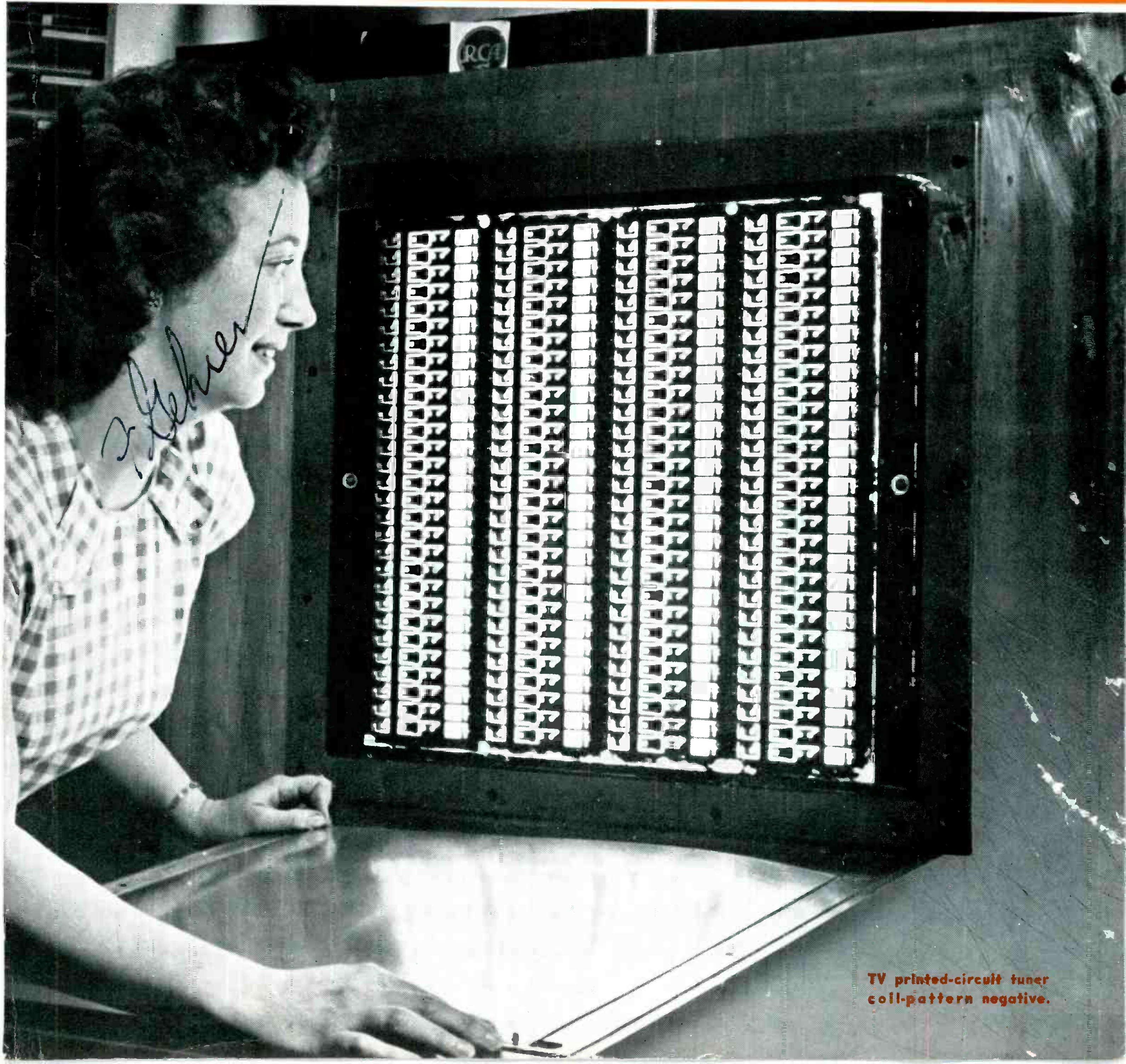
TELEVISION ENGINEERING

MAY, 1950



TV printed-circuit tuner coil-pattern negative.

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TELE-VISION ENGINEERING

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VOLUME 1 **MAY, 1950** **NUMBER 5**

MONTHLY FEATURES

Cover Illustration

Heart of the RCA TV printed-circuit tuner process; negative containing multiple-coil patterns used to make a print on a copper-clad sheet of phenolic plastic, coated with a light-sensitive material. Phenolic sheet is then placed in a chemical bath which etches out the circuits. After further processing, the sheet is cut into separate circuit segments.

Editor: LEWIS WINNER

ABC

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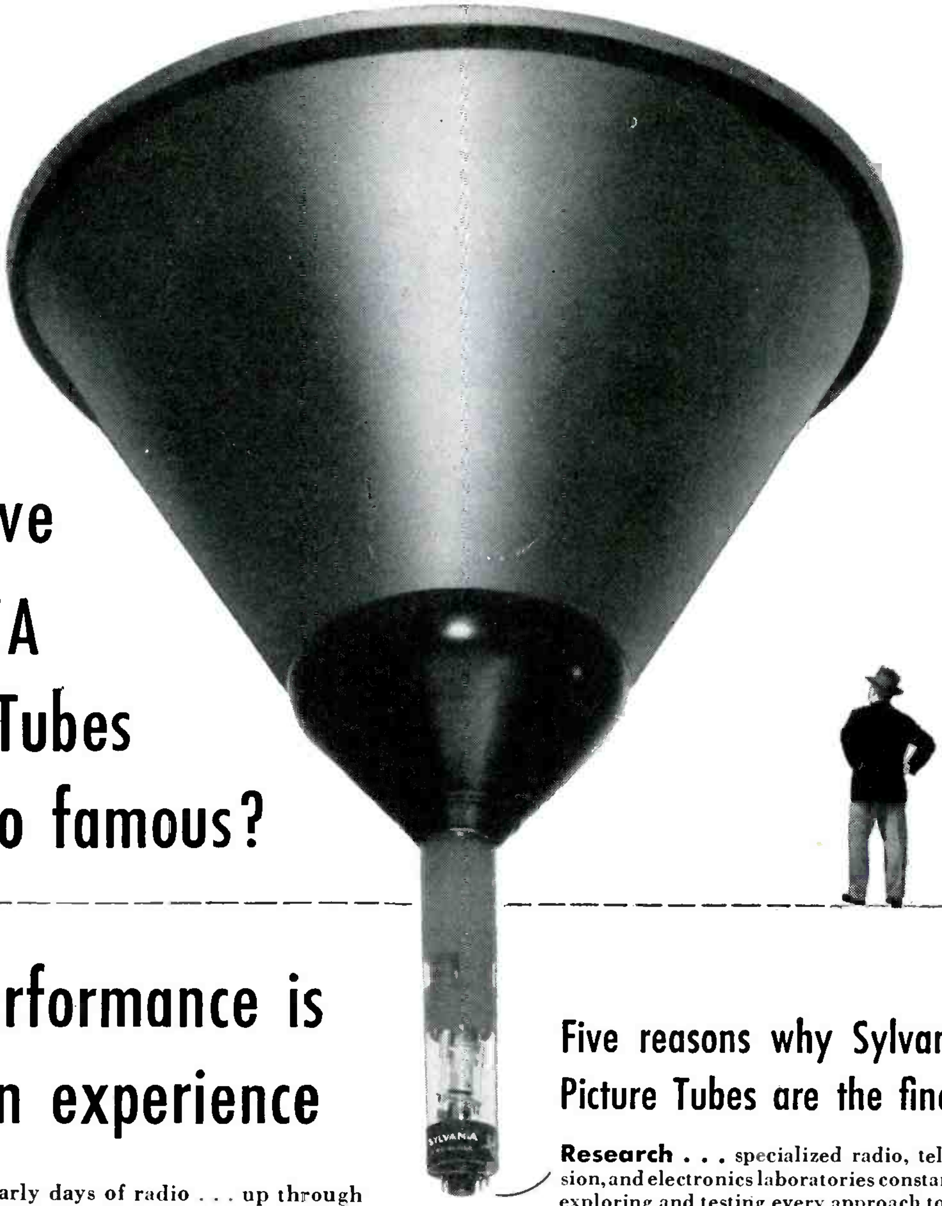

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TELE-VISION ENGINEERING

LEWIS WINNER, Editor

May, 1950

Warning . . . High Voltage

WITH THE SHOCKING NEWS of the accidental death by electrocution of WDOK's popular transmitter supervisor, Paul Quay, caused by a fall against a high-voltage cable, broadcasters throughout the nation once more have become alerted to the pounding destruction abounding in those thousand-volt open-housing circuits, which must circle a transmitter and, must, therefore, be approached with infinite care.

Quay's frightening death, one of six recently reported due to falls against live cables, reemphasized the urgent need for a stringent safety program at every broadcast plant throughout the land. Like the others, Quay had been working in an area with power surging through open lines, in this instance an eight-kv circuit, where the power should have been switched off. He had been measuring floor space behind the on-the-air transmitter when he lost his balance, struck the live lead and the paralyzing power pulsed through his body. The tragedy prompted WDOK's chief engineer, J. B. Epperson, to route a warning bulletin to all the stations of the Scripps-Howard network, of which WDOK is a member, which we feel should be *read*, *copied* and *adopted* as a daily creed by all in broadcasting. . . . AM, FM and TV.

Said the bulletin: "Let's all try to redouble our safety efforts both at the studio and transmitter by observing the following precautions . . . (1)—Never do any type of even slightly hazardous work, either mechanical or electrical, without a second party present. (2)—Be safety-conscious at all times. Observe all safety precautions on any job and never take unnecessary chances. We want the show to go on, but we also want our engineers to *go on living*. (3)—You are your brother's keeper. Don't ever hesitate to warn a fellow employee of impending danger even though you believe he may be aware of the risk involved. Warn him again and again if necessary."

Commenting on this heartbreaking accident to ye editor, Epperson said that the need for the safety campaign grows daily as TV spreads, because here even higher voltages are involved. We were told that TV transmitters and receivers are more potent killers, than the standard AM and FM broadcast equipment. Television servicing on both TV transmitters and receivers, Epperson stated, requires more intimacy with high-voltage circuits, than the standard broadcast service routine. In addition, we were advised that television requires mechanical work which is more likely to lead to accidents than in standard broadcasting. Elaborating on this point, Epperson stated that the installation of relay transmitters and receivers on towers and high buildings, transportation of these items, the installation of special lighting equipment and cables and numerous other factors tend to make television work at a transmitting station a considerable hazard. As a result, Epperson emphasized, a safety code must be pursued by all engineers, following a doctrine which will make them think twice before taking chances with high voltage, which perhaps could be an invitation to death.

Standard safety *do's* and *don't* are normally mounted on the walls of most stations. These rules should be read and followed diligently, with particular respect for such warnings as: Keep your left hand in your pocket when working on electric gear of any type that is alive, and don't work in a position where your head can become a conductor. . . . See that every interlock, that is taped closed, is tagged and that all circuits are grounded, checking with a grounding stick before working on the equipment. . . . Be careful when *hotting-up* lighting equipment if you are a TV lighting man. Usually both sides of the line are exposed on the normal lighting plug, just as it is plugged into a socket and if the plug is grasped too far forward, the results may be damaging. . . . And never hold on to a metal catwalk or pipe rigging when completing lighting circuits.

Watch those hot lines. They are meant for the gear of sight and sound, and not for the body . . . arms, legs or anywhere around!

Another Milestone for Upstairs TV

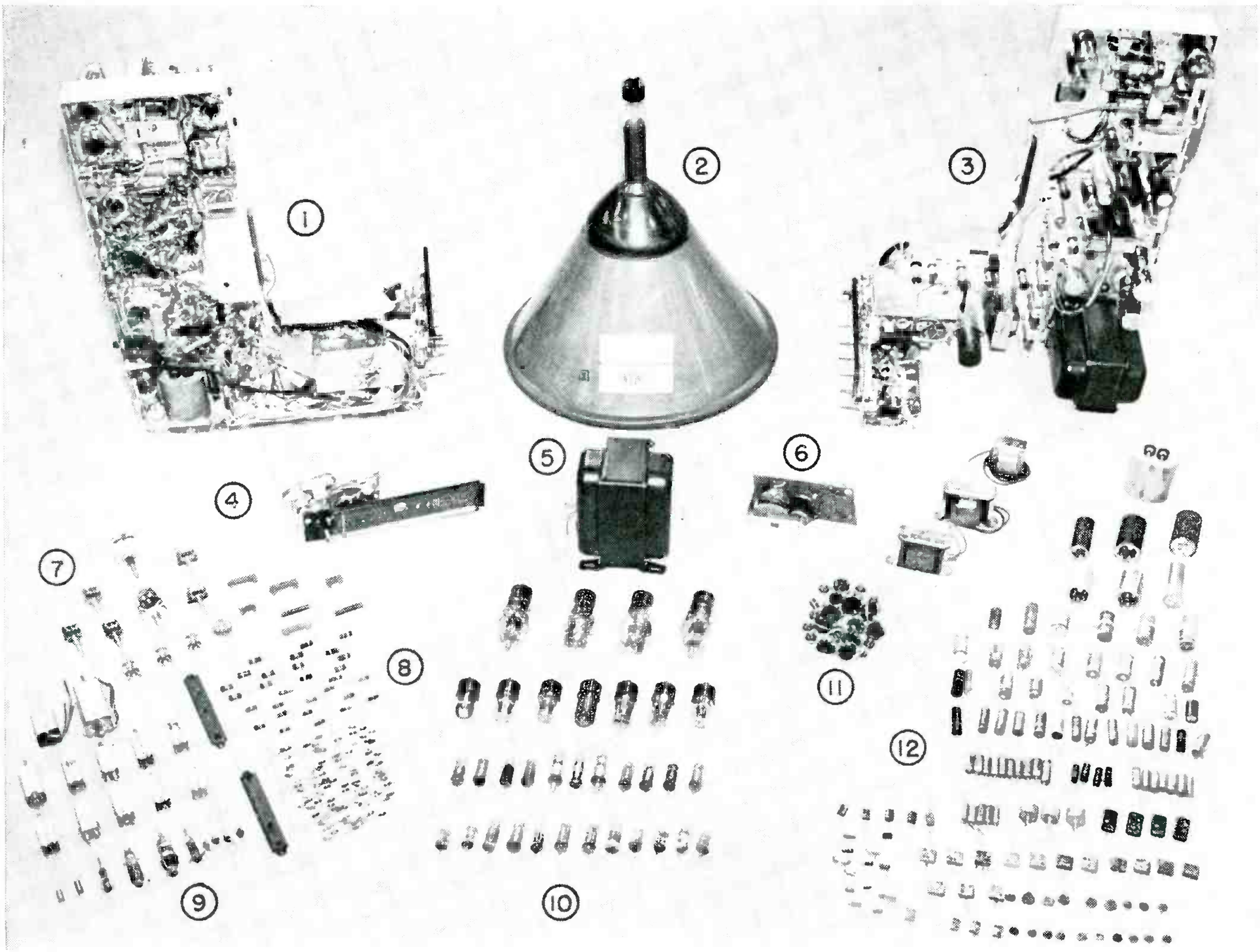
IN THE EAST AND THE WEST the ultrahighs appear to be winning new laurels in their practical adaptability to proposed TV allocation plans. In the east, the Bridgeport transmitter[1] has demonstrated its reliable high-band performance. And now, out on the Pacific coast, members of Stanford Research Institute, under the sponsorship of John H. Poole, operator of 530-mc station KM2XAZ, have developed an ultrahigh system, using *phase-to-amplitude modulation*, which it is claimed will add many more reliable miles to the higher frequencies.

The system is said to offer a method for obtaining high power levels from presently available tubes which are difficult to amplitude modulate by any other means. The *pta* transmitter is actually two separate phase-modulated transmitters, driven from the same crystal oscillator and fed into a common antenna. The output is an entirely conventional AM wave and is obtained by arranging outputs of the two channels to add *in phase* for the modulation peaks and to oppose each other so as to effectively cancel out during the minima of AM.

Congratulations to the group at Stanford for a development which is certain to play an important role in accelerating ultrahigh progress.—L. W.

[1]See this issue, page 20, and editorial TELEVISION ENGINEERING; April, 1950.

Preparing the TV Receiver Chassis



Electrical components required for a typical TV chassis.[1] On view are the main electrical items: (1) Bottom view of chassis; (2) 19AP4 picture tube; (3) top view of chassis; (4) tuning mechanism of Inputuner, containing continuously variable inductors; (5) power transformers; (6) fly-back transformer; (7) resistors, variable, including composition and wire wound; (8) resistors, fixed, including composition and wire wound; (9) inductors, including various types of transformers and coils, both fixed and slug tuned; (10) tubes; (11) sockets to correspond to tubes; and (12) capacitors, fixed, including ceramic, electrolytic, mica silvered, composition, mica and paper. In this chassis 99 capacitors are used, 9 coils (neglecting Inputuner assembly), 96 resistors, a sub-assembly and Inputuner assembly, 17 transformers, 35 tubes and 15 types of wire adding up to 1628″

In Producing a TV receiver, which can contain approximately eight times as many components as a comparable radio chassis, or as in the case of one of our models[1] some 417 electrical components and tubes plus 556 mechanical items, pieces of hardware, assemblies, etc., for a grand total of 973 parts, there are a mountainous variety of processing problems to consider.

Since a TV set involves a more substantial investment than the standard receiver, it is also very desirable and essential, particularly in a high-quality product, that the probable life be greatly in excess of that of a corresponding broadcast model.

Assuming that we shoot for three times the life, with eight times the number of components, we find that the probability of failure is about 24:1. This imposes upon the design engineer, the component acceptance section, the quality control department, and the entire manufacturing operation, a very substantial burden.

Quality must first be engineered into a product. Not only is it imperative that the engineering samples perform with a high degree of perfection and survive accelerated aging as well as high humidity and temperature runs, but also that any accumulation of components and tubes drawn from component stores, shall, when assembled into the television receiver, meet these same rigid standards of performance and durability. It has been found that approximately 90% of the man hours in the engineering department must be devoted to the precise determination of design centers and allowable component tolerances, as well as a quadruple checking of the operating conditions and ratings of all components which are used. If competitive prices are to be met, it is not possible to use the *Roman method* of overbuilding. It is well recognized that few would buy five-thousand dollar television receivers, in any quantity, regardless of their durability and performance. At the other end or other extreme, we have the flimsy construction which might be used in constructing buildings for a

[1]DuMont RA-109.

For the Production Line

Processing of Modern Receivers is Quite a Job, Involving Detailed Control from the Lab of the Design Engineer to Such Special Departments as Component Acceptance, Quality Control, Stores Section and Product Control. Careful Watchdog Practice Found to Yield Such Significant Results as Less Repairs, Less Scrap, Reduced Overhead and Increased Production.

by RICARDO MUNIZ, Division Manager, TV Receiver Manufacturing Div., Allen B. DuMont Laboratories, Inc.

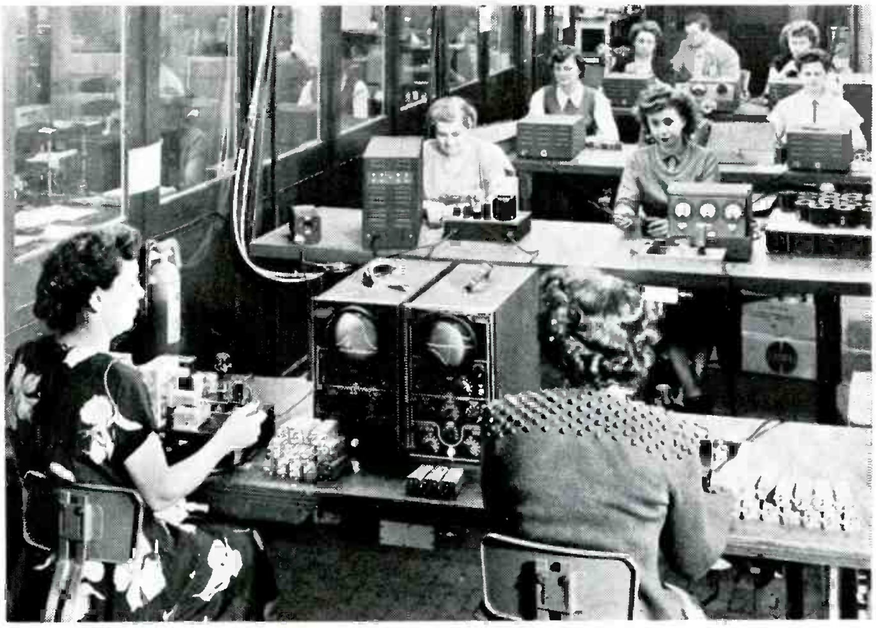
fair or exposition, buildings not intended to survive a winter. So, somewhere between the Roman and exposition type of design, appears the proper place for the high-quality television receiver. We must be quite certain that into each and every part, has been engineered, adequate and sufficient ratings and each and every part has been specified with narrow enough tolerances, yet tolerances which are not more narrow than necessary. And withal, we have a very *finite* length of time which can be applied to the task. This calls for an extraordinary amount of knowhow, and a fine quality of judgment. Inevitably and invariably, the design of such a complex piece of apparatus, as a television receiver, involves numerous compromises requiring skilled decisions.

After the engineering department has approved the components and issued a bill of materials to the purchasing department, the extreme application of care is again necessary, for all components must meet the rigorous standards the engineers have specified. A *component-acceptance section* is employed at our plant to provide the purchasing department with a listing of approved vendors for each component very promptly, so that there will be no delay in getting models into production. To expedite this operation, the *component acceptance section* uses the facilities of a proving-out laboratory, where are processed thousands of samples which have been brought in from vendors throughout the country. This analysis procedure results in a substantial approved component list for the use of the purchasing department. Since it is often desirable to have more than one supplier for any given component, from the point of view of both price and continuity of supply, several sources must be approved for each component, and this sometimes means that literally dozens must be checked.

After the material has been purchased, the *quality control department* becomes involved, with an *incoming inspection section*, playing a role. By means of an advanced statistical sampling control plan, this section must pass upon every component received, before it is allowed to go into a *stores section* for final accumulation and delivery to the production line. Vendors, having previously supplied acceptable samples, might be tempted to discontinue his own quality control to the point, where the delivered components do not meet our specifications. The continual policing method has paid

(*Continued on page* 30)

Incoming inspection test section at DuMont. In the foreground, if transformer cans are being checked on a 'scope against electrical specifications. At the rear table positions, instruments to test electrical limits are being used on other components before they are sent to the production lines.



Graphical Method For the

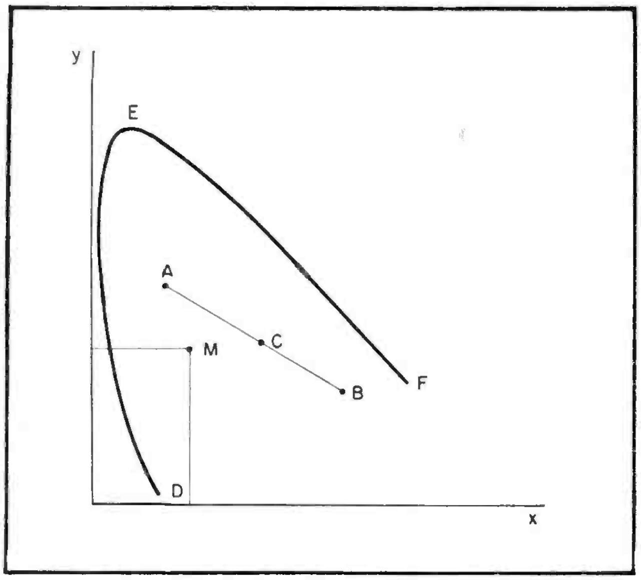


Figure 1 (Left)
Chromaticity diagram. A and B represent the loci of two colors, C the locus of their mixture.

Figure 2 (Left, below)
Application of modified force polygon method to find the locus C of the color mixture from A and B.

THE MATHEMATICAL COMPUTATION of the synthesis of a color mixture from color components, one of the problems encountered by all doing research on color television, and especially, of the resolution of such a color mixture into component colors, is a fairly lengthy one. The computation method, which because of its complex nature might lead to errors, can be supplanted by a graphical approach providing substantially reliable results.

In color mixture study, there are several basic factors[1] which must be considered. There is, for instance the colored illuminant, which is an illuminant emitting light representing a *mixture* of different spectral colors. This is specified by locus M in Figure 1, lying somewhere in the area enclosed by curve DEF in the chromaticity diagram, and is thus given by the quantities,

$$x_M,\ y_M,\ Y(L)_M$$

where x_M and y_M are the coordinates of the luminous color mixture in the chromaticity diagram, $Y(L)_M$ being the luminosity of this mixture. Curve DEF represents the loci of all spectral colors. If now, in the chromaticity diagram, A and B are the locus of a different color mixture each, then the locus C in the diagram of the resultant mixture of these two color mixtures will lie on the straight line connecting A and B, in the center of gravity of the two weight vectors representing the colors in A and B, respectively. One of these weight vectors, $Y(L)_a/y_a$, will be effective in point A, and the other $Y(L)_b/y_b$, in

[1]Hardy, A. C., *Handbook of Colorimetry*, Technology Press, Cambridge, Mass.; 1936.
Wright, W. D., *Measurement of Color*, Adam Hilger, London; 1944.

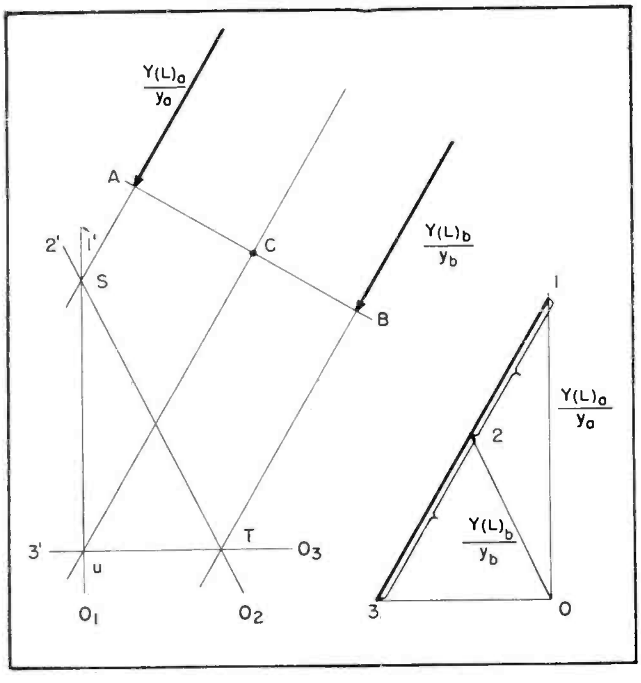
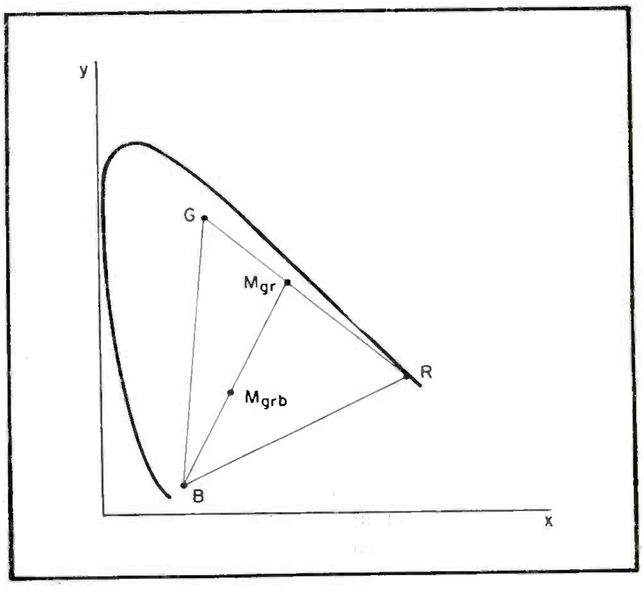


Figure 3 (Below)
Plot where M_{gr} represents the color mixture of the two chosen primaries: red (R) and green (G). M_{grb} represents the mixture of M_{gr} and the third, blue primary (B).



Synthesis and Resolution of Luminous Color Mixtures

Procedure Found to Provide a Means Through Which the Locus in a Chromaticity Diagram of a Mixture of Colors as Well as the Luminosity of the Mixture Can be Readily Determined. Graphical Approach Can be Reversed, So That It is Possible to Resolve Any Given Color Mixture Graphically Into Several Component Colors.

by **VICTOR A. BABITS**, Department of Electrical Engineering, Rensselaer Polytechnic Institute

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point B. Analyzing the luminosity of the color mixture in C, we find that

$$Y(L)_c = Y(L)_a + Y(L)_b$$

As indicated, it is possible to determine the locus C of the resultant color mixture in the chromaticity diagram by computation. However, a graphical method can be used for the determination of this locus.[2] This approach has been found to be reversible and, thus is applicable both to the mixture of a color from color components, and to the resolution of a color mixture into components. This permits us to resolve a color mixture into any arbitrary number of components.

This method, known from *mechanics*[3] as a vector polygon, is illustrated in Figure 2.

In applying the vector, we must start with the assumption that in point A a weight $Y(L)_a/y_a$ (luminosity over ordinate) is effective and in point B, a weight $Y(L)_b/y_b$. According to the suggested procedure. these two weight vectors must be plotted in an auxiliary graph, and then joined together along a straight line; i.e., their numerical values must be added up, the distance *1-2* thus equalling $Y(L)_a/y_a$, and the distance *2-3* being equal to $Y(L)_b/y_b$. We can now assume an arbitrary point *0* in the auxiliary graph, drawing the line *0-1*, and parallel to this the line O_1-$1'$ in the original graph. Similarly, from point S we can plot the line $2'$-0_2 parallel to *2-0* in the auxiliary graph. Finally, from point T we can plot the line $3'$-0_3 parallel to *3-0* in the auxiliary graph. This provides the point of intersection, U. A straight line drawn from this latter point, parallel to the two weight vectors, will intercept the line, or *weightless bar*, connecting A and B at a point, being the locus C of the resultant vector. In our particular case, this is the locus of the color mixture specified by the numbers x_c, y_c, as is apparent from the chromaticity diagram. As a result of this evalution, we find that the luminosity $Y(L)_c$ of the color mixture will be

$$Y(L)_c = Y(L)_a + Y(L)_b$$

If now three primary colors are to be mixed, Figure 3. . . . point B (x_b, y_b, $L(L)_b$) . . . point G (x, y_g, $Y(L)_g$) . . . point R (x_r, y_r, $Y(L)_r$) . . . then we first apply the described procedure with a view to finding the color mixture resulting from, for instance, G and R, and plot the locus of the color mixture M_{gr}. This graphical procedure results in the numbers x_{gr} and y_{gr}, specifying M_{gr}. The luminosity of the resultant color mixture M_{gr} is represented by

$$Y(L)_{gr} = Y(L) \;\; + Y(L)_r$$

The next step now involves location of the locus of the color mixture M_{grb}, resulting in one instance from the two colors providing M_{gr}, and on the other hand from the color B, as well determining of the numbers specifying M_{grb}. This can be achieved by repeating the aforesaid graphical procedure. In other words, another straight line can be drawn, this time connecting M_{gr} and B, with a weight $Y(L)_{M_{gr}}/y_{M_{gr}}$ in M_{gr}, and a weight $Y(L)_b/y_b$ in B. The locus of the resultant point M_{grb} will now lie somewhere on the straight line M_{gr}—B between these two points. The color obtained in M_{grb} will be the sought mixture of the three chosen primary colors in G, R and B, this final mixture being specified by the trichromatic coefficients x_{grb} *and* y_{grb}, its luminosity being represented by

$$Y(L)_{grb} = Y(L)_g + Y(L)_r + Y(L)_b$$

If we have a color mixture which is a compound not of three, but of four, five, six . . . or n components. the foregoing method may be applied in a progressive manner, by combining the mixture of two colors with a third color, then admixing a fourth color to the so obtained color mixture of three components, and so forth.

Since in the case of a color mixture which is the resultant of a larger number of color components, its determination in the foregoing manner may prove to be a lengthy procedure, another graphical method can be used. This approach furnishes the locus. in the chromaticity diagram, of a color mix-

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[2]Babits, Victor A., *The Colours and their Mixtures in Colour Television*. Journal of the Television Society, London, Vol. 5, No. 9, p. 269; 1949.

[3]Seely and Ensign, *Analytical Mechanics for Engineers*, Wiley; 1933.

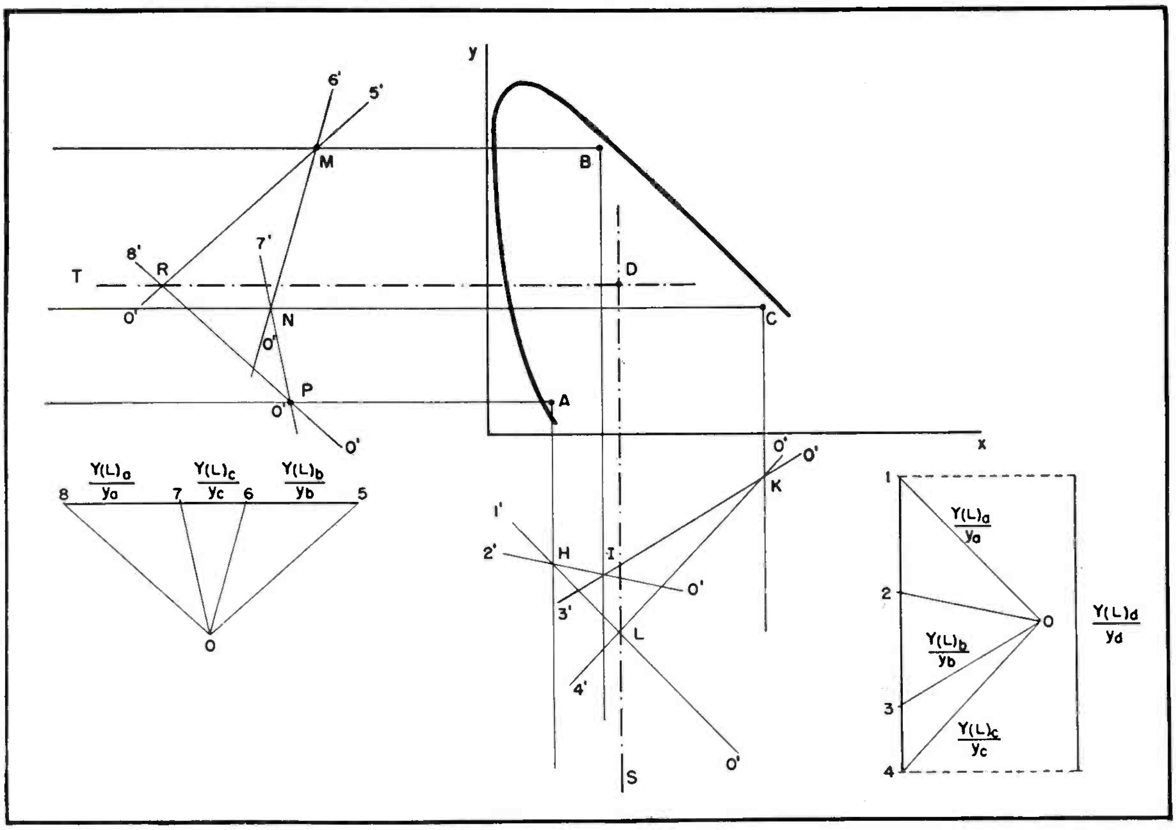


Figure 4
Graphical method for determining locus D of the color, being the mixture of the colors in loci A, B and C.

ture composed of several color components in two successive steps.

For simplicity's sake, the method will be explained for the case of three component colors only, but it is just as well applicable to color mixtures consisting of four, five, six, or any arbitrary number of component colors. The sought loci are plotted according to the following principle. Let us assume that in the chromaticity diagram of Figure 4, *A*, *B* and *C* represent three component colors, the resultant color mixture of which is to be determined by first, plotting its locus *D* in the chromaticity diagram. The loci in the chromaticity diagram of the component colors *A*, *B*, *C*, as well as their luminosities are known. The color weights effective in points *A*, *B* and *C* respectively will, therefore, be

$$Y(L)_a/y_a \quad Y(L)_b/y_b \quad Y(L)_c/y_c$$

If now we plot the center of gravity of these three color weights in the chromaticity diagram, the gravity center appearing in point *D*, the color corresponding to this locus *D* will represent the mixture of the above three color components.

Since point *D* is a gravity center, any arbitrary resultant of component weight vectors must, irrespective of the direction in which it is effective, necessarily pass through the center of gravity. Accordingly, we first apply the color weights parallel to the *y*-axis and thus determine the direction of the resultant. In Figure 4, this is *S-D*, which is, naturally, similarly parallel to the *y-axis*. Next, we must plot the three component vectors parallel to the *x*-axis and also in this case determine the direction of their resultant. In Figure 4 this is *T-D*. Considering that both these resultant vectors must necessarily pass through the center of gravity, it is obvious that the gravity center is given by the point of intersection *D* of the foregoing two resultants, in the *x*- and *y*-direction, respectively.

The real value of this method becomes apparent when the locus of a color mixture resulting from many more than three component colors is to be determined. In practice, the graphical construction outlined, which similarly represents an alternative of the vector polygon method known from *mechanics*, is carried out in the following manner. Lines are drawn parallel to the *y*-axis through points *A*, *B* and *C*. Then the three color weight vectors are plotted.

$$Y(L)_a/y_a \quad Y(L)_b/y_b \quad Y(L)_c/y_c$$

on the right hand side of the diagram (Figure 4), similarly parallel to the *y*-axis, one below the other. Next, the line *0'-1'* is drawn parallel to line *0-1*, and furthermore, from point *H* line *0'-2'* which must be parallel to *0-2*, and from point *1*, *line 0'-3'* must be drawn parallel to line *0-3*. Finally, from point *K*, line *0'-4'* is plotted parallel to *0-4*. The resultant vector will be found to pass through the point of intersection *L* of lines *0'-1' and 0'-4'*, and to be parallel to the *y*-axis. This line, therefore, intercepts the *x*-axis at the value x_d of the color mixture *D*.

We now repeat the above procedure, in this instance, however, by applying the color weight vectors parallel to the *x*-axis. The thus-obtained resultant vector is parallel to the *x*-axis, and intercepts the *y*-axis in the chromaticity diagram at the y_d-value of the color mixture *D*.

The luminosity $Y(L)_d$ of the color mixture in locus *D*, is, of course, known to be given by the expression

$$Y(L)_d = Y(L)_a + Y(L)_b + Y(L)_c$$

Now let us consider the reversed problem, i.e., the resolution of a color mixture into component colors, and solve it by inverting the foregoing graphical procedure. To this end, let us assume a color mixture in locus *M* (Figure 5) to be represented by the

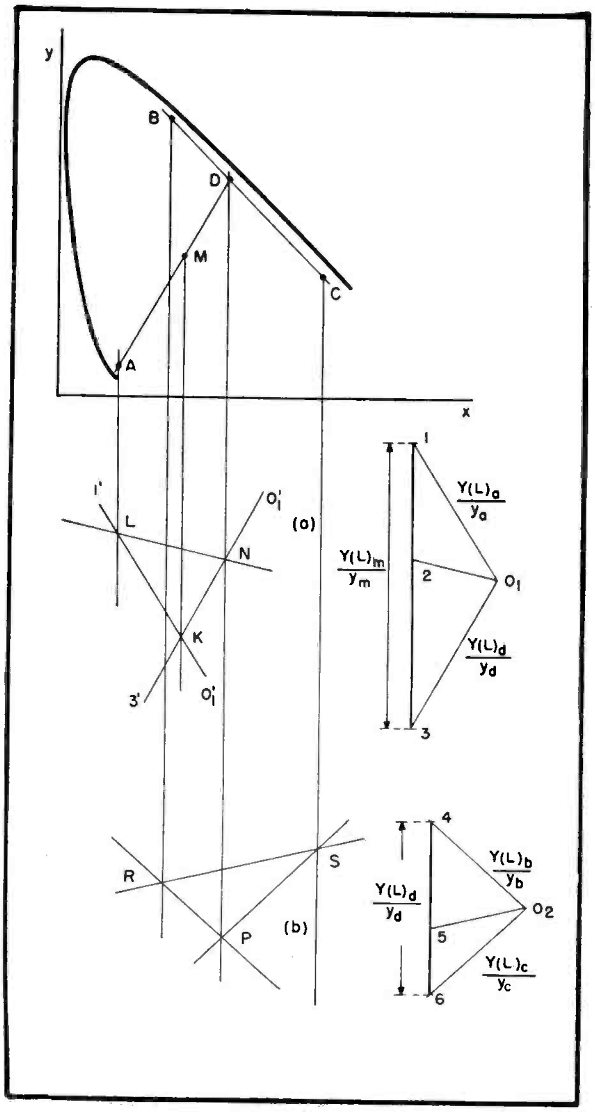


Figure 5
Graphical method for the resolution of a color mixture in locus M into the color components A, B and C.

quantities x_m, y_m *and* $Y(L)_m$, and attempt to resolve it into, for instance, three predetermined colors *A*, *B* and *C*. These three color components having been chosen by us, we naturally also know their respective coordinates in the chromaticity diagram. The problem now is, how to graphically determine the luminosities $Y(L)_a$, $Y(L)_b$ and $Y(L)_c$ corresponding to the three respective colors. The graphical method to be applied in this case will be the first of the two graphical constructions outlined, but reversed.

Color Weight Factor

The color weight of the color mixture *M* is known and is given by $Y(L)_m/y_m$. We can plot this vector on the right hand side of the diagram (Figure 5*a*), arbitrarily choosing a point of 0_1. The direction of the above vector is *K-M*, and this vector is now to be resolved into two components. One of these components will be color *A*, and the other color *D*. It should be recalled that color-locus *D* had originally been found by plotting line *A-M* which intercepted line *B-C* at locus *D*. In our present construction this color *D* will represent an auxiliary color. After having determined its color weight vector $Y(L)_d/y_d$, we can resolve this auxiliary color *D* into two component colors, *B* and *C*. Hence, we can achieve the resolution of the color (color mixture) *M* into the predetermined color components *A*, *B* and *C* in two successive steps.

Graphic Resolving of Colors

If, therefore, a color is to be graphically resolved into component colors, the following procedure should be applied. From points *A*, *B*, *C*, *D* and *M* the lines should be drawn parallel to the *y*-axis. Then, we can assume a point *K* somewhere on the vertical line passing through point *M*. Now, from this point *K* we can plot a line *0_1-1′* parallel to *0_1-1* and a line *0_1-3′* which must be parallel to *0_1-3*. These two lines will be found to intercept the corresponding verticals at points *L* and *N*, respectively. From 0_1 we can, thereupon, plot line *0_1-2* parallel to the line connecting *L* and *N*, which line *0_1-2* will intercept the vector $Y(L)_m/y_m$ at a point dividing it into the two component weight vectors:

$Y(L)_a/y_a$ and $Y(L)_d/y_d$

Having thus determined the quantity $Y(L)_d/y_d$, we can now plot Figure 5*b*, choose a point 0_2 and repeat the above procedure. That is, we can arbitrarily assume a point *P* on the vertical through *D*, and draw lines *P-R* parallel to *0_2-4* and *P-S* parallel to *0_2-6* through this point *P*. For this instance, line *0_2-5*, plotted parallel to the line connecting *R* and *S*, will deliver to us by interception, at point 5 (Figure 5 *b*) the color weight vectors.

$Y(L)_b/y_b$ and $Y(L)_c/y_c$

Since the coordinates y_a, y_b, y_c of the predetermined component colors *A*, *B*, *C* respectively, are known, the luminosities $Y(L)_a$, $Y(L)_b$, $Y(L)_c$ of these component colors may be readily determined from the foregoing results.

The Direct-View Single Tube

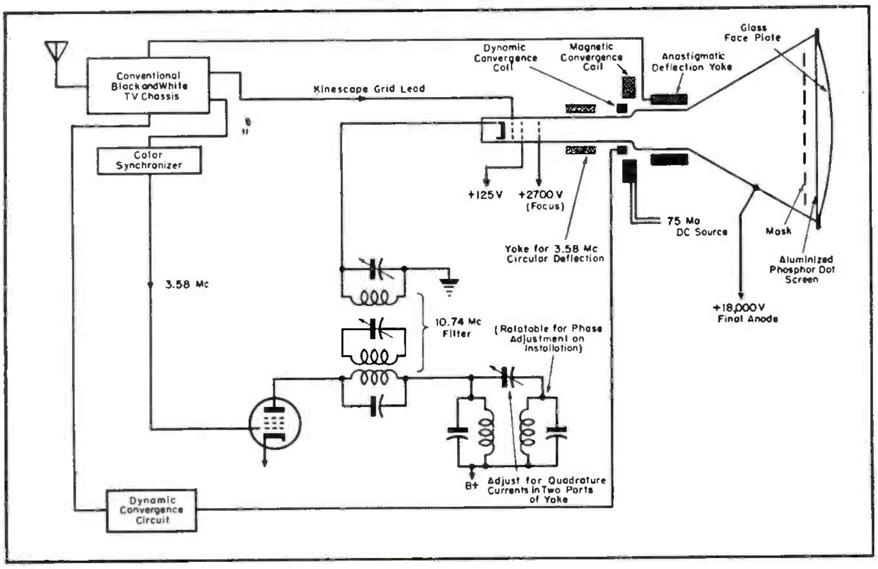


Figure 1 (Left)

Diagram of receiver circuit for single-gun tri-color picture tube.

Figure 2 (Left, below)

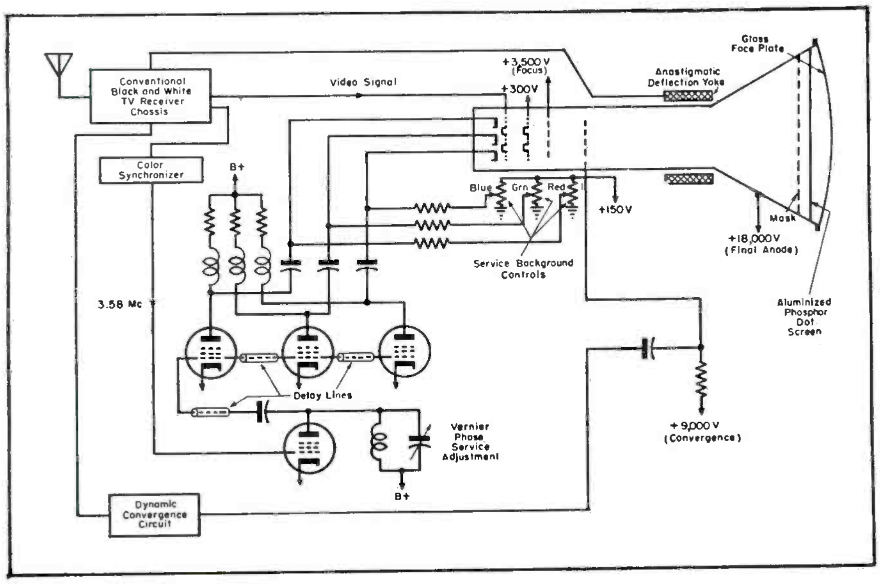
Block diagram of receiver for three-gun tri-color picture tube.

When the Color Hearings reconvened a short while ago, it was revealed that a direct-view tri-color picture tube would eventually be demonstrated before the Commission. About a month after the statement was made, that demonstration was held, with two types being displayed, a single gun and a three-gun.

As disclosed in last month's editorial[1], the tubes featured a screen composed of an orderly array of small, closely spaced, aluminized phosphor dots arranged in triangular groups, each group comprising a green-emitting dot, a red-emitting dot and a blue-emitting dot. In the laboratory-sample tubes used in the demonstrations there were 351,000 such dots, 117,000 of each color.

Two Receivers Demonstrated

Two types of receivers were shown, one model employing the single-gun tube utilizing 37 tubes and consisting essentially of a 27 tube black-and-white receiver to which were added ten tubes for color synchronization, beam rotation, additional power supplies, etc.



*Circuit Analysis**

In Figure 1 appears a circuit of the single-gun model. In this system, the video signal from the output of the video amplifier of a conventional black-and-white model is applied to the control grid of the single-gun tube in a conventional manner. Another signal from a video amplifier actuates an automatic color phasing and sampling synchronization circuit which produces a local 3.58-mc signal which is locked in step with the transmitter sampler.

Circular deflection of the beam, which produces sampling automatically, is provided by a small deflection yoke having two sets of coils which are fed with quadrature currents at sampling frequency to produce a rotating field. Service adjustment of color phasing is provided by mechanical positioning of this yoke. The amplitude of the circular deflection is adjusted to produce the proper convergence angle as required by the mask and phosphor-dot screen. The duration of the sampling period is controlled by a signal having

[1]Television Engineering; April, 1950.
*From testimony of E. W. Engstrom of RCA Labs.

Color Receiving Systems

Features of Receivers, Developed For Single Envelope One and Tri-Gun Color Picture Tubes, Recently Demonstrated in Washington Before the FCC.

by DONALD PHILLIPS

a frequency three times the sampling frequency which is injected into the kinescope cathode circuit. The amplitude and phase of this, a 10.74-mc signal, are determined by the alignment of a filter circuit which utilizes the third harmonic of the circular-deflection driver tube.

The gun in this tube is the same as that used in the 5TP4. Potentials of 18 kv for the final anode and 2.7 kv for the electrostatic focus electrode are derived from a kick-back voltage on the horizontal-deflection output transformer just as in conventional black-and-white receivers.

Convergence of the circularly deflected beam is produced by a magnetic lens in this single-gun tube. A coil similar to the focus coil normally employed in conventional black-and-white receivers is used for this purpose. The dynamic convergence variation is likewise applied magnetically in this tube and is introduced by means of a smaller auxiliary coil located near the main convergence coil.

The Three-Gun Tube Model

In the second model, using a three-gun picture tube, (Figure 2), a video signal from a conventional monochrome receiver is applied simultaneously to three, internally-connected, control grids of the three-gun tube. Another signal, derived from the video amplifier is used to actuate an automatic color phasing and sampling synchronization circuit which produces a local 3.58 mc sampling wave. The latter is applied through an amplifier tube and appropriate delay lines to three gating tubes which supply three sampling pulses, differing in phase by 120° at 3.58 mc, to three cathodes. Thus, each gun is turned on in time sequence corresponding to the original sampling process at the transmitter and the beam current from each gun excites only one of the three phosphor colors.

The tuning adjustment in the plate circuit of the 3.58 mc sampling-signal amplifier permits fine adjustment of the overall color phasing. However, proper color phasing is essentially determined by permanently installed delay lines which are initially cut to proper length.

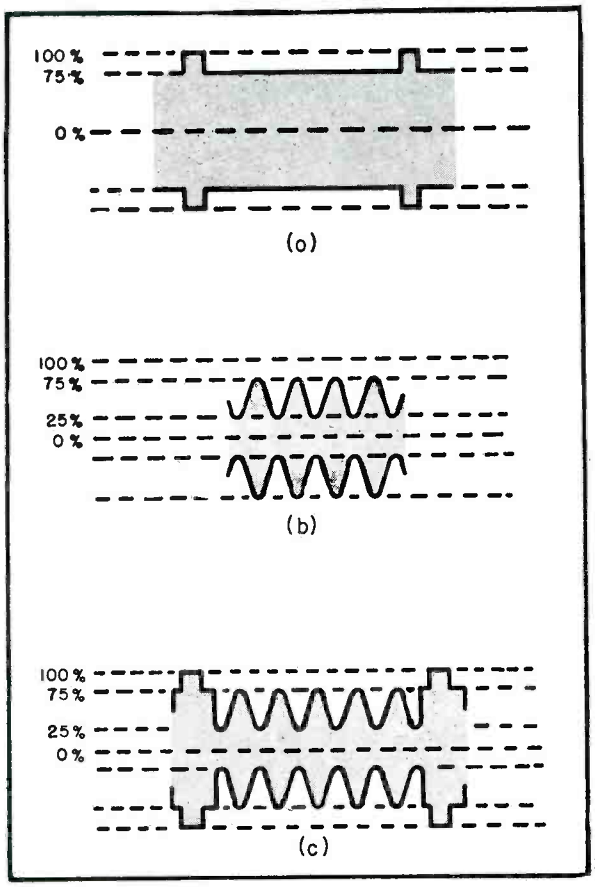
Deflection Circuitry

The deflection circuitry is of the conventional type. Minor changes in deflection-tube types were made to supply additional deflection power occasioned by the increased kinescope second-anode potential (18 kv). The deflection yoke of the anastigmatic type, has an internal diameter of two inches to accommodate the converged beams from the three guns.

The registration in this three-gun tube is built in by the proper registration of masking apertures with their corresponding groups of phosphor dots. Means are also provided to converge the three beams to the same point on the phosphor screen during scanning. This is done for the undeflected beams by a convergence electrode, operated at 9000 volts, and, when necessary, by small correcting magnets set up initially as a permanent service adjustment when the tube is installed. Because of the essentially flat face of the phosphor screen, simple geometrical considerations show that slightly less convergence is desirable as the beam is deflected from center. This dynamic convergence is accomplished by deriving a voltage from vertical and horizontal deflection circuits of the receiver and applying it to the convergence electrode through a capacitor.

An *rf* type anode voltage supply provides a potential of 18 kv for the kinescope final anode, 9 kv for the electrostatic converging electrode and approximately 3.5 kv for the parallel-connected first anodes which produce initial electron-beam focus.

TV Transmitter



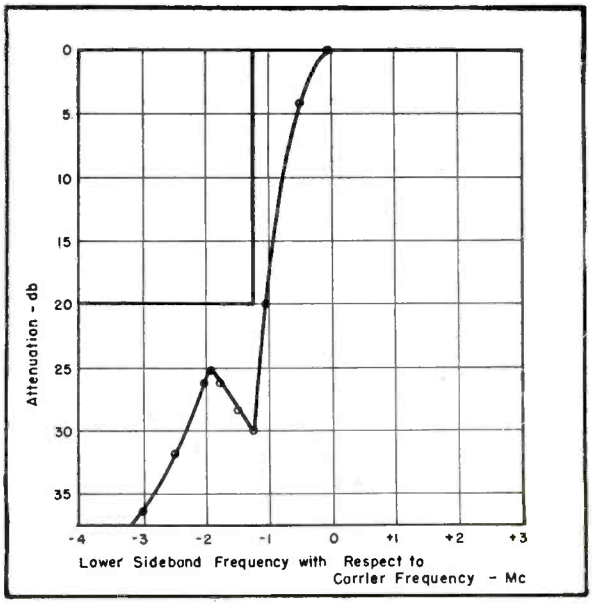


Figure 2

Results of lower frequency sideband measurements on a typical visual transmitter.*

Figure 1

Transmitter output waveforms occurring during measurement of sideband amplitude: (a) "Black Picture" operation, (b) sine wave modulation. (c) synthetic video signal modulation.

To SECURE valid information concerning higher and lower frequency sideband characteristics, the visual transmitter must be adjusted carefully. To facilitate such adjustments each of the steps, for the two methods, described in the initial installment[1], is detailed in this part of the paper.

***Method 1**—RF excitation of input of modulated amplifier*:

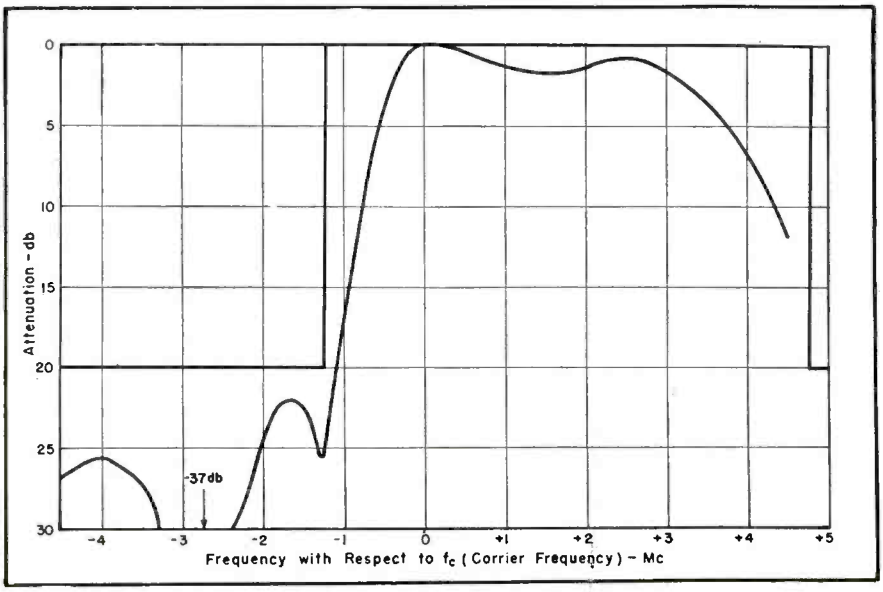
(*1*) The transmitter should be adjusted to give rated peak power output under conditions of black picture transmission. This condition is obtained by modulating the transmitter with synchronizing signals so that the output waveform appears as shown in Figure 1 (*a*).

(*2*) The output *rf* waveform envelope should then be examined by means of an *rf waveform monitor* and the black level indicated on the 'scope considered as reference level.

(*3*) The modulation should now be removed from the transmitter, and *rf* excitation applied to the modulated amplifier input circuit.

(*4*) The magnitude of drive should then be adjusted so that black level as indicated in step (*2*) is realized at the carrier frequency (f_c).

(*5*) Then the exciting frequency should be varied in small steps between (f_c —4.5) and (f_c +4.5) mc. Care must be exercised to keep the *rf* drive



[1]TELEVISION ENGINEERING; April, 1950.

Figure 3

Results of lower and higher frequency sideband measurements on a typical visual transmitter.**

Lower Sideband Measurements

Step-by-Step Application Analysis of Methods Evolved to Secure Higher and Lower Sideband Frequency Data, the Methods Involving RF Excitation of Input of Modulated Amplifier, Sine-Wave Modulation of Transmitter and Synthetic Video Signal Modulation of the Transmitter.

by **G. EDWARD HAMILTON** and **R. G. ARTMAN**

Eastern Division TV Engineer
American Broadcasting System

Chief TV Engineer
Midland Broadcasting Co. (WMBC)

constant. The voltage at the input to the modulated amplifier may be measured by means of a *vtvm* or other such means.

(*6*) Finally, the voltage or power output should be recorded at the transmission line for each excitation frequency. Measurement of field strength would be more desirable than transmission line measurements since the field strength method includes the selectivity of the radiating system.

Method 2 (a)*—Sine wave modulation of the transmitter.* (This method is perhaps the more preferable):

(*1*) The transmitter should be adjusted to give rated peak power output under conditions of black picture transmission. This condition is obtained by modulating the transmitter with synchronizing signals so that the output waveform appears as shown in Figure 1 (*a*).

(*2*) The output *rf* waveform envelope must then be examined by means of an *rf waveform monitor* and the synchronizing peak level, as indicated on the monitor, considered as 100% reference level.

(*3*) The modulation, applied in step (1) must then be removed. The modulated amplifier bias should then be increased until the peak of the output *rf* waveform envelope reaches 50% of the reference level obtained in step (*2*). It will be necessary to make changes to remove effectively *dc* reinsertion.

(*4*) Then 100-kc sine wave modulation is applied, and the degree of modulation adjusted so that the peaks of the resulting output waveform occur at 75% and 25% of reference level obtained in step (*2*). The results which should be obtained at this point, are shown in Figure 1 (*b*).

(*5*) In the next step, it is necessary to measure the amplitude of the 100 kc lower sideband to serve as reference[2].

(*6*) The final steps involve variation of the modulating frequency in discrete steps, and measuring the resulting higher and lower frequency sidebands.

Method 2 (b)*—Synthetic video-signal modulation of the transmitter.*

(*1*) Transmitter should be adjusted to give rated peak power output as indicated in step (*1*) in method 2 (*a*).

(*2*) Then the output *rf* waveform envelope must be examined by means of an *rf waveform monitor* and the synchronizing peak level considered as a reference.

(*3*) Sync, blanking and 100-kc sine wave signals must then be added to the modulation. The amplitude of these signals then must be adjusted until the output waveform, shown in Figure 1 (*c*), is obtained. Equipment capable of mixing synchronizing, blanking, and

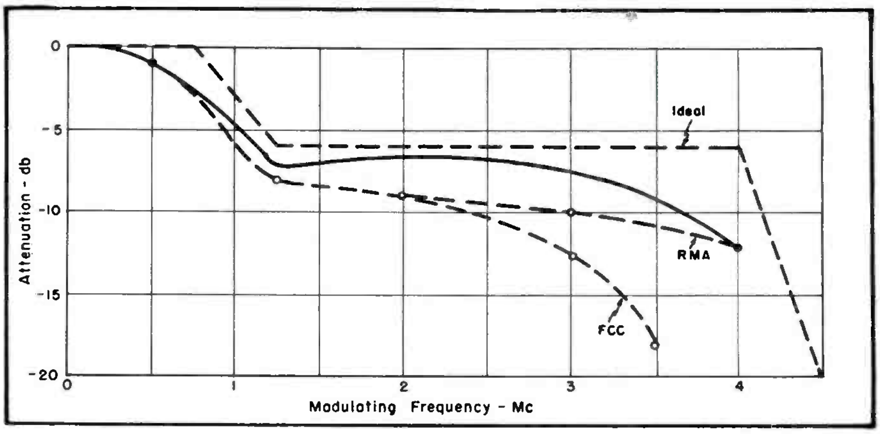
(*Continued on page* 30)

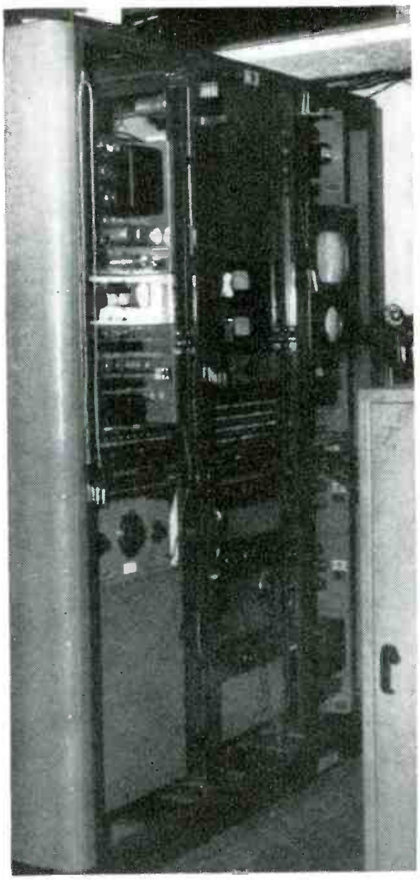
[2]Figure 7, Method A, Television Engineering; April, 1950.

*DuMont TA-116A and TA-118A.
**DuMont TA-146-A Acorn Series.

Figure 4

Attenuation characteristic corresponding to sideband distribution shown in Figure 3.





Typical microwave receiver control point in terminal equipment racks.

2,000 and 7,000-Mc

TV Microwave Relays

Part III . . . Characteristics of Magnetron Microwave Circuitry . . . Antenna Alignment Procedures . . . Transmitter and Receiver Tuning Techniques . . . Equipment-Saving Operational Tricks . . . Features of Passive Reflectors and Double-Dish Beam-Bender Redirectors.

by EARL D. HILBURN

Assistant Chief Engineer, WMAL, WMAL-FM, WMAL-TV

In Reviewing the operation of the 2000-mc relay setup it was disclosed that voltage regulation is an important factor and accordingly a constant-voltage control such as a 2-kw auto-transformer. tapped in five-volt steps, should be installed in the input line.

Another voltage-control circuit which requires close attention is that used with the magnetron. Prior to the application of high voltage to this tube the magnetron start switch must be depressed to bring the magnetron cathode temperature up, to assist in starting. Normal operation is indicated by about 150 ma of magnetron cathode current, with 2000 volts applied. If the current is very low (indicating operation on an improper mode) the plate voltage must be cut back, the start button depressed for a longer period, and plate power then reapplied.

The 4D32 voltage regulator in the 2000-volt supply must be adjusted so that the drop across this tube will be between 200 and 400 volts. Adjustment of the regulator causes considerable variation in magnetron current. Actually, the primary voltage control and the 4D32 regulator should be alternately adjusted, until the regulator voltage drop is within the prescribed limits and at the same time the magnetron current and voltage are normal.

The transmitter, now being on the air, the frequency can be checked with an absorption wavemeter, which is provided with the equipment. In general, since the transmitter frequency control is maintained to the required .05%, by means of thermostatic regulation of magnetron body temperature, it will be found that the transmitter will drift 6 or 8 mc in the first 15 or 20 minutes of operation. After this initial warm-up, it will be found that good frequency control can be maintained. If the tuning has not been tampered with since the last operation, the transmitter will drift in to the proper frequency. Since the magnetron carrier frequency is set manually, using the wavemeter as an indicator, it is not necessary to apply modulation to check carrier frequency.

While the transmitter is being set up, the receiver should be turned on and allowed to warm up. No *afc* system is provided to keep the receiver in tune, as it is extremely stable after it has been operating for 20 or 30 minutes and has reached maximum operating temperature. Accordingly, it should be warmed up prior to the actual period of test and operation. Assuming the receiver has had an adequate warm-up and the transmitter is on frequency, no adjustment of receiver tuning will normally be required. The second limiter grid current reading, in absence of signal, will be an indication of the *if* gain. Any marked departure from previously esatblished readings would indicate a tube failure or something abnormal in the receiver line-up. It is desirable to leave the limiter meter in the second limiter (sensitivity) position, until a rough alignment of the dishes has been achieved. In this position, the meter will give an indication of a received signal that is considerably weaker than that required to register on the first limiter (signal strength) position.

Actually, the process of aligning the antennas is the same with this equipment as it is with the 7000-mc relay system previously described. Directions are supplied by the operator at the receiver, on the basis of limiter-meter indication until the antennas have been adjusted to provide optimum signal over the course.

From the indicated limiter-grid current, with best reflector orientation, a good knowledge of the signal-to-noise ratio (and hence picture quality) can be obtained. It is desirable to run a plot of the receiver limiter meter deflection as a function of receiver input signal in microvolts. If a 2000-mc

NEW STABILIZING AMPLIFIER FOR TV STATIONS TYPE TA-5C

...best in the business!

HERE'S WHY. Type TA-5C removes 60-cycle hum and other low-frequency disturbances from the video signal—and suppresses switching transients. It reduces high-frequency noise components *substantially*—and cleans up the blanking pulses. It will restore the sync—or reduce it as required. It will maintain constant sync level—or amplify this level to any value up to 50 per cent. It makes it easy to extract a pure video signal from the composite signal—and provides video gains as high as 25 db.

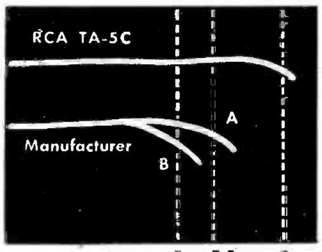
With this stabilizing amplifier you can switch between remote (composite) signal and local video signals. You can adjust video gain control without disturbing the sync. You can control gain, sync level, and sync clipping *remotely*—by means of external controls provided for the purpose. And with the TA-5C, *separate* output monitoring is independent of line characteristics.

For highest fidelity of video signal, cleanest output, and highest sync gain, nothing beats the TA-5C. Call your RCA Broadcast Sales Engineer for details. Or write Dept. 23E, RCA Engineering Products, Camden, N. J.

Check the performance of the TA-5C . . . and compare!

Characteristic	RCA, TA-5C	STAB AMP "A"	STAB AMP "B"
Fidelity Response	Uniform to 7 Mc	Uniform to 5 Mc	Uniform to 5.5 Mc
Signal Gain	25 db; works down to 0.15v input	20 db; works down to 0.2v input	20 db; works down to 0.2v input
Sync Gain	Up to 50%	Up to 40%	Up to 40%
Voltage Output	3v across 37.5 ohms	2.5v across 37.5 ohms	3v across 75 ohms
Separate Sync Output	Yes	No	No
Complete Sync Stripping	Yes	No	No
Clean Output Signal	Yes	No	No
No. of Tubes	19	24	27
No. of Controls	4	7	4

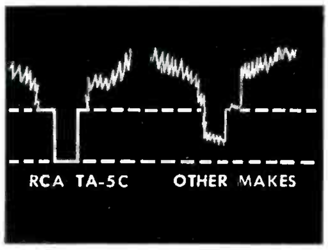
Highest signal fidelity



5 5.5 7

FREQUENCY RESPONSE (Mc.)

Cleanest output signal



OUTPUT QUALITY AND SYNC GAIN

TELEVISION BROADCAST EQUIPMENT
RADIO CORPORATION of AMERICA
ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N.J.

In Canada: RCA VICTOR Company Limited, Montreal

TV Microwave Relay

(*Continued from page 16*)

signal generator is not available, the measurements may be made with an *if* frequency signal generator, in terms of input to the first stage of the *if* amplifier. With this curve it is possible to interpret limiter meter reading directly into relative field intensity at the receiving antenna. Knowing the power gain of the various antenna systems, and the loss of the various cables available for use as transmitter transmission line, it is an easy matter to predict accurately the improvement that would be obtained in the picture out of the receiver, with various combinations of antennas and coax cables as the transmitter.

In determining the minimum limiter-grid meter reading that provides a usable picture, some criterion must be established as to picture signal-to-noise ratio. Local operating standards of picture quality will determine just what this is, though generally anything less than about a 20-db signal-to-noise figure will produce a visibly noisy picture. With a signal of such strength to produce this minimum standard picture, the limiter reading can be carefully noted and used as a reference on future tests and program setups.

After the antennas have been oriented and it has been established that a usable limiter grid reading has been obtained, the receiver tuning must be rechecked. Up to this point the klystron repeller voltage has been adjusted for maximum limited grid meter reading, without too much concern about the position of the discriminator tuning meter. The receiver is in tune when the limiter meter reaches its maximum as the tuning meter is on zero. If the tuning meter indicates an unbalance at maximum limiter current, the slugs in the external klystron cavity must be readjusted to provide the desired condition. After final receiver tuning the crystal current should be about .5 or .6 ma; it is generally found that optimum mixer signal-to-noise is obtained at this setting. This may be adjusted by means of the probe in the mixer assembly or the coupling loop within the klystron cavity.

The transmitter is now ready to modulate and deviation may be set. This is done upon advice from the receiver (by watching the output video waveform) or by transmitter personnel observing the outgoing signal on a monitor receiver. This latter unit, an accessory, actually consists of an insensitive portable receiver similar in general design to the main receiver.

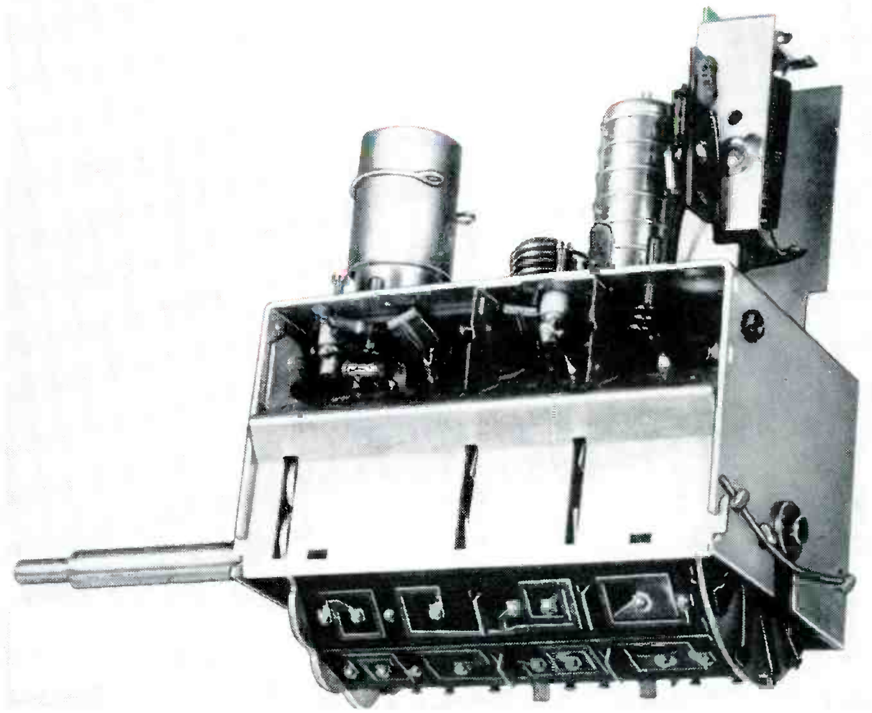
If the transmitter mechanical tuning is shifted slightly while modulation is applied, the output video signal at the receiver will be seen to fluctuate in level. This condition exists because the transmission line feeding the transmitting antenna is not perfectly flat, and standing waves on the line reflect a varying impedance on the transmitter output. Since the transmission line is rather tightly coupled to the magnetron cavity, it is apparent that any reflected reactance from the transmission line will have a de-tuning effect on the magnetron and cause the modulation characteristic to be nonlinear. This tendency will be minimized if the carrier is set to one of the compression points (i.e., condition of minimum receiver video output with constant modulator gain setting) within the allocated channel.

It is important to note at this point that any condition that might cause the standing-wave-ratio to raise will

(*Continued on page 33*)

The Printed-Circuit TV Tuner

Printed-Circuit Techniques, heretofore generally applied in the production of small components, now have been developed for large-surface work, and in one instance adopted for the processing of coils in a twelve-channel TV tuner[1].



The TV tuner which employs printed circuit coils.

Designed for Stagger Tuning

Evolved for use with a stagger-tuned picture-*if* system having a carrier of 25.75 mc and a sound-*if* system having a carrier of 21.25 mc, this new tuner is said to provide a voltage gain of between 28.7 and 34.9 db for all channels under typical operating conditions.

Use of Elevator Transformers

The input circuit of the tuner contains a pair of elevator transformers for matching to a balanced 300-ohm transmission line and to attenuate noise which may be induced in the transmission line. This circuit also contains a high-pass filter with cutoff at approximately 47 mc and with maximum attenuation at approximately 23.5 mc for rejection of intermediate frequencies at the grid of the *rf* amplifier.

Tuned Low-Pass Pi-Networks

A tuned low-pass pi-network, with a coil for each channel, provides gain and selectivity at the grid of the *rf* amplifier and reduces oscillator voltages at the antenna terminals. The constants and configuration of this pi-network have been chosen to provide a varying impedance transfer to the grid of the *rf* amplifier so that optimum noise factor can be achieved for all channels. This characteristic is said to favor operation of these tuners with indoor types of antenna.

Controlled Negative Resistance

Controlled negative resistance has been introduced at the grid of the *rf* amplifier to maintain high gain at high signal frequencies and to minimize the effects of cathode inductance.

The RF Amplifier

A 6CB6 is used in the *rf* amplifier, the output of which contains a double-tuned, *M*-derived band-pass filter with maximum attenuation at approximately the image frequency of each channel.

Temperature-Compensated Colpitts Circuit

This filter, with coils for each channel, is said to provide unusually high image rejection and also attenuates voltages of oscillator frequencies at the plate of the *rf* amplifier. The oscillator, with adjustable coil inductances for each channel, contains a single-ended, temperature-compensated Colpitts circuit to provide oscillator stability. A fine tuning control, located concentrically on the channel selector shaft, permits fine adjustment of the oscillator frequency. The mixer plate circuit contains a tuned low-pass filter section for the picture-*if* output and a high-Q trap for the sound-*if* output. This trap is tuned to 21.25 mc and attenuates sound-*if* frequencies at the picture-*if* output.

Minimization of Oscillator Frequencies

The low-pass filter section minimizes oscillator frequencies at both sound-*if* and picture-*if* grids. The picture-*if* output frequency is normally 22 mc, but may be adjusted for operation between approximately 21.8 and 23.0 mc so that it may be used with various stagger-tuned *if* combinations.

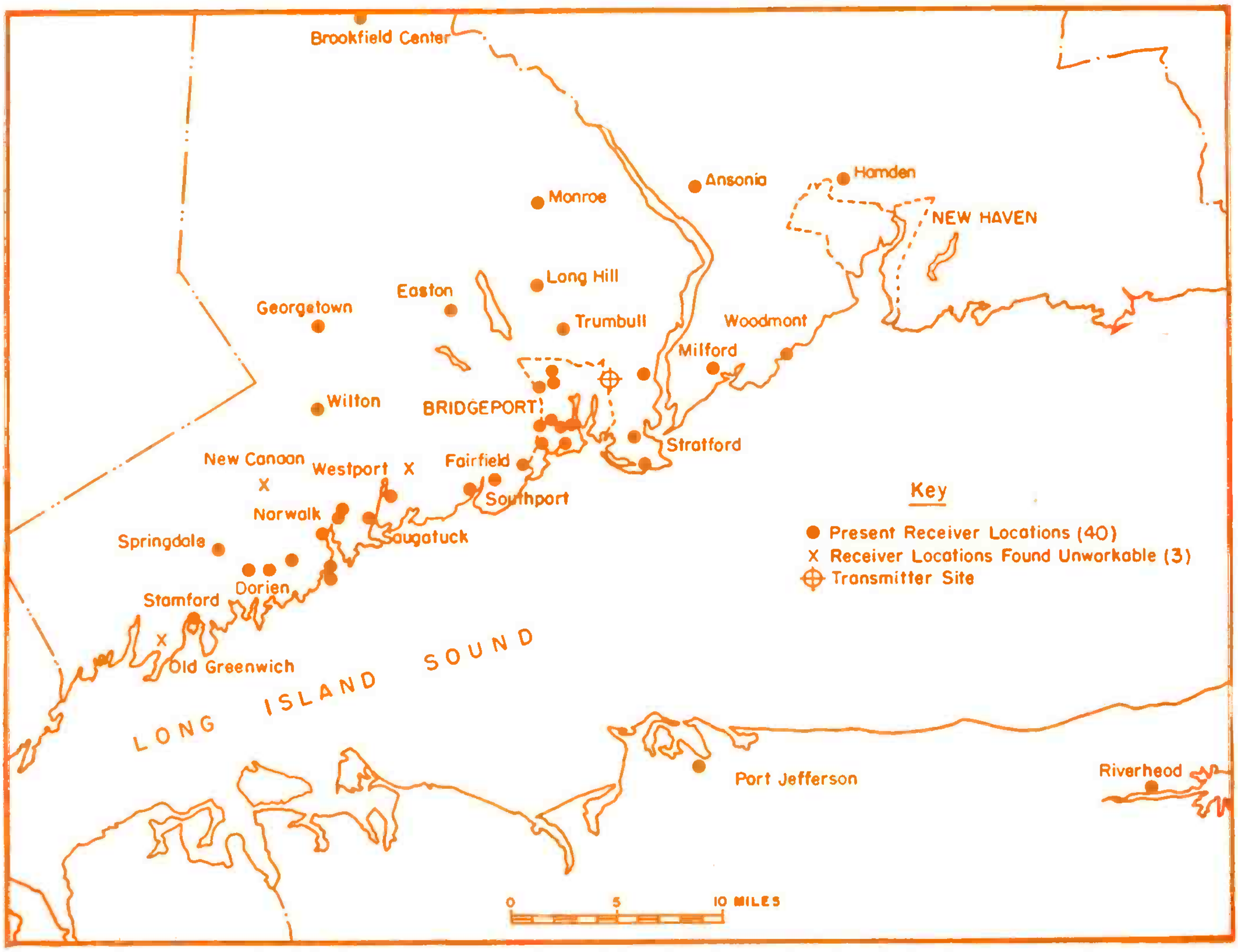
Turret Structure

The turret employs twelve removable segments, each containing the coils for one of the twelve channels. Tuning is accomplished by rotating the turret to connect the proper coils to stator contacts of the switch. A special long-life lubricating compound is said to be used on both the bearing and contact surfaces. The stator contact springs are solid hard spring silver; the turret contact rivets are solid coin silver.

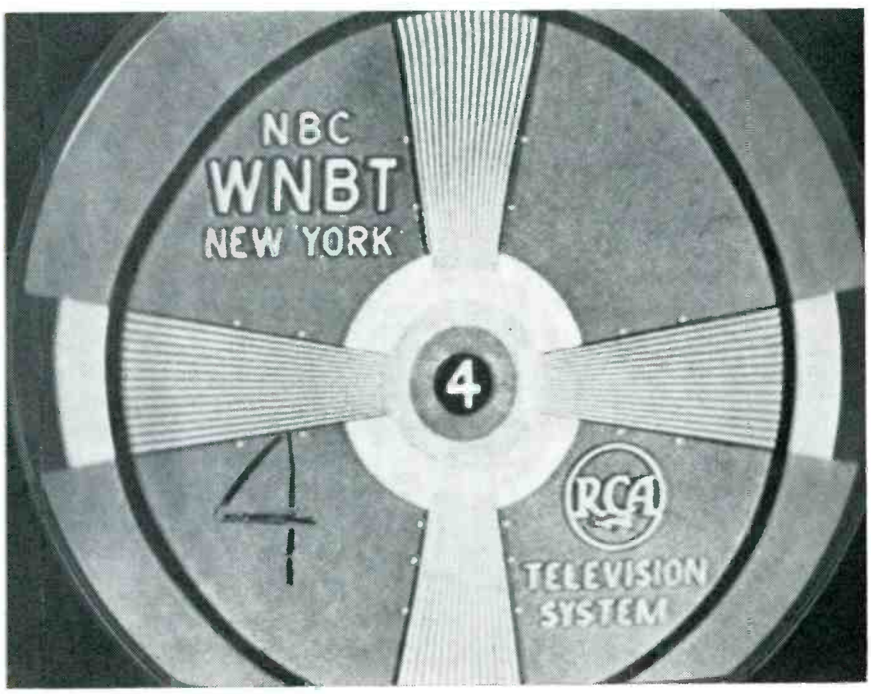
The tuner is said to be capable of withstanding well over 40,000 complete revolutions.

**See Cover, this issue.*
[1]*RCA-206ES*

The UHF Field Study



Map of receiver locations in the Bridgeport area used during the ultrahigh tests. The bullets represent the forty receiving sites; crosses, the receiver locations found unworkable; and the cross within the circle the transmitting site.



At the Beginning of the year, an all-important series of ultrahigh tests were begun in Bridgeport and between that city and New York, in an effort to investigate receiving and transmission possibilities in the higher bands.

Editorializing on these tests last month,[1] it was revealed that a 2000-mc relay had been installed affording a 55-mile link, with pictures and patterns emanating from a parabola on the Empire State Building, and picked up on a parabola in Connecticut. A signal-to-noise ratio of 30 db was reported for the relay system.

Three long-distance receiving point checking centers were set up to record and evaluate signal characteristics, and in the Bridgeport area, sites from one

Left and right: Reproductions of pictures received in the Bridgeport area, with receiver input terminal voltages of 3310 (left) and 935 (right) microvolts.

in the Bridgeport Area

First Comprehensive Ultrahigh Report, Recently Submitted to FCC, Offers Detailed Review of Receiving Antennas Used During Tests, Methods Employed to Measure Transmitting Power and Results Achieved at N. Y. City and Bridgeport-Stratford Receiving Points.

by WYN MARTIN

mile to twenty-three miles were chosen for a similar purpose. In the long-distance category were New York, Riverhead and Princeton.

The *RCA Building* was selected as one of the receiving points, NBC installing and operating field intensity recording equipment, 53 miles from KC2XAK, the Bridgeport station[2]. The equipment consists of a receiver,[3] equipped with an *uhf* converter. The receiver was modified by removal of the *agc* on the video *if* system, and by modification of the video second detector to facilitate driving a *dc* amplifier and Esterline Angus recorder. The receiving antenna, a horizontal dipole, has been mounted in a six-foot parabolic dish, all of which was mounted in a plastic radome on the roof of the building, 860′ above sea level. The field intensity at this antenna location has been recorded as approximately 2700 microvolts per meter.

Recordings thus far have indicated no variations in field intensity of significance, although occasional airplane effects have been observed and 10% variations have been found to occur in high winds. This is due, it is believed at present, to slight mechanical movement of the Bridgeport transmitting antenna which causes the main sharp 2° vertical lobe to be slightly elevated and depressed.

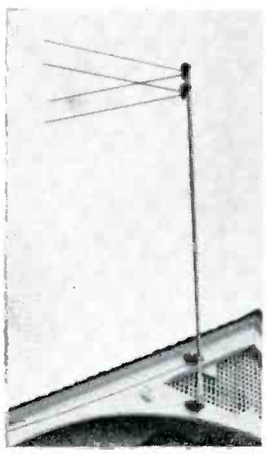
At the RCA Riverhead laboratory, the receiver is a special laboratory model, which drives a Bristol recorder. There is paralleled with the recorder a step analyzer which totalizes the time above which the field intensity rises, in twelve steps. The antenna is 30′ high on earth 20′ above sea level and is 33 miles from KC2XAK. The antenna gain is 17.5 db above a simple dipole. This antenna is behind an earth promontory 150′ high a few miles distant.

No daily trends of field variation have been observed but may develop as the warm months pass.

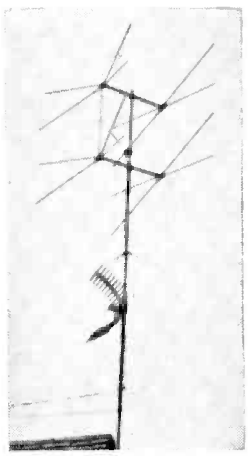
As indicated last month, an assortment of receiving antenna types were tried out in the Bridgeport area, with single fans and stacked vees found to provide the best results. A detailed review of the results achieved with the

(*Continued on page* 22)

[1]Television Engineering; April 1950.
[2]Television Engineering; March 1950.
[3]RCA 9T246.



Stacked V type antenna employed for ultrahigh reception.

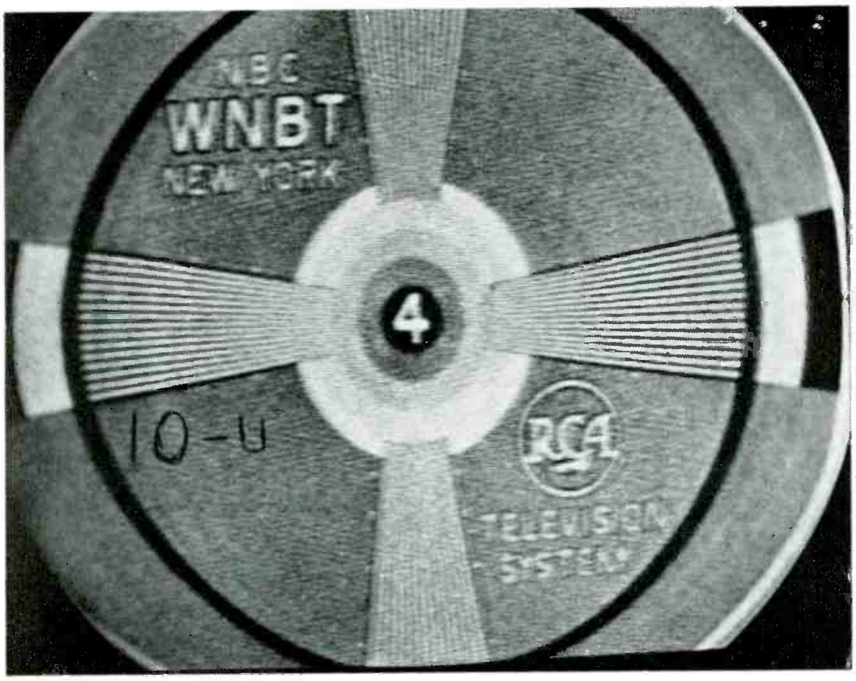


Parabola type of receiving antenna (at lower portion of mast) used for uhf pickup.

Location	Elevation	Distance (Miles)	Antenna	UHF Height (Feet)	Line	Length (Feet)	Peak Field Intensity uv/m in car 10' ant hu	u/v at receiver ter.	UHF Quality
Bridgeport	60'	4	Stacked Rhombic	70	RG59/U	70			Good
Bridgeport	400'	4.8	Fan	30	RG59/U	50	29,800	2,380	Excellent
So. Norwalk		15	Stacked Vee	30	RG59/U	55			Poor
Trumbull	430'	5.5	Fan	35	RG59/U	65	10,350	1.560	Good
Fairfield	150'	10	Stacked Vee	35	RG59/U	40			Fair
Fairfield	35'	6.1	Fan	40	RG59/U	55	803	1,490	Excellent
Norwalk		13	Parabola	30	RG59/U	65			Good
Fairfield		5	UHF Rhombic	40	RG59/U	70			Fair
Bridgeport		4	Stacked Vee	36	RG59/U	20			Excellent
Bridgeport	50'	2.8	Single Fan	80	RG59/U	30		3,310	Excellent
Saugatuck		14	UHF Fan	40	RG59/U	55			Poor—Very Snowy
Norwalk		15	Stacked Vee	50	RG59/U	50			Fair
Stamford		23	Stacked Fan	65	RG59/U	40			Fair
Hamden	120'	17.6	UHF Parabola	33	RG59/U	60		182	Fair—Usable
Stratford		5	Stacked Vee	45	RG59/U	70			Excellent
Trumbull	295'	4	Fan	30	RG59/U	50			Excellent
Darien		17	Stacked Vee	47	RG59/U	55			Excellent
Bridgeport	20'	3	Stack Rhombic	60	RG59/U	80			Excellent—Light Ghost
Woodmont	20'	8.8	Stacked Vee	30	RG59/U	65	400	242	Fair
Port Jefferson, N. Y.		22	Stacked Vee	40	RG59/U	80			Good—Some Snow
So. Norfolk		15	Stacked Vee	35	RG59/U	55			Fair—Some Snow
Bridgeport		3	Stacked Vee	30	RG59/U	60			Good—Some Reflections
Stratford	20'	1.6	UHF Fan	30	RG59/U	70	2,280	4,660	Excellent
Bridgeport	50'	4	Stacked Vee	50	RG59/U	50			Excellent
Ansonia		14	Stacked Vee	40	RG59/U	65			Poor—Snowy
Bridgeport	260'	2.2	UHF Fan	42	RG59/U	60	58,400	5,600	Excellent
Monroe	380'	7.5	Stacked Vee	40	RG59/U	65	5,170	935	Excellent
Westport	80'	11.4	Stacked Vee	55	280° Rnd Amph	125		410	Excellent
Bridgeport	40'	1.1	Fan	40	RG59/U	50	93,400	12,600	Excellent
Milford	90'	5.7	G.E. UHF Fan	33	RG8/U	30	18,400	792	Excellent
Bridgeport		3	Fan	47	RG59/U	70			Excellent
Norwalk		14	UHF Parabola	35	RG59/U	75			Good
Easton		6	Stacked Vee	30	RG59/U	65			Good
Norwalk		14	Fan	50	RG59/U	70			Fair
Georgetown		15	Stacked Vee	25	RG59/U	40			Poor
Riverhead, L. I.		32	Stacked Vee	55	RG59/U	80			Fair
Fairfield		4	Stacked Vee	45	RG59/U	80			Poor
Stratford		6	UHF Fan	60	RG59/U	90			Good
Southport	10'	8.5	Stacked Vee	40	RG59/U	70		326	Excellent
Bridgeport		2	UHF Fan	35	RG59/U	80			Good
Brookfield Center		22	UHF Fan	50	RG59/U	60			Unacceptable

TABLE I

Receiving results obtained in Bridgeport area. Terrain conditions represented a hill with no obstructions: on a side of hill away from KC2XAK; low, in back of hill; flat, in back of buildings; and on a hill in back of higher buildings.



Left: A 182-microvolt picture received in Bridgeport area.

various antennas appears in Table I.

Power Measurements[4]

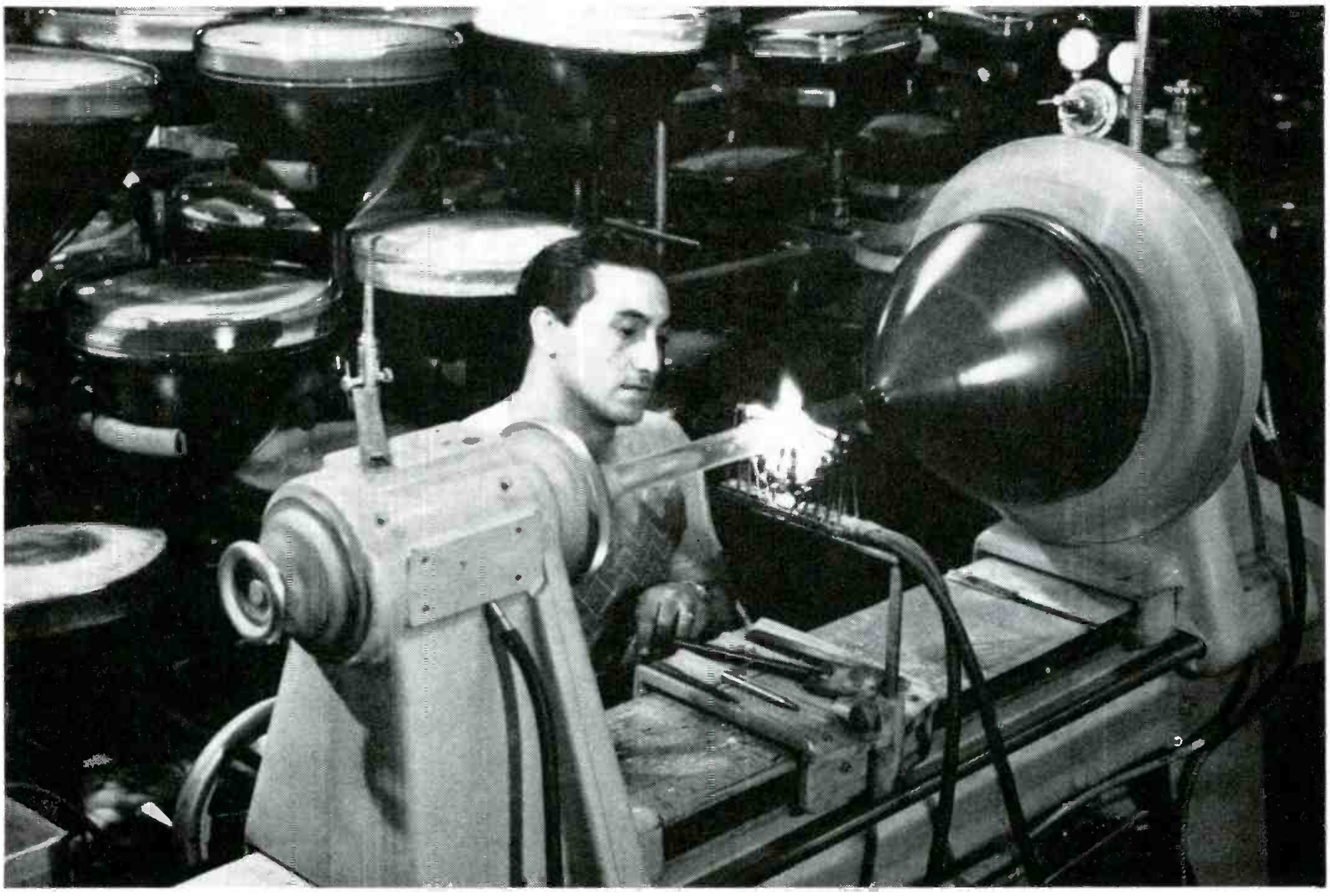
The ultrahigh probe also revealed that power output measurements at these frequencies can be made satisfactorily with a 1000-mc range dummy antenna wattmeter setup[5] featuring a coaxial load resistor, forced air cooled which has the same impedance of 51.5 ohms, normally used for the line supplying the antenna. Across this resistor is connected a crystal rectifier type voltmeter, with a meter scale calibrated 0 to 1000 watts.

In application, the output from the transmitter (following the vestigial

(*Continued on page* 33)

[4]Based on data supplied to the FCC.
[5]Bird Electronic Termaline Wattmeter, model 613.

Picture-Tube Production



Splicing neck on a TV picture tube.

Loading dollies for the picture tube exhaust oven. *(Views of picture-tube plant of Thomas Electronics, Inc.)*

TV TUBE *Developments*

by P. B. LEWIS

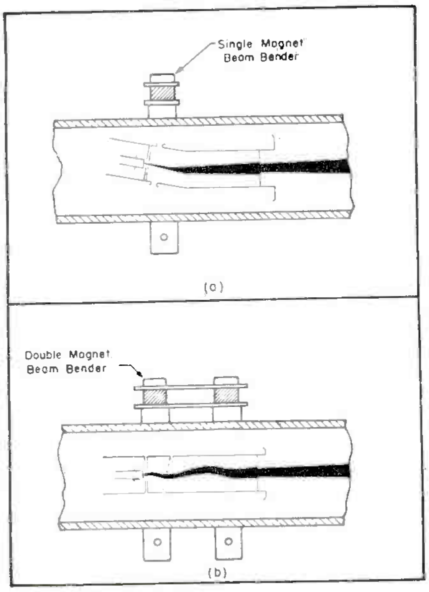
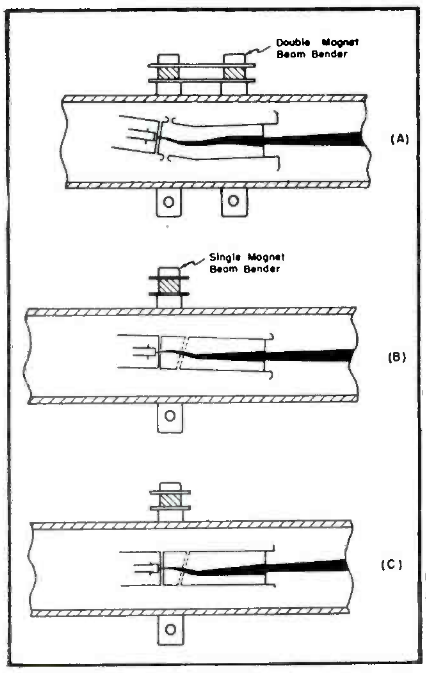


Figure 1

Electron beam paths in ion trap gun designs, the bent-gun structure being illustrated at top (a) and the slant-field design at bottom (b).

Figure 2

Electron beam paths in three other ion-trap designs: (a) tilted bent-gun design with a double magnet beam bender; (b) conventional ion-trap design with tilted gun (beam on axis); (c) conventional ion-trap design with single magnet (beam off axis).



In the production of picture tubes, two basic types of ion trap guns are employed; the bent-gun and the slant-field electron gun.[1] Proper operation of the conventional slant-field type requires a double-field bending magnet, while the bent-gun was designed for single magnet operation. Recently several modifications have been made to enable using either the single or double field magnets with either type of gun design.

In reviewing the problem, basically in an effort to shorten neck length or possibly use the single magnet, operation of a slant-field type gun, designed for a double field magnet, has been tried with a single field magnet. This method was not found too satisfactory since the electron beam is permitted to travel off axis, there being no path correcting field.

Other difficulties which have been noted, if the beam is permitted to travel off axis, were: (*1*) A greater range of pattern positioning becomes necessary to properly center the scan on the tube screen; (*2*) deflection or pattern cutoff may occur at the neck-bulb junction, and (*3*) unsymmetrical spot or pattern distortions may be introduced at the focus lens or in the deflection field.

To overcome these problems, a tilted slant-field gun was designed and used in short-neck tubes, such as the 16GP4. With a gun structure sealed into the tube neck at an angle to compensate for the tendency of the gun to project a beam off axis, the single field can be used. Operation with a single-field magnet is possible since the beam in the focus and deflecting region can travel coincident with the axis of the tube neck.

In another variation in design, a bent-gun has been arranged in the neck at an angle to permit operation in a tube, such as the 12LP4, which requires double magnets. In this case the tilt of the gun opposes the front correcting magnet field to obtain an *on-axis* beam. This method is obviously unnecessary for new designs. However, the tilted bent-gun can be used for the manufacture of types where the tubes are to be directly interchangeable with those using conventional slant-field electron guns.

[1]Hoagland, K. A., *The Design and Fabrication of TV Picture Tubes*, Television Engineering; *March, 1950*.

[2]RCA.

The 5826[2]

A TV Camera tube with a resolution capability of better than 500 lines, and improved gray-scale rendition in the vicinity of the *blacks*, has been developed.

Utilizing a photocathode which has the same spectral response as the companion outdoor pickup, type 5820, this camera tube is said to permit portrayal of colors in nearly their true tonal gradation.

Tube is said to provide commercially acceptable pictures with incident light levels greater than about 35 foot-candles.

The photocathode utilized is char-

Apparatus which is used to provide a high exhaust for picture tubes.

(Courtesy Tel-O-Tube)

Picture-Tube Design Modifications Which Permit Use of Single or Double Field Magnets With Either Slant-Field or Bent-Gun Ion Traps . . . Highlights of the Image, Scanning and Multiplier Sections of the New 5826 Image Orthicon.

acterized by a spectral response having high blue sensitivity, high green sensitivity, good red sensitivity, and practically no infrared sensitivity.

Because of its spectral characteristics and sensitivity, this tube can be substituted to advantage for the 5655. Requiring a minimum light level only .15 of that required by the 5655, the new tube makes it possible to reduce substantially the amount of illumination as well as air conditioning needed in the studio.

The new orthicon has three sections: image, scanning, and multiplier.

The image section contains a semitransparent photocathode on the inside of the face plate, a grid to provide an electrostatic accelerating field, and a target which consists of a thin glass disc with a fine mesh screen very closely spaced to it on the photocathode side. Focusing is accomplished by means of a magnetic field produced by an external coil, and by varying the photocathode voltage.

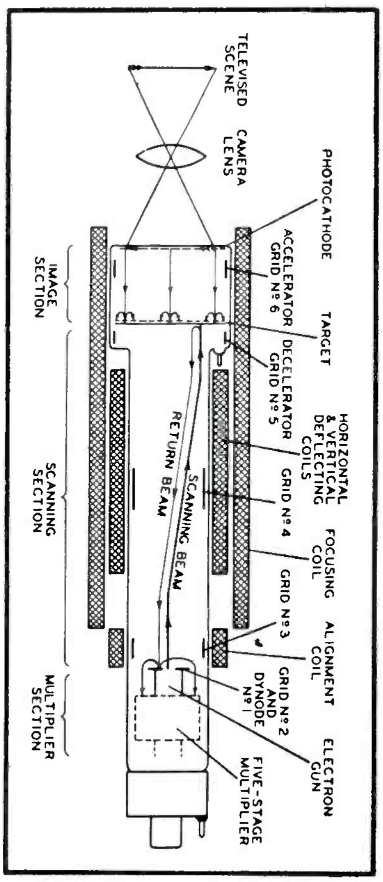
Light from the scene being televised is picked up by an optical lens system and focused on the photocathode which emits electrons from each illuminated area in proportion to the intensity of the light striking the area. The streams of electrons are focused on the target by the magnetic and accelerating fields.

On striking the target, the electrons cause secondary electrons to be emitted by the glass. The secondaries thus emitted are collected by the adjacent mesh screen which is held at a definite potential of about 2 volts with respect to target-voltage cutoff. Therefore, the potential of the glass disc is limited for all values of light and stable operation is achieved. Emission of the secondaries leaves on the photocathode side of the glass a pattern of positive charges which corresponds with the pattern of light from the scene being televised. Because of the thinness of the glass, the charges set up a similar potential pattern on the opposite or scanned side of the glass.

The opposite side of the glass is scanned by a low-velocity electron beam produced by the electron gun in the scanning section. This gun contains a thermionic cathode, a control grid (grid No. *1*, and an accelerating grid (grid No. *2*). The beam is focused at the target by the magnetic field of an external focusing coil and the electrostatic field of grid No. *4*.

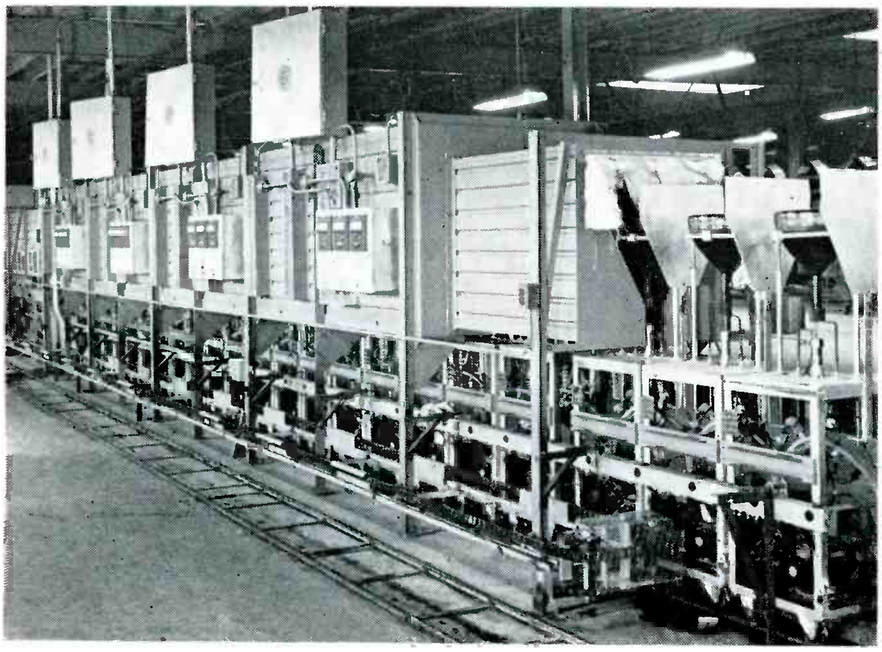
The 5826 image orthicon.

Schematic arrangement of the 5826.



Mobile storage racks for finished picture tubes (in the foreground), mobility facilitating tests (being run at the extreme left of the picture). After these tests tubes are placed on conveyor and fed to the packaging room.

(Courtesy Tel-O-Tube)

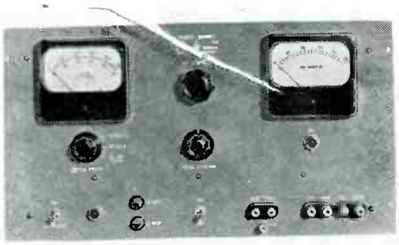


Production Aids

500-V/200-Ma Power Supply

A Power Supply providing a variable plate and bias supply voltage, as well as *ac* voltages for general laboratory use, has been announced.

Provides variable *dc* voltages from 0 to 500 volts at 200 ma. with 0.5% regulation. Also makes available 0 to 150 volts for bias use, plus 10 amperes *ac* at 6.3 volts. Meters are provided to monitor voltages and currents.—*Type 712A; Hewlett-Packard Co., 395 Page Mill Road, Palo Alto, Calif.*



H-P power supply.

'Scope Camera

A Recording Camera for photographing the screen of a 'scope and producing a print within one minute has been announced. Unit, an adaptation of the Polaroid-Land camera, is said to deliver an accurate photographic record of single transients or repetitive phenomena without the need for darkroom processing. A two position over-center shift makes it possible to make two recordings on one print.

Designed for use with any standard 5" 'scope. Consists of an adapter that locks in place against the *crt* tube face; a hood which attaches to the adapter and provides correct focus for the camera: the camera which is a standard Polaroid-Land body to which has been added a special f2.8 lens and between-the-lens shutter and the two-position over-center shift device. A viewing port in the side of the hood permits the operator to keep the cathode-ray screen under constant observation while operating the camera.

Print size is 3¼" x 4¼" with the two recorded images reduced by a ratio of only 2 to 1 from the original trace.—*Type F-284; Fairchild Camera and Instrument Corporation, 88-06 Van Wyck Boulevard, Jamaica 1, N. Y.*

Hand Torch

A Hand Torch using a self-pressurizing, self-vaporizing fuel, packaged in a disposable container, has been developed.

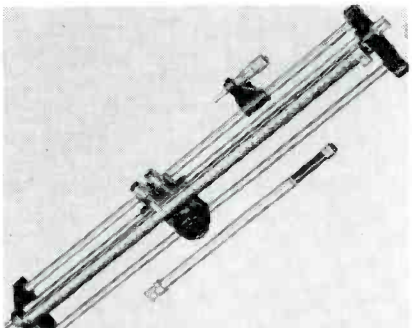
Torches light instantly with a match. Fuel containers, which are the size of an ordinary beer can, are sealed into position as the fuel tank of the torch.—*Prepo; Pressure Products Corp., 140 N. Dearborn St., Chicago 2, Ill.*

Instrument News

Slotted Line and Coaxial Elements

Slotted Line and coaxial elements have been developed for impedance, standing-wave, voltage and power measurements at ultrahigh frequencies. Slotted line can be used in such relatively inaccessible locations as at the top of antenna towers. Overall standing-wave ratio is said to be less than 1.02 at 1000 mc, and constancy of probe penetration is ±2½% or better.

Also available are crystal rectifiers, bolometers, a bolometer bridge, stubs, fixed line elements, a line stretcher, a tee, an ell, terminations attenuator filters, coupling elements and patch cords. A specially designed stand permits an assembly of elements to be clamped in position for measurement purposes.—*Type 874-LB slotted line and type* 874 *coaxial elements; General Radio Co.,* 275 *Massachusetts Ave., Cambridge 39, Mass.*



G-R slotted line and coaxial element setup.

Interference Locator

A Radio Interference locator for the 550 kc to 30 mc range has been made available.

Instrument utilizes an 8-tube superhet circuit and operates either from self-contained batteries or 115-volt mains. An auxiliary inverter power supply is available for automobile battery operation.

Each locator is supplied with both a loop and a collapsible rod antenna for normal use. An *rf* search probe, insulated for 35,000 volts *ac*, is also available for field use as is an audio probe for circulating current faults and cable fault location.

Other features of the locator include a built-in loudspeaker, built-in dual range output meter and battery test meter, calibrated *rf* and audio gain controls, a beat frequency oscillator for detecting unmodulated signal sources, etc.—*Model* 302; *Sprague Products Co., 61 Marshall St., North Adams, Mass. Description of the instrument is given in bulletin M-446.*

Sprague interference locator.

UHF Frequency Meter

A Tunable frequency meter has been designed for measurement of *rf* signals throughout the ultrahigh band. Dials are calibrated to read directly in mc. A coaxial type cavity resonator is employed in which the center conductor is adjusted by rotation of the frequency dial so as to vary the resonant frequency continuously from 470 to 950 mc.—*Type* 584; *Polytechnic Research and Development Co., Inc.,* 202 *Tillary Street, Brooklyn* 1, *New York.*

Brooklyn Poly ultrahigh frequency meter.

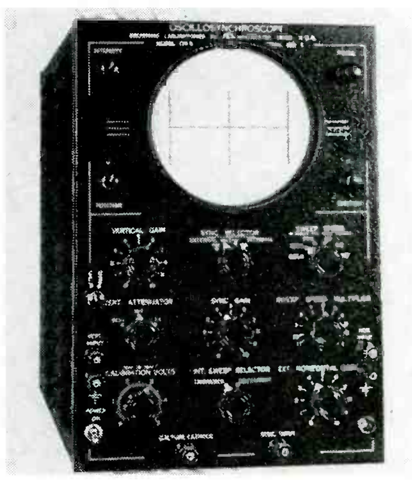
Oscillosynchroscope

A Portable Oscillosynchroscope providing wide band amplifier and versatile sweep facilities is now available.

Vertical amplifier response is said to be flat within 3 db from 5 cycles to 5 megacycles. Horizontal amplifier is direct coupled with high-frequency response extending to 500 kc.

Sweep generator may be triggered or recurrent with direct reading writing rate calibration for any internal sweep condition. Triggered sweep speeds from 1.0 microsecond per inch to 25000 microseconds per inch and recurrent sweeps of 10 to 100 kilocycles are available.

An adjustable calibration voltage may be used for determination of vertical deflection voltage amplitudes. Either *dc* or *ac* connection may be made to all deflection electrodes. Also provided is a panel connection to the *crt* cathode for external beam modulation.—*Type ON-5; Browning Laboratories, Inc., Winchester, Mass.*



Browning oscillosynchroscope.

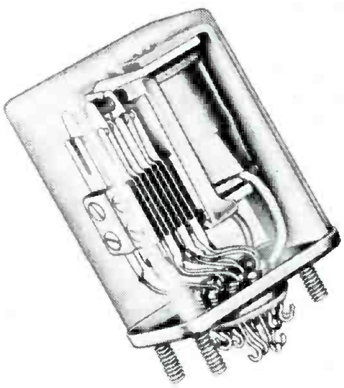
TV Parts and Accessory Review

Miniature Telephone Relay Assembly

A Hermetically-Sealed telephone-type relay, with 1" x 1 11/16" x 25/32" high steel enclosure is now available. Dimensions of unhoused relay are 11/16" x 1½" x 1⅜" long. Enclosure (*M type*) will accommodate the relay with maximum contact stack and can be fitted with all headers except standard octal plug. Hermetically sealed relays are desiccated at high temperature and sealed in one atmosphere of nitrogen, which is said to eliminate oxidation and reduce contact arcing.

Featuring a dual stack with contacts of any arrangement up to 16 springs (8 per stack) with a limit of six movable poles, the relay assembly is available with windings from a fraction of an ohm to 22,000 ohms or for operation up to 230 volts either *ac* or *dc*.

Minimum operating power is .050 watt per pole, allowing sensitivity of 1.5 *ma* in a single pole relay. Maximum coil power for the unenclosed unit is four watts.—*Type MT: Potter & Brumfield, 280 N. Main St., Princeton, Indiana.*



Potter and Brumfield miniature relay assembly.

Tantalytic Capacitor

A Small 1-Mfd 150-volt dc tantalyic capacitor has been produced. It is said that the capacitor, which is hermetically sealed, offers longer shelf life, lower leakage currents, and better low-temperature characteristics than conventional electrolytics.—*General Electric.*

G. E. tantalytic capacitor.

Permanent Magnets

Permanent Magnets, which are said to have a guaranteed energy product of at least 5¼ million BH_{max}, have been announced.

The manufacturer claims that when the standard RMA No. 3 loudspeaker magnet is made with this Alnico V, it has an output .7 *db* greater than when made of 4½ million BH_{max} regular Alnico V.—*Type Hyflux Alnico V; Indiana Steel Products Company, Valparaiso, Indiana.*

Plastic Tubulars

A Line of Plastic tubulars featuring the use of Mallocene, a plastic compound which becomes a part of the outer shell and adheres permanently to the leads, is now available.

The new product is the result of efforts to achieve a molded tubular capacitor with a plastic material that adheres securely to the wire leads. This had been thought impossible because such a plastic would stick to the mold. The problem has been solved by centering the cartridge in a tough plastic shell which is then filled with Mallocene.

As a result of this method the capacitors are said to provide triple-sealed moisture-proofing, require no outside wax coating and prevent oil leakage. In addition, there is said to be no problem of flattened or off-centered cartridges which sometimes result from the pressure of ordinary molding methods.

All units are designed for satisfactory performance at 85° C.—*Plascap capacitors; P. R. Mallory and Co., Inc., P. O. Box 1558, Indianapolis, Indiana.*

Mallory Plascap Capacitors

Miniature AF Transformer

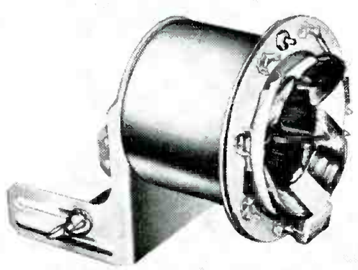
A Small Audio Transformer, .4" x .75" x .56" weighing .28 ounce has been developed. Five stock types cover input, interstage, output, and reactor applications.

Dependability is said to be provided through the use of a molded nylon bobbin and non-hygroscopic insulation throughout. Transformers are vacuum impregnated.—*Type SSO; United Transformer Company, 150 Varick Street, New York 13, N. Y.*

70° Sweep Yoke

A Sweep Yoke, designed to sweep up to 70° picture tubes has been announced.

Horizontal inductance of the yoke is 18 millihenries, while vertical inductance is 30 millihenries. It is available with either a laminated, or for higher efficiency, a ferrite core.—*G.E. Receiver Division, Electronics Park, Syracuse, N. Y.*



G. E. 70° sweep yoke

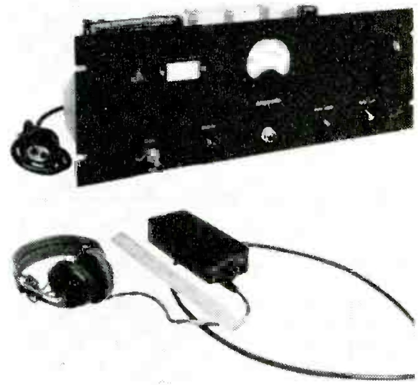
TV Broadcast Equipment

Cue System Link

A Radio Cue System has been developed for use in directing personnel via a radio link.

Transmitter operates on a low *rf* frequency into a loop antenna, which restricts the transmitted information to a closely confined area. Pocket receivers are small and lightweight. Several *rf* channels are available, should simultaneous transmission for separate activities be desired.

System may be used to direct technical personnel and cue actors. Can also be used in factories where the noise level is too high to permit direct communication.—*Type AB; Polarad Electronics Corp., 100 Metropolitan Avenue, Brooklyn 11, N. Y.*



Polarad cue system equipment. Top, transmitter; bottom, receiver.

Anti-Noise Microphone

An Anti-noise microphone is now available for application at such events as audience participation programs employing a *pa* system, without encountering the normal acoustic feedback. Mike can also be used to facilitate broadcast of sports events, where information is to be relayed to the sportscaster by assistants without interference with the running comment.

Has an effective output level of —45 dbm and the output impedances (tapped transformer) are 30/150/250 ohms. The microphone and handle assembly, is 8⅞" high, 1⅞" wide. and 1" thick overall; weighs approximately 13 ounces.—*Type KB-3A; RCA.*

RCA discriminating microphone.

Industry Literature

Polyken Industrial Tape, 222 W. Adams St., Chicago, 6, Ill., have published a booklet, *Tape is a Tool*, listing individual *Polyken tapes*, their specifications and uses. Sample strips of the many tapes are reproduced with magnified sections which show construction details.

The Electronics Division, Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y., has published a booklet covering forty basic germanium diode applications.

Text of the booklet is grouped in three sections which describe germanium diode applications in radio and television receivers; radio transmitters and amplifiers; and instruments and supervisory circuit devices.

The first section on crystal radio receivers and video circuit components contains ten schematic diagrams with circuit constants. The second section on transmitters includes six schematics. The section treating instrument and gadget uses describes twenty-four devices ranging from a sideband generator in which matched diodes are arranged as a ring modulator to a 144-mc tubeless radio receiver for the remote control of model airplanes and model boats.

Booklet may be obtained from authorized Sylvania radio tube distributors or with remittance of one dollar to the advertising department, Sylvania Electric Products Inc., Emporium, Pa.

Howard W. Sams & Co., Inc., 2201 East 46th St., Indianapolis 5, Indiana, has announced that beginning with the purchase of regular *Photofact* set 91, Service Men will receive a 64-page preliminary data supplement, containing schematic diagrams and other data on over 100 TV models, at no additional charge. At present other supplements are planned for distribution with sets 93 and 95.

Electronics Research Publishing Company, Inc., 480 Canal St., N. Y. 13, N. Y., will publish the *Electronic Engineering Master Index* for '49 in June.

The '49 edition indexes 8500 articles from nearly 400 world-wide scientific periodicals, journals, proceedings, and technical house-organs. Also listed are the 4000 applicable patents granted by the U. S. Patent Office during '49.

Index, cloth bound, 7½" x 10½", sells for $17.50.

Allied Radio Corp., 833 W. Jackson Blvd., Chicago, Ill., have published a 64-page *Dictionary of Electronic Terms* containing over 2,500 terms used in television, radio and industrial electronics.

The publication, edited by Harry L. Van Velzer, Associate Professor of Electrical Engineering, University of Illinois, has over 125 illustrations and diagrams of components, equipment, and electronic circuits.

Available for 25c.

Hytron Radio & Electronics Corp., Salem, Mass., have released the fourth of their reference guide for miniature tubes. Lists all small tubes to date; 132 miniatures including 41 new types, and 70 basing diagrams. Lists similar larger prototypes.

Personals

Dr. Donald B. Sinclair has been appointed chief engineer of the General Radio Company, succeeding *Melville Eastham* who retired from that post on February 15.

D. B. Sinclair

G. Edward De Nike has been appointed manager of Du Mont Teletron sales.

During 16 years with National Union, De Nike served as advertising and sales promotion manager, divisional sales manager, and sales manager. De Nike was also for several years vice president of Morris F. Taylor & Co.

Max F. Balcom has been elected chairman of the board of Sylvania Electric Products Inc., succeeding the late Walter E. Poor. *Frank A. Poor*, founder of the company, has been elected vice chairman.

Three new directors have been elected: *Edward J. Poor*, who resigned as chairman in 1943; *Richard L. Bowditch*, president of C. H. Sprague & Son Company, and *H. Ward Zimmer*, vice president in charge of operations.

William R. Thurston and *George G. Ross*, formerly of the General Radio staff at Cambridge, are now located at the engineering office in N. Y. C. *Ivan G. Easton*, formerly of the New York office, returns to Cambridge.

N. J. REALTORS SELECT MASTER-ANTENNA SYSTEM

At signing of contract for installation of multiple-outlet television antenna systems in Northern New Jersey. Buildings involved are the Fern Towers, Robert Towers, and Andrea Towers, with approximately 610 apartments.

Among those at the meeting were (seated, left to right): E. Schmidlin, architect; Jack Poppele, TBA prexy and vice prexy of WOR-TV; and B. E. Gerber, architect, and (standing, left to right): A. A. Richman, president of Lightning Electric Co.; Alexander Fisher, president of Commercial Radio Sound Corp., which will install the system, and Ira Kamen, manager of the TV department of Commercial Radio Sound Corp., who discussed the system at the signing session.

Citing the phenomenal growth of TV in the Jersey area, Poppele asserted that the inclusion of the master setups in the planning and construction of multiple-unit buildings has become an essential service that no builder can afford to ignore.

VWOA News

Two VWOA oldtimers won many well-earned headlines, at a press conference and a meeting in Washington and New York, during the past weeks. The press conference featured comments by VWOA life member, Brig. Gen. David Sarnoff on that all important tri-color tube for which so many have been waiting. Said the general: "I have watched the development of radio and electronics for more than forty years, but never before have I witnessed, compressed into a single device, so much ingenuity, so much brain power, so much development and such phenomenal results, as are represented in this color tube. . . . It has taken electronics a long way and what the significance of this color tube may be to the future, I believe it will be difficult to overestimate today. I think that the most fertile imagination would fall short in predictions compared to the realities which will follow." . . . Commenting on coaxial cable possibilities for color systems, the General disclosed that the telephone company has stated that it would adjust its cables for the required bandwidth to carry the color programs. Continuing on this subject, DS said: "Most of the interconnection will be by radio relays, where that problem (coaxial cable) does not exist. I think that the first transcontinental television transmission will be by radio relay rather than by coaxial cable. It will carry our color. . . . . . . Also, I believe that the present cable problem will not continue for long. I would not be surprised to have our experts find how to get our color through, even with the present limited bandwith of the coaxial cable. . . . In any event, the telephone company is on record that it would make proper facilities available for color transmissions. I think that by the time color television will be ready for the home, the cable problem will be solved." . . . At the meeting appeared FCC Commissioner E. M. Webster, an honorary member of VWOA. Speaking before the New York Chapter of the Armed Forces Communications Association and discussing frequency resources and national policy, Commander Webster said that there are six factors which we must consider closely: (*1*) Shall the government operate communications systems for the purpose of carrying their own communications? (*2*) Shall the military agencies operate communications systems in peacetime which can be expanded to meet their needs in wartime? (*3*) Shall the military agencies look to the commercial communications systems for their basic communications needs in wartime? (*4*) Can we find a method to finance *vhf* throughout the American hemisphere and in Europe so as to release high frequencies for vital communications services? (*5*) Can we find a method to finance a *stratovision* relay system for the relay of general communications over the North Atlantic so as to relieve the strain of existing high-frequency radio circuits? (*6*) Shall we have competitive private overseas communications systems, or shall we have a regulated monopoly? . . . The Commander indicated that the answer to none of these questions is simple or easy, and that it will take only the fullest coperation between our various government agencies and our industries to produce answers timely enough to protect our national interests."

TV Transmitter

(*Continued from page* 15)

sine wave signals is required for this operation.

(4) It is then necessary to measure the amplitude of the 100-kc lower sideband as reference.

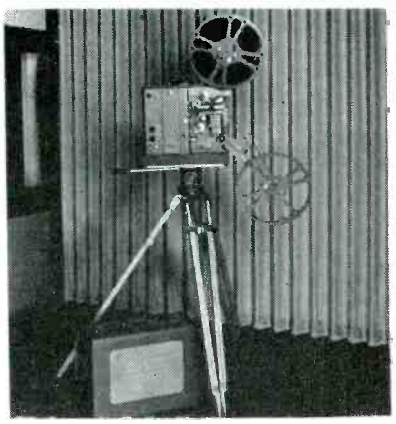
(5) In the final step, the modulating frequency must be varied in discrete steps and the resulting upper and lower frequency sidebands measured. Considerable care must be exercised to avoid false readings due to harmonics of synchronizing and blanking impulses.

Typical results, using method 2(*a*), are shown in Figure 2,*** for a transmitter which includes two class-*B* linear amplifiers following the modulated stage. Overcoupled circuits are employed throughout and notching filters are used to assure adequate lower sideband attenuation. It will be noted that the lower sideband is well below the 20 db attenuation factor specified. Since the irregularities occur below —20 db, little energy is present, and their effect is negligible. Similar results (both upper and lower sideband measurement) are shown in Figure 3 for another type of transmiter.**** This system employs a single class-*B* linear amplifier following the modulated amplifier. Overcoupled circuits are used between stages and between final amplifier and transmission line. The resulting attenuation characteristic of the transmitter appears in Figure 4.

***Results obtained on the DuMont Master Series transmitters. ****DuMont Acorn Series.

[***A detailed mathematical analysis of single and double sideband transmission reviewed in this paper, will appear in the July issue.***]

PORTABLE TV FILM PROJECTOR



Portable 16-mm TV film projector designed for use with either studio or field type image orthicon cameras. Employs pulsed-light illumination to simplify alignment of the unit with the camera. (*RCA*)

The TV Chassis

(*Continued from page* 7)

substantial dividends, and has become a well established valuable part of our routine. Component acceptance testing and incoming inspection, combbined with the process inspection services of the *quality control department*, which assure that our own processes stay within control, serve to provide chassis whose performances can be guaranteed.

After the design of new models is relatively complete, a number of engineering prototypes are reviewed by the *manufacturing and receiver quality control departments*. Changes to improve quality and simplify manufacturing operations are incorporated at this time. Subsequently, a test truck, fully equipped with noise generating equipment, power generating equipment, measuring instruments, a portable antenna mast, and also the new models, last but not least, leave for field test runs. The results of this operation are sifted and changes are decided upon. The test truck is later used to field test pilot run and production run models. The *product-control section* of the *receiver quality control* *department* takes a few chassis each day from the production run and measures them against the original engineering specifications for electrical performance in its *type test laboratory*. A daily report to management informs them of any changes or trends in process quality performance. The *product-control section* also follows up any field complaints which are reflected back to the factory and—if found to be valid—corrections are made in current production to overcome the field deficiencies which may have been revealed.

Material handling has also been found to demand close attention in chassis processing. To reduce material handling by hand labor to a minimum, we have provided a central signal system and mechanized our production lines. These actions have resulted in a very noticeably improved ratio of time usefully expended to time expended on lifting, lugging, carrying, moving, and transporting components, tubes, cabinets, sub-assemblies, work in process, and finished goods. As a result, the time of our employees is applied mostly to those tasks requiring the skilled human hand and brain. The pride which our workers take in participating as a team in this game of economical high-quality mass production has contributed immeasurably to the achievement of superior value in the product and smoothness in our manufacturing operation.

One detail which has been found to contribute to better workmanship is lighting. After a careful study on the subject of lighting, it was decided that the cold cathode lighting, although more expensive for the initial installation, would be cheaper in the long run in replacements. After six months of operation not a single tube in the entire plant has been replaced because of an operating failure.

The unyielding belief in quality has been found to pay off in production, too. Making it right is always more economical than fixing it. Less repairs, less scrap, reduced overhead, and greater production are made possible by scientific quality control.

Table I
List of miscellaneous hardware used in a DuMont chassis.

Connectors: *5*
Fuse holder: *1*
Fuse cartridge: *2*
Lamps: *2*
Dial light assembly: *1*
Cable assembly yoke: *1*
CRT socket assembly: *1*
Tuning Inputuner socket: *1*
Springs (tube): *1*
Chassis: *1*
Sockets: *35*
Bracket osc transformer: *1*
Mounting, capacitor: *4*
Bracket, resistor: *1*
Inputuner bracket: *1*
Clip assembly: *1*
Clip tube contact: *1*
Clip spring: *3*
Clamp, tube: *1*
Terminal boards: *28*
Standoff insulator: *2*
Insulator: *1*
RF shield: *1*
HV supply shield: 1
Tube shield: *1*
Tube base shield: *2*
Socket shield: *1*
Corona shield: *5*
Terminal lug ring: *1*
Screws, nuts and washers: *79*
Rivets: *136*
Lock nut (U No. 10): *4*
Corona shield, fastener: *1*
Washer (No. 10): *4*
Lacing linen: *140"*
Cable clips: *12*
HV chain cover: *1*
Insulator sheet: *1*
HV supply insulation: *1*
Control tag: *1*
HV shield mounting spring: *1*
Name plate: *1*
Drive screw (4"x¼"): *2*
Connector asy. tube: *1*
Flex slug: *50"*
Heater choke: *1*
Eyelet: *1*

UHF Study

(*Continued from page* 22)

sideband filter, *if* visual transmitter) is disconnected from the line supplying the antenna and connected to the dummy antenna wattmeter. The transmitter is then placed in operation (with a black picture in the case of the visual transmitter) and the transmitter adjusted for the desired characteristics, and a power output as indicated by the wattmeter. The power is then removed, the dummy antenna wattmeter disconnected and the transmitter output reconnected to the antenna line. Without further adjustments, power is reapplied. As both the dummy and the line represent a good *match* to the transmitter output, the power delivered to the antenna will be substantially equal to that previously indicated on the wattmeter. In the case of the visual transmitter, the peak power is obtained by multiplying the indicated black picture power by 1.68. It is believed that the power may be measured by this method to an accuracy of ±10% at 500 mc. The accuracy will probably be somewhat poorer at 1000 mc.

TV Microwave Relay

(*Continued from page* 18)

cause modulation waveform distortion and transmitter instability, as indicated previously. Accordingly, every care should be taken that the proper fittings are used with the cables, that they are made up properly, and that mating fittings are securely tightened.

With picture modulation applied and all operating adjustments set, the picture should be inspected critically for any possible video transmission line reflections or multipath on the operating course. Either of these may be corrected by the same methods outlined in the description of the 7000-mc relay operating procedure (i.e., adjustment of video-cable termination and reorienting the transmitting antenna).

No special precaution need be made as to operation during program. All critical circuits have meters permanently connected and no switching is required to check on the operation of various parts of the equipment.

Special Operating Setups

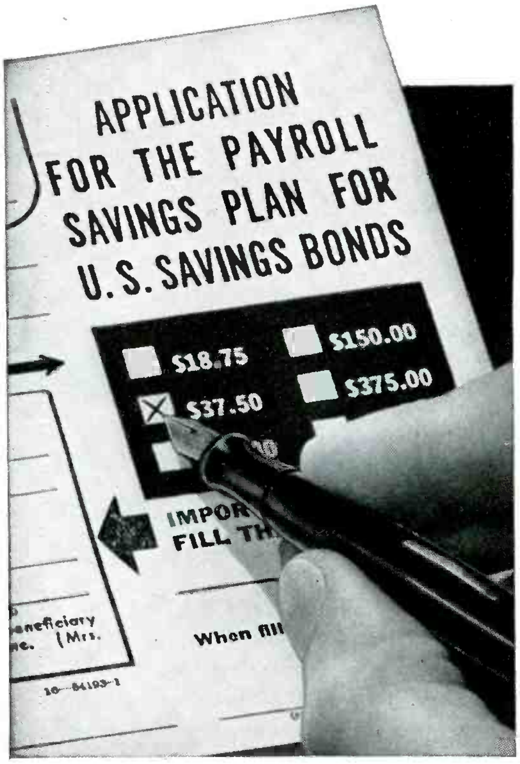
During the installation of the relay systems, an interesting assortment of operational innovations were uncovered. It was found, for instance, that

(*Continued on page* 35)

It's ~~EASY~~ to install "Payroll Savings"

If you've put off installing the Payroll Savings Plan in your company because you feel it would be "a lot of work," then this advertisement is certainly for you! Because it's really *very simple* to give your employees the advantages of investing in U. S. Savings Bonds the easy, automatic "Payroll" way.

. . . and 20,000 companies' experience proves it pays!



HERE'S ALL YOU NEED TO DO

Appoint one of your top executives as Savings Bond Officer. Tell him to get in touch with your State Director, Savings Bonds Division, U. S. Treasury Department. Here's what happens . . .

The State Director will provide application cards for your employees to sign—plus as much promotional material and personal help as necessary to get the Plan rolling in your company.

Those employees who want Savings Bonds indicate on the applications: how much to save from their pay; what denomination of Bonds they want; and the inscription information to appear on the Bonds.

Your payroll department arranges to withhold the specified amounts, arranges to get the Bonds, and delivers them to the employees with their pay.

The Bonds may be obtained from almost any local bank or from the Federal Reserve Bank or may be issued by the company itself upon proper certification by the Federal Reserve Bank or Branch in the company's District.

THAT'S ALL THERE IS TO IT!

In case you're skeptical as to how many of your employees would like to have Payroll Savings, canvass your plant—and be prepared for a surprise. (Remember that pay-check withholdings for Bonds are *not* a "deduction"—the employee takes home his Bonds with his pay.) One leading manufacturer, who had professed little faith in the Plan, found his eyes opened when he asked the people in his plant whether they would like to obtain Bonds in this way. Within only six months after he installed the Plan, half his employees signed up. A prominent aircraft manufacturer, whose company had used the Plan for some time, was not aware of its potentialities until his personal sponsorship increased participation by 500% among his company's employees.

THE BENEFITS ARE BIG—FOR EVERYONE

The individual employees gain security—they know that the Bonds they hold will return $4 for every $3 at maturity. The company gains from the resultant increased stability and efficiency of its workers. The whole nation gains because Bond sales help stabilize our economy by spreading the national debt and by creating a huge backlog of purchasing power to boost business in the years ahead.

Is it *good policy* to deprive your company of Payroll Savings—even one more pay day? Better at least have a talk with your U. S. Savings Bonds State Director, get the answers to your questions, and *know for sure.*

The Treasury Department acknowledges with appreciation the publication of this message by

TELEVISION ENGINEERING

This is an official U. S. Treasury advertisement prepared under the auspices of the Treasury Department and The Advertising Council.

TV Microwave Relay

(*Continued from page* 33)

a cable box, suitably installed, can be quite a handy item. In one instance, it protects the connector from dirt and weather. In addition, it facilitates setting up of the relay.

To set up the system, when such a box is used, merely requires carrying the transmitter can (in this instance a 7000-mc unit) to the rooftop, clamping it to the reflector, attaching the waveguide feed and screwing in the cable; a matter of a few minutes for one man. At the receiving location it is only necessary for a single operator to adjust the receiving antenna (by means of a microammeter mounted on the back of the receiver can) for maximum signal without need for communication with the transmitter.

The same parapet mounting reflector, furnished for use with the 7000 mc fixed-dish installations, may be used with the 2000-mc relay. In this case, a flat mounting plate can be clamped onto the casting in place of the transmitter can and the dipole assembly bolted to this. Hence, a reflector of this type may be used interchangeably with either of the microwave systems.

Passive Reflectors

For regular repeating telecasts, as in the case of the fixed reflector installations, flat-sheet passive reflectors have been found somewhat effective. Where line-of-sight does not exist between the transmitting and receiving antennas (or an excessive amount of interconnecting cable would be required between the antenna and one of the equipment units) a flat conductive sheet can be mounted rigidly at such an angle as to reflect the signal from its initial course and directed toward the receiving antenna. While this has been used rather infrequently in remote work, due to the time required in aligning such a system plus practical difficulties in rigidly supporting a suitable reflector, this scheme has been used rather widely in *stl's* and other fixed point-to-point services.

To provide the obvious advantages of being able to redirect a beam of microwave energy with a simple device, yet still retain the features of portability and easy adjustment, double-dish setups have been tried. Employed are two reflectors and their respective waveguide feeds, coupled together with a length of flexible weatherproof waveguide. With the flat-sheet passive reflector, any adjustment of the position of the reflector affects the angle of incidence as well as the angle of reflection; hence the alignment of the sheet is a difficult and time-consuming process. With the double-dish setup, the two antennas may be adjusted individually for optimum collection of the transmitted signal and redirection along the course to the receiver. Hence, the variables may be adjusted individually. While we have not used this enough to know its full capabilities, we have been successful in redirecting a signal without undue loss when the *beam-bender* is set up fairly close to one end or the other of the course.

[*To Be Concluded in June*]

Briefly Speaking . . .

A Report on TV, today and tomorrow, which will be read and reread on many occasions, presented recently by Philco's vice prexy in charge of research, David B. Smith, before the joint annual meeting of the Franklin Institute and the Philadelphia section of IRE, revealed in blunt terms just what is troubling the television industry. Detailing the freeze situation, Smith said that the original reason for the freeze was the unexpected interference between broadcasts of certain stations on the present channels, a condition which prompted a review of the channel allocation plan. Smith then pointed out that the problem had been studied thoroughly and solved during the year by new technical developments permitting a further allocation of new stations, with only minor modifications. He then stated that everyone has agreed that the use of the ultra-high channels would, of course, be necessary for an expanded national service. Continuing and discussing color, Smith said that the Commission has taken the position that it cannot act on the freeze and *uhf* until the question of color standards had been settled. With a compatible system in mind, he said, it would not be necessary to define specific standards of color television, before going ahead with the basic problem of opening up new service areas to those now requesting it. . . . Specifically covered in his report were such topics as the need for a system standard in monochrome and color, operational characteristics of color systems (field, line, and dot sequential) and five requirements for transmission standards. . . . Here is a report that is *must* reading for everyone. . . . A system capable of transmitting sound and video over a common TV link, which may be used with FM links and repeaters or with video cable circuits, was outlined during the recent NAB conference in Chicago by Federal Telecommunications Lab engineers H. G. Miller and Leo Staschover. They pointed out that the sound channel for this system includes a submitter which introduces the sound-program material at the transmitting end and a sound-channel subceiver which recovers the audio signal at the receiving end. . . . Tel-O-Tube Corporation of America has added 35,000 square feet of floor space to their production facilities at a new plant in East Paterson, New Jersey. . . . Claude Neon, Inc., have acquired all of the stock of the recently formed Standard Electronics Corp., and taken over Western Electric Company's inventories of AM and FM transmitting equipment, replacement parts, product designs and drawings. Edwin M. Martin remains as president of Standard Electronics. Claude Neon now has four subsidiaries: Reeves Instrument Corp., Reeves Hoffman Corp., Hudson American Corp. and the American Transformer Co. . . . The RMA will shortly be officially known as the Radio-Television Manufacturers Association. . . . FCC Chairman Wayne Coy will be the principal speaker at the RMA Banquet on June 8th in Chicago. . . . Four engineers of RCA received special awards recently for their significant contributions to the all-electronic color system: Randall C. Ballard, Alda V. Bedford, John Evans and William D. Houghton. . . . The plastics division of the Erie Resistor Corp., Erie, Penna., have expanded and acquired an additional building with over 14,000 square feet of manufacturing space.

ADVERTISERS IN THIS ISSUE

TeleVision Engineering

MAY, 1950

Announcing A New GR Standard Signal Generator

50 to 920 Mc

THE new General Radio Type 1021-A Standard-Signal Generator operates at frequencies between 50 and 920 Mc with the same convenience and reliability found in other G-R generators in the broadcast frequencies.

Its main use is the determination of radio receiver and circuit characteristics. With an inexpensive diode modulator, television picture modulation can be produced for overall testing of television receivers.

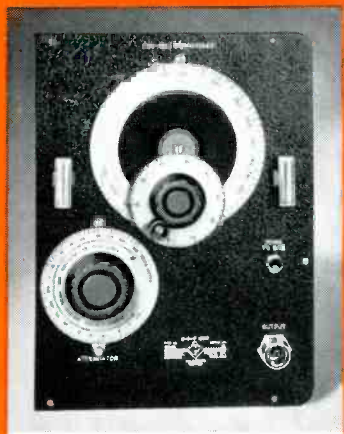
It is a convenient and well-shielded source of power for measurements with bridges, impedance comparators, and slotted lines. For these uses internal modulation is provided.

With the new G-R Type 874 line of Coaxial Elements, this generator provides a very complete and flexible system for measurements of voltage, power and standing-wave ratio from 50 to 920 Mc.

FEATURES

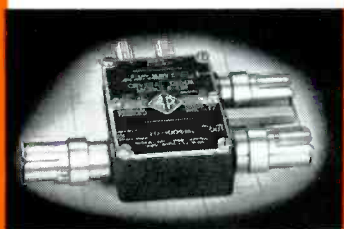
- **SIMPLICITY, RELIABILITY, CONVENIENCE** of a standard broadcast generator. **ACCURATE · COMPACT · LIGHTWEIGHT**
- **MODERATELY PRICED**
- **BUTTERFLY TUNING CIRCUIT** . . . no sliding contacts . . . no noise . . . perfectly smooth tuning . . . rugged design with good stability and very low drift
- **REGULATED POWER SUPPLY** assures good heterodyne beat note
- **OUTPUT FROM 0.5 MICROVOLT TO ONE VOLT** with overall accuracy better than ±20%
- **INTERNAL OUTPUT IMPEDANCE** 50 ohms
- **LEAKAGE AND RESIDUAL OUTPUT VOLTAGE** below sensitivity of most receivers
- **INTERNAL 1000-CYCLE AND EXTERNAL AMPLITUDE MODULATION** over audio range, adjustable from 0 to 50% . . . incidental fm under 100 parts per million over most of the ranges
- **T-V PICTURE MODULATION ON ALL CHANNELS** from 50 to 920 Mc with NO INCIDENTAL FM, when Type 1000-P6 Crystal-Diode Modulator and source of video signals are used. The power requirements for modulation are so low, video output from a standard T-V receiver can be used

TYPE 1021-AV V-H-F Standard-Signal Generator (50-250 Mc)..............	$595.00
TYPE 1021-AU U-H-F Standard-Signal Generator (250-920 Mc).............	615.00
TYPE 1000-P6 Crystal-Diode Modulator..............................	35.00



Type 1021-P2 Oscillator Unit (250-920 Mc)
Two separate oscillators are available. They are mechanically and electrically interchangeable, and are sold as separate units to convert the range of one standard-signal generator to that of the other.

TYPE 1021-P2 U-H-F Oscillator Unit only (250-920 Mc)....	**$420.00**
TYPE 1021-P3 V-H-F Oscillator Unit only (50-250 Mc).....	**$400.00**



Type 1000-P6 Crystal Diode Modulator
An inexpensive, wide-band modulator for amplitude modulation of carrier frequencies between 20 and 1000 Mc. Modulation-frequency range is 0 to 5 Mc.
$35.00

GENERAL RADIO COMPANY Cambridge 39, Massachusetts

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... a major advance in studio-type image orthicons

A NOTABLE PRODUCT of RCA leadership in tube research and engineering—the new RCA-5826 image orthicon provides important refinements over previous types of television camera tubes for studio use.

The new RCA-5826 combines exceptionally high sensitivity, a resolution capability of better than 500 lines, high signal-to-noise ratio—about twice that of outdoor camera types—and improved gray-scale rendition in the vicinity of the "blacks."

Having the same spectral response as the companion outdoor pickup type RCA-5820—a response closely approaching that of the eye—this new studio camera tube permits portrayal of colors in nearly their true tone gradation. The use of the RCA-5826 in the studio and the RCA-5820 outdoors facilitates the combination of indoor and outdoor pickups on the same program . . . improvements that are automatically extended to every receiver.

ANOTHER new RCA tube . . .

...the RCA 6AX5-GT Heater-Cathode Type Full-Wave Vacuum Rectifier: Designed to operate from a common 6.3-volt heater supply in ac-operated sets or auto receivers. Has the same heating time as other heater-cathode types, thus permitting the use of filter capacitors having lower peak voltage ratings than required for filament-type rectifiers. Delivers 125 ma. at 350 volts to a capacitor-input filter.

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