were originally anticipated.

Servicing Television Receivers

It is the labs' belief that provision should be made for the servicing of all tubes, on the theory that the user will in many cases attempt to replace defective tubes during the life of the receiver, even though he may not do so during the original service contract period. In addition, there is some reason to believe that picture tubes will be serviced, although it is on this point that most of the controversy stands.

Many manufacturers have made provision for wiping dust from the face of the tube. Others have not, and it would be desirable to have agreement on this servicing feature.

Shock Hazard

There is one important item, related to shock hazard, which has been studied particularly closely, since it does not appear to be fully understood by too many engineers. It is a fundamental requirement in the National Electrical Code that appliances involving potential above 150 volts above ground should have metal housings grounded. The normal way of handling this requirement would be to use a three-wire cord, with the third wire as the ground leg. However, at the initial conference on television receivers which was held a few years before the war, it was agreed that the industry would be severely handicapped if requirements for three-wire cords and receptacles were introduced, and an effort was made to accomplish the desired protection in another way. At that time, high-voltage supplies were obtained from insulated power transformers which were required to withstand a four-times dielectric potential between primary and secondary or to have an electrostatic shield. The postwar receivers did not employ such high-voltage transformers and, if the energized anode lead should come in contact with a ground through personal contact, a failure could occur in the primary side causing a 110-volt *ac* potential to be placed on exposed metal parts. For this reason an additional requirement has been introduced to test such a condition. With the low energy, high-voltage circuits now in use, protection against high voltage on the primary side can be provided by a suitable resistor or provision of an interlock with a complete back.

High-Voltage Wires

A development now in the hands of the RMA committee, in which the labs have been keenly interested has been the *high-voltage wire standard*. The only high-voltage cable available at this time is that which has been developed for oil-burner ignition systems and, although it does not meet all of the requirements of the television designer, it appears likely that a suitable labeled cable will be available as a result of this activity.

UHF TV Adapters

With the advent of *uhf* band, manufacturers will be providing for the use of adapters that are still in the design stage. To avoid a serious delay in the handling of listings of receivers, the labs have proposed a temporary requirement. A power supply connection in the form of a conventional two-wire attachment plug receptacle may be identified for *uhf* adapter use. Non-hazardous energy signal circuit connections to adapters can be provided as in the case of phono connections. However, where other inter-connections are involved it will be impossible to judge the hazards of interchangeable adapters. Markings limiting receivers and adapters for specific combinations appear to be the only method of handling interconnections involving hazardous energy circuits.

TV Parts and Accessory Review

WITH THE ADVENT of TV receivers with their elevated voltages, many hours of continuous operation and the generated heat, component requirements have become increasingly critical. Operating temperatures have been steadily climbing; 50° C, for instance, became relatively cool some time ago. Thermometers placed in sets have been pushing up the mercury to 70, 75, 85 and even 100° C. Meanwhile, design engineers have learned that there are temperatures below 0° C, and many engineers have been flirting with operating temperatures all the way down to 40° C and below.

In producing such components as the tubular capacitor, for TV, there has been a never-ending search and research for better waxes, better tubes, better end-fills, etc., to meet the exacting receiver conditions encountered.

One of the foremost factors limiting the application of the standard paper tabular has been the high operating temperatures which cause dripping of impregnating compounds, the end-fill, or the overall dip. In many cases it has been a compromise between eliminating the overall dip and taking a chance on decreased life caused by transmission of water vapor through the paper case, and the use of the overall dip with the danger of dripping same on to adjacent components such as variable capacitors, trimmers, relay contacts and so on.

In analyzing the problem, there seemed to be, according to one manufacturer,[1] two general lines of attack: (1) To develop a housing which would be impervious to moisture and would also prevent impregnating waxes or oils from leaking out; and (2) to develop a new impregnant. This new impregnant had to be of a non-liquid nature and preferably have all of the other characteristics of the commonly used impregnant.

The dielectric constant of the new material sought was of prime importance.[2]

As a result of their investigation, they came up with an impregnant[3] which they claim has seven characteristics: solid when set, relatively high dielectric constant, high dielectric strength, high insulation resistance, excellent resistance to moisture, ability to give up moisture, and high dielectic strength at elevated temperatures.

The use of this material permitted the processing of a molded-plastic tubular.[4] However, the design had one or two drawbacks. The most important drawback was higher cost, while the lesser was its fairly high positive temperature coefficient of capacitance. The latter characteristic limited its use to the less critical circuits.

To solve the problem, a paper tube was tried as a mold and case. This resulted in the production of a *self-molded paper-tube* plastic tubular,[5] which has been found possible to operate at temperatures up to 212° F.

Spiral-Type Inputuner

A spiral-type *Inductuner*[6] which requires 5.9 turns of tuning motion as against 10 turns for previous models is now available. A four-section inputuner, the unit has a continuous tuning range of from 54 to 216 mc.

Tuner has a dial which illuminates the TV channel numerals on an outer circle and then automatically switches the illumination to the FM designations on an inner circle when the tuner traverses the FM band.

Can be used on either 300 or 72 ohm antenna systems, by means of an input transformer.

Ion Trap and Focalizer Units

A focalizer unit[7] utilizing Alnico permanent magnets to replace the wire wound focus coil which is said to permit permanent precision focusing of the picture that is not affected by temperature or line voltage changes, has been developed by Quam-Nichols for set manufacturers.

Output Transformers

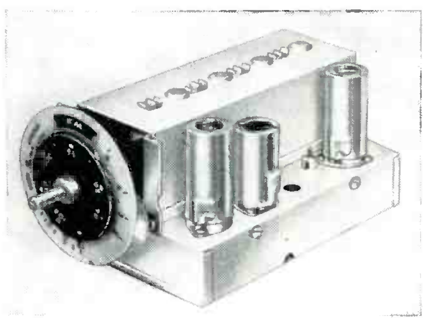
High fidelity output transformers, which are said to have a frequency response of ±1db 10 cps to 10,000 cps, and deliver full rated power at 20 cps, are now available from Acro Products Co.[8] Transformers feature a symmetric coil structure with

(*Continued on page 36*)

[1]Aerovox.
[2]According to Aerovox, the dielectric constant in itself is not the most important factor in reducing the size of a capacitor. It is their opinion that it is better to consider the merit of a dielectric as the product of the dielectric constant or specific inductive capacitance times its dielectric strength. This figure of merit, they say, presents a truer picture of the value of a dielectric as far as final capacitor performance is concerned. In referring to dielectric strength, in all instances, they refer to the working strength. And, according to Aerovox, the actual dielectric strength at which the material can be worked depends more on the life test conditions than on actual rating.
[3]Aeroline. [4]Duranite.
[5]Aerovox '87.
[6]DuMont.
[7]Quam-Nichols Co., Chicago.
[8]5328-30 Baltimore Ave., Philadelphia, Penna.

TV picture-tube focalizer unit.
(*Courtesy Quam-Nichols*)

Spiral-type inputuner.
(*Courtesy DuMont*)



Veteran Wireless Operators Association News

THE ALL-IMPORTANT results of the recent VWOA election, announced at the annual business meeting in New York City, held during the first week in January, revealed that W. J. McGonigle was re-elected president and that A. J. Costigan was named first vice president; E. N. Pickerill, second vice president; W. C. Simon, secretary; R. J. Iverson, assistant secretary, and C. D. Guthrie, treasurer. Elected to the board of directors were Geo. H. Clark, A. J. Costigan, C. D. Guthrie, W. J. McGonigle, Capt. Fred Muller, Haraden Pratt, W. C. Simon and G. E. Sterling. . . . R. K. Davis and A. J. Rehbein served as co-chairmen of the ballot committee and A. J. Stobbart and H. T. Williams assisted in polling the votes. . . . Ye prexy announced at the meeting that the annual dinner-cruise would be held on February 25, 1950, at the Hotel Astor in celebration of VWOA's twenty-fifth anniversary. . . . Geo. Clark, in reporting for the Monument Committee, disclosed that plans will soon be presented to the City of New York officials for the replacement of the Wireless Operators' Monument in Battery Park, which is expected to take place shortly after the construction work on the Brooklyn Tunnel is completed.

Personals

LEONARD B. VICTOR, who recently joined our ranks, notes that his key days began in '17, when he was with the U. S. Signal Corps as a radio operator. From '19 to '23 he was in the Merchant Marine aboard several ships. From '23 to '35 he was engaged in lab work and in the manufacture of radio apparatus. In '40 he reentered the Merchant Marine as a chief op aboard a passenger ship of the Moore-McCormick Lines, and during '49 he was named manager of the radio department of that company. . . . Another old-timer, Arthur A. Stockellburg, has rejoined our ranks as a life member. . . . We are indeed sorry to report the death of two of our members, M. G. Carter, who passed away in the Southampton hospital on December 30, 1949 after a short illness, and Loyd A. Briggs, who died on Jan. 4, 1950, at New Haven Hospital. . . . J. Devenport, who has had a short leave of absence, is back aboard a United Fruit vessel. . . . Henry Hayden, Jr., reports that he would welcome QSO with other VWOA members on 75 meters' phone and 80 meters' *cw*, or 2 meters' phone. His call is W2FO. . . . W. A. Knight has left the Rural Radio Network, where he was assistant chief engineer for two years, to rejoin Press Wireless as engineer at Hicksville, L. I. . . . George B. Robinson, now with NBC as a field engineer and formerly with WOR, spent two years, from '45 to '47, at sea. Reminiscing, he says that those twenty-four months were quite thrilling. "Didn't dare touch the key of the old ET-3626 until I heard WSC call KCRF," he notes, "and then I was back in business." . . . Thomas G. Brown is with Motorola as zone manager in southern Illinois, where he is installing 2-way communications equipment.

Instrument News...

Wave-shaping equipment which has been used to produce time marks in cathode-ray oscillography, has been found quite useful in TV test bench work. Recently announced for this operation has been a unit[1] which can convert a sinusoidal input voltage (maximum amplitude 30 volts *rms*) into a series of sharp unidirectional pulses, which may be displayed directly on the face of a *crt*. The timing marks, consisting of short breaks in the oscillograph trace, are obtained by connecting the output of the marker to the *Z* input terminals of the oscilloscope.

The unit may be plugged into the terminals of an *af* oscillator.

Two types are available, one[2] giving negative pips, and another[3] giving positive pips.

Volt-Ohm-Mil-Ammeter

The requirements of lab procedures has prompted the production of a 5½" volt-ohm-mil-ammeter[4] with mirrored, hand-drawn scales, featuring the use of ½% resistors.

Ranges provided are six *dc* volt ranges from 0 to 6000, at 20,000 ohms/volt; six *ac* volt ranges from 0 to 6000, at 5,000 ohms/volt; five *dc* current ranges; and resistance ranges from 0 to 100 megohms. Meter has a precalibrated rectifier unit.

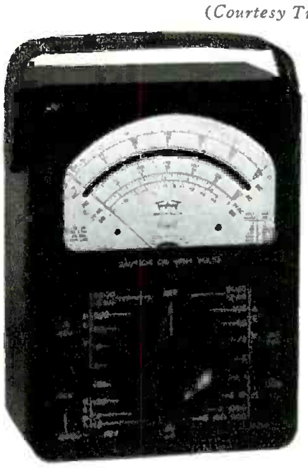
[1]Labmarker; Berkshire Laboratories, P.O. Box 70 C, Concord, Mass.
[2]Model 1N. [3]Model 1P.
[4]Type 630-A; Triplett Electrical Instrument Co., Bluffton, Ohio.

Wave-shaping unit developed to produce time marks for 'scope work.

(Courtesy Berkshire Laboratories)

The volt-ohm-mil-ammeter featuring hand-drawn scales.

(Courtesy Triplett)



TV Sound Activities

SYNCHRONOUS MAGNETIC tape recording and playback equipment, which has demonstrated its interesting possibilities on many occasions in permitting the instantaneous playback of sound tracks and facilitating TV show production, has been a subject of several developmental probes. As the result of one investigation, the use of standard ¼" magnetic tape has been provided for, instead of emulsion-coated acetate film stock.

The difficulties involved in producing a synchronous ¼" tape recorder, that would continuously maintain coordination between the aural and the visual, without the use of sprockets, appear to have been solved by a method[1] which automatically compensates for expansion and contraction of the tape, which varies from day to day as a result of changes in humidity, temperature and tensions.

Two sync tape recorders of this type have been installed by CBS-TV.

The equipment contains a tape recorder unit 3, plus the *sync* control mechanism in console cabinet. The basic tape speed is 15" per second with push button control to advance or retard the speed for *framing* sound and picture. When the push button is manually released the *sync* control automatically takes hold and maintains synchronism between the sound-on-tape and the picture-on-film. A visual indicator is built into the equipment to indicate proper synchronous operation and to aid in *framing*.

Magnetic Tape Sound-Slide Film Synchronizer

In another sound development, a system for synchronizing a magnetic tape recorded script with any automatic slide projector, without the use of tone signals or push-buttons, has been evolved. A dual-channel tape recorder[3] is used as the recording and playback medium. At pre-set intervals, a pulse is sent to the projector, activating the projector's tripping mechanism.

The script is recorded in the normal manner on sound recording tape. At each point in the script where the slide is to change, a 2" long, ⅛" wide strip of self-adhering copper foil is placed on the back, or uncoated side of the recording tape. As the recording tape passes a laminated switch on the recorder during playback, the copper foil shorts out a section of the laminated switch, which activates a relay to send the tripping pulse to the projector.

One-Hour Provision

Because the recorder utilizes two sound tracks on standard sound recording tape, a maximum continuous message length of one hour can be accommodated. The activating foil is placed on the upper part of the tape in forward direction of tape travel, and on the lower part for reverse tape travel.

Magnetic tape sound-slide film synchronizer.

[1]Pic-Sync; Fairchild Recording Equipment Corp., 154th St. and 7 Ave., Whitestone, New York.
[2]Fairchild unit 100.
[3]Twin-Trax; Audio-Visual Division, Amplifier Corp. of America, 398-3 Broadway, New York 13.

Parts-Accessories

(*Continued from page 32*)

accurate reactive balance. Design is said to minimize phase shift so that over 30 db of stable degenerative feedback can be carried around the output transformer without need for phase correction in the feedback loop.

Available in six models for most popular tube combinations, including a special unit for use with triode connected 807's as used in the Williamson circuit.

Tube Developments

Rauland Picture Tubes

Seven types of TV picture tubes are now being produced by the Rauland Corp.,[1] including 10" and 12½" glass and 12½" and 16" metal cone types.

In the 10" family are the 10BP4 with an essentially flat screen and the 10FP4 with an aluminized reflector P4 screen. Three tubes are in the 12½" group: the 12KP4 with an aluminized reflector P4 screen; 12LP4 with an essentially flat screen and the 12UP4 with a metal cone. In the 16" category are the metal cone types: 16AP4 and the 16EP4, with a neck 2⅝" shorter than the 16AP4.

The 12LP4, 16AP4 and the 16EP4 tubes are also being furnished with the black or filter type faces,[2] in accordance with the developments of C. S. Szegho.

Raytheon Picture Tubes

A type 16LP4 direct-view magnetic deflection and focus picture tube is now available from Raytheon.[3] Has an electron gun designed to be used with an external ion-trap magnet to prevent ion spot blemishes.

Hytron Rectangular All-Glass 16" Tubes

A direct-viewing 16" picture tube with a rectangular screen, type 16RP4, has been announced by Hytron.[4]

Tube features a neutral gray face. Its weight is said to be approximately two-thirds that of the 16-inch, all-glass round tube. Magnetic focus and deflection are employed.

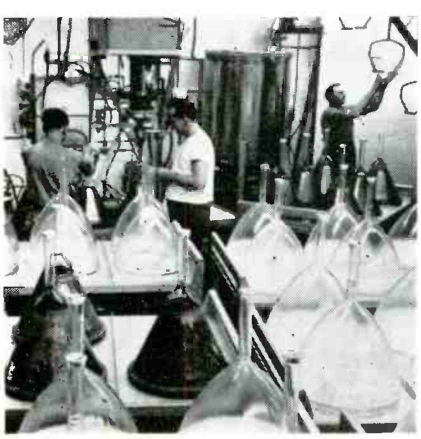
Eimac Pentodes

A beam-pentode, the 4E27, rated conservatively at 125 watts plate dissipation and designed for *vhf* service, is now available from Eimac.[5]

Design innovations include a moulded-glass header, shell type base, low-loss leads, non-emitting grids and a *pyrovac* plate.

[1]4245 North Knox Avenue, Chicago 41, Ill.
[2]Glass contains a neutral gray oxide to establish a predetermined light absorption quality. Trade names of screen are Luxide (*Rauland*) and Glareban, Filter Face and Blaxide.
[3]Newton, Mass.
[4]Hytron Radio and Electronics Corp., Salem, Massachusetts.
[5]Eitel-McCullough, Inc., 240 San Mateo Ave., San Bruno, Calif.

Cleaning and inside coating picture-tube station under a conveyor in the Ottawa, Ohio, Sylvania plant.



Personals

Alfred C. Viebranz is now general sales manager of the Electronics Division of Sylvania Electric Products, Inc.

Viebranz, who was formerly government sales representative for the electronics division at Washington, D. C., succeeds George C. Connor, who has become general sales manager of the photo-flash division.

A. C. Viebranz

Edward A. Malling has been appointed sales manager for component parts in the General Electric receiver division at Electronics Park, Syracuse, N. Y.

E. A. Malling

Clarence G. Felix has been named assistant to John W. Craig, general manager of the Crosley Division, Avco Manufacturing Corp.

T. DeWitt Talmage has been appointed assistant sales manager of the Kellogg Switchboard and Supply Co., Chicago.

Larry F. Hardy has become president of the Television and Radio Division of Philco Corp.

Frederick D. Ogilby has been appointed vice president of sales of the Television and Radio Division of Philco.

Wesley L. Wilson has become general sales manager of the cathode-ray tube division of Arcturus Electronics, Inc., 54 Clark Street, Newark, New Jersey. Wilson was formerly commercial manager of the components division for North American Philips Company, Inc.

B. K. V. French has been named application engineer for the electronic parts division of Allen B. Du Mont Labs., Inc., 35 E. Market St., East Paterson, N. J. He will collaborate with engineers and production men of TV set manufacturers in fitting Du Mont components to their assemblies.

E. F. Peterson has been named manager of sales of the G. E. tube divisions, with headquarters at Schenectady.

L. B. Davis has been appointed manager of the G. E. receiving tube division at Owensboro, Ky.

K. C. DeWalt is now manager of the G. E. cathode-ray tube division at Electronics Park, Syracuse, N. Y.

Air Conditioning

(*Continued from page* 27)

the coils to hold the temperature to the desired point.

The grouping of several studios on one fan system, with the returns from each studio going back into the same system coupled with all of the studios being served by one chilled-water refrigeration system, gives a fly-wheel effect that quickly picks up peak loads which might otherwise overload an individual system. In fact, WBZ has been able to use its regular studios for temporary television broadcasting without undue trouble from the added heat thrown off by the powerful lighting required for TV work.

The hundreds of delicate relays are kept cool and clean through the air cleaning system. And the air, after passing up through the racks, enters an exhaust duct so that the transmitting room is as comfortably cool as the studios.

The acoustical treatment of the ductwork, designed by Henry Gurin of NBC, prevents noise from the air-conditioning system entering the studios. Each duct, divided into small cells with a lining of glass fibre board, reduces this noise and also prevents *cross-talk* between studios.

Industry Literature

The Seletron Rectifier Division of Radio Receptor Co., 251 West 19th St., New York 11, N. Y., has prepared a four-page folder describing industrial applications of Seletron selenium rectifiers in units up to 75 kw. Detailed are typical installations used in theatres, elevator motor supplies, and power packs for *dc* motors.

The Hickok Electrical Instrument Company, 10529 Dupont Avenue, Cleveland 8, Ohio, have released a 50-page booklet, No. 342, covering FM and TV servicing with the 'scope. Available at $1 per copy.

The Allegheny Ludlum Steel Corp. metallurgical staff have published a 16-page booklet titled *The Working of Tool and High Speed Steels.* Booklet details design, machining, cutting-tool angles, speeds, heat treatment, grinding.

Sorensen and Company, Inc., 375 Fairfield Avenue, Stamford, Conn., have released two electronic-voltage regulator catalogs.

One catalog, No. A-1049, contains specifications and description of the voltage regulators for the control of *ac* power. Another issue, No. B-1049, lists and describes the Sorensen line of *dc* power sources and supplies.

The Pheoll Manufacturing Co., 5700 Roosevelt Road, Chicago 50, Ill., have prepared a 28-page catalog, No. 80A, describing *Sems* (lock-washer screws).

Products illustrated include screws in round, pan, truss, fillister, flat and oval head styles. These are listed in both slotted and Phillips recessed head types.

Audio Development Company, 2833 Thirteenth Avenue, South, Minneapolis 7, Minn., have published a 16-page catalog, No. 49A, describing chokes, filament transformers, sound effect and band-pass filters, impedance matching transformers, interstage transformers, microphone cable transformers, patch cords, reactors, etc.

Radiart Corporation, 3571 West 62 Street, Cleveland 2, Ohio, have released bulletins covering TV receiving antennas and accessories. Also available from Radiart is an 8-page catalog describing vibrators, power converters and antenna-mount accessories.

Germanium Diodes

(*Continued from page* 13)

the diode in the best way possible, as for example in the control of the local oscillator voltage. Often this single adjustment will change the operating point enough to permit striking a proper mean between the several characteristics such as noise, sensitivity and output impedance.

Tests have shown that the maximum curvature of the current voltage curve occurs very close to zero voltage, so that it is unnecessary to add separate *dc* biasing voltage to obtain maximum mixing action, an effective advantage at the ultrahighs.

Briefly Speaking . . .

The TV multiple-antenna single-mount site idea, a blueprint project for years, will soon bounce out of the lab and bless the skyline of New York City via the Empire State Building. NBC will share its channel-4 position with WJZ-TV, operating on channel 7, and it's expected that WPIX (channel 11) and WABD (channel 5) may become neighbors on the skyscraper, too. In Rochester, Stromberg-Carlson has a TV site on a choice hill which it suggests can be used by at least two other TVcasters. The one-tower or one-hill approach is expected to be followed widely, not only by new stations, which everyone hopes will be with us soon, but those now in operation who have found that their coverage can be increased substantially with a higher, more ideally-located tower. . . . WOR-TV will play host to engineers attending the annual winter general meeting of the AIEE on Friday morning, February 3. . . . Davis T. Schultz is now on the board of directors of the Raytheon Manufacturing Company. He is vice president and treasurer of Raytheon. . . . Sheldon Electric division of Allied Electric Products, Inc., Irvington, New Jersey, will soon begin the construction of a new building for the production of picture tubes. . . . Bruno New York, Inc., 460 West 34 St., N. Y. City, are now distributors for the Jerrold Mul-TV systems. . . . WRGB's three-tower relay system has been replaced by a coax system. Two cables are now on duty for WRGB and are also serving TV stations in Syracuse and Utica. . . . WSYR-TV, Syracuse New York, is now installing a G. E. 5-kw transmitter. Also being installed is a five-bay antenna atop a 200-foot tower which is mounted on the rooftop of a Syracuse building providing a total height of 1270 feet for the antenna. . . . A new research lab and specialized production building is now being constructed by Motorola in Phoenix, Arizona. . . . Charles A. Gardiner has been elected treasurer of the Hudson Wire Company, Ossining, New York. . . . H. G. Batcheller is now chairman of the board of the Allegheny Ludlum Steel Corp. and E. B. Cleborne has succeeded him as president. . . . W. H. SaLee is now general sales manager of the Janette Manufacturing Company, Chicago, Illinois. Ogden J. Maag will serve as assistant sales manager. . . . A factory branch office at 2700 Polk Ave., Houston, Texas, has been opened by the Gates Radio Company, Quincy, Illinois. Wayne E. Marcy will serve as southwestern branch manager in this office and Joseph Woods will assist as store manager. . . . John L. Merrill, former president of All-America Cables, died recently. . . . Dr. Albert W. Hull has retired from his post as assistant director of the G. E. research laboratory and will serve as a consultant. . . . Melvin B. Schwartz has been appointed sales manager of Television Equipment Corp., New York City. . . . Dr. Dayton Ulrey has retired as chief engineer of the Lancaster, Pa., TV and special purpose tube plant of RCA. . . . Charles G. Roberts, Jr., product manager for radio and TV broadcast equipment at G. E., died recently. . . . Taco's chief engineer, Kendrick H. Lippitt, will present a paper on *uhf* and *vhf* antenna requirements before the FCC when the Commission holds its hearings next month.

ADVERTISERS IN THIS ISSUE

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JANUARY, 1950

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TYPE 874-D20 Adjustable Stub	**15.00**
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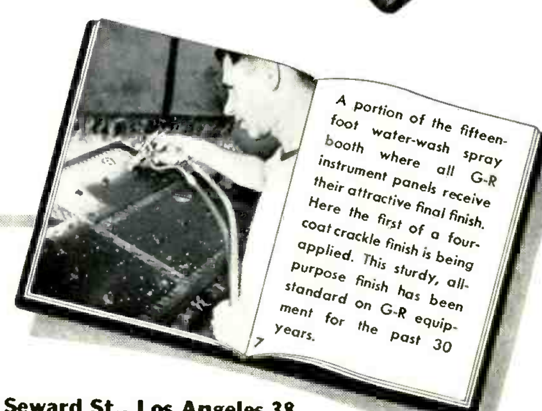
Write for complete information on the new G-R line of U-H-F Measuring Equipment.



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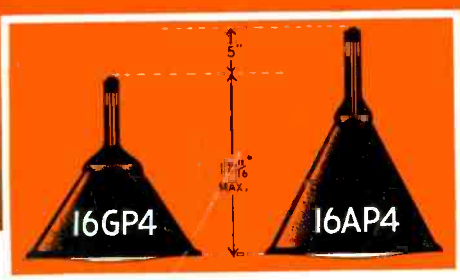

...the new, short metal-cone kinescope with "Filterglass" face plate

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RCA Application Engineers are ready to co-operate with you in applying the 16GP4 and associated components to your specific designs. For further information write RCA, Commercial Engineering, Section A 58 R, Harrison, N. J.

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